COMPARATIVE NUTRITIONAL EVALUATION OF SOME LESSER KNOWN NON LEGUMINOUS BROWSE PLANTS FOR RUMINANTS.

Dupe O. Ogunbosoye and O.J. Babayemi
Department of Animal Science, University of Ibadan, Nigeria.
Corresponding author: bosoyeme@yahoo.com

ABSTRACT

Foliage of some non-leguminous plants was examined by their chemical composition and in vitro gas fermentation characteristics. Dry matter (DM), crude protein (CP), crude fibre (CF) and ash level of the browse species ranged between 27.75 and 43.99, 5.43 and 20.93, 26.53 and 40.09, 5.37 and 11.52 % respectively. Neutral detergent fibre (NDF, 32.08-65.33 %), acid detergent fibre (ADF, 22.08-49.61 %) and acid detergent lignin (ADL, 5.76-12.60 %). The gas volume (GV) and methane produced at 24hrs incubation varied significantly ($P<0.05$) among the species with values 13.50-25.50 and 8.00-13.50 respectively. Organic matter digestibility (OMD, 36.13-54.22%), Metabolizable energy (ME, 4.72-6.74 %) and Short chain fatty (SCFA, 0.26-0.55 %) also varied greatly among plant species. The result revealed that some of the plants studied could be proved to be useful to ruminants as dietary supplement to poor quality dry season feed since their protein concentrations are above the minimum recommended level.

Key words*:browse species, lesser known, dry season foliage and in vitro fermentation*

INTRODUCTION

Dry season in Nigeria has always been a challenging period for the livestock farmers, as the period is known for inadequate feed, characterized by scarce forage with low quality. Babayemi (2007) reported that the available grasses during this period are of low quality because they are fibrous, deficient in most of the essential nutrients like protein and minerals. The animals are left with crop residues which could neither meet their nutrient requirements nor sustain them. The aftermath effects of this period culminates in weight loss and low milk yield and high incidence of kids' mortality and disease outbreak of livestock as a result of malnutrition. The most commonly used forages are *Leucaena leucocephala* and *Gliricidia sepium* (Arigbede *et al* 2003, Babayemi *et al* 2006), but their utilization are limited due to the mimosine and coumarin respectively present in them.

However, there are a number of browse plants yet to be exploited for ruminants. The forages are important in the sense that they are evergreen when other feed resources are not very much available and are high in the nutrients needed for normal functioning of ruminants (Bamikole *et al* 2004). Meanwhile, the fodder crops could also serve as means for the conservation of environment through increased greenery, protection of soil from erosion, supply of fuel wood and other minor household items (Khanal *et al* 2001). They can also serve as wind break and as well as source of food and can create additional income for the farmers. The present study therefore determined the chemical composition and in vitro fermentation characteristics of relatively unknown non- leguminous browse plants by ruminants.

MATERIAL AND METHODS

Fodder collection

The browse plants were collected from the humid zone of Nigeria in May 2005 from National Centre for Genetics Resources and Biotechnology (NACGRAB) Moor Plantation, Ibadan, Nigeria (Latitude $7^{o}15'$ to $7^{o}30'$N and Longitude $3^{o}45'$ to $4^{o}1'$E). The area was tropical with average rainfall of 1415 mm and the average daily temperature between 28 ^{o}C to 35 ^{o}C. Dry matter content of the plants was determined immediately at 105 °C.

Chemical Composition

Each fresh sample consisted of leaves and small part of stems. The samples were oven-dried to constant weight at 105 ^{o}C for 2 days to determine dry matter (DM) and later ground to pass through 1mm sieve for later use. Crude protein (CP), ether extract (EE), crude fibre (CF) and ash content of the fodders were determined as outlined (AOAC, 1990). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analyzed (Van Soest *et al* 1991).

In vitro gas production technique

The substrate was placed in a calibrated gas tight plastic syringe fitted with a piston lubricated with vaseline. Rumen fluid was collected through suction tube (Babayemi and

Bamikole 2007) from three West African Dwarf (WAD) goats that were previously fed *Panicum maximum* with *Gliricidia sepium* and compounded feed consisting of 20 % corn, 20 % wheat bran, 25 % corn bran, 20 % palm kernel cake, 8 % ground nut cake, 3 % soya beans, 3 % oyster shell, 0.75 % table salt, 0.25 % fish meal.

