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Adoption of improved postharvest fisheries technologies among fish processors in Lagos state, Nigeria

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Abstract: This study assessed the adoption of improved postharvest fisheries technologies (IPFT) among fish processors in Lagos State, Nigeria. Validated interview guide was used to elicit information from 90 fish processors selected from12 fishing communities through the multistage sampling procedure. Data collected were analyzed with the use of frequency, percentage,and mean and regression analytical technique. Results reveal that majority of the fish processors(83.3%) were between 21 and 50 years old, mostly female (90.0%), married (87.8%) and had at least primary education (74.4%) with a mean fish processing experience of 4.39 years. All (100%) of the fish processors were aware of fisheries extension services and were visited either forth nightly (61.1%) or on a monthly basis (38.9%) and sourced processing information through the extension agents (74.4%).*Esusu* and cooperative societies were the source of credit to 43.3% and 38.9% of the fish processors, respectively. Mean daily processed fish and monthly income were 13.42kg and N39.977.78, respectively. Awareness and trial of most of the technologies were reported to be high among the fish processors, while the subsequent adoption of such technologies was moderate with most technologies discontinued. Age ($t = -0.214$, $p<0.01$), and interest rate ($t = -0.234$, $p<0.05$) significantly determined the adoption of IPFT. This study concludes that adoption of IPFT is a function of socioeconomic characteristics, and effectiveness of extension service. It therefore recommended that efforts should also be made by extension agents at persuading the fish processors to adopt previously rejected and discontinued IPFT through organising of results and methods demonstrations to fish processors in groups and cooperative societies.
Keywords: Technology adoption, *Esusu*, Fish handling, Postharvest, Improved technologies

INTRODUCTION

In developing countries, a major perennial issue militating against food insecurity is postharvest losses and this is more pronounced in fisheries. Once fish is harvested from the natural (water) environment, rapid deterioration of products set in especially under the hot tropical environment (Okunade and Bolorunduro, 2014).Fish is among the food items that are highly perishable due to their composition of high moisture content (Hodges *et al.,* 2010). Hence, subjecting fish to processing immediately after the fish is caught is crucial so as to extend the shelf-life of fish until it gets to the consumers' tables. In Nigeria, fish handlers (including fish processors) rely heavily on traditional and local postharvest technologies that are not effective in preventing microbial spoilage of harvested fishes (Tabor, 2000; Nkeme *et al.*, 2013). Donye *et al.* (2013) noted that a means to reducing postharvest losses in agriculture is through the adoption of affordable agricultural innovations. Therefore, effectively minimizing postharvest losses in fisheries demands the introduction and use of improved postharvest fisheries technologies in the areas where fishes are highly produced within the country. Improved postharvest fisheries technologies have been disseminated to the grassroots through the extension activities of the Agricultural Development Programmes (ADPs) of the States within the country (Jegede and Bolorunduro, 2002).

However, postharvest fisheries technologies are faced with varied level of adoption with some of the technologies receiving no adoption at all, while others received low to moderate levels of adoption in Lagos and other states of Nigeria. The varying levels of adoption of improved technologies is attributed to fish production/processing characteristics of the fisher folks and effectiveness of extension service delivery and research (Tawari, 2006). This is also because postharvest handlers of fish are characterized by poverty, subsistence level of operation, lack of access to information on improved technologies, inadequate finance to procure proven technologies among others. Tawari and Davies (2009) asserted that the economic status of the fisher folks plays a significant role in the adoption of new techniques. Davies (2005) andTawari (2006) also added educational attainment to the list of factors that favour the adoption of new technologies.

In Lagos State, different improved postharvest technologies have been introduced to fish farmers, fisher folks and fish processors over the years by the Lagos State Agricultural Development Authority (LASADA) which serves as the extension department/unit of the State Ministry of Agriculture. Prominent among the introduced technologies are the Chokor, Altona, Magbon-Alade, Waltanable and Burkinable smoking kilns. Despite the introduction of these technologies for more than one decade, fish processors in fishing communities within the State were noted to be in use of the traditional processing technologies. In areas where the technologies were adopted, the adoption has been noticed to be both slow and of low rates. Although, sufficient empirical

data exists on the adoption of improved fish production technologies, there is a dearth of information on the adoption level of improved postharvest fisheries technologies.

Recognizing the fact that non-adoption or low adoption rate of improved postharvest fisheries technologies will lead to increasing postharvest losses of fish even with the adoption and utilization of improved fishing technologies; this study sought toexamine the adoption of improved postharvest fisheries technologies among fish processors in Lagos State, Nigeria. The specific objectives of the study were to describe the socioeconomic and fish processing characteristics of the fish processors, examine fish processors' access to extension services, and to determine the level of adoption of the different postharvest fisheries technologies by the fish processors in Lagos State. The study also tested a hypothesis to identify the determinants of the adoption of improved postharvest fisheries technologies.

METHODOLOGY

The study was conducted in Lagos State which is located in the south-western part of Nigeria on the narrow coastal plain of the Bight of Benin and lies approximately on Longitude $20^{o}42'$E and $3^{o}22'$E respectively and between Latitudes $6^{o}22'$N. It covers a total land area of 4,000km^2, out of which 30.0% is water. The State has a marine shoreline of about 180km and extends inland about 32 km (at its farthest points) from the shoreline. Due to the availability of the water resources, fishing becomes one of the major occupations of the residents of Lagos State especially those in riverine fishing communities. Some community members especially women are also engaged in fish processing, marketing and trading.

Multi-stage sampling procedure was used for the selection of 96 fish handlers from Lagos State. Stage 1 involved the random selection of two extension blocks each from the three agricultural extension zones in Lagos State to give a total of 6 out of the 16 extension blocks in the State.In stage 2, two extension cells were selected using simple random sampling methods from each of the chosen blocks to give a total of 12 cells/fishing communities.This was followed by selection of 50% of the fish handlers from each of the 12 cells through the simple random sampling technique based on the sampling frame obtained from the frontline extension agents in charge of the circles. This gave a total of 96 fish handlers that were interviewed for this study. However, 90 of the responses were found to be useful for data analysis.

A pretested and validated interview schedule was used to elicit information on the specific objectives of the study from the 96 fish processors in Lagos State. The level of adoption was determined through the awareness, trial, adoption and discontinuance stages of adoption. Collected data were analysed using descriptive (frequency, percentage and mean) and inferential statistics (regression analysis).

RESULTS AND DISCUSSION

Socioeconomic characteristics of fish processors - Table 1 reveals that the highest proportions (41.1% and 35.6%) of the fish processors were in the age brackets of 31-40 and 41-50 years, respectively, while 16.7% of the fish processors were older than 50 years. The mean age of the fish processors was 41.93 yearsand this implies that the fish processors were young and in active stage of their lives. According to Ande (2008), this population depends on themselves and can also be depended on. By implication, the fish processors are mature and responsible enough to make sound decisions on whether to adopt or reject a technology. This may explain why most of the introduced postharvest technologies were adopted by the fish processors. Age has been reported in previous studies (George *et al.*, 2014; Bolorunduro *et al.*, 2005; Fabiyi and Hamidu, 2011) as an important variable in the adoption of technologies among farmers.Majority (90.0%) of the fish processors were female, while only 10.0% of the fish processors were male indicating that fish processing in the study area is dominated by women. Low involvement of men in fish processing was also reported by George *et al.* (2014)which agrees with the assertion of Bolorunduro (2003) who noted that women were primarily responsible for postharvest activities in the fisheries sector of Nigeria. A study in Northwestern Nigeria however reported that men were primarily involved in postharvest activities in the fisheries sector (Bolorunduro *et al.,* 2005). This implies that people's involvement in fish processing is gender biased in Nigeria depending on the prevalent religious and cultural beliefs that dictate which work is accepted by men and women.

In terms of marital status, the highest proportion (87.8%) of the fish processors was married. The marital status of thefish processors imposes responsibility of housekeeping, child bearing and rearing. This also implies that they might have children and other dependants, thereby, requiring that they make additional income. In pursuit of this additional income, the fish processors are likely to adopt technologies that have the potential to improve their living condition through increased income. This is because household size has been found to be an important variable that influenced the adoption of improved technologies according to Atala *et al.* (1992) and Nkeme *et al.*(2013) who reported that the

larger the household size, the higher the adoption rate of Chokor kiln technology.Table1 also shows that one-quarter (25.6%) of the fish processors had no formal education, 37.8% and 35.6% of the fish processors attained elementary and secondary educational levels, respectively. With this level of education, it could be easy for them to understand and implement instructions from extension agents on new postharvest technologies. This could therefore aid their adoption of such technologies. This assertion is in line with positions of Fabiyi and Hamidu (2011) and Atala (1944) cited by Bolorunduro (2005) who noted that educational level have significant role to play in the adoption decision of respondent. Atala (1984) further reiterated that more enlightened and educated persons tend to be more dynamic in response to technological innovations.

Table 1 further reveals that more than three-quarters (78.8%) of the fish processors had between 1 and 5 fish processing experience with a mean fish processing experience of 4.39 years indicating that the fish processors have not been into fish processing for a long time and are thereby expected to easily adopt new and promising postharvest technologies since they do not have much years of experience to rely upon.Olaoye (2010) noted that experiences played prominent role in any farming enterprise. This assertion was based on the findings of earlier studies (Nkeme *et al.,* 2013) on related topic that relationship between processing experience and adoption of improved technologies (such as Chokor Smoker kiln) was positive. Asiedu-Darko (2013) also posited that farmers' knowledge and experience play vital roles in the dissemination and adoption of new technologies.

More than half (52.2%) and 47.8% of the fish processors practiced fish processing on full time and part times bases, respectively implying that anyone could be engaged in fish processing. This means that fish could be sustainably supplied in the study area as postharvest losses could be easily reduced. Also, the type of postharvest technologies required by those who engage in fish processing could be different from that needed by those who operate on part-time basis. It was also found from the study that 42.2% of the fish processors were also involved in trading and farming in addition to fish processing implying that fish processors had more than one means of livelihood aside from fish processing especially those that operated on part-time basis.Table 1 also reveals that, close to two-thirds (65.6%) of the fish processors were members of cooperative societies. The membership of social organizations such as cooperative societies could be an indication that credit facilities could be sourced from the cooperative societies. Olaoye *et al.* (2014) also reported that most fish farmers were members of cooperative societies. The cooperative society is also a means through which extension agents could reach out to the fish processors for group demonstration of technologies.These assertions are based on the submission of Atala *et al.* (1992) and Fabiyi and Hamidu (2011) who identified social participationas one of the socioeconomic characteristics that may influence the adoption of improved technologies.

Infrastructure such as school buildings (63.3%), perennial water source (52.2%)and smoking kiln/shed (87.8%) were available to most of the fish processors. This is an indication that the fish processors' children might have access to school and therefore fish processors are not likely to use their children in form of child labour. Furthermore, more than three-quarters (78.9%) of the fish processors also sourced fresh fish from fishermen/traders. Other sources of fish for processing were middlemen, cold stores and cooperative societies. This implies that the most prominent source of fish for processing was fishermen which indicate that the fish processors were not likely to procure fish at exorbitant prices since they buy directly from the fishermen at cheap prices.

Table 1: Socioeconomic characteristics of fish processors in Lagos (n= 90)

Socioeconomic characteristics	Frequency	Percentage	Mean
Age (Years)			
21-30	6	6.7	
31-40	37	41.1	41.93 years
41-50	32	35.6	
51-60	13	14.4	
>60	2	2.2	
Sex			
Male	9	10.0	
Female	81	90.0	
Marital status			
Single	2	2.2	

Socioeconomic characteristics	Frequency	Percentage	Mean
Married	79	87.8	
Widowed	6	6.7	
Separated	3	3.3	
Educational attainment			
No formal education	23	25.6	
Elementary education	34	37.8	
Secondary education	28	31.1	
Tertiary education	5	5.6	
Fish processing experience (Years)			
1-5	71	78.8	
6-10	13	14.4	4.39 years
>10	6	6.7	
Mode of processing			
Full time	47	52.2	
Part time	43	47.8	
Secondary occupation			
Trading	38	42.2	
Farming	38	42.2	
Vocational practice	14	15.6	
Membership of cooperative societies			
Yes	59	65.6	
No	31	34.4	
***Available infrastructures**			
School buildings	57	63.3	
Hospital/health centre	28	31.1	
Bank	5	5.6	
Market	0	0.0	
Perennial water source	47	52.2	
Electricity	41	45.6	
Cold store	25	27.8	
KVA generating set	8	8.9	
Smoking kiln/shed	79	87.8	

Source: Field survey, 2013 * Multiple response

Access to extension services and information

Table 2 reveals that all (100.0%) of the fish processors were aware of extension services and 61.1% of the fish processors had extension visits on forth night basis, while the remaining (38.9%) were visited on monthly basis. Higher proportions (27.8% and 66.7%)of the fish processors were contacted very regular and regular basis, respectively. Close to three-quarters (74.4%) of the fish processors sourced information from extension agents, while radio and television were the sources of information on fish processing by 23.4% of the fish processors. This means that although all the fish processors were aware of extension services, they were not visited by extension agents at the same rate implying that information on improved postharvest technologies were not disseminated to the fish processors at the same time. This further implies that fish processors would be adopting technologies at different levels.Fabiyi and Hamidu (2011) also found that awareness of a technology is a variable that determines that adoption of such technology. Bolorunduro *et al.* (2005) also noted that fish processors' contact was an important variable in the adoption of improved postharvest fisheries technologies. It was also deduced that extension agents were the major source of information for fish processing.

Table 2: Fish processors' access to extension services

Variables	Frequency	Percentage
Awareness of extension service		
Yes	90	100.0
No	0	0.0
Number of extension visits per year		
Forth nightly	55	61.1
Monthly	35	38.9
Quarterly	0	0.0
Never	0	0.0
Frequency of contact		
Very regular	25	27.8
Regular	60	66.7
Not regular	5	5.6
***Sources of information for fish processing**		
Extension agents	67	74.4
Other farmers	7	7.8
Radio	21	23.4
Television	21	23.4

Source: Field survey, 2013 * Multiple response

Processing characteristics of the fish processors

Table 3 reveals that about sixty percent of the fish processors earned a monthly income higher than N4,000.00 while more than one-quarter (28.9%) of the fish processors earned between N21,000.00andN40,000.00 with a mean monthly income of N39,977.78k. Table 3 also reveals that the highest proportions of the fish processors financed their fish processing activities from*Esusu*(43.3%)and cooperative societies (38.9%). About 42.2% of the fish processors were reported in Table 3 to have acquired more than N20, 000.00credits in the last production season. Equal proportions (28.9%) of the fish proportions had credits of N1,000.00 – N10,000.00 and N11,000.00 – N20,000.00 with a mean credit of **N**15,563.64k. Majority (82.2%) of the fish processors took credits at interest rates of between 1 and 10%. The mean interest rate with which the fish processors took credits was 4.4%. Table 3 further reveals that the highest proportions (46.7%) of the fish processors processed between 1 and 10kg, while 27.5% and 25.6% processed more than 20kg and 11-20kg, respectively. The mean quantity of fish processed on a daily basis was 13.42kg. These findings were pointers to the fact that fish processing is being done at small scale and subsistence level.

Also, close to two-thirds (62.2%) of the fish processors lost 10% or less of fresh fish between harvest/purchase and processing, while the remaining 37.8% lost more than 10%. Table 3 also shows that 34.4% and 71.1% of the fish processors market their processed fish at processing sites and local fish markets, respectively. Processed fish was also marketed at urban markets by 32.2% of the fish processors. Fresh fish was sourced from landing sites and middlemen by 70.0% and 25.6%, respectively. Table 3 also reveals that fishes were being sold in sizes by 80.0% of the fish processors, while 61.1% of the fish processors sold their produce by hand in 200 pieces.The study therefore revealed that although local market was the major site for marketing processed fish, marketing fishes were done in more than one site which indicates that processed fish could be found readily available to different consumer types at different times and places.Sourcing of fish directly from the fishermen at landing sites also indicates that fresh fishes were easily sourced, at cheaper prices since it does not involve additional costs that would have been added if they passed through the traders/middlemen.

The mean interest rate of 4.40% is an indication that fish farmers were able to pay back the credits obtained within the shortest period of time. The fish processors' ability to pay back credits on time might also be attributed to the small size of loans the fish processors were able to acquire. Esusu and cooperative societies were also found to be the main sources of credits for fish processing thereby implying that fish processors relied heavily on their personal savings and cooperative societies they belonged to instead of getting loans through the agricultural and commercial banks. Reasons for this may be because the informal means of sourcing credits may be more lenient with fish processors in terms of loan recovery, collateral and interest rates than the formal institutions which require more strict measures such as landed properties as collateral, sureties and guarantors, higher interest rates, etc. The

dependence on the informal credits is however a reason for the continued subsistence level of processing which has a negative impact as far as ensuring the sustainable supply of processed fish in the study area.This is why Ihimodu (2003) and Ochomma (2008) claimed that credit is necessary in agriculture as it enhances agricultural productivity (Tawari and Davies, 2009). The failure of many development interventions such as the Green Revolution Project was also attributed to lack of finance among other factors (Tawari, 2006).

Table 3: Processing characteristics of the fish processors in Lagos state (n = 90)

Variables	Frequency	Percentage	Mean
Monthly income			
≤20,000.00	10	11.1	
21,000.00-40,000.00	26	28.9	N39,977.78
>40,000.00	54	60.0	
***Major sources of finance**			
Agricultural bank	8	8.9	
Esusu	39	43.3	
Cooperative societies	35	38.9	
Commercial bank	2	2.2	
Non-Governmental Organizations	3	3.3	
Personal savings	10	11.1	
Credit obtained in the last production season (N)			
0.00	10	11.1	
1,000.00 -10,000.00	26	28.9	
11,000.00 -20,000.00	26	28.9	**N**15,563.64
>20,000	38	42.2	
Interest rates (%)			
1-10	74	82.2	
11-20	3	3.3	4.40%
>20	3	3.3	
Quantity of fish processed daily (kg)			
1-10	42	46.7	
11-20	23	25.6	13.42kg
>20	25	27.5	
***Quantity lost between fish purchase and processing (%)**			
≤10	56	62.2	
11-20	25	27.8	
>20	9	10.0	7.67%
***Site of fish marketing**			
Processing sites	31	34.4	
Local fish markets	64	71.1	
Urban markets	29	32.2	
***Sources of fish for processing**			
Landing sites	72	80.0	
Neighbouring towns/states	11	12.2	
Middlemen	23	25.6	
***Form of selling fish**			
Use of weighing scale (kg)	18	20.0	
Hand (200 pieces)	55	61.1	
Sizes	72	80.0	

Source: Field survey, 2013 * Multiple response

With respect to the type of fish species processed, Figure 1 reveals that higher proportions of the fish processors processed *Clarias spp.* (95.6%), *Tilapia spp.* (94.4%), *Gymnarcus niloticus* (51.1%), *Sardinella maderensis* (71.1%), *Ethmalosa fimbriata* (74.4%), *Heterotis niloticus* (52.2%), *Chrysicththys nigrodigitatus* (54.4%) and *Ilisha Africana* (66.7%).

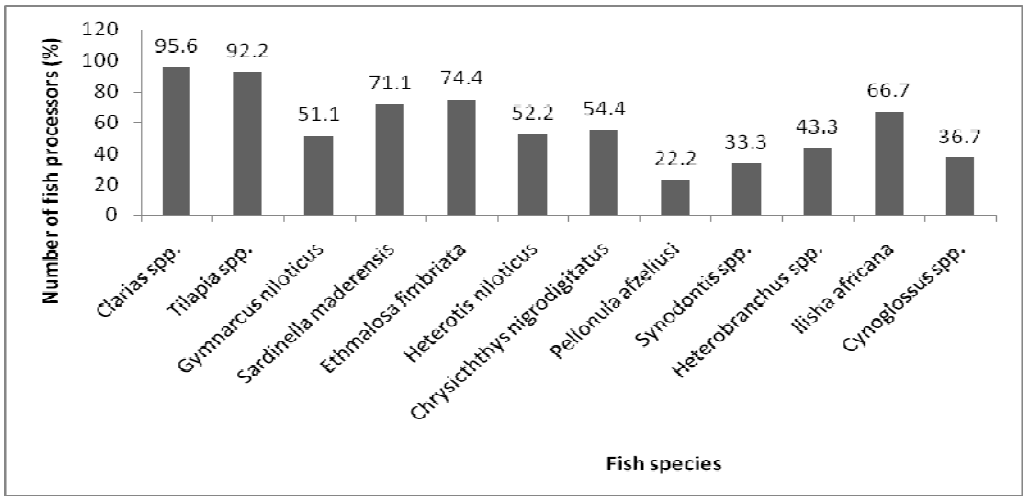

Figure 1: Fish species processed by fish processors in Lagos state

Levels of adoption of improved postharvest technologies

The awareness, trial, adoption or rejection and discontinuance of the various improved post-harvest technologies by the fish processors is as presented in Table 4 under the fresh fish handling technologies, processing technologies, preservation technologies and fish storage technologies.

Fresh fish handling technologies: As found in Table 4, almost all the fish processors were aware of killing fishes by piercing the head with needle or other sharp objects immediately after capture (91.1%), cutting the fish and removing the gills (94.4%), washing the fish in clean running water (97.8%), stowing the fish on ice in insulated boxes (95.6%) and conveying the fish to landing sites as soon as possible (96.7%). Table 4 further shows that almost all the fish processors that were aware of these handling techniques have tried and adopted the different technologies. However, significant proportions of those that had adopted the technologies were also reported in Table 4 to have discontinued killing fishes through piercing after capture (68.9%), cutting the fish and removing the gills (47.8%) and conveying the fish to the landing sites (41.1%). These findings indicated high levels of awareness, trial and adoption of the different fish handling technologies but levels of discontinuance were also generally high with these technologies with the exception of washing the fish in clean running water, and stowing the fish on ice in insulated boxes which were not highly discontinued. By implication, washing fish in cleaning water and stowing the fish on ice were still the most commonly used fish handling technologies in Lagos State.

Fish processing technologies: Table 4 reveals that majority of the fish processors were aware of using de-scaler for scale removal (98.9%), de-gilling, de-fining, de-spining, de-gutting and cutting fish into pieces (96.7%), washing in clean water/salted water (98.9%) and packaging in polythene /polypropylene bags (84.4%). Trial and adoption of the different fish processing technologies were also done by almost all those who were aware of the technologies. However, 34.4% of the fish processors discontinued using de-scaler for scale removal and packaging in polythene /polypropylene bags, while 28.9% discontinued de-gilling, de-fining, de-spining, de-gutting and cutting fish into pieces. Washing in clean water/salted water was discontinued by only 6.7% of the fish processors. The findings also showed that the fish processors had high levels of awareness, trial and adoption of all the fish processing technologies and the technologies were also highly discontinued with the exemption of washing in clean/salted water (brine). Hence, washing in brine generally was the most commonly used fish processing technology in the study area.