Rumen fluid was collected into pre-warm thermo flasks, sieved with a four layered cheese cloth mixed with a sodium buffer (9.8g $NaHCO_3$ + 2.77g $(Na_2)HPO4$ + 0.57g KCl + 0.47g NaCl + 0.12g $MgSO4.7H_2O$ + $CaCl2.2H_2O$ per 1000ml) in a ratio 1:2v/v. respectively. 30 ml of inoculums was introduced into the 120 ml capacity syringes that contained 200mg DM of each sample in triplicate under continuous flushing with CO_2. The syringes were incubated in an incubator at 39 ^oC.

Gas production was recorded at 3, 6, 9, 12,15,18,21, 24 h and after 24 h of incubation, 4 ml of NaOH (10 M) was introduced into the incubated samples as reported (Fievez *et al* 2005) to estimate the amount of methane produced. The volume of gas produced at interval was plotted against the incubation time, and from the graph, the gas production characteristics were calculated using the equation $Y= a + b (1-e^{-ct})$ as reported (Qrskov and McDonald, 1979), where Y = volume of gas produced at time't', a = initial gas produced, b = gas produced from insoluble but degradable fraction, c = gas production rate constant for b, t = incubation time. Metabolizable energy (ME, MJ/kg DM) and organic matter digestibility (OMD %) were also determined as outlined (Menke and Steingass, 1988) while short chain fatty acid (SCFA, mol) was also estimated as reported (Getachew *et al* 1999).

Data collected were subjected to analysis of variance (ANOVA) and means separations where there were significant differences were by Duncan multiple range F-test Statistical Analysis System (SAS, 1998) package.

RESULTS AND DISCUSSION

Tables 1 and 2 present the proximate and fibre composition of the browse species. The dry matter (DM) content varied significantly (P< 0.05) from 27.75 to 43.99 g/100 g DM in *Moringa oleifera* and *Dacryodes edulis* respectively while the crude protein (CP) ranged between 5.43 g/100 g DM in *S. zamaragensis* to 20.93 g/100 g in *Moringa oleifera*. Crude fibre (CF) content of non-legumes varied significantly (P<0.05) from 26.53 g/100 g DM in *M. oleifera* to 40.09 g/100 g DM in *Blighia. sapida* while significant differences were found in ash values and these varied from 5.37 to 11.52 g/100 g DM. The fibre fraction content also varied significantly (P< 0.05). The Neutral detergent fiber (NDF) which is a measure of plant cell wall contents ranged between 32.08 g/100 g DM in *Moringa oleifera* and 65.33 g/100 g DM in *Sysygium zamaragensis* and while ADF which also is a measure of cellulose content of the feed also varied from 22.08 g/100 g DM in *Moring oleifera* to 49.61 g/100 g DM in *Sysygium zamaragensis*.

The acid detergent fibre (ADL) varied from 5.76 g/100 g DM to 12.60 g/100 g DM in *Moringa. oleifera and Sysygium zamaragensis* respectively. The dry matter (DM) content of the fodder species obtained in this study was similar to what obtained elsewhere (Khanal et al., 2001, Ventura *et al* 2004). The lower values of protein in few of the fodders might be due to the fact that they are non-legumes. Plant variety, time of harvest, age of plants, leaves to petiole ratio and ecological zone might also be responsible (Bamikole *et al* 2004). The values agreed with the CP content obtained by Khanal *et al* (2001). However, despite the fact that these plants are non-legumes the crude protein values of some of browse species are high and within the requirement for ruminant (Subba, 1999), while only *Sysygium zamaragensis* fell short of the minimum level recommended of ARC (1981) and Norton (1994) that recommending 7 % and 8 % respectively as the critical level for ruminal activity. If this fodder is to be fed to ruminant, it has to be supplemented with high protein feed in order to meet the animal's need. The ash content of browse species connotes the mineral level of the diet and were within the range reported elsewhere (El hassan *et al* 2000; Khanal *et al* 2001). All the forage plants in this study contained significant neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) but the values are within the range in which ruminant can utilize without any impediment. In other word, NDF is inversely related to the plants' digestibility (Gillespie, 1998). The higher the NDF, the lower the intake and the lower also is the digestible energy of the feed (Meissner, 1991). The value of ADF of a plant determines its cellulose and lignin content which influence its digestibility, but hemicellullose has been reported to be more digestible than cellulose (Gillespie, 1998). The lignin content of the plants in this study was high and this may hinder the digestibility because it is the most indigestible component of the fibre fractions

(Gillespie, 1998). The digestibility of *Moringa oleifera* will be high as a result of its lower lignin level.

Tables 3 and 4 reveal gas fermentation characteristics of the browse species. The gas volume produced at every interval varied significantly among the plant species except in the early incubation period where there was no appreciable gas produced. Meanwhile gas production is synonymous to digestibility of feed. But from the 9th hour of incubation, an appreciable amount of gas was noticed among the plant species until the end of fermentation period of 24 hours. The highest (25.50 ml) and the lowest (13.50 ml) gas production were obtained from *Moringa oleifera* and *Napoleonaea imperialis* respectively. The low gas production observed amongst the fodders may be connected to their high fiber contents most especially ADL, although it was observed by NRC, 2001 that a feed high in NDF is of advantage to lactating dairy cow. The results obtained for the gas production agreed well with what was obtained for forage *Panicum maximum* and legume mixture (Ajayi and Babayemi, 2008) but lower than what was reported in earlier study (Babayemi 2007). The variations could be due to many factors such as the diet of animals used for rumen liquor (Babayemi, 2007) and plant maturity (Bamilole *et al* 2004). Figure 1shows the methane production of the non-leguminous browse species. *Gmelina arborea* had the highest (13.50 ml) methane production and was closely followed by *Moringa oleifera* (12.50 ml) while the least value was observed in *Napolionaea imperialis* (8.00 ml). Methane production is an energy loss to animal. It has been reported in earlier studies that many of the available feedstuff giving to the ruminants have been implicated to enhance methanogenesis and contribute to global warming (Babayemi, 2007; Ajayi and Babayemi, 2008). High production of methane from these fodders could indicate an increased proportion of acetate and butyrate but decrease in propionate production (Babayemi *et al* 2004)

The mean values of ME, OMD and SCFA differed significantly (P<0.05) among the plant species. *Moringa oleifera* had the highest values in all and closely followed by *Hura crepitens*. The values for ME, OMD and SCFA were similar to those reported for spent tea leaf (Babayemi *et al* 2006). But for *Moringa oleifera*, the ME value obtained in this study was still lower than what was reported elsewhere (Makkar *et al* 1996). The variation may not be unconnected with different agro climatic conditions. As a result of low gas production in this study, the metabolizable energy, OMD and SCFA were low. The reduction may be due to the presence of secondary metabolites that may be found in majority of the samples. Many other factors may be responsible for these variations in the gas production and the in vitro parameter values during fermentation, depending on the level of the NDF and ADL of the tested feedstuff, the presence of secondary compounds, donor animals, time and method of rumen collection (Areghore and Abdulrazak, 2005; Babayemi, 2007). *Moringa oleifera,* having the highest gas production may then need to be supplemented with energy-rich feed like *Panicum maximum* for production of propionic acid that is glucogenic if to be fed to ruminants. Nsamsaeng *et al* (2006) reported that higher gas production would lead to the production of more acetic and butyric acids which may not benefit the animals. Since gas production is synonymous to digestibility, and that *Moringa oleifera* is highly degradable in the rumen, it is therefore suggested this browse species will need to be supplemented with feed that contains appreciable quantity of secondary metabolites such as tannin in order to reduce the effect of micro-organisms in the rumen but increasing the quantity of protein by-passing the rumen in to the lower gastro intestinal tracts (GIT) for its effective utilization.