Table 4: Percentage distribution of fish processors' level of adoption of improved fish handling and processing technologies in Lagos (n = 90)

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
Handling of fresh fish				
Kill the fish immediately after capture by piercing the head with a needle/ sharp object to ensure instant death	91.1	88.9	88.9	68.9
Cut the fish immediately & remove the gills/	94.4	94.4	94.4	47.8

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
cut off the head				
Wash the fish in clean running water	97.8	94.4	91.1	11.1
Stow the fish on ice in insulated boxes/in the absence of ice stow in a clean box with lid,	95.6	74.4	74.4	23.3
Convey the fish as soon as possible to the landing sites for further preservation/ sales	96.7	94.4	94.4	41.1
Fish processing				
Using of de-scaler/sharp knife for scale removal	98.9	95.6	94.4	34.4
De-gilling, De-fining, De-spining, De-gutting and cutting fish into pieces	96.7	94.4	94.4	28.9
Washing in clean water/salted water (brine)	98.9	96.7	93.3	6.7
Packaging in polythene /polypropylene bags for use.	84.4	80.0	80.0	34.4

Fish preservation technologies: Table 5 shows that awareness was high among fish processors with respect to Chokor smoking kiln (81.1%), Magbon-Alade smoking Kiln (94.4%) and use of fine netting materials, fly-screens, sticky flytraps/swats and electrocutors during sun drying (86.7%), while awareness was moderate among the fish processors as regards Modified Altona Kiln (51.1%), Improved Banda smoking kiln (51.1%), Burkinabe smoking Kiln (53.3%), Solar-tent Dryer (62.2%) and box-type dryer (63.3%). Most of the fish processors tried the use of Chokor smoking kiln (68.9%), Magbon- Alade smoking kiln (76.7%) and use of fine netting materials (84.4%). More than half of the fish processors have also adopted Chokor (56.7%) and Magbon-Alade smoking kilns (56.7% and 70.0% respectively) and use of fine netting materials (84.4%). About 17.8% of the fish processors discontinued the use of fine netting materials while 14.4% and 27.8% also discontinued Chokor and Magbon-Alade smoking kilns respectively. This is an indication that awareness level varies among the fish processors with regards to the fish preservation technologies with Chokor and Magbon-Alade smoking kilns being the highest in terms of awareness. Trial and adoption of these technologies also varies.

Fish storage technologies: Table 5 also shows that majority of the fish processors were aware of the use of disinfectants (97.8%), use of fumigants (82.2%), use of jute bags and polythene bags (91.1%), use of raised platform to stack dried fish (95.6%) and application of anti-coagulant and rodenticide (90.0%), while awareness remained moderate with respect to the use of insulated ice container (56.7%) and use of correct bulk and shelf storage (48.9%). Almost all those that were aware of the technologies with high level of awareness also tried and adopted the different fish storage technologies. More than half of those that adopted the use of fumigants (61.1%) and application of anti-coagulants and rodenticides also discontinued them after adoption over years.

The high level of awareness with respect to almost all the postharvest fisheries technologies is in disagreement with the findings of Bolorunduro *et al.* (2005) who reported low levels of awareness across all the introduced improved kilns. Trial and adoption also followed at almost the same rate as adoption while discontinuance was also high among most of the technologies that were initially adopted by them. This might be attributed to the low level of fish processing experience of the fish processors which made them to adopt any promising idea or innovations. Such ideas or innovations were then discontinued when the expected result is not forthcoming. It could also be inferred from the study that use of fine netting materials, Magbon-Alade smoking kilns, use of jute bags, use of raised platform and washing fish in clean running water and salted water were the most commonly used improved postharvest fisheries technologies in Lagos State, Nigeria.

Table 5: Percentage distribution of fish processors'level of adoption of improved fish preservation and storagetechnologies in Lagos state (n = 90)

Improved Post-Harvest Technologies	Aware (%)	Tried (%)	Adopted (%)	Discontinued (%)
Fish preservation				
Modified Altona (Watanabe) Kiln	51.1	27.8	27.8	12.2
Altona Kiln	46.7	17.8	11.1	5.6
Modified Ivory-Coast Kiln	40.0	8.9	4.4	0.0

Improved Post-Harvest Technologies	Aware (%)	Tried (%)	Adopted (%)	Discontinued (%)
Improved Banda Smoking Kiln	51.1	16.7	16.7	3.3
Burkinabe Smoking Kiln	53.3	12.2	8.9	0.0
Chorkor Smoking Kiln	81.1	68.9	56.7	14.4
Magbon- Alade Smoking Kiln	94.4	76.7	70.0	27.8
Kainji Gas Kiln (KGK)	46.7	12.2	7.8	6.7
Solar-Tent Drijer	62.2	35.6	31.1	6.7
Box type Dryer	63.3	26.7	24.4	10.0
Coca-cola Cooler that uses kerosene (Chiller)	37.8	11.1	11.1	6.7
Air blast and Plate Freezers	37.8	7.8	6.7	4.4
Usage of finenetting materials (60-100 meshes per square inch), fly-screens, sticky flytraps/swats & electrocutors, during sun-drying	86.7	84.4	84.4	17.8
Fish storage				
Use of disinfectant such as Dettol / Izal	97.8	96.7	96.7	30.0
Use of fumigants such as phosphine, phostoxim tablets andpyrethrum plus piperonyl butoxide	82.2	81.1	77.8	61.1
Use of Jute bags polypropylene sacks, imported cartons and head pans for bulk storage of dried fish	91.1	84.4	84.4	21.1
Use of raised platform to stack stored package dried fish against moisture and insect infestation	95.6	88.9	87.8	13.3
Application of anti-coagulant and rodenticide against rodents	90.0	88.9	88.9	54.4
Use of insulated ice container constructed with marine plywood	56.7	42.2	38.9	18.9
Use of correct bulk and shelf storage	48.9	23.3	20.0	5.6

Determinants of adoption of improved postharvest technologies

Table 6 reveals that age (t=-0.214) and interest rate (t=-0.234) negatively and significantly determined the adoption of improved postharvest technologies at 1% and 5% levels of significance, respectively. Other variables were positive but insignificant determinant of the adoption of improved postharvest technologies at 5% level of significance. The R square was found to be 0.0854 indicating that only about 8.5% of the adoption of improved postharvest fisheries technologies is explained by the independent variables.This implies that the older the fish processors are, the less they are likely to adopt improved fisheries technologies. Significant associations have been reported between age and adoption of improved technologies (Bolorunduro*et al.*, 2005; Feder *et al.,* 1985; Fabiyi and Hamidu, 2011).Also, if the interest rate on credits for fish processing is high, fish processors may not adopt most of the improved fisheries technology due to the fact that they may not be able to afford such technologies.It could therefore be inferred that adoption of improved technologies was high because the fish processors were youths and took loans at low interest rates.

Table 6: Regression analysis of Fish handlers' determinants of adoption of improved fishing technologies

	Unstandardized Coefficients		Standardized Coefficients	t-value
	B	Std. Error	Beta	
(Constant)	-276.665	1014.417		-.273
Age	0.749	3.498	0.077	-0.214*
Household size	0.306	4.611	0.122	0.066
Level of education	0.500	3.634	0.078	0.138
Co-operative society	-9.612	12.016	-0.586	-0.800
Daily quantity of fish processed (kg)	-1.982	2.766	-0.381	-0.717

	Unstandardized Coefficients		Standardized Coefficients	t-value
	B	Std. Error	Beta	
Extension visits	-3.041	8.186	-0.163	-0.372
Extension contact	-9.455	5.144	-0.642	-1.838
Income per month	-0.130	0.378	-0.030	-0.344
Credit accessible	-0.049	0.407	-0.011	0.437
Interest rate	-1.089	0.397	-0.278	-0.234**

Dependent Variable: Adoption; R = 0.924; R square=0.854; Adjusted R square= 0.470; Std Error of the Estimate= 5.139

CONCLUSION AND RECOMMENDATIONS

It could be inferred from this study that fish processing is dominated by married women who haveformal education, were members of cooperative societies and have little fish processing experience. From the processing characteristics of the fish processors, it could be concluded that fish processing is done at subsistence level. The fish processors were aware, tried and adopted most of the technologies. However, discontinuation was also high with respect to most of the adopted technologies. The study therefore concluded that adoption of improved postharvest fisheries technologies is strongly determined by the fish processors' age, and interest rate of acquiring credits

The study therefore recommends that agricultural and commercial banks should make credit facilities easily accessible to fish processors through reduced interest rates and affordable collateral. This can allow fish processors to borrow more to utilize for the adoption of improved postharvest fisheries technologies that will be required in the plan to expand business. Efforts should also be made by the extension agents at persuading the fish processors to adopt previously rejected and discontinued improved postharvest fisheries technologies. This could be achieved through organizing of results and methods demonstrations to fish processors in groups and cooperative societies.

REFERENCES

Ande, C. E. (2008). *Essential Economics for senior secondary schools (2nd edition)*. Ogun state, Nigeria: TONAD Publishers Limited. 167p.

Asiedu-Darko, E. (2014). Farmer's perception on agricultural technologies: A case of some improved crop varieties in Ghana. *Agriculture, Forestry and Fisheries, 3*(1), 13-16.

Atala, K., Ajia, T. D. and Olukosi, J. O. (1992).Adoption of soyabean utilization innovations among women in Samaru village of Sabon gari Local Government Area Kaduna State Nigeria. *Agricultural system in Africa,* 2,1 – 24.

Atala, T. K. (1984). The relationship of socioeconomic factors in agricultural innovations and utilization of innovation sources in two Nigerian villages. *Nigerian Journal of Agricultural Extension, 2*(1 & 2), 1-10.

Bolorunduro, P. I. (2003). Improved fisheries technologies and approaches for their dissemination: A case study of Niger State. Proceedings of the 16th Annual Conference of the Fisheries Society of Nigeria, November 4-9, 2001, Maiduguri, Nigeria, 74-79.

Bolorunduro, P. I., Adesehinwa, A. O. K. and Ayanda, J. O. (2005). Adoption of improved fish preservation technologies in Northwestern Nigeria. *TROPICULTURA, 23*(3), 117-123.

Davies, R. M. (2005). Development of Appropriate Technology of fish processing in Nigeria. A paper presented at a one-day workshop on intensive fish farming on Thursday, 24th February 2005, 25p.

Donye, A. O., Ja'afar-Furo, M. R. and Obinne, C. P. O. (2013). Improving smallholder farming and extension in Nigeria: The sasakawa Africa fund for extension education strategy. *Agriculture and Biology Journal of North America, 4*(2), 97-102.

Fabiyi, E. F. and Hamidu, B. M. (2011). Adoption of improved technologies in Soyabean processing and utilization in Tafawa Balewa Local Government Area of Bauchi State, Nigeria. *African Journal of Food, Agriculture, Nutrition and Development, 11*(1), 4527-4537.

Feder, G., Richard, E. J. and Zilberma, D. (1985). Adoption of agricultural innovations in developing countries: A survey. In: Economic development and cultural change, University of Chicago, USA, 33(2), 86-90.

George, F. O. A., Ogbolu, A. O., Olaoye, O. J., Obasa, S. O., Idowu, A. A. and Odulate, D. O. (2014). Fish processing technologies in Nigeria: A case study of Ibeju-Lekki Local

Government Area, Lagos State. *American Journal of Food Technology, 9*(6), 302-310.

Hodges, R. J., Buzby, J. C. and Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: Opportunities to improve resource use. *Journal of Agricultural Science, 149*, 37-45.

Ihimodu, I. I. (2003). Management of Training for Rural Development I In a Deregulated Economy. Paper presented in the 13th Annual Conference of the Nigeria Rural Sociological Association held at Ladoke Akintola University of Technology, Ogbomosho, Nov. 26-28, 25p.

Jegede, D. C. and Bolorundworo, P. I. (2002). Constraints to the adoption of disseminated post- harvest fish handling technologies in North-Western zone. *Proceedings of the 26th Annual Confrence of the Nigerian Society for Animal Production*, 26, 112-114.

Nkeme, K. K., Ndaeyo, N. U. and Akpaeti, A. J. (2013). Chokor Smoker Kiln technology adoption in Akwa Ibom State: Constraints and prospect. *American Journal of Research Communication, 1(3)*, 89-96.

Ochomma, U.C. (2008). Constraints to capacity building programmes in rural communities in Rivers State. Unpublished M.Sc Thesis, Department of Agricultural Economics and Extension, Rivers State University of Science and Technology, Port Harcourt. 90pp.

Okunade, S. O. and Bolorunduro, P. I. (2014). An integrated approach to the reduction of postharvest losses of fish in West Africa. TW Press and Publishers, Kaduna, Nigeria. 65p.

Olaoye, O. J. (2010). Dynamics of the adoption process of improved fisheries technologies in Lagos and Ogun States, Nigeria. An unpublished Ph.D thesis submitted to the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, 337p.

Olaoye, O. J., Ashley-Dejo, S. S., Adelaja, O. A. B. and Abdulraheem, I. (2014). Perception of small scale fish farmers on agricultural extension service delivery towards aquaculture development in Oyo State, Nigeria. *International Journal of Biology and Biological Sciences, 3*(3), 031-037.

Tabor, I. G. (2000). A decade (1998-1999) of fisheries Research Activities at the Nigeria Institute for Oceanography and Marine Research: Hope for self- sufficiency in fish production in Nigeria; Proceedings of 18th Annual Conference of the Committee of Directors Research Institutes (CODRI), NIDMR, Nigeria, 29p.

Tawari, C. C. (2006). Effectiveness of Agricultural agencies in fisheries management and production in the Niger Delta. Doctor of Philosophy (Ph.D) thesis, Rivers State University of Science and Technology, Port Harcourt, Nigeria (Unpublished).180p.

Tawari, C. C. and Davies, O. A. (2009). The relationship of fisherfolks characteristics to technologies adoption in Niger Delta, Nigeria. *Ozean Journal of Applied Sciences, 2*(4), 361-369

Assessment of pest management strategies used in mango production in Ogbomoso Agricultural Zone of Oyo state

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Abstract: Mango is an important horticultural crop in the rural economy of Ogbomoso Agricultural zone of Oyo state since it serves as a good source of income for farmers. However, the production of mango is being threatened by pests. This study focused on the assessment of pest management strategies employed by mango farmers in the study area. A multistage sampling procedure was adopted in selecting 360 mango farmers and structured interview schedule was used to obtain data from them. Descriptive statistics such as means, standard deviation, percentages and frequency counts were used to describe the data. Pearson Product Moment Correlation (PPMC) was employed as inferential tool. The major pests of mango in the study identified by farmers included fruit flies, flower feeders, twig borers and termites. The study reveals that pest management strategies used by mango farmers included regular pruning (72.5%), trappings (65%), weeding (75%) and use of pesticides (85%). Poor marketing outlet, pests and diseases incidence, low price of produce and lack of information on modern techniques of mango production were constraints indicated by farmers in the study area.There were significant correlation between farmers' age ($r = -0.875$, $p < 0.045$), farm size ($r = 0.724$, $p < 0.005$), farming experience ($r = -0.535$, $p < 0.564$), year of formal education ($r = 0.812$, $p < 0.032$) and pest management strategies used by farmers in the study area. The study concluded that mango farmers in the study area used several pest management strategies. It is recommended that extension agency should intensify efforts at educating farmers on the use of Integrated Pest Management (IPM) strategies in mango production.
Keywords: Mango pest management, Pesticides, Pruning, Trapping

INTRODUCTION

Mango (*Mangiferaindica*L.) is a tropical evergreen deciduous) tree which belongs to Anacardiaceae family and indigenous to India and Southeast Asia. It is cultivated for its edible fruit that varies in shape (kidney, round, oblong, oval). World production of mango was estimated at 35 million tons in 2009 with a production area of 5 million hectares. India is the largest producer of mango in the world accounting for about 13.5 million MT about half of world production in 2009, while Nigeria ranked 8th in the world with a mango production of 828,161 MT in 2009. It is instructive to note that Nigeria does not feature in the league of ECOWAS exporters of mango (ITC, 2011).

There are many varieties of mangoes produce in Nigeria such as Julie, Peter, Hindi, John Peter and Zill (Ugese *et al*, 2012). However, Kerosene and Sherri are the famous varieties of mangoes produced in the study area. Mangoes are mostly grown by peasant farmers in rural communities. A greater percentage of mango fruits is produced in Guinea and Sudan savanna zones of Nigeria (Olaniyan, 2004); with cultural practices limited to weeding and little attention paid to the enhancement of plant nutrition in the form of inorganic fertilizer application (ITC, 2011).

Mango fruit has a single flat and kidney-shaped seed surrounded by flesh that is rich in vitamins A, C and D. (http://www.chiangmai, 2014) In Nigeria, mangoes are mostly consumed as fresh fruit (Ugese *et al*., 2012). However, it can also be consumed in processed form as juice, puree, pickles, chutney, jam, flakes and mango pulp. Mango production also serves as a good source of income for farmers especially women and youths at the end of dry season. Based on the above information, it is very obvious that mango can be said to be nutritionally and economic important to the rural households. It is very pertinent to note that horticultural industry in sub-Saharan Africa is generally being threatened with several constraints like the incidence of pests and diseases (Norman, 2003). Pests' infestation in mango orchards in Ogbomoso agricultural zone had been observed and poses a big threat to mango production as a lucrative business in the area. This study was designed to gather reliable information on pest management practices with respect to mango and identify major constraints militating against the sustainable production of mango fruits. Therefore, this study was embarked upon to:

1. describe the socioeconomic characteristics of mango farmers,
2. identify common mango pests in the study area,
3. assess mango pest management strategies used by mango farmers and
4. identify key constraints to mango production.

Hypothesis of the study

There is no significant relationship between selected socioeconomic characteristics of mango farmers and the use of pest management strategies in mango production.

METHODOLOGY

The study was carried out in Ogbomoso agricultural zone of Oyo state in southwest Nigeria. It is one of the four agricultural zones in Oyo state and comprises five Local Government Areas (LGAs) namely: Ogo-Oluwa, Surulere, Orire, Ogbomoso north and Ogbomoso south. The major occupation of rural people in this zone is farming and they engage in the cultivation of crops like maize, yam, cassava, sorghum, fruit and leafy vegetables, cashew and mango.

A multistage sampling procedure was used in selecting respondents for the study. The first stage involved the purposive selection of three LGAs (Ogo-Oluwa, Surulere and Orire) being rural LGAs and their popularity in mango fruit production. Random selection of two villages from each of the LGAs was carried out at the second stage. A list of mango producers was developed from the selected villages with the assistance of Extension officers in the area. A total of 360 mango producers was selected for interview and the size of sub-samples taken from each of the selected villages was determined by the proportionate availability of mango producers. Data were collected using a pre-tested interview schedule. Descriptive statistics such as frequencies, percentages, mean and standard deviations were used to describe the data. Pearson Product Moment Correlation (PPMC) was employed as inferential statistical tool.

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Socioeconomic characteristics of mango farmers who participated in the survey are presented in Table 1. The age distribution indicates that more than one third (38.3%) of the farmers were within the age range of 41- 50 years, while only 8.4% were within the age range of 21 – 30 years and the mean age was 50.6 years. This is an indication that the respondents are still in their active working age. The marital status distribution shows that majority (90.0%) of the farmers were married while a small proportion (7.5 %) were still single. Majority (95.0%) of mango farmers were male,, while the remaining percentage (5.0%) were female indicating a strong gender disparity in mango fruit production in the study area. However, a majority of these female farmers were widows and female household heads whose husbands had left the area in search of better jobs. Less than one third (30.8%) of the farmers had no formal education. Only 1.7% had less than six years of formal education, more than half (60.8%) had between six and twelve years of formal education and 6.7% had above twelve years of formal education. This high literacy level is likely to make the majority of the farmers more responsive to improved technologies with respect to pest management in mango fruit production than those without formal education (Adeola, 2015).

Table 1 also shows that majority (90.8%) of the mango farmers were still operating at small scale level having mango trees scattered on their farms within the range size of 2 – 4 hectares. It was observed that farmers did not pay attention to regular spacing in planting their mango trees which is likely to negatively affect the optimum plant population expected per hectare. Mango fruit production experience of farmers were within the range of than 5 years to 20 years and above with a mean year of experience in mango production stood at 18. 8 years (Table 1). This substantial experience in mango production is likely to enable them to take a right decision in adopting an innovation that would enhance mango fruit production.

Table 1: Distribution of respondents according to socioeconomic characteristics n = 360

Variables	Frequency	Percentage
Age (years)		
21 -30	30	8.4
31 -40	39	10.8
41 -50	138	38.3
51 – 60	102	28.3
Above 60	51	14.2
Marital status		
Single	27	7.5
Married	324	90.0
Widow	9	2.5
Sex		
Male	345	95.8

Variables	Frequency	Percentage
Female	15	4.2
Years of formal education		
Below 6	6	1.7
6 – 12	219	60.8
Above 12	24	6.7
No formal education	111	30.8
Farm size (Hectares)		
< 2	327	90.8
2 – 4	27	7.5
> 4	6	1.7
Farming experience (Years)		
< 5	22	6.1
6 – 10	52	14.4
11 – 15	86	23.9
16 – 20	136	37.8
> 20	64	17.8

Source: Field survey, 2015

Table 2 shows the list of pests being encountered by mango farmers in the study area. Fruit flies happened to be the major pests of mango being experienced by farmers (52.5%) in the area, closely followed by flower feeders (47.5%). Other pests indicated by farmers included ants (29.2), twig borers (20.8%) and termites (19.2%). The presence of these pests if left uncontrolled could pose a threat to the production of mango fruit in the study area. This is a great challenge for extension to acquaint farmers with innovations capable of tackling the pest invasion and strategies that can reduce the losses that might be due to pests in mango fruit production.