Table1: Proximate composition (%) of the browse species

Plant species	Dry Matter	Crude protein	Crude fibre	ash	Ether extract
Gmelina arborea	35.46c	11.66d	31.66c	7.10d	10.07e
Dacryodes edulis	43.99a	6.98e	28.30d	10.65b	10.54d
Blighia sapida	38.12c	13.53c	40.09a	6.02fg	12.26a
Syzygium zamaragensis	37.27d	5.43f	28.43d	9.15c	10.20ed
Moringa oleifera	27.75f	20.93a	26.53c	5.37f	11.07c
Hura crepitens	27.67f	17.89b	27.62ed	11.52a	11.64b
Napoleonaea inperialis	39.12b	11.71d	35.37b	6.12e	12.14a
SEM	0.04	0.21	0.58	0.17	0.13

abcdefg: Means within the column with the same letters are not significantly different (P< 0.05)

Table 2: Fibre fractions (g/100 g DM) of some non-leguminous family unrelated browse trees

Plant species	Neutral detergent fibre	Acid detergent fibre	Acid detergent lignin
Gmelina arborea	44.34f	32.02e	9.09c
Dacryodes edulis	46.49e	34.73d	9.37c
Blighia sapida	56.99c	35.54cd	11.76b
Syzygium zamaragensis	65.33a	49.61a	12.60a
Moringa oleifera	32.08g	22.08f	5.76e
Hura crepitens	52.46d	39.36b	8.22d
Napoleonaea inperialis	58.86b	36.39c	9.33c
SEM	0.31	0.37	0.29

Means within the column with the same letters are not significantly different (P<0.05)

Table 3: In vitro gas production of browse species (ml/200 mg / DM)

Browse spp	3	6	9	12	15	18	21	24
G. arborea	1.67	5.00	8.00ab	12.67ab	15.00ab	18.00ab	20.00ab	22.50a
H. crepitans	2.17	4.33	9.33	1.33ab	15.50ab	18.33ab	20.17ab	21.50ab
N. imperialis	1.33	3.00	6.00b	8.67b	9.83d	11.00b	12.67b	13.50b
M.oleifera	3.00	7.33	12.33a	16.17b	20.33a	22.17a	24.17a	25.50a
B. sapida	1.50	3.17	7.50b	10.33ab	13.00ab	14.50ab	16.67ab	18.00ab
S.samaragensis	1.00	3.83	8.33ab	9.83ab	11.33b	13.50ab	16.00ab	17.17ab
D. edulis	0.50	3.33	7.17b	8.83b	10.33b	12.17b	13.33b	15.33ab
SEM	1.00	1.60	1.49	2.05	2.43	2.51	3.28	3.50

Means within the column with the same letters are not significantly different (P<0.05)

Table 4: Metabolizable energy (ME, MJ/kg/DM), organic matter digestibility (OMD, %) and short chain fatty acids (SCFA, mol)

Browse specie	ME	OMD	SCFA
Gmelina arborea	5.89ab	44.45bc	0.47ab
Hura crepitans	6.10ab	49.51ab	0.45ab
Napoiionaea imperialis	4.72b	36.13b	0.26b
Moringa oleifera	6.74a	54.22a	0.55a
Blighia sapida	5.44ab	42.92ab	0.37ab
Syzygium zamaragensis	4.88b	36.02b	0.35ab
Dacryodes edulis	4.72b	38.58b	0.31ab
SEM	0.48	3.10	0.84

Means within the column with the same letters are not significantly different (P< 0.05)

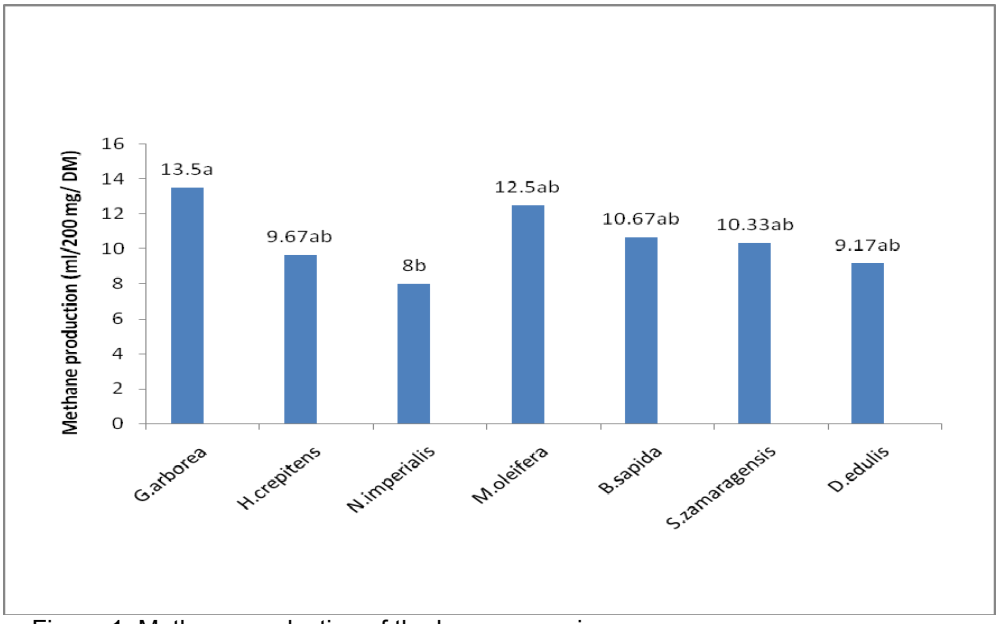


Figure 1: Methane production of the browse species

CONCLUSION

The study showed that browse plants were high in crude protein and moderate fibre fractions. In vitro gas production of the browse plants increased up to 24 h incubation, indicating the potential to degrade beyond the time limit. The low organic matter digestibility exhibited by the plants probably suggests the presence of secondary metabolites. It is therefore suggested that analysis of the anti-nutritional factors be carried for further studies.

REFERENCES

Aregheore, E.M and Abdulrazak, S.A. (2005). Estimation of organic matter digestibility and metabolizable energy content of agro-industrial waste using in vitro gas production. *Nig. J .Anim. prod*. 387.

Ajayi, F.T and Babayemi, O. J. (2008). Comparative *in vitro* evaluation of mixture of *Panicum maximum* cv Ntchisi with stylo (*Stylosanthes guianensis*), Lablab (*Lablab purpureus*), Centro (*Centrosema pubescens*) and histrix (*Aeschynomene histrix*). *Livestock Research for Rural Develpment* 20 (6)

Arigbede O.M., Bamikole, M.A and Babayemi, O.J. (2003). Evaluation of three forms of two indigenous multipurpose tree species fed to West Africa Dwarf goats. Asset Series. Vol (3) 33-41

Association of Official Analytical Chemist AOAC. (1990) *Official Method of Analysis* 15th edition. Washington. D.C. U.S.A Pg 69-90

Babayemi, O.J and Bamikole, M.A. (2006) Some productive and nutritive effects of Tephrosia *bracteolata, Tephrosia candida, Leucaena leucocephala* and *Gliricidia sepium* for West African dwarf goats kept on range. *Journal of Central European Agriculture*. Vol. 7 (2)

Babayemi, O.J. (2007). In vitro fermentation characteristics and acceptability by West African Dwarf goats of some dry season forages. *African Journal of Biotechnology* Vol. 6 (10), pp. 1260-1265

Bamikole, M. A., Ikhatua O.M., Arigbede, O.M., Babayemi, O.J and Etela (2004). An Evaluation of the Acceptability as forage of some Nutritive and Anti-nutritive Components and of the Dry Matter Degradation Profiles of Five Species of Ficus. *Tropical Animal Health and Production*, 36; 157-167.

Fievez ,V., Babayemi., O.J and Demeyer, D. (2005). Estimation of direct and indirect gas production in syringes. A tool to estimate short chain fatty acid production that requires

Getachew G., Makkar., H. P. S and Becker, K. (1999). Stoichiometric relationship between short chain fatty acid and in vitro gas production in presence and absence of polyethylene glycol for tannin containing browse. EAAP Satellite Symposium, Gas production fermentation kinectics for feed evaluation and to assess microbial activity. August 18-19. Wageningen, Netherlands.