Table 2. Distribution of mango farmers by pests encountered on their orchards

Pests	*Frequency	Percentage
Termites	59	19.2
Fruit flies	189	52.5
Twig borers	75	20.8
Ants	105	29.2
Flower feeders	171	47.5

*** Multiple responses. Source:** Field survey, 2015

Pest management strategies used by mango farmers

The study found that mango farmers were using some strategies for the control of pests in their mango orchards (Table 3). The strategies included the pruning operation that involves cutting of some dead or diseased branches that was always and often performed by 52.5% and 20.0% of the respondents, respectively. Weeding was also a pest control strategy always (55.6%) and often (37.5%) carried out by mango farmers in the study area. Also, the study reveals that the use of pesticides was a common pest control strategy always (85.0%) used by mango farmers. However, use of synthetic chemical insecticides for the control of mango pests by mango farmers may pose a risk to their health and the surrounding environment. Inadequate knowledge of the appropriate recommended insecticides is likely to expose both the producers and consumers to serious health risks. Banjo (2010) opined that indiscriminate use of pesticides could lead to actual yield loss, extinction of natural enemies and development of resistance by these pests to the pesticides.

Table 3: Distribution showing pest management strategies among mango farmers n= 360

Strategies	Always	Often	Rarely	Never
Pruning	189 (52.5)	72 (20.0)	33 (9.2)	66 (18.3)
Weeding/slashing	200 (55.6)	135 (37.5)	25 (6.9)	0 (0.0)
Trapping	134 (37.2)	120 (33.3)	26 (7.3)	80 (22.2)
Use of pesticides	306 (85.0)	42 (11.7)	4 (1.1)	8 (2.2)

Figures in brackets represent percentages
Source: Field survey, 2015

Constraints to mango fruit production

The study found thatconstraints to mango production indicated by the respondents included, poor marketing outlet (60.0%), the incidence of pests and diseases (79.2%), low price of produce (57.5%) and lack of information on modern techniques of mango production (Table 4). This is an indication that pests and diseases incidence was a common constraint frequently experienced by farmers in mango fruit production in the study area. Research has shown that pests and diseases had the highest frequency of problems commonly encountered by farmers in mango production (Ajayi and Nyishir, 2006). This implies that there is a need for concerted efforts on the part of researchers and extension agents to make pests and diseases control strategies available to mango farmers.

Table 4: Distribution of respondents based on constraints to mango fruit production n = 360

Constraints	Frequency*	Percentage
Poor marketing outlet	216	60.0
Pests and disease incidence	285	79.2
Low price of the produce	207	57.5
Lack of information on modern techniques	261	72.5

Source: Field survey, 2015 * Multiple responses

Relationship between mango farmers' selected socioeconomic characteristics and use of pest management strategies.

The results of the analysis as shown in Table 5 reveal that age (-0.875, $p \leq 0.05$) of the farmers had a negative and significant relationship with the use of pest management strategies. This implies that as the farmers advance in age, there is a tendency to use fewer strategies in controlling mango pests in their orchards. However, the younger farmers may be willing to invest and use more strategies in order to make the mango production a profitable enterprise. With respect to farm size, a positive and significant ($r = 0.724$, $p \leq 0.05$) relationship existed between the farm size and the use of pest management strategies in mango production. This implies that as farm size increases along with an increase in mango tree population, a farmer is likely to assume more responsibilities of managing the orchards by employing more strategies in protecting the trees against pest infestation. The analysis also reveals that farming experience had negative but not significant relationship (- 0.535, $p \leq 0.01$) with the use of pest management strategies. Farmers' experience in mango fruit production would have made them realized the production of mango fruits as a non-profitable enterprise due to low market outlets and prices hence, it is needless to engage in the use of one or more strategies to control pests. The results further show that education also had a positive and significant (0.812, $p \leq 0.05$) relationship with the use of pest management practices. This is an indication that farmers with higher education are likely to be more responsive to new ideas and this would probably lead to their quest for more pest management strategies in combating the pest problems in mango fruit production.

Table 5: Relationship between some selected socioeconomic characteristics and use of pest management strategies

Variables	r value	p value	Remark
Age	-0.875	0.045	Significant
Farm size	0.724	0.005	Significant
Farming experience	-0.535	0.564	Non-significant
Education	0.812	0.032	Significant

CONCLUSION AND RECOMMENDATION

This study has shown that farmers had been making use of some pest management strategies in their efforts to control pests in mango fruit production. Pest management strategies employed by farmers include pruning, trapping, weeding and use of pesticides (synthetic chemicals). However, other pest management strategies such as biological control, use of resistant cultivars and use of natural resources were not known to the mango farmers in the study area. The study, therefore, recommends an intensive effort of extension agencies in educating farmers especially on the use of appropriate synthetic chemicals as well as encourage IPM strategies in mango production. A timely intervention of extension agency in this direction would go a long way to

ensuring sustainable development in mango fruit production.

REFERENCES

Adeola, R. G. (2015). Farmers' Perception of African Locust Bean Tree (*ParkiaBigloblosa*) as an Economic Tree in Oyo State, Nigeria. *American International Journal of Research in Humanities, Arts and Social Sciences* 10 (2): 127 - 130

Ajayi, A. R. and Nyishir, S. A. (2006). Mango variety production, marketing and consumption preferences among households in Benue State, Nigeria. *Proceedings of the 23rd Annual Conference of the Horticultural Society of Nigeria,* 337-343Pp.

Banjo A. D., Aina, S. A. and Rije, O. I. (2010). Farmers' knowledge and perceptions towards herbicides and pesticides usage in Fadama of Okun-Owa, Ogun State of Nigeria. *African Journal of Basic and Applied Sciences,* 2(5-6): 188-194.

Chiangmai-Chiangrai (2014). Marvelous Mango. chiangmai-chiangrai magazine accessed http://www.chiangmai-chiangrai.com/fruit-mango.html accessed and retrieved/05/2016

Nanakaan, S. (2011). Export Factsheet ECOWAS: Mangoes. International Trade Centre (ITC) report. www.intracen.org/.../111129 accessed and retrieved 12/06/2015.

Norman, J. C. (2003). The horticultural industry in tropical Africa. *Acta Horticulture*. (ISHS) 621: 69-79.

Olaniyan, A. O. (2004). General information about mango and citrus production in Nigeria. Paper presented at the Mashav International Training on Mango and Citrus Orchards Growing and Management, Held at Maizube Farms, Minna, Niger State, 22nd Nov–3rd Dec, 2004, 10pp

Ugese, F. D., Iyango, P. O. and Swem, T. J. (2012).Mango (*MangiferaIndica*L.) Fruit Production and Production Constraints in Gboko Local Government Area of Benue State.*Production Agriculture and TechnologyJournal8 (1): 164-174*

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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:

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

π = Probability $(Y) = \frac{e^{\alpha+\beta_1X_1+\beta_2X_2}}{1+e^{\alpha+\beta_1X_1+\beta_2X_2}}$ ……(2)

Where: π 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.

Effect of Students Industrial Work Experience Scheme on Fish Farming in Ogun State, Nigeria

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Abstract: This study assessed the effect of Students Industrial Work Experience Scheme (SIWES) on fish farming in Ogun State, Nigeria by interviewing 55 beneficiaries and 65 non-beneficiaries of SIWES through the with-and without approach. Data were collected with the use of interview guide and analysed same using frequency, percentage, mean, standard deviation and t-test analytical tool. Results reveal that beneficiaries of SIWES had higher number of ponds (mean = 14.16±2.31), higher stocking density (2936.36±902.951 fish), larger farm size (6.66±4.62 plots) and higher annual income (N6.78±1.89 million) than the non-beneficiaries who had an average of 7.59±5.70 ponds, stocking density of 2416.67±967.087 fish, farm size of 4.21±2.18 plots and annual income of N2.54±0.35 million. The t-test analyses revealed that significant differences existed in the number of workforce (t= 2.619, p=0.010), number of ponds (t= 2.407, p=0.018) and annual income (t= 2.755, p=0.007) of the SIWES attached and non-SIWES attached fish farms in Ogun State. We concluded that SIWES had positive effect on fish farming in Ogun State and therefore recommended that all fish farms should be encouraged to accept SIWES students on their farms as this will improve their productivity through reduced unit cost of production, increased income and ultimately increased profit.
Keywords: Fish farming, Increased income, Fish ponds, Protein-deficiency, SIWES beneficiaries

INTRODUCTION

Students Industrial Work Experience Scheme (SIWES) is a skill acquisition scheme aimed at providing students of higher institutions of learning-universities, polytechnics, and colleges with practical on-the-job training (James, 2015). It allows the students to utilize their acquired theoretical knowledge in the context of real life work situations at industrial and commercial establishments. It is a cooperative effort as it involves the industries, institutions of learning and coordinating agencies-Nigeria Universities Commission (NUC), National Board for Technical Education (NBTE) and National Commission for Colleges of Education (NCCE) in Nigeria, under the management of the Industrial Trust Fund (ITF), established in 1974 by the federal government (Ugwuanyi*et al.,* 2010).

Concerned university students are scheduled to undergo 6 months of industrial attachment at the 3rd or 4th year of their courses during the period of their degree programme, while students of polytechnics and colleges are to undergo SIWES programme for 4 months in the 1st or 2nd year (James, 2015). The overall goal is to build youths who are equipped with necessary practical skills that will be useful for them after graduation to meet the standard skills required in an industrial and commercial sector (NUC, nd). The acquired skills couldalso be used in the establishment of personal businesses. It is however surprising that numerous Nigerian graduates that underwent the scheme are unemployed. Reasons adduced for this ugly situation by employers of labour include the fact that the graduates do not have the kind of skills that are needed in the industrial sector (Mafe, 2010; Akerejola, 2008). Also, most of the unemployed graduates could not translate both the theoretical and practical knowledge into use as entrepreneurs and employers of labour.

Aquaculture is the fastest growing food commodity in the world and is expected to have an important role in food security in the nearest future (Chris, 2013). Fish farming is one of the areas where students are sent for industrial attachment in order to expose them to work methods and techniques in handling equipment and machinery that may not be available in their institutions (ITF, 2004) with a view to increasing the immediate and long-term fish production in the country. The need to increase fish supply from aquaculture cannot be overemphasised now that the country is among the protein-deficient nations (Akegbejo-Samsons, 1997).

Fish farms had benefitted from SIWES through reduced cost of labour and extension service delivery organised by SIWES. This is because; the fish farms are not mandated to pay the SIWES attached students as they were being paid by the Nigerian government. Therefore, the fish farms could get as many students as needed without paying any amount or by just giving them as little incentives as they deem fit. The students could then perform any tasks as assigned to them while gaining work situation experiences from the fish farms. The students could further benefit the farms through suggestions of creative ideas that could improve the farms' productivity. There have also been collaborations between fish farms, higher institutions of learning, and SIWES officials on means to increase fish productivity. Through these collaborative efforts, fish farms had benefitted from

research results of the institutions of learning. Despite these benefits to the students and fish farms, there is little or no empirical studies to determine the effectiveness of SIWES on either the students or even the employers.

It is therefore imperative to examine the impact of SIWES on fish farming in Ogun state, Nigeria with the specific objectives were to describe the socioeconomic characteristics of the fish farmers, determine the production characteristics and identify the factors affecting fish farming in OgunState, Nigeria. The hypothesis of the study stated in null form is that "there is no significant difference in the production parameters of SIWES attached and non-SIWES attached fish farms.

METHODOLOGY

The study was conducted in Ogun State in south-western Nigeria. The state has a total population of 3,728,098 in 2006 (Olaoye *et al.,* 2007). The state is located in the rainforest vegetation belt of Nigeria within longitude 2°45' and 3° 55' E and latitudes 7° 01 N and 7°8' N in the tropics. It is bounded in the west by Benin Republic, in the south by Lagos state and Atlantic Ocean, in the east by Ondo State, and in the north by Oyo State. It covers a land area of 16,409.28 km^2, less than two percent of the country's landmass (Olaoye *et al*., 2007). The rainy season starts around the middle of March and continues until late October. The dry season starts in November and lasts until February in most locations in the state. The main occupations of the people in the state are: agriculture, fishing, clothing, textiles and civil service. The state was divided into four agricultural extension zones namely: Abeokuta, Ilaro, Ijebu-Ode and Ikenne (OGADEP, 2005).

A multistage sampling procedure was adopted in this study to sample one hundred and twenty fish farms in Ogun State. The first stage involved the random selection of two (Ijebu-Ode and Abeokuta) out of the four agricultural extension zones in Ogun state. This was followed by the purposive selection of one extension block from each of the selected extension zones. The final stage was the selection of all the fish farms in the two extension zones but not all the fish farms could be accessed. Also, some fish farms declined to participate in the study but a total of 120 fish farmers responded to the research instrument. About 55 out of the 120 fish farmers had SIWES students attached to them, while 65 were non-beneficiaries of SIWES.

Primary data were collected with the aid of pre-validated interview guide designed for the purpose of this study. The interview guide consists of three sections which are on the socioeconomic characteristics of the fish farmers, production characteristics and factors affecting fish farming in Ogun State.

Impact was determined using the with-and-without approach whereby the annual income, production output, labour cost, number of workforce, number of ponds, stocking density and farm size of the SIWES attached and non-SIWES attached fish farms were compared.

Data were subjected to descriptive statistics such as frequency count, percentage, mean and standard deviation. Student's t-test was used as inferential tool to test the hypothesis of the study at 1% and 5% levels of significance.

RESULTS AND DISCUSSION

Socioeconomic characteristics of fish farmers

Table 1 reveals that 90.1% and 89.2 of the beneficiaries and non-beneficiaries of SIWES respectively, were male implying that fish farming was dominated by male persons thereby supporting reports from earlier studies(Adewuyi*et al.,* 2010; Deji and Koledoye, 2013) conducted in Ogun and other south-western states which noted male dominance in fish farming. More than half (50.9%) of the beneficiaries were aged 41-50 years, while 40.0% of the non-beneficiaries were within the same age range. Less than one-third (30.9% and 29.2%) of the beneficiaries and non-beneficiaries were respectively between 31 and 40 years. The mean ages were 44.51±8.95 years and 45.77±9.29 years for beneficiaries and non-beneficiaries, respectively indicating that the fish farmers were still productively active.This is in tandem with similar findings of other researchers (Adebayo and Daramola, 2013; Sikiru*et al.*, 2009; Agbebi, 2012) who found that people within the active work force are adventurous, economically active and industrious and the implication of this is that there is a brighter future for the production of fish which could facilitate the sustainable development of the aquaculture sector.

Almost all of the beneficiaries (94.5%) and non-beneficiaries (92.3%) were married. This implies that fish farming in Ogun state has been dominated by married persons and agrees with earlier researches (Apata, 2012; Olaoye*et al.*, 2013) which reported that married persons were highly involved in fish farming within Southwest, Nigeria. It has been noted that marriage attached additional social responsibilities and commitments on individuals who are married. Hence, being married could be both a cause and effect for a person's motivation in fish farming because married fish farmers could be given assistance in terms of labour, soft loans and managerial services by their spouse(s), children and other family members such as in-laws. This could explain Ekong (2003)'s position that marriage is

highly cherished in the Nigerian society. Responsibilities and commitments that come with marriage could also explain a person's involvement in fish farming.

Table 1 further reveals that while the least form of education among the beneficiary fish farmers was secondary education (40.0%), some of the non-beneficiary fish farmers had no education (3.1%) and highest of primary education (10.8%) and only about 43.1% of them equally had secondary and tertiary educations. This implies a generally high level of education among the fish farmers but that It was also deduced that the fish farmers generally had considerably high level of education which implies that fish farming could be sustainably developed as most of the fish farmers already had the prerequisite as fish farming required some level of technical and scientific knowledge that only educated persons could understand (Ashley-Dejo*et al*., 2013). Olaoye (2010) also noted that education is an important tool in a person's decision making process.

Also, 72.7% and 27.3% of the beneficiary fish farmers had respectively 1-5 and 6-10 persons per household, while 63.1%, 29.2 and 7.7% of the non-beneficiary fish farmers respectively had 1-5, 6-10 and 11-15 persons per household. The mean household sizes were 5.11±1.72 and 6.55±2.53 persons for beneficiary and non-beneficiary fish farmers, respectively. This is an indication that non-beneficiaries of SIWES had larger household sizes than the beneficiaries and this could explain why the beneficiaries of SIWES requested for additional hands from SIWES as trainees because according to some researchers (Adebayo, 2012; Daramola and Adebayo, 2013), large family size could serve as source of free and cheap labor.

Majority (89.1% and 81.5%) of the beneficiary and non-beneficiary fish farmers, respectively had fish farming as their primary occupation, while more than half (56.4%) and 36.9% of the beneficiaries and non-beneficiaries had no other occupations. This could imply that fish farming has been a profitable enterprise through which the fish farmers used as a good source of livelihood(Adewuyi *et al.*, 2010; Tiamiyu *et al.,*2015).It also indicated that more of the beneficiaries than non-beneficiaries had no other occupations and this could explain why the SIWES attached farms were requesting for SIWES students as a way of increasing the productivity as they concentrated their energy and resources on the proper management of their only venture because a person's occupation is a valid means through which the person acquires self-satisfaction (Olaoye *et al*., 2013).

Also, majority (85.5% and 75.4%) of the beneficiaries and non-beneficiaries, respectively had 1-10 years of fish farming experience with mean fish farming experiences of 7.49±5.83 and 8.18±6.84 years for beneficiaries and non-beneficiaries, respectively. Olasunkanmi (2012) also reported that the highest proportion of the fish farmers in Osun state had 1-10 years of fish farming experience.

Table 1: Socioeconomic characteristics of SIWES attached and non-SIWES attached fish farmers

Socioeconomic variables		**Beneficiaries (n = 55)**		**Non-beneficiaries (n = 65)**	
Variables	**Response categories**	**Frequency**	**%**	**Frequency**	**%**
Sex	Male	50	90.1	58	89.2
	Female	5	9.1	7	10.8
Age (years)	21-30	3	5.5	2	3.1
	31-40	17	30.9	19	29.2
	41-50	28	50.9	26	40.0
	1-60	7	12.7	15	23.1
	>60	0	0.0	4	6.2
	Mean±SD	44.51±8.95		45.77±9.29	
Marital status	Single	3	5.5	4	6.2
	Married	52	94.5	60	92.3
	Divorced	0	0.0	1	1.5
Educational level	No formal education	0	0.0	2	3.1
	Primary education	0	0.0	7	10.8
	Secondary education	22	40.0	28	43.1
	Tertiary education	33	60.0	28	43.1
Household size (persons)	1-5	40	72.7	41	63.1
	6-10	15	27.3	19	29.2
	11-15	0	0.0	5	7.7
	Mean±SD	5.11±1.72		6.55±2.53	
Primary	Fish farming	49	89.1	53	81.5

occupation	Trading	0	0.0	4	6.2
	Civil service	4	7.3	3	4.6
	Others	2	3.6	5	7.7
Other occupations*	None	31	56.4	24	36.9
	Fish farming	6	10.9	12	18.5
	Trading	12	21.8	18	27.7
	Civil service	5	9.1	4	6.2
	Artisans	17	30.9	19	29.2
Fish farming experience (years)	1-10	47	85.5	49	75.4
	11-20	7	12.7	13	20.0
	21-30	1	18.2	3	4.6
	Mean±SD	7.49±5.83		8.18±6.84	

***variables with multiple responses**
Source: Field survey (2016)

Production characteristics of beneficiary and non-beneficiary farmers

As shown in Table 2, almost all of the beneficiary (90.9%) and non-beneficiary (89.2%) fish farmers spent less than N50,000 per annum on labour with mean annual labour costs of N47,727±12,082 and N34,846±2,355 expended by beneficiaries and non-beneficiaries of SIWES, respectively. With respect to number of work force, 69.1% and 81.5% of the beneficiary and non-beneficiary fish farmers, respectively employed the service of at most 5 persons, while 6-10 and 11-15 persons were equally employed by 10.9% of the beneficiaries of SIWES. Also, 9.1% of the beneficiary fish farmers had more than 15 employees on their farms, while 12.3% and 6.2% of the non-SIWES attached fish farms had 6-10 and 11-15 employees, respectively with none of them having more than 15 employees. The mean workforce of the farms was 8.40±3.49 and 3.91±3.22 persons for beneficiaries and non-beneficiaries, respectively.

Table 2 further shows that 81.8% and 98.5% of the beneficiaries and non-beneficiaries operated on 1-6 plots of land for their fish farming activities. The mean farm sizes indicate that non-beneficiary fish farmers had 4.21±2.18 plots of land, while the beneficiary fish farmers operated on 6.66±4.62 plots of land. The highest proportions of the beneficiaries (69.1%) and non-beneficiaries (87.7%) operated 1-10 ponds. None of the non-beneficiaries operated on more than 20 ponds, while 18.2% of the beneficiaries made use of more than 20ponds for their fish farming activities. The beneficiary fish farmers operated on an average of 14.16±2.31ponds, while 7.59±5.70 ponds were in operation by the non-beneficiary fish farmers.

These findings are indications that both categories of fish farmers operated on small number of ponds 1-10 ponds on small farm sizes of 1-6 plots. This agrees with Adebayo and Daramola (2013)'s research report which found that majority of the fish farmers in Ibadan, a metropolis in Oyo State had 1-5 units of ponds. However, the mean values indicate that SIWES attached farms had larger farm sizes than the non-SIWES attached farms. The mean number of ponds also implied that the SIWES attached farms had almost twice the number of ponds operated by the non-beneficiary of SIWES.

More than three-fifths (63.6%) and about half (50.8%)of the SIWES attached farms and non-SIWES attached farms respectively stocked 2001-4000 fishes respectively during a production cycle. The mean stocking densities for SIWES and non-SIWES attached farms were 2936.36±902.951 fishes and 2416.67±967.087 fishes respectively implying that the SIWES attached farms stocked more fishes than the no-SIWES attached farms which could be as a result of the larger farm sizes and higher number of ponds in operation on the SIWES attached farms.More than 70 percent of the SIWES attached fish farms realized between N1 and10 million annually while 64.6% of the non-SIWES attached fish farms realized same amount. The mean annual income was N6.78±1.89 million and N2.54±0.35 million respectively for SIWES attached and non-SIWES attached fish farms indicating that SIWES attached fish farms realized higher income than the non-SIWES attached farms. This is attributed to the larger farm sizes, higher number of ponds, and larger stocking densities that characterized the SIWES fish farms.

Table 2: Production characteristics of the beneficiary and non-beneficiary fish farmers

Production parameters	Categories	Beneficiaries Frequency	%	Non- beneficiaries Frequency	%
Production output per kg	1.0-1.9	39	70.9	52	80.0
	2.0-2.9	12	21.8	8	12.3
	≥3.0	4	7.3	5	7.7
	Mean±SD	1.72±0.46		1.69±0.45	
Labor cost (N thousand)	≤50	50	90.9	58	89.2
	51- 100	3	5.5	7	10.8
	>100	2	3.6	0	0.0
	Mean±SD	47.727±12.082		34.846±2.355	
Number of workforce	≤5	38	69.1	53	81.5
	6-10	6	10.9	8	12.3
	11-15	6	10.9	4	6.2
	>15	5	9.1	0	0.0
	Mean±SD	8.40±3.49		3.91±3.22	
Farm size (plots)	1-6	45	81.8	64	98.5
	7-12	5	9.1	1	1.5
	13-18	1	1.8	0	0.0
	>18	4	7.3	0	0.0
	Mean±SD	6.66±4.62		4.21±2.18	
Number of ponds	1-10	38	69.1	57	87.7
	11-20	7	12.7	8	12.3
	>20	10	18.2	0	0.0
	Mean±SD	14.16±2.31		7.59±5.70	
Stocking density	≤2000	15	27.3	33	50.8
	2001-4000	35	63.6	29	44.6
	4001-6000	5	9.1	3	4.6
	Mean±SD	2936.36±902.951		2416.67±967.087	
Annual income (N million)	<1	8	14.5	23	35.4
	1-10	40	72.7	42	64.6
	>10	7	12.7	0	0.0
	Mean±SD	6.78±1.89		2.54±0.35	

Source: Field survey, 2016

Factors affecting fish farming in Ogun State

As shown in Table 3, the mean values indicate that majority of the fish farmers considered high inflation rate in the economy (2.17) as the most severe factors affecting fish farming in Ogun State. This was followed by high cost of feeding (2.12), high investment cost (1.98), and poor quality of fish seed (1.93) which ranked second, third and fourth respectively. These results are in tandem with that of Olaoye (2010) who identified high cost of feeding as a constraint to fish farming in Ogun State. High cost of fish feed and market price fluctuation were also identified by other researchers (Adebayo and Daramola, 2013; Olasunkanmi, 2012) as severe constraints to fish production in south-western states of Nigeria.

Table 3: Factors affecting fish farming in Ogun State

Factors affecting fish production	Level of severity				Mean	Rank
	Very serious	Serious	Not a problem	I don't know		
Lack of appropriate land or site	4 (3.3)*	24 (19.8)	86 (71.1)	7 (5.8)	1.21	10th
Old age	4 (3.3)	20 (16.5)	88 (72.7)	9 (7.4)	1.16	11th
Lack of sufficient fund	22(18.2)	49 (40.5)	41 (33.9)	9(7.4)	1.69	6th
Poaching	22 (18.2)	41 (33.9)	52 (43.0)	6 (5.0)	1.65	7th
Lack of technical know-how	17 (14.0)	46 (38.0)	51 (42.1)	7 (5.8)	1.60	9th
Disease and predation	45 (37.2)	56 (46.3)	15 (12.4)	5 (4.1)	1.92	5th
High inflation rate in the economy	45 (37.2)	56 (46.3)	15 (12.4)	5 (4.1)	2.17	1st

High cost of investment	29 (24.0)	65 (53.7)	22 (18.2)	5 (4.1)	1.98	3rd
Poor marketing channel	25 (20.7)	33 (27.3)	56 (46.3)	7(5.8)	1.63	8th
Poor quality fish seed	33(27.3)	51(42.1)	33(27.3)	4(3.3)	1.93	4th
High cost of feeding	37(30.6)	64(52.9)	17(14.0)	3(2.5)	2.12	2nd

***Figures in parentheses are percentages**
Source: Field survey, 2016

Differences in the production parameters of beneficiary and non-beneficiary fish farmers in Ogun State

As shown in Table 4, t-test result reveals that there were significant differences in the number of workers (t= 2.619, p=0.010), number of ponds (t= 2.407, p=0.018) and annual income (t= 2.755, p=0.007) of the SIWES attached and non-SIWES attached fish farms in Ogun State. Table 4 however shows that there was no significant differences in the production output (t = 0.336, p=0.737) and labor cost (t = 1.811, p=0.073) among the beneficiaries and non-beneficiaries. This implied that SIWES attached farms had higher number of workers, operated higher number of ponds and realized more income than the non-SIWES attached fish farms.

Table 4: Test of differences in the production parameters of the beneficiary and non-beneficiary fish farmers in Ogun State

Production parameters	Farmer's type	Mean	Standard deviation	Mean difference	t-value	df	p-value
Labour cost (N)	Beneficiaries	47727.34	12,082.686	12881.04	1.811	119	0.073
	Non-beneficiaries	34846.30	2,355.330				
Income (N)	Beneficiaries	6777272.73	1888415.69	4234696.97	2.755	119	0.007*
	Non-beneficiaries	2542575.76	351898.128				
Number of ponds	Beneficiaries	14.16	21.308	6.573	2.407	119	0.018**
	Non-beneficiaries	7.59	5.697				
Number of workforce	Beneficiaries	8.40	13.486	4.491	2.619	119	0.010*
	Non-beneficiaries	3.91	3.224				

*means significant at 0.01 level of significance while **means significant at 0.05 level of significance, df = degree of freedom.
Source: Field survey, 2016

CONCLUSION AND RECOMMENDATIONS

SIWES has been found to have positive impacts on fish farming in Ogun State as it yielded as SIWES attached fish farms operated higher number of ponds, larger farm sizes and higher stocking density, while also earning higher income annually than the non-SIWES attached farms. To ensure the sustainable supply of fish to Nigerians especially from Ogun State through increased productivity, there is the need to overcome the challenges confronting fish farming in the State. It is therefore recommended that all the fish farmers in Ogun state should be encouraged to accept SIWES students on their farms as this will improve their productivity through reduced unit cost of production, increased income and ultimately increased profit.

REFERENCES

Adebayo, O. O. and Daramola, O. A. (2013). Economic analysis of catfish (*Clariasgariepinus*) production in Ibadan metropolis. *Discourse Journal of Agriculture and Food Sciences, 1*(7): 128-134.

Adewuyi, S. A., Phillip, B. B., Ayinde, I. A. and Akerele, D.(2010).Analysis of Profitability of Fish Farming in Ogun State, Nigeria. *Journal of Human Ecology*, *31*(3): 179 -184.

Agbebi, F. O. (2012). Assessment of the impact of extension services on fish farming in Ekiti State, Nigeria. *Asian Journal of Agriculture and Rural Development, 2*(1): 62-68

Akegbejo-Samsons, Y. (1997). *Introduction to aquaculture and fisheries management in Nigeria*. Abeokuta: Good education Publishers. Pp. 5-7.

Akerejola, O. (2008). Information and guidelines for Students Industrial Work Experience Scheme. Available: http://www.itf-nigeria.org/docs/siwes-op-guide.pdf.

Apata, O. M. (2012). Awareness and adoption of fish production technologies in south-western, Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences, 3*(5):819-822.

Ashley-Dejo, S. S., Olaoye, O. J., Fakoya, E. O., Ikeweinwe, N. B., Idowu, A. I., Bolarinwa, K. K. and Adelaja, O. A. (2013). Limitations to the adoption of recommended aquaculture production technologies by small scale fish farmers in Oyo State Nigeria. *Global Journal of Science Frontier Research Aquaculture and Veterinary, 13*(9):29-37

Chris, W. (2013). Sustainable aquaculture in the North Central region U.S.- A review of perceptions and recommendations from the aquaculture community. *Journal of Extension, 51*(2): 1-12. Article #2COM1

Deji, O. F. and Koledoye, G. F. (2013). Gender analysis of fish farming technologies adoption by farmers in Ondo State. *Academic Journals, 8*(26): 1219-1225.

Ekong, E. E. (2003). *An introduction to rural sociology (2nd edition).*Uyo, Nigeria: Dove educational Publishers. Pp 259-285.

Industrial Trust Fund – ITF. (2004). Information and Guideline for Student Industrial Work-Experience Scheme. Jos, Nigeria: Industrial Training Fund. 11 pp.

James, S. A. (2015). *SIWES Hand book (An updated version).* SIWES Unit, Federal College of Education, Abeokuta. 43pp.

Mafe, O. A. T. (2010). Invited Paper presented at the Workshop on "Achieving the Necessary Professional Standards in Chemical Engineering in our Universities" organized by the Nigerian Society of Chemical Engineers, AfeBabalola Hall, University of Lagos, 29thSeptember, 2010.

National Universities Commission – NUC (nd). *Students Industrial Work Experience Scheme (SIWES) Job specification for Agriculture for all Nigerian Universities.* Jos, Nigeria: ITF Printing Press. 9pp.

Ogun State Agricultural Development Programme– OGADEP. (2005). Annual in-house review Fisheries report. Ogun State Agricultural Development Programme (OGADEP) Fisheries Unit, 10pp.

Olaoye, O. J. (2010). Dynamics of the adoption process of improved fisheries technologies in Lagos and Ogun States, Nigeria. An unpublished PhD thesis submitted to the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, 337pp.

Olaoye, O. J., Adekoya, B. B., Ezeri, G. N. O., Omoyinmi, G. A. K. and Ayansanwo, T. O. (2007). Fish Hatchery Production Trends in Ogun State: 2001-2006. *Journal of Field Aquatic Studies - Aqua field,* 3: 29-40.

Olaoye, O. J., Ashley-Dejo, S. S., Fakoya, E. O., Ikeweinwe, N. B., Alegbeleye, W. O., Ashaolu, F. O. and Adelaja, O. A. (2013): Assessment of socioeconomic analysis of fish farming in Oyo State, Nigeria. *Global Journal of Science Frontier Research Aquaculture and Veterinary, 13*(9): 45-55.

Olasunkanmi, J. B. (2012). Economic analysis of fish farming in Osun State, South-Western Nigeria. *IIFET 2012 Tanzania Proceedings*. 10pp.

Sikiru, B. O., Omobolanle, N. M., Ayorinde, B. J. O. and Adegoke, O. O. (2009). Improving *Clarias* productivity. *Journal of Biological Research, 3*(1&2):24-28.

Tiamiyu, S. A., Fakoya, E. O., Olaoye, O. J., Ashimolowo, O. R. and Ojebiyi, W. G. (2015). Assessment of the effect of National Fadama Development Project (FADAMA II) on fish farming in Lagos State, Nigeria. *Ibadan Journal of Agricultural research, 11*(2): 56-65.

Ugwuanyi, C. F., Ezema, J. U. and Nnamdi, A. (2010). Challenges of Students' Industrial Work Experience Scheme (SIWES) in Library and Information Science in the ICT Environment. *Library Philosophy and Practice.*Accessed on 10th September 2011, from http://www.thefreelibrary.com/Library+Philosophy+and+Practice/2010/July/1-p52045

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Estimation and the determinants of technical efficiency among small scale Soyabean farmers in Nigeria: Evidence from central agricultural zone

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Abstract: The study estimated technical efficiency and its determinants among small scale soyabean farmers in the Central Agricultural Zone in Nigeria. Data were collected from 485 soyabean farmers, sampled through a multi-stage procedure, using structured questionnaire. Cobb-Douglas regression functional form, using the stochastic frontier production function, was used to analyze the data that were collected. The estimated technical efficiency ranged from 10% to 99% with a mean of 53%. The study revealed that the important factors having positive impacts on technical efficiency levels were education, farming experience, farm size, extension contact, access to credit and improved soyabean variety, while age and household size had negative influence. The study recommends that policies designed to increase technical efficiency should be directed at increasing access to education and credit, farm size, extension contact and use of improved varieties.
Keywords: Small-scale soyabean farmers,technical efficiency,Cobb-Douglas production function, stochastic frontier model

INTRODUCTION

Over the past two to three decades, the dominant role of agriculture in the Nigerian economy, especially in ensuring food security, gave way to massive importation of basic food items especially grains like rice, beans and millet (CBN, 2007). Agriculture in Nigeria from 1970 to 2000 grew at 1.7 percent per annum relative to the population growth rate of 2.7, with fluctuating agricultural levels leading to annual negative growth in agriculture. Thus, the performance of agriculture has been unsatisfactory with low rates of growth, resulting in pervasive rural poverty and food insecurity in the country, which needs to be addressed urgently.

In an attempt to revitalize the agricultural sector, theFederal Government initiated several policies, agricultural development programmes and projects, aimed at transforming the dominant traditional agriculture through the adoption of modern farm technologies. Modern farm technologies are known to be technically and economically more efficient than the traditional technologies. Due to the importance of soyabean production to the GDP and food security of the country, the government has paid considerable attention to soyabean production by establishing programmes and projects to boost soyabean production.Among other programmes are the National Special Programme for Food Security (NSPFS) aimed at increasing agricultural productivity in areas where the country has comparative advantage and expanding the frontiers of rural household options using technologies for arable crop production, and the State Mandate Crop Programme (SMCP), which was adopted as a business development strategy on the basis of its potential in poverty reduction and food security (BNARDA, 2005).

These programmes imply zoning of production, which means that communities direct their efforts towards the production of goods and services which they have a comparative advantage over other communities. The crops considered under these programmes include: Sesame, cocoa, cassava, gum Arabic, maize, oil palm, groundnuts, cotton and soyabean. These crops basically are "cash" crops, and are also referred to as "mandate" crops. States of Central Agricultural Zone of Nigeria, where soyabean is predominantly produced, were mandated via the programmes to produce soyabean among other crops, depending on the available resources and the prevailing ecological potential. Shaib *et al*. (1997) recorded that the Central Agricultural Zone is the largest rice, groundnut and soyabean producer in Nigeria, producing well over 40 percent rice and groundnut as well as 64 percent of soyabean.

Despite these efforts, the performance of agricultural contribution to the nation's GDP has continued to decline,it declined to about 23 percent by mid 1980's (CBN, 1991). However, there was an improvement in the sector's contribution to the nation's GDP in the 2000s as it contributed 41.2 and 42 percent in 2005 and 2006 to the GDP, respectively(CBN 2006).Substantial opportunities exist to raise soyabean productivity in Nigeria by increasing the efficiency with which resources are used at the farm level, especially in soyabean production. This is because many studies have shown that Nigerian soyabean farmers are not fully efficient in resource use (Otitoju and Arene, 2006;Amaza and Ogundari, 2006;Ugela, 2008;Olorunsanya *et al*., 2009;Owor, 2010;).

The broad objective of this study is therefore to estimate the technical efficiency and its determinants among small holder farmers in Central Agricultural Zone in Nigeria, using the stochastic frontier

production function. Technical efficiency refers to the ability to produce the highest level of output with a given bundle of resources (that is, ability to produce on production frontier). Previous studies on technical efficiency of soyabean farmers seem to be restrictive and limited.The study by Otitoju and Arene (2006) was limited to the technical efficiency of Benue State soyabeanfarmers.Also, Ugela (2008) and Owor (2010) used stochastic frontier production to estimate technical efficiency of soyabean production in Benue State;Amaza and Ogundari (2006) and Olorunsanya *et al*. (2009) estimated technical efficiency of Borno and Kwara States soyabean farmers, respectively.This study estimates the technical efficiency of Nigerian soyabean farmers at a wider scope as it covers Central Agricultural Zone which consists of eight States. Results of the study provide useful information for policy makers informulatingprogrammes related to expanding food production of the Zone. The test hypothesis is that soyabean farmers in the Zone were not technically efficient.

METHODOLOGY

The study area, Central Agricultural Zone in Nigeria, comprises seven States, namely: Benue, Kogi, Niger, Kwara, Nasarawa, Taraba and Plateau as well as the Federal Capital Territory, Abuja. The Zone is the largest soyabean producing Zone in the country (Shaib *et al*., 1997). A multistage sampling technique was used to purposively select Benue, Niger and Plateau States, based on their high level of soyabean production in the Zone.From the list of all soyabean farmers obtained from the respective States' Agricultural Development Projects, which formed the sampling frame, the respondents were randomly drawn to obtain 0.2 percent of each State's soyabean farming population.A total sample of 485 respondents were selected comprising 240, 125 and 120 from Benue, Niger and Plateau States, respectively. Data were obtained through the use of structured questionnaire,administered to the selected 485 respondents, to elicit information on socioeconomic characteristics and production resources

Theoretical model

Theoretically, a stochastic production function is defined by

$Y_i = f(X_i; B) \exp (V_i - U_i)$, i=1,2,……(1)

Where Y_i is output of the i^{th} farm, X_i is the vector of input quantities used by the i^{th} farm, B is a vector of unknown parameters to be estimated, f represents an appropriate function (e.g. Cobb Douglas, translog, etc.). The term V_i is a symmetric error, which accounts for random variations in output due to factors beyond the control of the farmer such as, weather, disease outbreaks, measurement errors, etc, while the term U_i is a non-negative random variable representing inefficiency in productionrelative to the stochastic frontier. The random error V_i is assumed to be independently and identically distributed as N (o,σ^2_v) random variables independent of the U_i, which are assumed to be non-negative truncations of the N (o,σ^2_u) distribution (i.e. half-normal distribution) or halve exponential distribution.

The stochastic frontier model was independently proposed by Aigner *et al*. (1977) and Mecusen and Van-den Broeck (1977). The technical efficiency of an individual farmer is defined in terms of ratio of the observed output to the corresponding frontier output, given the available technology.

Technical efficiency (TE) = Y_i/Y_i^*

$= f(X_i;B) \exp (V_i - U_i)/f(X_i;B)\exp (V_i)$

$= \exp (-U_i)$……..(2)

Where Y_i is the observed output and Y_i^* is the frontier output.

The parameters of the stochastic frontier production function were estimated using the maximum likelihood method.

Empirical model

The technology of soyabean farmers in Central Agricultural Zone in Nigeria is assumed to be specified by the Cobb-Douglas production frontier function. This function, according to Ogundari and Ojo (2006), has been used by many empirical studies, particularly those relating to developing countries' agriculture. The Cobb-Douglas stochastic frontier production model estimated is defined as:

$LnY_i = \beta o + \beta_1 Lnx_{1i} \beta_2 LnX_{2i} + \beta_3 LnX_{3i} + \beta_4 LnX_{4i} + \beta_5 LnX_{5i} + V_i - U_i$------(3);

where:

Y_i =soyabean output of the i^{th} farmer in kilograms per hectare

X_{1i} = farm size in hectares,

X_{2i} =labour in man-days per hectare,

X_{3i} = quantity of seeds planted in kilograms per hectare,

X_{4i} = the total amount of fertilizer applied in kilograms per hectare,

X_{5i} = agro-chemicals in litres per hectare, and

$\beta o - \beta_5$ =regression parameters to be estimated.

In order to determine factors contributing to the observed technical efficiency, the following model was formulated and estimatedjointly with the stochastic frontier model, using a single stage maximum likelihood estimation procedure,using thecomputer softwareFrontier Version 4.1 (Coelli, 1996).

$TE_i = \sigma_0 + \sigma_1 Z_{1i} + \sigma_2 Z_{2i} + \sigma_3 Z_{3i} + \sigma_4 Z_{4i} + \sigma_5 Z_{5i} + \sigma_6 Z_{6i} + \sigma_7 Z_{7i} + \sigma_8 Z_{8i} + \sigma_9 Z_{9i}$……..(4)

Where:

TE_I= technical efficiency of the i^{th} farmer,

Z_{1i} = age of the farmers in years,

Z_{2i} = educational level of farmers in years,

Z_{3i} = farming experience of farmers in years,

Z_{4i}= improved soyabeanvariety,

Z_{5i} = number of extension contactsin a year,

Z_{6i}= membership of farmers cooperatives (member = 1, non member = 0),

Z_{7i} = access to credit (access = 1, no access - 0),

Z_{8i} = household size in numbers, and

σ_0- σ_8 = parameters to be estimated.

Z_2, Z_3, Z_4, Z_5, Z_6, Z_7 and Z_8 are expected to have positive influence while Z_1 is expected to have a negative influence on technical efficiency.

RESULTS AND DISCUSSION

Socioeconomic characteristics of soyabeanfarmers

The frequency distribution of the socioeconomic characteristics of the sampled farmers is presented in Table 1.The result shows that most (44.1%) of the farmers were within the age range of 21-40 years; the mean age was found to be 46 years. The result agrees with the findings of Ogunwale (2000) that the mean age of farmers in Nigeria is between 45 to 48 years; andNwachukwu and Ezeh (2007), that this group forms the cream of productive work force which suggests a high tendency for dynamism and innovativeness. Since the age of farmers has relationship with the quality and quantity of work they can carry out on the farm,the result implies that most of the farmers sampled can effectively carry out farm operations. Furthermore,since the older farmers tend to be more conservative and less vulnerable to the wind of change involving the adoption of modern technologies than younger farmers(Olagunju and Adeyemo,2007), the result implies that farmers in the study area are likely to be receptive to technological innovations.

Analysis of gender shows that soyabean farming is dominated by male farmers(86.7%). This result is in contrast with the findings of Sigot (1995), that womenin Africa are responsible for an estimated 70 percent of total food production throughout the continent. A majority of the sampled farmers(86.8 percent) were married. The high proportion of married respondents suggests that family labour could be available for soyabean farming in the study area, and the farmers likely to be stable in their places of farming as marriage is associated with occupational stability. Marriage, according to Igben(1980), is one of the most important factors influencing production and productivity. The study reveals an average household size of 9 members with 1-10 members accounting for 64.7 percent. The high average household size suggests high availability of family labour for soyabean farming operations in the study area. A large household size is an obvious advantage in terms of farm labour supply. This is in agreement with Ekong (1988) and Sule (2006) that large household size characterizes a typical traditional African society with large blood relations, who have a great role to play in family labour in the agricultural sector.

Majority (69.9 percent) of respondents had some level of formal education;40 percent attended secondary school, 15.9 percent had primary education while 14 percent attained tertiary education. This finding contradicts the reported high illiterate status of farmers from Central Agricultural Zone of Nigeria(Shaib *et al*.,1997), but agrees with Ochepo (2010) who found a high percentage (92.8%) of rural people who are mostly farmers to be educated at various levels in the Zone. The high proportion of literates among the sampled farmers suggests that farmers in the study area are likely to be receptive to new improved, technology which could have positive implications on their productivity.

A majority of (63.7%) of respondents had farm sizes between 1-2 hectares with only 1.2 percent having upward of farm hectares, giving an average of 1.57 hectares. This indicates that farmers in the study area were predominantly small-scale operators based on the classification of farm holdings in Nigeria by Olayide(1980), that small scale holds 1-5.99 hectares, medium scale 6-9.99 hectares and large scale upward of 10 hectares.