Getachew, G., Robinson., P.H., DePeter, E.J and Taylor, S.J. (2004). Relationships between chemical composition, dry matter degradation and in vitro gas production of several ruminant feeds. *Animal Feed Science and Technology* 111: 57-71.

Gillespie. J.R. (1998). Animal science. Delmar publishers, international Thompson publishing company, 1204pp.

Makkar, H.P.S. and Becker, K. (1996). Nutritional value and anti-nutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Science and Technology* 63: 211-228.

Meissner, H.H., Viljoen, M.D., Van Nierkeki, W.A. (1991). Intake and digestibility by sheep of Anthephora, Panicum, Rhode and Smuts finger grass pastures: Proceeding of the IVth International Rangeland Congress, September1991. Montipellier, France, pp 648-649.

Menkel, K.H and Steingass, H. (1988). Estimation of the energetic feed value from chemical analysis and in vitro gas production using rumen fluid. *Animal Research Development*, 28:7-55.

Ngamsaeng, A., Wanapat, M, and Khampa, S. (2006). Evaluation of local Tropical plants by *In vitro* rumen fermentation and their effects on fermentation end-products*. Parkistan Journal of Nutrition* 5 (5): 414-418.

Norton, B.W. (1994). Nutritive value of tree legumes in Forage Tree Legumes in Tropical Agriculture (Eds). R.C. Gutterdgeand, H.M. Sheton). Pp 177-191(CAB 1: Wollingfovel).

NRC (2001). Nutritive Requirements of Dairy cattle. 6th revised edition, national Academy press, Washington, DC

Khanal, R.C. and Subba, D.B. (2001). Nutritional evaluation of leaves from some major fodder trees cultivated in the hills of

Nepal. *Animal Feed Science and Technology* 92, pg 17-32.

Subba, D.B. (1999). Tree fodders and browse plants as potential nutrient suppliers for ruminants. In: Neopane, S.P., Khanal, R.C. (Eds.), Proceedings of the 3rd National Workshop on Livestock and Fisheries Research, Nepal Agricultural Research Council, Kathmandu, Nepal.

Ørskov, E.D. and McDonald, I. (1979). The estimation of protein degradability in the rumen from incubation measurement weighted according to rate of passage. *Journal Agricultural Science*. (Camb) 19; 499-503.

SAS (1998). Statistical Analytical Systems. SAS/STAT. User's guide. Version 6. 3rd edition Cary. North Carolina, USA. 943.

Van Soest, P.J., Robertson, J.B. and Lewis, B. (1991). Methods for dietary fiber, and non starch polysaccharides in relation to animal nutrition, *J. Dairy Science*. 74, 3587-3597.

Ventura. M.R., Castanon. J.I.R., Pieltain. M.C. and Flores. M.P. (2004). Nutritive value of forage shrubs: *Butiminaria bituminosa, Rumex lunaria, Acacia salicina, Cassia sturtii,* and *Adenocorpus foliosus.* Small Ruminant Research 52:13 – 18.

AN ANALYSIS OF ACTIVITIES OF BEE HUNTERS AND BEEKEEPERS IN OYO STATE, NIGERIA.

Matanmi, B.M, G.B. Adesiji and M.A Adegoke
Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, Nigeria.
Correspondence to: Dr. G.B.Adesiji (drgbolaadesiji@yahoo.com)

ABSTRACT

The study compared the socio-economic characteristics of bee hunters and beekeepers. It also compared the bee sting prevention techniques and problems the two categories of bee farmers encountered in bee farming. The population for the study is made up of both bee hunters and beekeepers. A snowball technique was used to select the bee hunters as there was no official record while the list of beekeepers was obtained from beekeepers association. A total of fifty respondents were selected for the study consisting of 20 bee hunters and 30 beekeepers. An interview schedule was used in collecting data from the bee hunters since it was assumed that majority of them might not be able to read and write, while a questionnaire was used in gathering information from the beekeepers since it was believed that they were literates. The finding of the study showed that 76.7% of beekeepers are below 51 years of age, while 30% of the bee hunters' fall within this age category, majority (90%) of the two categories of bee farmers was male. The beekeepers have higher education than bee hunters. About 75.0% of bee hunters used no prevention methods against bee sting while 100.0% of the beekeepers used bees dress/suit. About 60% of the bee hunters cited sting as problem they encountered while 46.7% of the beekeepers cited inadequate working space. Also, the keepers had better yields and made more income than the bee hunters. Since majority of bee hunters did not make use of bee sting prevention methods while beekeepers made use of bee dress, bee hunters should be trained of the importance of using bee sting prevention methods and should also be encouraged to have their own farms and move from being a bee hunter to beekeeper.