Credit availability is critical to agricultural operations in Nigeria.The results of our study show that majority(71.8%) had no credit access, which agrees with the separate findings of Otubusin (1986) and Lawal (2000) that access to credit is a major constraint to farmers in Nigeria. Since access to credit provides farmers with means of expanding and improving their farms (Tijani *et al*.,2006), limited credit access could reduce their efficiency by limiting their ability to procure farm inputs and information needed for improved productivity.

Table 1: Distribution of respondents according to their socioeconomic characteristics

Variables	Frequency	Percentage
Age (years)		
≤ 20	65	13.4
21 - 40	214	44.1
41 – 60	179	36.9
≥ 60	27	05.6
Mean = 46.0		
Sex		
Male	420	86.6
Female	65	13.4
Marital Status		
Single	27	05.5
Married	421	86.6
Widowed	25	5.2
Divorced	12	02.5
Household Size		
1-10	314	64.7
11-20	115	23.7
21-30	46	9.5
≥ 30	10	2.1
Mean = 9.19		
Educational Status		
No Formal edu. (0yrs)	146	30.1
Prim. Sch. (6yrs)	77	15.19
Sec. edu (12yrs)	194	40.0
Tertiary Edu (16yrs)	68	14.0
Mean = 12years		-
Farming exp (years)		
≤ 15	160	33.0
16 – 30	268	55.3
31 – 45	57	10.5
≥ 45	06	1.2
Mean = 20.77		
Farm Size (ha)		
0.1 – 2.0	309	63.7
2.1 – 3.0	117	24.1
3.1 – 4.0	42	08.7
4.1 – 5.0	11	0.23
≥ 5.0	06	01.2
Mean = 1.57		
Access to Credit		
Access	137	
No Access	348	28.2

Source: Field Survey, 2010

Production function estimates

The maximum likelihood estimate of the stochastic frontier model for soyabean production is presented in Table 2. The sigma squared (σ^2=0·23) is significant at 1 percent level of probability, indicating a good fit and correctness of the distributional assumption specified. The gamma (γ) estimate of 0.99 is statistically significant at 1 percent. This implies that the one-sided random inefficiency component strongly dominates the measurement error and other random disturbances, indicating that about 99 percent of variation in actual output from maximum (production frontier output) between farms arose mainly from differences in farmers' practices and management rather than random variabilities (technical inefficiency). These factors are under the control of the farmer and the influence of which can be minimized to enhance technical efficiency. The coefficients of farm size (0.22), labour(0.31), seed(0.16) and fertilizer(0.09) are positive and

statistically significant at 1 percent while that of agrochemicals is positive but not significant. This implies that a 1 percent increase in farm size,labour, seed and fertilizer would lead to 2.2,3.1,1.6 and 0.9 percent increase, in output of soyabean, respectively.

Table 2: Maximum likelihood estimates of the parameters in the stochastic frontier model of soyabean farmers in Central Agricultural Zone in Nigeria.

Variables	Parameters	Co-efficient	t-values
Constant	β_0	6.76	37.57***
Ln Farm size	β_1	0.22	5.69***
Ln Labour	β_2	0.31	6.57***
Ln seed	β	0.16	4.27***
Ln fertiliser	β_4	0.09	3.79***
Ln agrochemicals	β_5	0.04	0.36
Sigma squared	(σ^2)	0.23	14.85***
Gamma	(γ)	0.99	66.17***
Log likelihood function		-334.09	
LR test		223.85	

Source: Field Survey, 2010.
***t- values significant at 1 percent

The frequency distribution of the technical efficiency indices of soyabean farmers is presented in Table 3. The individual technical efficiency estimates of the farmers range between 0.10 to 0.99 with a mean of 0.53. Furthermore, 55.3 percent had a technical efficiency index between 0.31 and 0.60 while 5.8 percent were in the range of 0.91 to 1.00. The average soyabean farmer in the sample would save 46(1-0.53/0.99) percent while the most technically inefficient could realize a cost saving of 90(1-0.10/0.99) percent if he/she attains the technical efficiency level of the best practiced soyabean farmer among the respondents. These results indicate that majority of farmersin Central Agricultural Zone in Nigeria achieved moderate technically efficient production. The mean technical efficiency of 53 percent obtained for soyabean in the study area is lower than the mean of 98 percent obtained for soyabean in the Guinea Savannas of Nigeria from Borno State by Amaza and Ogundari (2006) but compares favourably with the mean of 55 percent obtained by Ugela (2008) in his study of resource use efficiency in soyabean production in Benue State. The level of technical efficiency obtained in this study suggests that opportunities exist for increasing productivity and income through increased efficiency by 47 percent, which is the average inefficiency level of sample farmers, by adopting the technologies and techniques used by the best practiced soyabean farmers.

Table 3: Distribution of technical efficiency estimates of soyabean farming in Central Agricultural Zone in Nigeria.

Efficiency range	Frequency	Percent
<0.30	58	12.0
0.31-0.60	268	55.3
0.61-0.90	131	27.0
0.91-1.00	28	5.8
Total	485	100
Mean	0.53	
Minimum	0.10	
Maximum	0.99	

Source: Field Survey, 2010

Determinants of technical efficiency

The determinants of technical efficiency in soyabean production (see Table 4)in Central Agricultural Zone of Nigeriawere education, farm size, farming experience, extension contact, improved variety, membership of farmers cooperatives and access to credit, and positively and significantly related to technical efficiency, while age and household size are significant but negatively related to technical efficiency. The result implies that except for age and household size, these factors increase the technical efficiency of soyabean farmers.

The positive relationship between improved soyabean variety and technical efficiency is likely due to the fact that when improved varieties are planted they yield more than traditional/local

varieties. The positive significant role of improved variety agrees with Tchale *et al*.(2008) that farmers that grow hybrid maize are about 5 percent more efficient than those that grow local maize varieties. The positive relationship between credit and technical efficiency is consistent with those of Onyenweaku and Ohajianya (2005), and Onyenweaku *et al*.(2005) in their efficiency studies of rice and yam production in South Eastern and Northern Nigeria, respectively; Bravo-Ureta and Evenson (1994) in their study of peasant farmers production efficiency in Eastern Paraquay and Linguard *et al*.(1983) in a comparative efficiency of rice farmers Philippines. The result, however, differs from that of Okike (2000) who found a negative relationship between credit and technical efficiency in estimating economic efficiency of crop / livestock interaction of farmers in Northern Nigeria.

The positive and significant relationship between education and technical efficiency agrees withOnu *et al*.(2000) in their findings on economic efficiency of cotton production in Nigeria; Belbase and Grabowski(1985) in technical efficiency in Nepalese agriculture; Kalarijan and Shand (1986) in estimating location-specific technical efficiency of Malaysian agriculture; and Bravo-Ureta and Pinheiro (1995) who measured technical, allocative and economic efficiencies in Dominica.The positive influence of farming experience is consistent with those of Onyenweaku and Ohajianya (2005), and Onyenweaku *et al*.(2005)Kalirajan (1981), and Kalarijan and Flinn (1983) in their efficiency studies of yield variability in paddy production in India and farm specific technical efficiency in Philippines, respectively.

The positive influence of membership of farmers associations/cooperatives is consistent with the result of Okike (2000) in Northern Nigeria. Members of farmers associations have more access to agricultural information, credit and other production inputs as well as more enhanced ability to adopt innovations. The positive influence of extension contact is in accordance with a priori expectation that extension contact leads to more efficient transmission of information to farmer as well as enhancing the adoption of innovations and agrees with those of Onyenweaku and Ohajianya (2005), Onyenweaku *et al*. (2005), Kalirajan (1981), Kalirajan and Flinn (1983).

The negative and significant relationship of age is in consonance with a prori expectation that as the farmers advance in age they become less efficient in production. Ageing farmers would be less energetic to do strenuous work, thus leading to low productivity as well as low technical efficiency. This is in line with the findings of Okoye, *et al*. (2007).The negative significant influence of household size is likely due to the fact that larger household provide higher family labour which may not be efficient in carrying out farm operation due to lack of efficient supervision because of family bond.

Table 4: Estimated determinants of technical efficiency in soyabean production in central Agricultural Zone, Nigeria

Variables	Parameters	Co-efficients	t-values
Constant	σ_0	6.90	6.67***
Age	σ_1	-1.00	2.51**
Education	σ_2	0.22	2.38**
Farm experience	σ_3	0.56	14.86***
Extension contact	σ_4	0.23	4.16***
Improved variety	σ_5	0.06	2.11**
Membership of farmers' cooperative	σ_6	0.19	2.49**
Access to credit	σ_7	0.06	2.37**
Household size	σ_8	-0.09	-2.25**

Source: Field Survey, 2010.
***and** t-values significant at 1 and 5 percent, respectively.

CONCLUSION AND RECOMMENDATIONS

The individual technical efficiency indices of soyabean farmers in Central Agricultural Zone of Nigeria range from 10 to 99 percent with a mean of 53 percent. This result suggests that there are ample opportunities to increase productivity and income of soyabean farmers in the study area, by increasing the efficiency with which resources are used at the farm level. The mean technical index of 53 percent implies that there is scope for increasing production of soyabean by 47 percent, by adopting the best practiced technologies and techniques.

Factors that had significant positive influence on technical efficiency of the soyabean farmers were education, farm size, extension contact, improved soyabean variety, membership of farmers' cooperatives and access to credit. Policies aimed at increasing soyabean farmers' technical efficiency should encompass improving farmers' access to credit, education and improved soyabean varieties, through the establishment of sustainable microcredit

schemes and greater investments in formal education as well as technology development and transfer. Also, farmers should be encouraged to increase farm sizes through provision of adequate tractor hiring services, and strengthening of farmers cooperatives by providing improved inputs to farmers timely and adequately through farmers cooperatives. Experienced farmers should be encouraged to remain in soyabean farming and extension services more proactive and effective.

REFERENCES

Amaza, P.S. and Ogundari, K. (2006). Production Efficiency of Soyabean Farmers in the Guinea Savannas of West Africa: Empirical Evidence from Nigeria. Ibadan: *International Institute for Tropical Agriculture.*

Aigner, D.J., Lovell, C.A.K. and Schmidt, P. (1977). Formulation and estimation of stochastic frontier production model*Journal of Economics* 6, 22-37.

Belbase, K. and Grabowski, R. (1985). Technical efficiency in Nepalese agriculture*Journal of Development Areas* 19 (4), 515-525.

Benue Agricultural and Rurul Development Authority (2005). Implementation Completion Report on National Special Programme for Food Security. Makurdi: Planning, Monitoring and Evaluation Department.

Bravo-Ureta, B.E. and Evenson, R.E. (1994) Efficiency in agricultural production: the case of peasant farmers in Eastern Paraguay. Agricultural Economics 10, 270-288.

Bravo-Ureta, B.E. and Pinheiro, E.(1997). Technical, allocative and economic efficiency in peasant farming: evidence from the Dominican Republic. Journal of Development Economics 35 (1), 48-67.

CBN (2007). Annual Report and Statement of Accounts for the Year Ended December 2006. Abuja: *Central Bank of Nigeria.*

Coelli, T.J.(1996). A Guide to DEAP Version 2.1: a Data Envelopment Analysis Computer ProgrammeArmidale: Centre for Efficiency and Productivity Analysis. Department of Econometrics, University of New England.

Ekong, E.E. (1988). An Introduction to Rural Sociology. Ibadan: Funak Publishers Limited.

Igben, M.S. Socioeconomic activity of workers in some selected Nigerian rural communities: Implications for rural development in Nigeria. Benin: Paper presented at the Centre Conference, University of Benin, 22nd-25th September, 1990.

Kalirajan, K. (1981). An economic analysis of field variability in paddy production*Canadian Journal of Agricultural Economics* 29 (3), 287-294.

Kalirajan, K. and Flinn, J.C. (1983). Measurement of farm specific technical efficiency, *Pakistan Journal of Applied Economics 2, 167-180.*

Kalirajan, K. and Shand, R. T. (1986). Estimating location-specific and farm-specific technical efficiency: An analysis of Malaysian agriculture*Journal of Economic Development* 11 (2), 147-160.

Lawal, W .L .(2002). Economic Analysis of Fish Culture in Benue State. PhD Thesis, Makurdi: Department of Agricultural Economics, University of Agriculture.

Linguard, J., Castillo, I. and Jayasuriya, S. (1983). Comparative efficiency of rice farmers in Central Luzon in the Phillipines, *Journal of Agricultural Economics* 34 (2), 37-76

Mecusen, W. and Vanden-Broeck, J. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error*International Economic Review* 18, 435.

Nwachukwu, I.N. and Ezeh, C.I. (2007). Impact of selected rural development programmes on poverty alleviation in Ikwuano L.G.A, Abia State Nigeria, African Journal of Food, Agriculture, Nutrition and Development 7(5), 1-18.

Ochepo, C.O. (2010). Evaluation of the Local Empowerment and Environmental Management Project in Benue State. MSc Thesis, Makurdi: Department of Agricultural Extension and Communication, University of Agriculture.

Ogunwale,B. (2007) Communication Channels for Information Dissemination on Poverty Alleviation among Small-Scale Farmers in Oyo State. Ibadan: Annual Conference of Agricultural Extension Society of Nigeria held at University of Ibadan.

Okike, I. (2000). Crop-Livestock Interaction and Economic Efficiency of Farmers in the Savanna Zone of Nigeria. Ph.D Thesis, Ibadan: Department of Agricultural Economics, University of Ibadan.

Olagunju, F.I. and Adeyemo, R.(2007). Agricultural credit and production efficiency small-scale farmers in South-Eastern Nigeria, Agricultural Journal 2(3), 426-433.

Olayide, S.O. (1980). Food and Nutritional Crisis in Nigeria. Ibadan: Ibadan University Press.

Onu, J.K., Amaza, P.S. and Okunmadewa, F.Y. (2000). Determinants of cotton production and economic efficiency *African Journal of Business and Economic Research* 1 (1), 234-240

Otubosin, S.O. (1986). Modern aquaculture practice for increased fish production in Nigeria. Port Harcourt: Proceedings of the Annual Conference of the Fisheries Society of Nigeria, held at University of Port Harcourt, 26th-29th November.

Onyenweaku, C.E., Igwe, K.C. and Mbanasor, A.J. (2005). Application of stochastic frontier function to measurement of technical efficiency in yam production in Nassarawa State, Nigeria, *Journal of Sustainable Tropical Agriculture Research 3, 20-25.*

Owor, A.A. (2010). Economic Analysis of Soyabean Production in Benue State. Msc Thesis, Makurdi: *Department of Agricultural Economics, University of Agriculture.*

Shaib, B., Adamu, A. and Bakshi, J. (1997). Nigerian National Agricultural Research Strategy Plan: 1996-2010. Abuja: *Federal Ministry of Agriculture and Natural Resources.*

Tchale, H., Kumwenda, I., Wobst, P. and Mduma, J. (2008). Technical efficiency of small holder farmers in Malawi in the post reform era*Journal of African Economics 13(1), 102-113.*

Tijani, A.A., Alimi, T. and Adesiyan, A.T. (2006). Profit efficiency among Nigerian poultry egg farmers: a case study of Aiyetero farm settlement, Nigeria *Journal of Agriculture and Biological Science* 2(6), 256-261.

Ugela, J.I. (2008). Resource-Use Efficiency in Soyabean Production in Benue State. M.Sc. Thesis, Makurdi: *Department of Agricultural Economics, University of Agriculture*

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Farmers' awareness of climate change and intensity of its effects on food production in Southwest Nigeria

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Abstract: The awareness of climate change is the aggregate of knowledge and perception held by the society on climate change which perhaps affects their behaviour, quality of responses and reactions to the problems. The purpose of this study was to provide empirical information on the factors influencing climate change awareness and the intensity of the effects of changing climatic conditions on agricultural production in Southwest Nigeria. Three states were purposively selected across southwest Nigeria to ensure that the three local ecological zones in the area were covered. The states selected include Ekiti, Ogun and Oyo States. Data were collected with the use of structured questionnaire administered to 360 randomly sampled farm units. Data collected were analysed using descriptive statistics and binary probit model. The result of the probit model signified that farmer's age, education, farming experience, farm size, farming income and extension contacts are variables that significantly influenced farmers' awareness of climate change. The explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.712) was good and relatively high, indicating that the significant variables are responsible for about 71% variation in farmers' awareness of climate change phenomenon in the area. Effects of climate change include reduction in crop yield, drying up of rivers, lakes and streams and heat stress on crop and livestock were some of the serious effects of climate change on agricultural production in Southwest Nigeria.
Keywords: Climate change, Adaptation, Awareness, Food production

INTRODUCTION

Change in climate is one of the predominant factors that influence agricultural production. Climate change is an alteration in the climatic condition over a period of time due to the effects of natural variability and/or as a result of human anthropogenic activities (IPCC, 2001). The impact of climate change is global, but the most adverse effects is expected to be felt in developing countries, especially those in Africa (Nwafor, 2007; Jagtap, 2007). On country specific, Ayinde, *et al.* (2010) stated that the vulnerability of African farmers to the effects of climate change is expected to be most severe in Nigeria, due to their low coping capability. The effects of climate change cut across all the sub-sectors of Nigerian agriculture such as livestock, crop production, agroforestry, fishery, agricultural products processing and so on. For instance, climate change affects animal production through changes in pastures and forage crop availability, changes in the distribution of livestock diseases and pests; effects of weather and extreme events on animal health, growth and reproduction. The changes in temperature and precipitation might further alter arable and forest crop yields, water and nutrient budgets in the field thereby subjecting crops to stress. On the damages to aquatic lives, climate change will likely affect the metabolism, growth and distribution of many aquatic organisms as well influence diseases that afflict them. For agricultural processing, Enete, *et al.* (2013) reported that climate change has significantly affected cassava processing through poor storage quality of processed cassava products. In addressing this global threat, Tubiello and Rosenzweig (2008) stated that, a wide range of adaptation practices exist within farming system to help maintain or increase crop and livestock yields under climate change.

Climate change adaptation methods according to Nyong, *et al.* (2007) are those strategies that enable the individual or the community to cope with or adjust to the impacts of the change in climate. In agriculture, adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socioeconomic conditions including climatic variability, extreme weather conditions such as droughts, floods and volatile short term changes in local and large-scale markets (Kandlinkar and Risbey, 2000). Farmers' adaptation to the effect of climate change is often time shaped by their awareness of the changes in the climatic conditions (Amusa, 2014).

Climate change awareness is the aggregate of knowledge, attitudes or beliefs held by the society on climate change and global warming. According to Oruonye (2011), climate change awareness is a synthesis of the people's conception, interpretation and perceptions of climate change related issues which affect their behaviour, and the quality of responses and reactions to the problems. Nzeadibe, *et al,* (2011) stated that the perception of climate change governance by stakeholders, such as farmers, is important as perception (awareness) can shape the preparedness of these actors to adapt and change or modify their farm practices. In affirmation, Madddison (2007) noted that awareness of climate change is a necessary prerequisite for adaptation

practices by farmers. Farmers' perception of climate change is related to awareness level and availability of information on the phenomenon. The spatial behaviour and behavioural responses of individuals and communities are often framed around their awareness of climate change problems.

It is expected that improved knowledge through education and farming experience will positively influence farmers' awareness and decision to take up climate change adaptation measures. Improved education and disseminating strategies constitute important policy measures for stimulating awareness and local participation of farmers in various development and national resource management initiatives (Anley *et. al.,* 2007). Farming experience improves awareness of change in climate, the potential benefits and willingness to participate in local natural resource management of conservation activities. The coping capacity among Nigerian farmers like other developing countries is still low. This among other factors could be linked to the relatively low level of awareness of climate change in developing countries when compared with developed nations where people are more informed about issues surrounding climate change. The perceived relatively low level of awareness about climate change among farmers in developing countries is an impediment to effective implementation of common undifferentiated commitments to the convention on climate change and the protocol processes, particularly, the Clean Development Mechanism (CDM) (Oruonye, 2011). One of the major constraints encountered by farmers in adaptation is lack of adequate information and consequently low awareness of climate change.

Inadequate information about climate change among the farmers limits their level of awareness of the global phenomenon. Maddison (2007) submitted that preliminary evidences from a number of studies across African countries revealed that large number of farmers already perceive that the climate has become hotter and the rain has become less predictable and shorter in duration. Sofoluwe, *et al.* (2011) confirmed that most Nigeria farmers are already aware of the changes in climate. But despite this observation, there is still appreciable need for improved awareness among farmers and other major stake holders in natural resources exploitation and management about climate change.

Literature evident in Deressa *et al,* (2008) estimated determinant of farmers' choice of adaptation methods. The study of Gbetibouo (2009) investigated farmers' perceptions and adaptations to climate change, while Maddison (2007) focused on perception of and adaptation to climate change in Africa. These studies estimated the determinants of the discrete decision to adapt to climate change after being aware of the phenomenon but none indicated further the intensity of the effects of the climate change that prompted their awareness. Therefore, empirical-based information on the awareness and intensity of the effects of climate change on food production activities of farmers in southwest, Nigeria is imperative to help farmers build effective adaptive response to the impact of climate change. Specifically, the study identified major sources of awareness of climate change among farmers, determinants of farmers' awareness, and the intensity of the effects of climate change on agricultural production in Southwest Nigeria.

METHODOLOY

Study Area - The study was carried out in Southwest Nigeria. Southwest is made up of six states which include: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. Southwest Nigeria falls within latitudes 6^0 N, 4^0 S and longitudes 4^0 W, 6^0 E, covering about 114,271 kilometre square. The average annual rainfall of Southwest Nigeria ranges between 1,200 to 1,500mm with a mean monthly temperature range of 18^0- 24^0C during the rainy season and 30^0 - 35^0C during the dry season (Adepoju, *et al,* 2011). Southwest Nigeria is predominantly agrarian due to the rich alluvial soil in the area. Notable food crops cultivated in the area include: cassava, maize, yam, cocoyam, cowpea, vegetables and cash crops such as cocoa, kola nut, rubber, citrus, coffee, cashew, mango and oil palm. Livestock such as goat, pig, sheep and poultry are predominantly reared in the area.

Sampling and data collection - Multi-stage random sampling technique was used for selecting 360 farm units for the study. Three states were purposively selected in Southwest Nigeria to ensure that the three local ecological zones in the area were covered. The three states selected were Ekiti State from derived savanna, Oyo State from guinea savanna and Ogun State from rainforest belt. From each of the three states, two agricultural zones were randomly sampled. These were Zones I and II from Ekiti State, Ibadan/Ibarapa and Ogbomosho zones from Oyo State while Ijebu Ode and Abeokuta zones were selected from Ogun State. From each of the selected six agricultural zones, two local government areas (LGAs) were randomly selected. Random sampling technique was used to select two farming communities from each of the sampled 12 LGAs making 24 farming communities for the study. From each of the selected farming communities, random sampling technique was also used to select 15 farm households giving a total of 360 farm units. Data for this study were obtained from primary source through the use of structured questionnaire. Data were

collected with the assistance of five trained research assistants. Out of the 360 copies of questionnaire administered, 348 copies were retrieved from the respondents (farmers) representing 96.7% return rate.

Data Analysis - The data collected were analyzed with descriptive statistics (mean) using 4-point rating scale and binary probit model as detailed below.

To determine the intensity of the effects of climate change on agricultural production in southwest Nigeria, mean and standard deviation were employed using 4-point rating scale technique. The 4-point rating scale of the intensity of the effect of climate change was graded as Very Serious, (VS) = 4, Serious (S) =3, Less Serious (LS) =2 and Not Serious (NS) = 1. The mean ratings of the respondents based on the 4-point rating scale were graded using boundary limit as stated below:

Response Categories		*Ordinal values*	*Real limit values*
Very Serious	(VS)	4	3.50 – 4.00
Serious (S)		3	2.50– 3.49
Less Serious	(LS)	2	1.50 – 2.49
Not Serious	(NS)	1	1.00 – 1.49

Probit Model

Since the awareness of climate change was obtained from a dichotomous (discrete) choice question with Yes = (1) if aware of climate change or No = (0) if not aware, binaryprobit model was employed to estimate the determinants of farmers awareness of climate change in the study area.

The hypothesised determinants of 'awareness' of climate change in this study are:

$\mathbf{X_1}$= Gender of the Household Head; Dummy (1 if male, 0 otherwise),

$\mathbf{X_2}$ = Ages of Household head (years); Continuous (in number),

$\mathbf{X_3}$= Years of Education (in years); Continuous (in number),

$\mathbf{X_4}$= Household size; Continuous (in number of persons),

$\mathbf{X_5}$ = Years of Farming experience; Continuous (in number),

$\mathbf{X_6}$ = Farm size; Continuous (in number of ha),

$\mathbf{X_7}$ = Educated members; Continuous (in number of persons),

$\mathbf{X_8}$ = Farm income; Continuous (in Naira N),

$\mathbf{X_9}$ = Extension visits (in number); Continuous (in number of time per cropping season),

$\mathbf{X_{10}}$ = Membership of farmers cooperatives; Dummy (1 if membership of cooperative, 0 otherwise).

The explicit form of the binary probit model is specified as:

$Pr (Y = 1/X) = ß_0 + ß_1X_1 + ß_2X_2 + ß_3X_3 + ß_4X_4 + ß_5X_5 + ß_6X_6 + ß_7X_7$ .....+ e

Where:

Y = Dichotomous probability estimate with 1, if a farmer is aware of climate change and 0 if otherwise.

$ß_0$ = Intercept

ß1, …ß14= Coefficients of the independent variables.

X1,…X14= Determinants of farmers' awareness of climate change.

e = the stochastic error term.

RESULTS AND DISCUSSION

Sources of Farmers' Awareness of Climate Change in Southwest, Nigeria

Farmers' awareness of climate change phenomenon is shaped by a number of socioeconomic and institutional factors. Figure 1 presents multiple responses and percentage distribution of major sources of awareness of climate change among farmers in southwest Nigeria. The result shows that 79.02% of the farmers were aware of climate change through personal observation of variations in the indicators, 62.64% of the farmers indicated extension agents as their source of awareness of the phenomenon, 27.87% of the farmers indicated researchers as their sources of awareness, 22.41% got their information through friends, 20.11% through radio/television, 19.25% through farmers' cooperatives, 17.81% from newspapers, 5.46% through the internet while only 3.74% of the farmers got their information about climate change through politicians.

The findings of this study are in line with that of Adebayo, *et al* (2011) reported that there is a high level of climate awareness among farmers (90%) insouthwest Nigeria; and that their main sources of information about climate change arepersonal observation, personal contacts, family and friends as well as radio andtelevision.The study of Deressa, *et al*. (2008) showed that 81% of the farmers around Nile basin in Ethiopia personally noticed a decrease in the amount of rainfall or a shorter rainy season.The findings of this study also concur with the report of National Metrological Services Agency (NMSA) (2001) which showed that farmers through personal observation are aware of increasing trend in temperature and decreasing trend in precipitation.

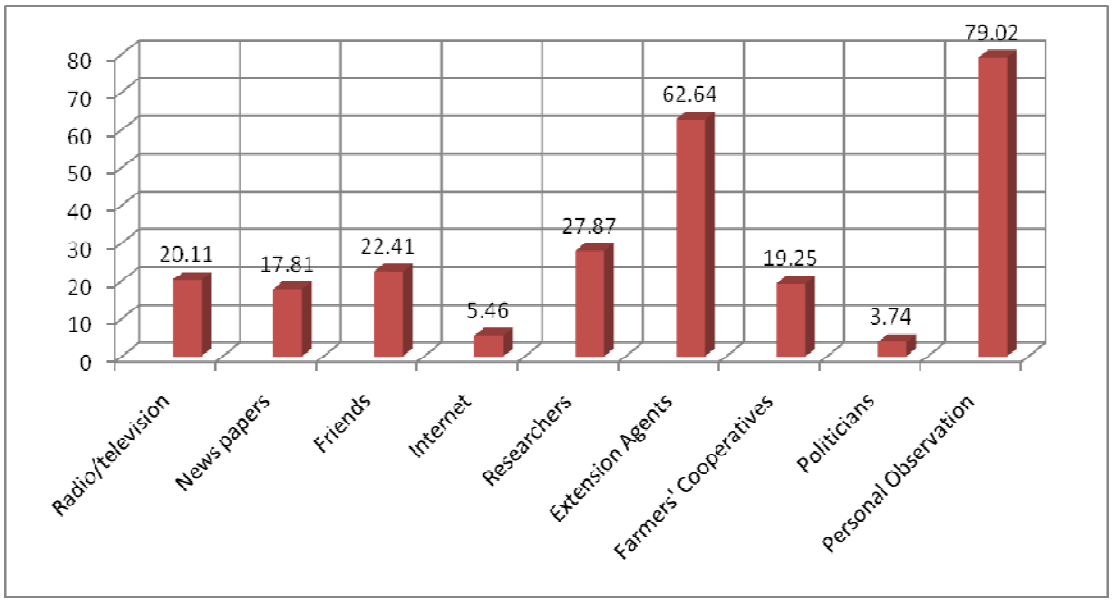

Figure 1: Percentage distribution of sources of awareness of climate change among farmers in Southwest Nigeria

The findings of this study also agreed with that of Maddison (2006) who in a study reported that the awareness of climate change appears to hinge on farmer's experience and the availability of extension services specifically related to climate change. In addition, Gbetibouo (2009) reported that farmers with access to extension services were likely to be aware of changes in the climate because extension services provide information about improved farm practices under the prevailing biophysical conditions such as climate and weather. This corroborates the fact that effective extension service delivery is a good avenue for farmers' increased awareness of climate change.

Socioeconomic Determinants of Farmers Awareness of Climate Change in Southwest Nigeria

The result of the binary probit model analysis on determinants of farmers' awareness of climate change presented in Table 1 shows that, the explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.712) was relatively high and seems good. By implication, the estimated independent variables in the model are responsible for about 71% variation in farmers' awareness of climate change phenomenon in the area. The overall goodness of fit as reflected by Prob>Chi^2 (0.000) was also good. In terms of consistency with *a priori* expectations on the relationship between the dependent variable (awareness) and the explanatory variables, the model seems to have behaved well. Out of the ten (10) explanatory variables specified in the model, six (6) were statistically significant at 1 and 5%.

The parameter estimates of the probit model only provided the direction of the influence of the explanatory variables on farmers' awareness of climate change and did not show the actual magnitude of change or probabilities in the coefficients. Thus, the marginal effects (dy/dx) from the probit model, which measure the expected change in probability of awareness of climate change with respect to a unit change in an independent variable was also presented in the table.

Age of the farmers (AGE) was positively and significantly related to awareness of climate change at ($p<0.01$). This implies that older farmers are more likely to be aware of the changes occurring in climatic and weather conditions over the years. The result of the marginal effect on age suggests that an additional unit in age of the farmers would result in 0.013 (1.3%) increase in probability of becoming aware of climate change in the study area. The findings of this study on influence of farmers age on climate change awareness is in line with the findings of Deressa, *et al* (2008) who found that the likelihood of perception of climate change is significant and positively related to farmers' age. Although, this finding disagreed with the result of Maddison (2007) who in their separate studies found out that farmers age has no significant relationship with awareness and perception of climate change.

Years of education (YRSOFEDU) of the farmers also positively and significantly related to awareness of climate change in southwest Nigeria at ($p<0.01$). This conformed with expectation as educated farmers are expected to be more aware of climate change through improved access to relevant farm information sources such as news media and

extension visits. The result of the marginal effect on years of education implied that an additional unit in years of education of the farmers would yield 0.041 (4.1%) increase in probability of becoming aware of climate change in the study area. This finding agreed with that of Gbetibouo (2009) who established that education of farmers was significantly although negatively related to perception of climate change in Limpopo Basin of South Africa. The findings of the study also agreed with the report of ACCCA (2010) that education improves awareness of the potential benefits from adaptation. Wozniak (1984) reported that research evidences have shown that education increases one's ability to receive, decode, and understand information relevant to making innovative decisions.

Table 1: Parameter Estimates and Marginal Effects of the Probit Model Analysis of Socioeconomic Determinants of Farmers' Awareness of Climate Change in Southwest Nigeria

Variables	Regression Estimated Coefficients (ß)	Std. Error	Marginal Effects Change in Prob. (dy/dx)	Std. Error
GENDERHHHD* (male 1, female 0)	0.67368 (0.26)	0.29771	0.14306 (0.26)	0.05469
AGE (number of years)	0.05409 (3.86)***	0.01423	0.01340 (3.80)***	0.00370
YRSOFEDU (number of years)	0.16604 (5.92)***	0.02873	0.04113 (5.78)***	0.00745
HHSIZE (number of persons)	-0.08717 (-0.15)	0.04046	-0.02159 (-0.15)	0.00999
YRSFMEXPR (number of years)	0.03067 (2.49)**	0.01234	0.00759 (2.49)**	0.00297
FMSIZE (in hectare (ha))	0.03335 (3.34)***	0.09753	0.01826 (3.34***)	0.02408
EDUMEMBERS (number of persons (adults))	0.10337 (1.66)	0.06230	0.02661 (1.66)	0.01565
INCOME (in naira ₦)	2.27576 (2.24)**	1.01696	0.06375 (2.24)**	0.25726
EXTVISITS (number of visits per season)	0.11437 (3.25)***	0.03516	0.02833 (3.25)***	0.00913
MEMCOOP* (member 1, non member 0)	-0.29878 (-1.18)	0.25230	-0.07135 (-1.18)	0.05837
CONSTANT	2.77765 (4.92)	0.56496		

Note: *** denotes $p \leq 0.01$, ** denotes $0.01<p\leq0.05$.
Figures in parenthesis () are z-ratios
LR $chi^2 = 269.29$; Pseudo $R^2 = 0.712$
Prob> $chi^2 = 0.000$
Number of Observation = 348
For the marginal effects, (*) dy/dx is for discrete change of dummy variable from 0 to 1
z and P>|z| correspond to the test of the underlying coefficient being 0

Years of farming experience (YRSFMEXPR) significantly and positively affected farmers' awareness of climate change at ($p<0.05$). This also conformed with *a priori* expectation as experienced farmers are expected to be more aware of climate change considering their long years in farming occupation. The positive relationship indicated that as years of farming experience of the farmers increase, there is likelihood for increase awareness of climate change. The result of the marginal effect shows that an additional one year increase in farming experience of the farmers would result into 0.007 (0.7%)

increase in probability of gaining awareness of climate change in the study area. The findings of this study on influence of farming experience on awareness of climate change agreed with the findings of Ayanwuyi, *et al*, (2010) on farmers perception of impact of climate changes on food crop production in Ogbomosho agricultural zone of Oyo State, Nigeria where the authors found out that years of experience in farming enterprise significantly and positively relate to perception of climate change. In addition, Hassan and Nhemachena (2008) found out that farming experience increases the probability of uptake of adaptation options through awareness because experienced farmers have better knowledge and information on changes in climatic conditions and crop and livestock management practices.

Farm size (FMSIZE) was positively and significantly related to awareness of climate change in southwest Nigeria at ($p<0.01$). In other words, farmers with more farm sizes are more likely to be aware of climate change than farmers with small farm holdings. It is therefore possible that large farm size may account for diverse effects of climate change on farmers which will on the long run increase the level of awareness through personal experience. The result of the marginal effect showed that an additional unit increase in farm size would lead to 0.018 (1.8%) increase in probability of becoming aware of climate change in the study area. In affirmation, Ayanwuyi, *et al.,* (2010) while estimating farmers' perception of impact of climate changes on food crop production found that farm size had significant and positive relationship with farmers' awareness of climate in Ogbomosho agricultural Zone of Oyo state, Nigeria. Although, the findings of this study technically disagreed with that of Deressa, *et al.,* (2008) who found out that farm size was significantly but negatively influenced the perception of climate change by farmers. The disagreement in the two findings could have been informed by the variation in locations and the land tenure systems practiced in the two study areas.

Farming income (INCOME) was significantly and positively correlated to the probability of being aware of climate change at ($p<0.05$). This suggests that higher income farmers are more likely to have access to farm related information than low income farmers. The result of the marginal effects relates that a unit increase in farm income will increase the probability of becoming aware of climate change by 0.064 (6.4%) percent. Farm households with higher income and greater assets are in better position to adapt after gaining awareness of new farming technologies. Farming income has significant effects on farmers access to information/awareness and consequently adaptation to climate change. Hence, Gbetibouo (2009) reported that poverty or lack of financial resources is one of the main constraints to adjustment to climate change; that about 60 percent of the respondents who did not adapt indicated lack of financial resources as the main constraint to adaptation. The results of the study of Shan (2009) showed that access to credit increases the likelihood that farmers will have access to current information and take up portfolio diversification to adapt to climate change.

The coefficient of the number of extension visits (EXTVISITS) was positive and significantly influenced farmer's awareness of climate change at ($p<0.01$). This also conforms with *a priori* expectation as number of extension visits to farmers are expected to increase awareness of the farmers about weather and climate related information. For instance, Oyebanji, (1996) stated that the aim of extension service is to provide farmers with the necessary education, skills and technical information to enable them take effective farm management decisions for enhanced daily farm practices. The marginal effects of the extension visits implied that a unit increase in extension visit to the farmers would increase the probability of becoming aware of climate change by 0.028 (2.8%). This corroborated the result of the study of Deressa, *et al* (2008) who found out that the likelihood of perceiving climate change is positively related to information on climate and farmer-to-farmer extension visits. Awareness is necessary prerequisite for adaptation to climate change. Therefore, the results of the studies of Hassan and Nhemachena (2008), Apata *et al.*, (2009) and Bryan, *et al*., (2009) indicated that access to extension services had a strong positive influence on adapting to climate change.

Intensity of the Effects and Signs of Climate Change on Agricultural Production in Southwest Nigeria

Literature suggests that climate change is already having significant negative impacts in Nigeria, and these impacts are expected to increase in the future. The result presented in Table 2 show some indices of intensity of the effects of climate change on agricultural production from the perception of farmers in southwest Nigeria. Two (2) out of the twenty three (23) identified effects of climate change on food production as presented in the table had mean values that fell within 3.50-4.00. These two effects with their respective mean values include: higher temperature and heat (3.58) and prolonged drought (3.51) on a 4-point rating scale. This implies that these two effects of climate change are perceived as having very serious impact on agricultural production in southwest Nigeria.

The result in the table shows further that, eleven (11) out of the twenty three (23) identified signs and effects of climate change on food production had mean values that ranged between 2.51 to 3.14 which fell within the real limit of number 2.50-3.49 indicating that the 11 effects are already having serious impact on agricultural production in the area.These variables with their corresponding mean values on a 4-point rating scale include: decreased rainfall amount (2.71), unusual heavy rainfall (2.55), increased cases of flooding (2.83), deceased soil moisture (2.51), reduction in crop yield (2.53), poor quality of stored farm produce as a result of heat (3.10), drying up of rivers, lakes and streams (2.88), increased drying up of seedlings after germination (3.14), heat stress on crop and livestock (2.62), increased soil erosion resulting from unusual heavy rains (2.73) and increased post harvest spoilage of harvested crops (2.87). The findings of this study conformed with that of Ozor and Nnaji (2011) who found that significant effects of climate change on agricultural production as perceived by farmers in Enugu state include: soil erosion, post harvest losses due to climate variability, decrease in yields of crops and animals, flooding, heat from high temperature, drought and decrease in soil moistures.

The findings of this study also corroborated the report of Tarhule and Woo (1997) which showed that drought is responsible for about 90% of famine events in northern Nigeria through effects on agricultural production. Findings of Ishaya and Abaje (2008) showed that the threat of climate change is more on health, food supply, biodiversity lost and fuelwood availability than on businesses and instigating of disaster; and it is the poor, who depend heavily on the natural resources that are mostly affected by incidence of climate change. The findings of this study also agreed with the findings of Adebayo, *et al* (2011) who found that in terms of climate change effects on farming enterprises, reduction in crop yield were reported by 60% of the farmers interviewed in southwest Nigeria while about 46.7% of the farmers also noted a general low level of farm productivity as a consequence of climate change.

Table 2: Mean Ratings of the Responses of Farmers in Southwest Nigeria on Intensity of the Signs & Effects of Climate Change on Agricultural Production (N= 348)

S/N	Signs & effects of climate change on agriculture	$\bar{X}$	SD
1	Decreased rainfall amount	2.71**	0.993
2	Unusual heavy rainfall	2.55**	0.831
3	Higher temperature and heat	3.58***	0.650
4	Heavy winds	2.22*	0.819
5	Increased cases of flooding	2.83**	0.952
6	Prolonged drought	3.51***	0.679
7	Increased desertification	2.37*	0.837
8	Increase in pest and disease problems	2.09*	1.084
9	Extinction of some crop species	1.79*	1.169
10	Deceased soil moisture	2.51**	0.859
11	Premature ripening of fruits	1.61*	1.144
12	Reduction in crop yield	2.53**	0.890
13	Poor quality of storage farm produce as a result of heat	3.10**	0.608
14	Stunted growth of crops	2.48*	0.938
15	Drying up of rivers, lakes and streams	2.88**	0.942
16	Increased drying up of seedlings after germination	3.14**	0.599
17	Heat stress on crop and livestock	2.62**	0.859
18	Intense weed growth	2.39*	0.995
19	Increased soil erosion resulting from unusual heavy rains	2.73**	0.831
20	Storage losses in roots and tubers	2.47*	0.913
21	Increased salinity/water pollution due to climate variability	1.79*	1.168
22	Decrease in fish population due to salinity, water level, ocean currents or speed	2.10*	0.952

23	Increased post harvest spoilage of harvested crops	2.87**	0.792

Note: *** Very Serious (VS)
** Serious (S)
* Less Serious (LS)

The result in Table 2 also shows that, the remaining (10) identified sign and effects of climate change on food production had mean values that ranged between 1.61 to 2.48 which fell within the real limit of number 1.50-2.49 indicating less serious effects of the climate change items on agricultural production in the area.These variables with their corresponding mean values on a 4-point rating scale include: heavy winds (2.22), increased desertification (2.37), increase in pest and disease problems (2.09), extinction of some crop species (1.79), premature ripening of fruits (1.61), stunted growth of crops (2.48), intense weed growth (2.39), storage losses in roots and tubers (2.47), increased salinity/water pollution due to climate variability (1.79) and decrease in fish population due to salinity, water level, ocean currents or speed (2.10). The finding of this study indicating less serious effects of heavy winds, increased desertification, increase in pest and disease, stunted growth of crops and intense weed growth among others on food production in southwest Nigeria disagreed with part of the findings of Ozor and Nnaji (2011) who found out that intense weed growth, incidence of pests and diseases and premature ripening had significant effects on agricultural production in Enugu State. The findings of the study on less serious effects of storm on agriculture in southwest Nigeria disagreed with the findings of Adebayo, *et al.* (2011) whose findings showed that farmers in swamp zone of southwestern Nigeria report concern about increased incidence of storms damaging boats, nets and increased incidence of boats capsizing during storms; resulting from the effects of climate change.

CONCLUSION AND RECOMMENDATIONS

From the results of this study, it can be concluded that a reasonable percentage of farmers in Southwest Nigeria are aware of climate change, even though, there is still room for intensified effort in awareness creation about the global phenomenon. Major sources of their awareness included personal observation, extension contacts, interaction with researchers in data collection process, friends and cooperatives. Internet, radio/television and newspapers are low sources of awareness of climate change among the farmers. The results of the probit model signified that age of the farmers, years of education, farming experience, farm size, farming income and number of extension visits are factors that influenced farmers' awareness of climate change. The intensity of heat, prolonged drought, decreased rainfall amount, unusual heavy rainfall, flooding, reduction in crop yield, drying up of rivers, lakes and streams and heat stress on crop and livestock among others are serious effects of climate change on agricultural production in Southwest Nigeria. Based on these findings, the study therefore recommends more awareness creation among farmers about climate change using media such as radio/television, newspapers, internet and farmers' cooperatives. Effort should be made by government at all levels towards capacity building of the farmers through improved education, extension visits and increase in income, improved access to credit and land ownership. In particular, agricultural extension services should be made more effective towards improved farmers' awareness and training on adaptive responses to the observed effects of climate change on food production activities of the farmers.

REFERENCES

Advancing Capacity to Support Climate Change Adaptation (ACCCA). (2010). Improving decision-making capacity of small holder farmers in response to climate risk adaptation in three drought-prone districts of Tigray, Northern Ethiopia: Farm – Level Climate change Perception and Adaptation in Drought Prone Areas of Tigray, Northern Ethiopia (Vol. 3). Makelle, Ethiopia: ACCCA.

Adebayo, K; Dauda, T. O; Rikko, L. S; George, F. O. A; Fashola, O. S; Atungwu, J. J; Iposu, S. O; Shobowale, A. O and Osuntade, O. B. (2011). Emerging and Indigenous Technology for Climate Change Adaptation in Southwest Nigeria. *African Technology Policy Studies Network Research Paper,* No. 10. Nairobi: APTS.