KEY WORDS: Bee hunters, Beekeepers, Hives, Honey.

INTRODUCTION

An important area of agriculture, which has not received sufficient attention in the past, is apiculture. It is the modern technique of keeping bees for honey, comb/wax, pollen, bee venom and royal jelly. Bee keeping is an occupation that combines knowledge of habit and behaviour of bees under varying environmental conditions with the efficient manipulation of special equipment of the operator. The production of honey depends largely on areas where bees can get the necessary nectar to protect their hives. . But according to Akachukwu (1993) the importance of honey over sugar has been realized and concerted effort is being geared towards boosting its production.

The modern methods of bee farming are neglected areas of agricultural research in developing countries probably because scholars and policy makers have not been able to adequately demonstrate the importance in the farming systems. Modern bee keeping that entails housing the bees is not difficult to embark upon because investment is low, it does not require large area of land and water and there is no need for daily care (Oluwole, 1999).

There are basically two methods of honey gathering. These are the bee hunting and beekeeping. Bee hunting involves bee hunting which involves locating a natural colony of bee and setting the colony on fire in the order to harvest the colony. This method of bee hunting has been criticized on the ground that it is destructive both to the environment and the stability of the ecosystem. The hive combs are removed while the brood or uncapped combs are thrown away. Honey is extracted either by squeezing it out of the combs using, hand or honey extractor.

Beekeeping on the other hand involves the construction of hives with movable frames separated by space for bees to fix their combs on the frame (Langstroth hive). This allows for large-scale bee farming. Modern bee keeping also involves the use of bee suit consisting of bee dress, hand gloves, boots and veil (all these protect the bee farmer against bee sting). In modern bee keeping, bees could be fed with sugar solution or diluted honey which is provided in a trough. In the dry savannah region where the atmosphere is dry it may be necessary to provide bees with drinking water which is provided with a trough to avoid bee drowning.

Bee keeping in Oyo State

Bee keeping in the traditional way is well known in Oyo State. In realization of this fact the Government of Oyo State and the Institution of Agricultural Research and Training (I.A.R. and T) in collaboration with the Israel Embassy having drawn out programmes aimed at training bee keepers in modern method of bee keeping. In fact, there is the Center for Bee Research and Development located in Ibadan.

As part of Oyo State Government's effort to promote modern bee keeping technique and foreign exchange earnings, the Ministry of Agriculture also set up apiaries (Bee farms) at Agodi Garden and Rural Community Development Centre, Awe. This has contributed immensely to the development of bee keeping in Oyo State.

The objectives of this study are therefore to:

(1) compare the socio-economic characteristics of the bee hunters and beekeepers in five selected Local Government Area of Oyo State;
(2) compare their bee sting prevention techniques;
(3) compare yield and income of bee hunters and beekeepers and
(4) compare the problems encountered in honey collection.

METHODOLOGY

The study was carried out in five Local Government Area of Oyo State, namely: Saki East, Saki West, Iseyin, Akinyele and Ibadan North Local Government Areas. Within the afore-mentioned Local Government Areas are such villages as Aba Serafu, Osogun, Ilerin, Aha, Ado-awaye, Ojigun, Babalawo, Seriki, Olugbode, where bee farms are located.