Adepoju, A. O., Yusuf, S. A., Omonona, B. T and Okunmadewa, F. Y. (2011). Vulnerability Profile of Rural Households in South West Nigeria. *Journal of Agricultural Science*. 3 (1): 128 – 139.

Amusa, T. A. (2014). Gender and Climate Change Adaptation Decisions among Farming Households in Southwest Nigeria. *An*

Unpublished Ph.D Thesis, Submitted to the Department of Agricultural Economics, University of Nigeria Nsukka.

Anley, Y., A. Bogale and A. Haile-Gabriel. (2007). Adoption Decision and intensity of soil and water conservation measures by smallholder subsistence farmers in Dedo District, Western Ethiopia. *Land Degradation and Development*, 18: 289-302

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 West Nigeria. *Contributed Paper Presented at International Association of Agricultural Economists' 2009 Conference*, Beijing, China, 16 – 22 August, 2009.

Ayanwuyi, Kuponiyi, E; Ogunlade, F. A and Oyetoro, J.O (2010). Farmers Perception of Impact of Climate Changes on Food Crop Production in Ogbomosho Agricultural Zone of Oyo State, Nigeria. *Global Journal of Human Social Science.* 10 (7): 33 – 39.

Ayinde, O. E; Ajewole, O. O; Ogunlade, I and Adewumi, M.O. (2010). Empirical Analysis of Agricultural Production and Climate Change: A Case Study of Nigeria.*Journal of Sustainable Development in Africa.* 12 (6): 275 – 283.

Bryan, E., Deressa, T.T., Gbetibouo, G.A and Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science and Policy*, 1 (12): 413-426.

Deressa, T. T; Hassan, R. M; Ringler, C; Alemu, T and Yesuf, M. (2008). Analysis of the Determinants of Farmers' Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia.*International Food Policy Research Institute Research Brief 15 – 9.*Washington, DC: International Food Policy Research Institute.

Enete, A. A, Amusa, T. A and Nwobodo, C. E (2013). Climate Change and Cassava Processing in Southeast, Nigeria. *TROPICULTURA,*31 (4): 272-282.

Gbetibouo, G. A. (2009) Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa. *International Food Policy Research Institute (IFPRI) Discussion Paper 00849*. Washington, DC: IFPRI.

Hassan, R and Nhemachena, C. (2008). Determinants of African farmers' strategies for adaptation to climate change: Multinomial choice analysis. *African Journal of Agricultural and Resource Economics.* 2 (1): 83-104.

Intergovernmental Panel on Climate Change (IPCC) (2001). Climate Change: Impacts, adaptation, and Vulnerability. Contribution of Working Group II to the Forth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Ishaya, S and Abaje, I. B. (2008). Indigenous People's Perception of Climate Change and Adaptation Strategies in Jema's Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning* 1(18): 138-143.

Jagtap, S (2007) Managing vulnerability to extreme weather and climate events: Implications for agriculture and food security in Africa. *Proceedings of the International Conference on ClimateChange and Economic Sustainability held* at Nnamdi Azikiwe University, Awka, Nigeria. 12-14 June 2007.

Kandlinkar, M and Risbey, J., (2000). Agricultural impacts of climate change: If adaptation is the answer, what is the question? *Climatic Change,* Vol 45: 529–39.

Maddison, D. (2006). The Perception of and Adaptation to Climate Change in Africa. *CEEPA Discussion Paper No. 10.* Centre for Environmental Economics and Policy in Africa, University of Pretoria, South Africa.

Maddison, D. (2007). The Perception of and Adaptation to Climate Change in Africa. *Policy Research Working Paper 4308*. New York: World Bank.

National Meteorological Services Agency (NMSA). (2001). *Initial National Communication of Ethiopia to the United Nations Framework Convention on Climate Change (UNFCCC),* Addis Ababa: National Meteorological Services Agency.

Nwafor, J. C. (2007) Global climate change: The driver of multiple causes of flood intensity in Sub-Saharan Africa. *Paper presentedat the International Conference on Climate Change andEconomic Sustainability held at Nnamdi Azikiwe University,Awka,* Nigeria, 12-14 June 2007.

Nyong, A., Adesina, F and Osman-Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitig Adapt Strat Glob Change*. 12: 787–797.

Nyong, A. (2005). Impacts of Climate Change in the Tropics: The African Experience. *Being A*

Keynote Presentation at A Scientific Symposium on Stabilization of Greenhouse Gases, Held at Met Office, Exeter, United Kingdom, 1 - 3 February, 2005.

Nzeadibe, T. C; Chukwuone, N. A; Egbule, C. L and Agu, V. C. (2011). Farmers' Perception of Climate Change Governance and Adaptation Constraints in Niger Delta Region of Nigeria. *African Technology Policy Studies Network RESEARCH PAPER | No. 7*. Nairobi Kenya: African Technology Policy Studies Network (ATPS).

Oruonye, E. D. (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State Nigeria. *Journal of Geography and Regional Planning,* 4 (9): 513-517.

Oyebanji, O.O. (1996). The Development of Agricultural Extension in Nigeria. Agricultural Extension in Africa, 1 pp 235. Technical Center for Agricultural Co-operation. The Netherlands.

Ozor, N and Nnaji, C. (2011).The role of extension in agricultural adaptation toclimate change in Enugu State, Nigeria. *Journal of Agricultural Extension and Rural Development*. 3 (3): 42-50.

Shan, A. A. (2009) Farmers access to credit in North-central Nigeria. *International Journal of Agricultural Development*. 3 (2): 58 – 72.

Sofoluwe, N. A., Tijani, A. A and Baruwa, O. I. (2011). Farmers' Perception and Adaptation to Climate Change in Osun State, Nigeria. *African Journal of Agricultural Research,* 6 (20): 4789 - 4794.

Tarhule, A. and Woo, W. (1997). Towards an Interpretation of Historical Droughts in Northern Nigeria. *Journal of Climate Change*, 37 (4): 601 – 616.

Tubiello, F. N and C. Rosenzweig. (2008). Developing climate change impact metrics for agriculture. *Integrated Assessment Journal.* 8 (1): 165–184.

Wozniak, G. D. (1984). The adoption of interrelated innovations: A human capital approach. *Review of Economics and Statistics,* 66 (LXVI): 70–79

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Perception of nomads on girl-child education for sustainable pastoralism development in Ogbomoso agricultural zones, Oyo state, Nigeria

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Abstract: Education plays an important role in socioeconomic development and it is particularly an issue among marginalized cultures. This study investigated the perception of nomads on girl-child education in Ogbomoso, Nigeria. Snowball technique was used to select 50 respondents based on availability. Data were analyzed using descriptive and inferential statistical tools. The study found that 98.0% of the respondents were married with children. The majority (88.0%) were not educated beyond primary school while 82.0% relied solely on pastoralism as a source of livelihood. All the nomads sampled believe in girl-child education. Majority (98.0%) were aware of the benefit in educating a girl-child and that girl-child education is a necessity while 60.0% of them agreed that it is good for a girl-child to be in school. Results further show that educational background and religion both have significant influence on their level of awareness of the benefits of girl-child education. The study concludes that nomads have a positive perception to girl-child education and this is a reason for allowing their female children to attend schools. The study therefore recommended that the government through the National Commission for Nomadic Education (NCNE) should provide a forum to sensitize the nomads to allow their girls complete their education.

Keywords: Girl-child education, Nomadic children, Nomads livelihood

INTRODUCTION

Educational development in Sub-Saharan Africa is faced with serious challenges. One major challenge is ensuring that every child, irrespective of his or her socio-cultural and economic background, has access to and completes quality basic education. This entails utilizing appropriate strategies and making adequate provisions for all children within school age to attend school and receive relevant and functional education. Education is a factor for bringing changes in individuals regardless of gender. Hence, girl-child education increases economic productivity, improves health, nutrition and environmental management, reduces poverty and infertility rates, and lowers infant and maternal mortality. It is imperative to say that education plays a particularly important role as a foundation for girls' development towards adult life. According to the U.S. Agency for International Development and the World Bank, 57 percent of the 72 million primary school age children who do not attend school are females (Gender Statistics, 2010). Additionally, girls are four percent less likely than boys to complete primary schools.

Whilst many gains have been recorded with regards to overall level of education worldwide and more children than ever are now attending primary school (King, 2013), there is still not world-wide gender parity in education. In every income bracket, there are more female children than male children who are not attending school. Generally, girls in the poorest household have the lowest chance of getting an education (Jensen, 2010). This inequality does not necessarily change in adulthood. Gender inequality in education is extreme. Girls are less likely to access school, to remain in school or to achieve in education. Nomads are seen by many as those without access to good food, clean water, health care, clothes, or even shelter. Aderinoye, Ojokheta and Olojede (2007) are of the view that nomads are "those who do not have access to education; who do not understand their socio-cultural predicament and lack the basic literacy skills". These challenges made it difficult for nomads to contribute to national development despite the fact that they have the potentials to provide the country with food and meat in the event of food crisis.

The National Commission for Nomadic Education (NCNE) was established to among other things, create wider opportunities for an estimated 9.3 million nomads (6.6 per cent of Nigerians) to acquire literacy skills. Specifically, Decree 41 of 1989 mandated NCNE to formulate policy and issue guidelines in all matters relating to nomadic education in Nigeria; implement guidelines and ensure geographical spread of nomadic education activities and target for the nomadic people who cross state boundaries; establish schools in the settlements carved out for nomadic people (FGN, 1989; Mohammed, 2010). Government then realized that unless a special educational provision was made for the nomads, they would have no access to formal and non-formal education. The obvious fact that they also participate in national activities such as census and elections were equally ignored (Muhammad & Abbo, 2010). One of the Commission's basic responsibilities is the provision of primary education to the children of pastoralists and migrant fishermen. This responsibility is carried out in close collaboration with states and local governments and the local communities. As at March 2001, there were

1,574 nomadic primary schools located in all (36) states of the Federation. Out of this number, 1102 are schools for nomadic pastoralists, while 472 are schools for migrant fishermen. The total pupil enrolment in these schools was 203,844 made up of 118,905 males and 84,939 females. The total number of teachers as at 2001 was 4,907. Since the inception of the programme, about 15,833 pupils have successfully graduated from the nomadic school system. This is made up of 10,290 boys and 5,543 girls, which represents 65.0% and 35.0% respectively. Formal education is often positively associated (even by nomadic groups themselves (Dyer, 2008) with increased social capital, yet it remains very difficult for migrating groups to take advantage of it.

A girl is a female human from birth through childhood and adolescence to the attainment of adulthood when she becomes a woman. The focus on poverty reduction enables the right to education to be a powerful tool in making a change in the lives of girls and women. Educating girls and women is an important step in overcoming poverty and ensuring economic growth and development. An educated woman is an empowered woman and more marketable in terms of employment. The lack of education denies a girl child the knowledge and skills needed to advance her status. If education must contribute to development, then it must be equally made available to all citizens regardless of gender and an array of socio-cultural barriers (CEDAW, 1979). This is because the greatest investment that any nation can make for the quick development of its economic, political, sociological and human resources is education.

This study therefore sought to examine the level of awareness of benefits of girl-child education and determine the level of participation of girl-child in education among nomads. It also investigated the perceived constraints to girl-child education by nomads and identified the socio-cultural effects of girl-child education on nomads.

METHODOLOGY

The study was carried out in Ogbomoso agricultural zones, Ogbomoso in Oyo State, Nigeria. Ogbomoso has a total population of 657,417 inhabitants (NPC, 2006) with a mean annual rainfall of 1,247mm and a relative humidity of 75% and 95%. Situated in the northern part of Oyo State, Ogbomoso is mainly known for marketing of agricultural products as well as white collar jobs and various handiworks such as trading, carpentry, tailoring among others.

The population of the study are the nomads in Ogbomoso agricultural zone of Oyo State. The study area was purposively selected based on the large number of settled nomads in the area. All the local government areas in the zone were selected for this study. In selecting the sample, ten households were randomly selected from each agricultural zone making a total of 50 household heads that form the sample size for this study. A head per hut was used to represent the household. Data for this study was obtained from primary and secondary sources. The independent variables measured included the socio economic characteristics of the nomads (such as age, religion, marital and education status), the level of awareness of benefits and participation and perceived constraints while the dependent variable was the perception of nomads on girl child education in the study area. The descriptive statistics such as frequency counts and percentages was used to analyze the socioeconomic characteristics of the respondents and their level of awareness of girl-child education.

RESULTS AND DISCUSSION

Socioeconomic characteristics of nomads in the study area

The larger percentage of the households in the sample (60.0%) were male-headed (Table 1). This implies that some households, as observed in the study, were represented by women whose husbands have gone in search of pasture for their livestock while there could be other reasons such as divorce for heading the household. Majority (98.0%) of the sample were also married. The results further show that household heads were in their productive age, as 74.0% are less than 40years. The nomads in this study generally had only primary school education. This is evident in about 88.0% who had no secondary education (Table 1). It therefore means that the few who have diversified their economic engagement, away from livestock and related chores, do so with their primary school leaving certificate. The attainment of primary school certificate may be as a result of their constant movement from one place to another and such movements could have been the basis for the implementation of the National Nomadic Education Programme (Ardo, 2007). The nomads in this study, like many others around sub-Saharan Africa, are largely Muslims as 96.0% of the sample from this study practice Islamic religion. About 82.0% of the sample does not engage in any other occupation except livestock related activities. The majority (88.0%) earned a low income of less than N20, 000. This implies that they earn much less than a thousand Naira on daily basis and this may be due to lack of access to opportunities such as education and low social status in communities (Maryam, 2015; Oniye, 2010). It is assumed that education can help

people including nomads to maximize their potentials to the full capacity.

Table 1: Distribution of the sampled nomads based on their socioeconomic characteristics (n=50)

Variables	Frequency	Percentage
Gender		
Male	30	60
Female	20	40
Marital status		
Married	49	98
Divorced	1	2.0
Marriage type		
Monogamy	26	52
Polygamy	24	48
Age (years)		
20-29	16	32
30-39	21	42
40-49	10	20
50-59	2	4
60-69	1	2
Educational background		
No formal education	34	68
Primary education	10	20
Secondary education	5	10
Higher education	1	2
Religion		
Christianity	2	4
Islam	48	96
Primary occupation		
No work	15	30
Cheese making	4	8
Pastoralist	29	58
Tailoring	1	2
Veterinary doctor	1	2
Number of children		
<5	34	68
5-9	15	30
10-19	1	2

Source: Field Survey, 2015

Level of involvement in girl-child education and their awareness of the benefits

Table 2 shows that all the households (100.0%) had their female children attending school. This shows that nomads have been allowing their girl-child to be educated. It could be because they have begun to see the benefits in girl-child education as 60.0% of the nomads agreed that it is good for a girl-child to be in school. A few (8.0%) were of the opinion that education does not exclude anyone while 18.0% of them agreed that their girl-child attends school to attain socioeconomic status and 14.0% believe that girl-child education is due to civilization. Subsequently, 98.0% of the sampled households were aware that girl-child education is a necessity. The availability of nomadic schools could also have influenced the rate of nomads' children education. By this, we may say that the government policy through National Commission for Nomadic Education (NCNE) has positively influenced the education of nomads' children particularly the girl-child.

Table 2: Distribution of the nomads based on their level of involvement in girl-child education (n=50)

Variable	Frequency	Percentage
Involvement		
Yes	50	100
Why?		
It is good to be educated	30	60
Everyone goes to school	4	8
For position (Socioeconomic status)	9	18
Civilization	7	14

Source: Field Survey, 2015

Awareness of girl-child education

Table 3 shows that 64.0% agreed that girl-child education lead to civilization and majority (94.0%) believed it is a source of income generation. All the households sampled (100.0%) believed that girl-child education is a means to successful productive future with 98.0% claiming that it gives a level of independence.

Table 3: Distribution of the household heads based on the awareness of girl-child education (n=50)

Variables	Frequency	Percentage
Is it a necessity?		
Yes	49	98
No	1	2
Does it lead to civilization/ modernization?	32	64
Yes	18	36
No		
Is it a source of income generation?		
Yes	47	94
No	3	6
Does it give a level of independence?		
Yes	49	98
No	1	2
Is it a means to successful productive future?		
Yes	50	100
Is it a means to end poverty?		
Yes	49	98
No	1	2

Source: Field Survey, 2015

Perception of nomads on the socio- cultural effects of girl-child education

Results in Table 4 show that out of the sampled households, 96.0% were aware that girl-child education is not a waste of money. All the nomads (100.0%) agreed that girl-child education does not lead to loss of culture while majority (78.0%) said it does not lead to late marriage. Moreover, all of them (100.0%) agreed that it leads to increase in their wellbeing while majority (90.0%) said it create opportunities. This resonated with Shao's (2010) findings that some parents in Monduli district had realized the value of educating their daughters although they were still confronted with a number of challenges when it came to sending girls to school. This is also similar to Oniye's (2010) position on women education.

Table 4: Distribution of the sample based on the socio-cultural effects of girl-child education (n=50)

Variables	Frequency	Percentage
Is it a waste of money?		
Yes	2	4
No	48	96
Does it lead to civilization/modernization?		
Yes	31	62
No	19	38
Does it lead to loss of culture?		
Yes	0	0.0
No	50	100
Does it lead to late marriages?		
Yes	11	22
No	39	78
Does it increase well-being?		
Yes	50	100
No	0	0.0
Does it create opportunities?		
Yes	45	90
No	5	10

Source: Field Survey, 2015

Constraints limiting nomads from educating their girl-child

The results in Table 5 show poverty and excess work pose serious concern to the nomads as 64.0% were of the opinion that poverty prevents them from educating their girl-child. For most (84.0%) of the sample, excess workload in the home is a source of great concern such that girls are prevented from going to school so they can help their mothers in some household chores. However, certain factors do not pose serious concerns over girl-child education as 96.0% of the household heads said peer pressure does not affect the education of a girl-child. Majority (94.0%) also agreed that poor educational background of parents does not affect a girl-child from being educated. Moreover, 92.0% of the heads in this study believed religion does not affect the education of a girl-child.

Table 5: Distribution of nomads based on the constraints faced in educating their girl-child (n=50)

Variables	Frequency	Percentage
Poverty		
Yes	32	64
No	18	36
Too much workload		
Yes	42	84
No	8	16
Peer pressure		
Yes	2	4
No	48	96
Poor educational background		
Yes	3	6
No	47	94
Culture		
Yes	4	8
No	46	92
Religion		
Yes	4	8
No	46	92

Source: Field survey, 2015

CONCLUSION AND RECOMMENDATIONS

This paper explains the pastoral community's perspectives on girls' education, based on their perception, parents' and girls' educational aspirations and impediments to girls realizing their aspirations. The study found that majority of parents are well disposed to girl-child education, few held negative stance concerning the value of educating girls. This shows that girl-child education awareness is on the increase and successful policy is possible, and progress can be made only when both the conceptual and the practical aspects of educational provision for nomads are considered at the same time. The need for the girl-child education among the nomadic pastoralists is not only imperative but it is indispensable for the socioeconomic development of Nigeria. To achieve this, emphasis must be given to the provision of sustainable education to the girl-child while the NCNE should ensure sensitization programmes to increase the awareness of girl-child education among nomads.

REFERENCES

Aderinoye, R., Ojokheta, K., & Olojede, A. (2007). Integrating mobile learning into nomadic education programmes in Nigeria: Issues and perspectives. *The International Review of Research in Open and Distance Learning*. 8(2). Retrieved March 2nd from http://www.irrode.org/index.php.irrodi/article/view/347/919.

Ardo, A. A. (2007). Basic Education in Nigeria, Ibadan; Sterling-Horden Publisher.

Dyer, C. (2008) Literacies and Discourses of Development among the Rabaris of Kutch, India. In 'Interdisciplinary K. Basu, B. Maddox and A. Robinson-Pant Special Issue of 863-879.

Convention for Elimination of all forms of Discrimination Against Women (CEDAW). Accessed online at www.un.org/womenwatch/daw/cedaw/cedaw.htm on September 19, 2013.

Federal Government of Nigeria (1989): Nomadic Commission for Nomadic Education Decree 41 of 1989. Federal Government of Nigeria (1989): Operational Guidelines on Nomadic Education. Kaduna: National Commission for Nomadic Education.

Gender Statistics (2010). 'Improving the lives of women and girls in Nigeria: Issues, policies and actions'. British Council, Nigeria, 2012.

Global Monitoring Report (GMR) (2010). Reaching the Marginalised. Education for All Global Monitoring Report 2010. Paris: UNESCO.

Jensen, L. (2010). Millennium development goals report. Accessed online at http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2010/MDG_Report_2010_En.pdf Summary Report, Kenya Ministry of Education, UNICEF, Commonwealth of Learning and Commowealth Secretariat, Vancouver, British Columbia, Canada, http://www.col.org/SiteCollectionDocuments/ NomadicReport_A4_web.pdf

King, E. (2013). Intersecting sources of education inequality. World Bank Data Blog. Accessed online at http://blogs.worldbank.org/opendata /intersecting-sources-of-education-inequality on September 19

Maryam, A. S. (2015). Nomadic education and the girl child: an analysis ofthe factors for and against the girl child educationamong nomadic pastoralists. Accessed on 23 May, 2016 at http://www.chr.up.ac.za/chr_old/indigenous/documents/Nigeria

Muhammed, N. D., and Abbo, B. M. (2010). *Reaching the hard-to-reach nomads through open and distance learning: A case study of nomadic education programme in Nigeria.* A conference paper at the Sixth Pan Commonwealth Forum on Open Learning (PCEB) in Kochi Kerala, India.

Muhammad, N.D. (2010). *The National commission for nomadic education. (NCNE) Service chapter*. Kaduna: NCNE National Commission for Nomadic Education Decree 41 of 12 December 1989. NCNE,

Situation report on nomadic education prepared by the Department of Programme Development and Extension, National Commission for Nomadic Education, Kaduna, Nigeria

National Population Commission, (2006). Census result from the National Population Census Nigeria (2006).

Oniye, A. O. (2010). 'Women Education: Problems and Implications for Family Responsibility'. *The Nigerian Journal of Guidance and Counselling, 9 (1)*. Accessed online at www.unilorin.edu.ng/unilorin/publication.com.

Shao, J.E. (2010). *An assessment of the strategies used in promoting basic education for girls in Monduli District pastoral communities*. Unpublished MA (Education) dissertation, Universityof Dar-es-Salaam

Socioeconomic contribution and marketing of *Parkia Biglobosa* (Jacq Benth) in Saki-West Area of Oyo State, Nigeria

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Abstract: The study on the socioeconomic contribution and marketing of locust bean in Saki-west area of Oyo state, specifically described the socioeconomic characteristics of the respondents, reviewed the utilization of plant parts, identified the processing challenges and determined the profitability of locust bean enterprise. A total of 100 respondents were interviewed. Descriptive statistics such as mean, mode, frequency and percentages were used to analyse the demographic relationships that exist in the market. Enterprise budgetary analytical approach was used to estimate cost and return. Gini coefficient was used to analyse the market structure. The result showed that 96% of the respondents were females, 35-45 age category have the highest percentage (33%). The finding revealed that the Islamic religion predominate the study area. Acquisition of the majority's (79%) occupational skill is by inheritance from family lineage. The study revealed, *inter alia:* long cooking time as a major challenge with consequent increased fuelwood consumption and the utilization of the bark of *Parkia biglobosa* for treatment of cradle cap *(seborrhoeic dermatitis*). The study revealed that locust beans has a short viability duration (<1month) and leaf wraps as packaging material is reported by (56%) of the respondents. The study showed the average profitability of all the markets, Sango market with the highest Net Profit (₦2259.82) while Gbawojo market has the lowest Net Profit (₦1135.87). Computation of Gini coefficient (G) helped to reveal the market structure. The result, G= 0.31844 indicates the oligopolistic nature of the market. The study recommends that mass awareness be channelled towards the economic value of locust bean tree, which aims at, guiding against its use for fuelwood, improving of Nigerians' general wellbeing through the consumption of locust beans and desist from intake of immune destroyers while improving the status of locust beans producers in the society.

Keywords: Socioeconomics, Marketing, Enterprise budgetary, Market structure, "*Parkia biglobosa"*

INTRODUCTION

Parkia biglobosa commonly known as the African locust bean tree grows in the savannah region of West Africa up to the southern edge of the Sahel zone 13° (Campbell-Platt, 1980) is named after the famous Scottish botanist and surgeon, Mungo Park by Robert Brown and has long been widely recognized as an important indigenous multipurpose fruit tree in many countries of the sub-Saharan Africa. The locust bean tree is native to West Africa and it is also called by different local names in different localities; for instance, it is referred to as "*kinda"* in SerriaLeone, "*kpalugu"* among the inhabitants of Northern Ghana, "*Nere*" in Burkina Faso, "*IgiIgba"* in Yoruba land and "*worku*" in Ghana (Odunfa and Adewuyi, 1985; Diawara *et. al.,* 2000). The seeds (karwa- Hausa; Iyere- Yoruba) are traditionally used as food condiment (dawadawa- Hausa; *Iru*- Yoruba; soumbala in Burkina faso, Mali, Cotdevoire and Guinea, Ogiri in the Eastern Nigeria). Dehydrated "tempeli" is an equivalent fermented product in Indonesia (Steinkrans *et. al.,* 1965). The tree is the source of a natural nutritious condiment which features frequently in the traditional diet of both rural and urban dwellers in at least seventeen West African countries including Nigeria. *P. biglobosa* is a deciduous perennial that grows to between 7 and 20 metres high in some cases up to 30 metres. The tree is a fire-resistant halophyte characterized by a thick dark grey-brown bark. The pods of the tree, commonly referred to as locust beans, are pink in the beginning and turn dark brown when fully mature. They are 30-40 centimetres long on average, with some reaching lengths of about 45 centimetres. Each pod can contain up to 30 seeds.

The most important use of African locust bean is found in its seed, which is a grain legume, although it has other food and non - food uses, especially the seeds which serves as a source of useful ingredients for consumption, the locust beans is made up of 39-47% of protein, 11.7-15.4% of carbohydrate (Campbell-platt, 1980). A matured locust bean tree can bear more than a tone of fruits to be harvested. Where the tree is grown, the crushing and fermenting of these seeds constitutes an important economic activity. Various parts of the locust bean tree are used for medicinal purposes. As a standing tree, locust bean may have a positive effect on the yield of other nearby crops. Annual production of seeds in northern Nigeria is estimated at around 200, 000tonnes. While the products of the tree are not common in international trade, they form an important part of local and regional trade in West Africa the seeds are especially prized, and much trade occurs locally

in the Sahel region where they are transferred between borders. Alabi *et. al.,* (2005) reported that locust bean is rich in lipid, protein, carbohydrate, soluble sugars and ascorbic acid. The cotyledon is very nutritious, has less fibre and ash contents. The oil content is suitable for consumption since it contains very low acid and iodine contents. The oil has very high saponification value and hence would be useful in the soap industry. It has essential acids and vitamins and serves as a protein supplement in the diet of poor families *Dawadawa* is used in soups, sauces and stews to enhance or impart meatiness. The fruit pulp of the African locust bean is sweet to the taste, which indicates the presence of natural sugars and thus a potential energy source. The attractive yellow colour indicates the presence of phyto-nutrients, possibly carotenoids, which are important precursors of retinol (vitamin A). It has a sour taste which indicates the presence of ascorbic acid (vitamin C), Gernah *et al*., (2007).

It is a multipurpose tree that provides domestic products and income for many rural people, especially women (Sabiiti *et. al*., 1992). The major income-generating products from Parkia are made from the fruits of the tree and include seeds, pulp, and a product made from the fermented seeds, locally called *Soumbala* (Kronborg *et. al*., 2013). *Soumbala* has a high protein content 38.4 g per 100g (Teklehaimanot, 2004), and is a traditional and integrated food product consumed throughout West Africa, often in 80% of all meals (Hall *et. al.,* 1997) According to Simonyan (2012) economically, the tree provides income and employment to many household members and particularly women who are more involved in processing and marketing of locust bean products. Trading activities are in raw seeds, fermented food condiment, charcoal and firewood among others provides reasonable income and employment products. Ecologically, African locust bean tree plays a vital role in nutrients recycling and erosion control, the tree acts as buffer against the effect of strong wind or water runoff that usually causes damage to crops and soil products. Being leguminous plant, it fixes Nitrogen in the soil thereby enriching the soil nutrients content.

METHODOLOGY

The study area: Oyo State is an inland State in South Western Nigeria with its capital at Ibadan. It lies within Latitudes 07° 3'N and 09° 12' N and Longitudes 02° 47' and 04° 23' E. It Covers a Land area of 32,249 square Kilometres and Bounded by Kwara State in the North, Osun State in the East, Ogun State in the South and in the West partly by Ogun State' and Benin Republic. Saki west local government area of Oyo state, Nigeria has its headquarters in Saki. It has an area of 300 km² and a population of 278,002 at the 2006 census Geographically, it approximately stretches from latitude 08°30'N to 08°55'N and longitude 02°45'E to 03°35'N. It shares boundary with Kwara state in the north, Saki east local government area in the south and is bounded to the west by the Republic of Benin.(Wikipedia, 2009)

Sampling Procedure, Sampling Size andMethod of Data collection: A multi-stage sampling procedure was used to select 100 respondents, which involves 3 stages;in the first stage, purposive selections of three localities in Saki-west LGA of Oyo state (Sango, Ogidigbo, and Ajegunle) in which major production and marketing activities occur. In the second stage, selection of five markets where the product marketer were in high concentration were purposively selected in the localities, viz. in Sango area;(i) Sango and (ii) Idimagoro market,in Ajegunle area; (iii) Ajegunle and (iv) Gbawojo market,and in Ogidigbo area;(v) Ogidigbo market. In the third stage, random selection of respondents were done based on the list of available marketer in the market for the day proportionally to the size of respondent in each market viz. in these order 40% i.e. 40 questionnaires for (i) above and 15% i.e. 15 questionnaire for (ii)-(v) markets respectively. This is because Sango is a major market that has a large number of sellers in the study area.

Method of Data analysis: Descriptive statistics tools, which include mean, mode, frequency, percentage, to present and describe the demography relationships that exist in the market. Enterprise budgetary analytical approach was used to estimate cost and return in Locust bean processing and marketing so as to be able to know the net profit. Benefit Cost Ratio (BCR) was used to evaluate and confirm the profitability of each respondent of locust bean processors and marketers(Adegeye and Dittoh, 1985).Gini Coefficient was also used to analyse the market structure.

RESULTS AND DISCUSSION

Parkia biglobosa contribute significantly to the socioeconomic livelihood of the people. The study showed (Table 1) that females dominated the enterprise with just very minute (4%) involvement of male. Processing of locust beans is mainly done locally by women (Adewumi and Olalusi, 1995). The abstinence of men in this occupation could be as a result of social ego or rather the social discrimination due to the smell; this situation may be a result of the product's odour and product quality due to the poor manufacturing practice (Farayola *et. al*., 2012).Majority (79%) inherited the profession while 21% acquired their skill by training. This means that no formal skill is required for the processing, the skill is usually passed down the lineage. Ethnic diversity of processors revealed that (71%) of them are Yorubas while traces of Igbo (2%) and Hausa (27%) were also revealed.

The processors majorly being Yoruba could be as a result of Saki-west being core of Oyo State, a seat of Yoruba speaking state while 27% of Hausas in the area could be to the fact that Saki-west, Oyo is closer to the North parts of Nigeria and Igbos were farther from the study area.

Table1:Socioeconomic characteristics of respondents

Variables	Frequency	Percentage	Mode
Sex			
Male	4	4	
Female	96	96	Female
Age (Years)			
18-25	11	11	
26-34	31	31	
35-45	33	33	35-45
46-55	19	19	
>55	6	6	
Marital status			
Married	83	83	Married
Single	9	9	
Divorced	8	8	
Family size			
2-4	18	18	
5-7	45	45	5-7
8-10	30	30	
>10	7	7	
Ethnic group			
Yoruba	71	71	Yoruba
Igbo	2	2	
Hausa	27	27	
Religion			
Christianity	15	15	
Islamic	72	72	Islamic
Traditional	13	13	
Level of education			
Primary	72	72	Primary
Secondary	21	21	
No formal education	7	7	
Mode of acquisition of occupation			
Inheritance	79	79	Inheritance
Apprenticeship	21	21	
Those involved in other occupation			
Yes	17	17	
No	83	83	No
Source of capital			
Personal savings	84	84	Personal savings
Bank Loan	13	13	
Cooperative	3	3	

Field Survey Data, 2015

In Table 2, Most (96%) of the respondents do not cultivate, the 4% that said they cultivated *Parkia biglobosa,* said its establishment only occurred years ago by error and that they had tried to further cultivate but prove abortive. The respondents said that it is not that they do not want to cultivate the plant but they have problem with how to break the seed's dormancy because it is encased in a tough, elastic and relatively thick coat that has a very low permeability to any solvent (Simonyan, 2012). The most pressing challenge encountered in the processing of locust beans according to majority (44%) is the long cooking time, which results in consumption of large volume of fuel. De-hulling and cooking of the locust bean seeds are time consuming, laborious and inefficient(Akande *et al.*2010). Other challenges include problem with storage of market demand excesses, technological improvement as a result of problem arising due to social discrimination due to bad odour and sources of raw material.

Table 2: Production and challenges

Variables	Frequency	%	Mode
Do you cultivate			
Yes	4	4	
No	96	96	No
Source of raw material			
Farm	74	74	
Free Area	26	26	
Do you store			
Yes	65	65	Yes
No	35	35	
Storage method			
Sun drying	4	4	
Sack	61	61	Sack
Viability of unprocessed beans			
< ½ Years	11	11	
½ -1 Year	80	80	½-1 Year
2-4 Years	9	9	
Production challenges			
Locust beans Cost Price	22	22	
Fuel Wood Consumption	44	44	Fuelwood consumption
Electricity and water	17	17	
Labour Intensiveness	17	17	
Suggested solutions			
Establishment of Plantation	4	4	
Technological improvement	57	57	
Stable power and borehole	9	9	

Field Survey Data, 2015

Table 3 revealed that the bark of *Parkia biglobosa* is used by majority (66%) of the locust beans producers for treatment of cradle cap called ęęla by the Yorubas, 34% use it for treatment of scabies. Cradle cap (*seborrhoeic dermatitis*) is a yellowish, patchy, greasy, scaly and crusty skin rashthat occurs on the scalp of newly born babies. It is usually not itchy and does not bother the baby. The leaves are used for the treatment of malaria (45%) and also for the control of flea (55%) called "*yooro"* by the Yorubas. This support the view of Audu *et al.,* (2004) that it is used for a wide range of ailments such as malaria, diarrhoea; jaundice. The seed is used by majority (55%) for regulation of blood pressure, for treatment of pile, serves as a substitute for maggi, and improves vision.

Table 3: Valuation and utilisation of *Parkia biglobosa* plant parts

Variables	Frequency	Percentage	Mode
Is the plant valuable?			
Yes	93	93	Yes
No	7	7	
Bark Usage			
Scabies	34	34	
Cradle-cap (eela)	66	66	Cradle-cap (eela)
Leaves Usage			
Malaria	45	45	
Control of flea (Yooro)	55	55	Control of flea (Yooro)
Root Usage			
Stomach	45	45	Stomach
None Usage	55	55	
Seed Usage			
Regulation of HBP	54	54	Regulation of HBP
Pile treatment	9	9	
Substitute for Maggi	21	21	
For good eyes sight	16	16	

Field Survey Data, 2015

In Table 4, Locust beans enterprise in the study area could be termed profitable with Benefit Cost Ratio (BCR) of1.22**,** 1.17, 1.13, 1.1, and 1.21 for Sango, Idimangoro, Ajegunle, Gbawojo and Ogidigbo markets respectively. Investment criteria require that BCR should be greater than [BCR > 1] before a business can be termed profitable (Adegeye and Dittoh, 1985). Rate of Return on Investment (RORI) of 21.65, 17.4, 13.0, 10.22 and 21.3 for Sango, Idimangoro, Ajegunle, Gbawojo and Ogidigbo markets respectively also shows that the business is lucrative in the study area.

Table 4: Average Profitability of Sellers in the Five (5) Markets

Market	TFC (₦)	TVC (₦)	TC (₦)	TR (₦)	Profit (₦)	ROR (%)	RORI (%)	BCR	P.I
Sango	6035.32	4404.86	10440.18	12700	2259.82	121.60	21.65	1.22	0.18
Idimangoro	6489.99	4512.48	11002.47	12916.67	1914.2	117.40	17.40	1.17	0.15
Ajegunle	6640.72	4546.04	11186.76	12650	1463.24	113.10	13.00	1.13	0.12
Gbawojo	6618.44	4495.69	11114.13	12250	1135.87	110.20	10.22	1.1	0.09
Ogidigbo	6239.15	4077.01	10316.16	12516.67	2200.51	121.30	21.30	1.21	0.18

Field Survey Data, 2015 Keys: TFC- Total Fixed Cost, TVC- Total Variable Cost, TC –Total Cost, TR- Total Revenue, ROR- Rate of Return, RORI- Rate of Return on Investment, BCR- Benefit Cost Ratio

In Table 5, Gini coefficient (G) of 0.31844 was obtained in this study, which indicates the inequality in sales revenue of respondents and hence high level of concentration. This is a reflection of inefficiency in the market structure for locust beans processors in the study area.This implies that profit is not evenly distributed among the marketers and producers of *Parkia biglobosa.*With Lorenz curve showing the inequality along the 45º line of perfect equality of income (Figure 1), Gini coefficient thus indicating locust bean market as oligopolistic in structure. This results implies that a small numbers of sellers exert control of the sales of *Parkia biglobosa.*

Table 5: Computation of Gini Coefficient Showing the Market Structure

N	Freq. of sellers	% of sellers (X)	Cumm. % of sellers	Total sales (₦)	% of Total sales	Cumm.% of Total sales (Y)	(XY)
7000-9000	16	16	16	130000	10.29	10.29	0.01646
9001-11000	8	8	24	82000	6.49	16.78	0.01342
11001-13000	16	16	40	196000	15.52	32.3	0.05168
13001-15000	60	60	100	855000	67.7	100	0.6
Total				**1263000**			**0.68156**

G=0.31844Field Survey Data, 2015

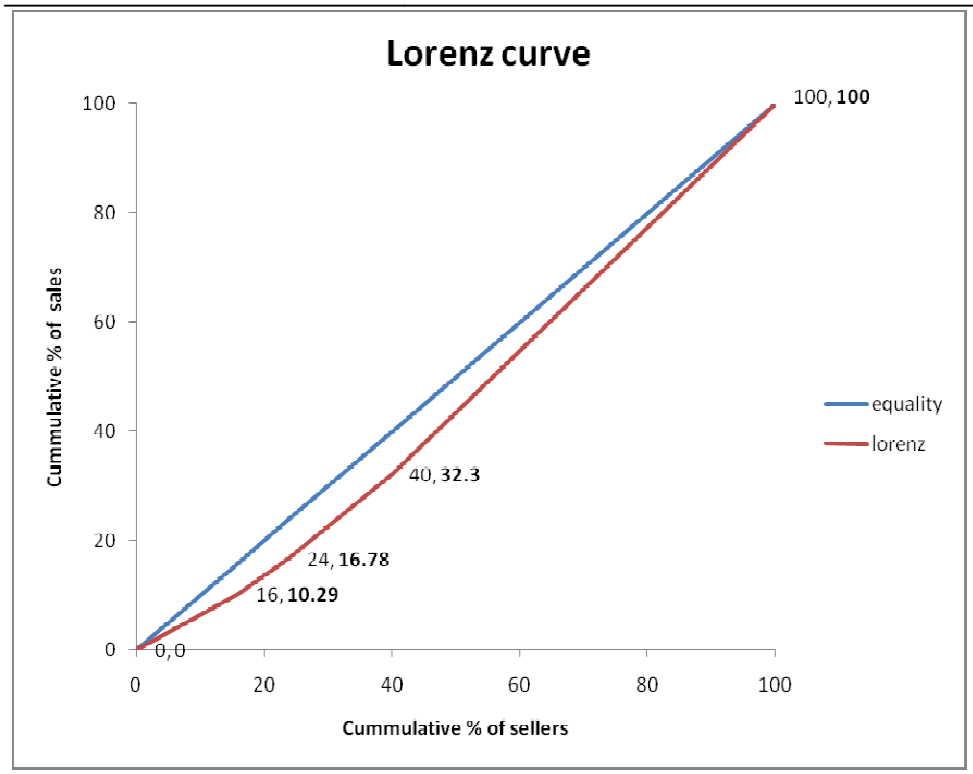

Fig 1: Lorenz curve showing the distribution of the sellers against the size sales of locust beans processors in Saki-west area of Oyo state

CONCLUSION AND RECOMMENDATION

Following the result of this study, it can be concluded that locust beans enterprise is worthwhile. The processors see the profit made from sales as being sustainable to meet their basic needs, though investment in the enterprise is low, owing to the fact that the capital source is from profit made from previous sales, which barely could sustain them. In addition, it could be concluded that with increase in capital the quantity of locust beans will increase with a consequent increase in the profit made. It was recommended that marketing of *Parkia biglobosa* should be encouraged through provision of soft loans by the government to the producers and marketers to enhance easy large scale production. Plantation of *Parkia biglobosa* should also be established by government and individuals to prevent extinction. Awareness about the nutritive and medicinal value of *Parkia biglobosa* should be publicised to boost the health condition of the populace.

REFERENCES

Adegeye, A.J and Dittoh, J.S (1985):Essential of Agricultural Economics. *Impact publisher Nigeria Limited*. Pp 164-177

Adewumi, B.A. and Olalusi, A.P. (1995): Performance of a Manual Operated Concave –type Locust Bean Dehuller. *Journal of Agric Tech* Vol 6 No 2:23-30

Akande, F. B., Adejumo, O. A., Adamade, C. A. and Bodunde, J.(2010)*African Journal of Agricultural Research* Vol. 5(17), pp. 2268-2271, 4 September, 2010. Available online at http://www.academicjournals.org/AJAR ISSN 1991-637X ©2010 Academic Journals

Alabi, D.A., Akinsulire, O.R. and Sanyaolu, M.A., (2005): Qualitative determination ofchemical and nutritional composition of *Parkia biglobosa* (Jacq.) *Benth. African journal of biotechnology* 4(8): 812-815 www.univ.academicjournals.org/AJB

Audu, I., Oloso, A. and Umar, B. (2004): Development of a concentric cylinder locust bean dehuller. *Agricultural Engineering International Journal of Science research and development*, vol. 5: Pp. 201-205.

Campbell–Platt, G. (1980): African locust bean (*Parkia species)* and its West African fermented food product, *Dawadawa. J. Ecology of Food and Nutrition*, 9: 123-132. Diawara, B., Sawadogo, L.,Amoa-Awua, W.F. and Jakobsen, M.(2000): sCapability building for and development in quality assurance and fermentation technology for African fermented foods. HACCP system for traditional African fermented foods: soumbala. WAITRO, 26: Pp. 11-62

Farayola C.O., Okpodu, V. and Oni, O.O. (2012): Economic Analysis of Locust Beans processing and Marketing in Ilorin, Kwara state, Nigeria.*Int. J. Agril. Res. Innov. &Tech*. 2 (2): 36-43.

Gernah, D.I., Atolagbe, M.O. and Echegwo, C.C. (2007): Nutritional composition of the African locust bean *(Parkia biglobosa)* fruit pulp.*Nigerian Food Journal* Vol. 25, No 1, Pp. 190-196.

Hall J. B.,Tomlinson H. F., Oni P. I., Buchy M. and Aebischer D. P. (1997). *Parkia biglobosa: A monograph*. School of Agricultural and Forest Sciences Publication 9 University of Wales, Bangor Pp105

Kronborg, M., Lykke, A.M., Ilboudo, J.B., Hien, Mand Balslev H. (2013): Parkia biglobosa as an Economic Resources for Rural Women in South-western Burkina Faso. *West African Journal of Applied Ecology,* vol. 21(2)

Sabiiti E. N. and Cobbina J. (1992): Initial agronomic evaluation of Parkia biglobosa in the humid zone of Nigeria. *Agrofor Syst*. 17: 271–279.

Simonyan, K.J. (2012): African Locust Bean Processing, Prospects, Status and Challenges.ISBN 978-978-923-050-5Department of Agricultural and Bioresources Engineering,College of Engineering and Engineering Technology, Michael Okpara University of Agriculture

Steinkrans, K. H., Van Buren, J.P., Hackler, L.R. and Hand, D.B. (1965): A Pilot Plant Process for the Production of Dehydrated Tempeh*Food Tech* 19(1): 63-68.

Teklehaimanot, Z. (2004): Exploiting the potential of indigenous agroforestry trees*: Parkia biglobosa* and *Vitellariaparadoxa*in sub-Saharan Africa. *Agrofor. Syst*. 61: 207–220.