The population for the study is made up of both the bee hunters and beekeepers with the sole aim of rearing bees for honey production in five Local Government Areas of Oyo State. The official list of bee hunters are not available as no record of them have been kept, but a snowball technique was used to select twenty (20) respondents based on the current practice or involvement in traditional bee keeping. The list of beekeepers was made available by the Bee Keepers Association of Nigeria (BAN). There were thirty (30) beekeepers in number that fall within the study area. Therefore, the sample size consists of fifty (50) respondents consisting of 20 bee hunters who could be identified in the study area and thirty (30) beekeepers respectively. An interview schedule was used in collecting data from the bee hunters, while a questionnaire was used in gathering information from the beekeepers. Descriptive statistics like frequencies and percentages were used for the data analysis.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Bee Hunters and Beekeepers.

The results in table 1 show the socio-economic characteristics of the bee hunters and beekeepers in the study area. The table shows that 76.7% of the bee keepers are less than or equal to 50 years of age, while 30% of the bee hunters falls within this age category. This finding is similar to that of Farinde *et al* (2005) and Chukwuemeka (1999), who found that 73.8% of bee keepers were between 31-60 years of age.

Majority of the respondents (90.0% bee hunters and 80.0% of beekeepers) are male. This finding is similar to that of Onwbuya (2004) in Nsukka Local Government Area of Enugu State who found that 91.1% bee hunters were males.

About 45% of bee hunters have primary education while 6.7% of the bee keepers have primary education. About 25% of the bee hunters have secondary education while 13.3% of the beekeepers have secondary education. About 80% of bee keepers have post-secondary education while none of the bee hunters has post-secondary education.. This implied that effective bee farming extension programmes could be encouraging because of the number of beekeepers who can read and write but not bee hunters.

About 40% of bee hunters have between 4-9 years of bee farming experience while 76.7% bee keepers have the same 4-9 years of bee farming experience. About 60% of bee hunters have ten or more years of bee farming experience while 6.7% of the beekeepers have the same ten or more years of bee farming experience.

Bee sting Prevention Methods by Beekeepers and Bee Hunters.

The result in table 2 shows the bee sting prevention methods by bee hunters and beekeepers. The table shows that majority of the bee hunters (75%) do not have any bee farms. The table also shows that 75% of the bee hunters do not have any bee sting prevention method. This implies that extension workers need to train them on bee sting prevention methods. About 20% of the bee hunters used fire to kill bees this has some negative ecological implications as the bees are exterminated while 5% use honey to cover their hands to prevent bee stings. On the other

hand, all the beekeepers make use of bee dress/suit to prevent bee stings.

Amount of Money Realised by Bee hunter and Beekeepers in honey Production

The results in table 3 indicate that the highest honey output per harvest of bee hunter is between N9000.00 and N10,000.00. This implies that their yield is low owing to poor management whereas, the least honey output per harvest of beekeepers is between N20,000.00 and N30,000.00. Majority (55.0%) of bee hunters have honey output per harvest of Between N5,000.00 and N6,000.00 follow by N7,000.00 and N8,000.00 (35.0%) while the majority of beekeepers have honey output per harvest of between N40,000.00 and N50,000.00 (36.7%). This is followed by honey output per harvest of between N60,000.00 and N70,000.00 (26.7%).

Number of Hives Cultivated by Bee hunters and Beekeepers

The results in table 4 show that the highest number hives cultivated by bee hunters is between fourteen and seventeen (13.3%). Majority (75.0%) of them cultivate between ten and thirteen hives in a year. The result is different for the beekeepers whose least cultivated hives in a year is between ten and thirteen which is the highest for the bee hunters. The number of hives cultivated in a year by beekeepers also varies but the highest percentage of them (36.7%) cultivate between eighteen and twenty one hives in a year. The highest cultivated hives by the beekeepers is between thirty four and thirty seven but with very low percentage (3.33%).

Problems encountered by Bee Hunters and Beekeepers.

Result in table 5 shows the problems encountered by bee hunters and beekeepers. The table shows that 60% of bee hunters claimed bee sting as a problem they encountered in bee farming. About 20% of bee hunters and 13.3% of beekeepers reported inadequate information about bee farming as a problem they encountered in their bee farming. About 46.7% of beekeepers reported inadequate working space of land as the problem they encountered, yet another 20% and 3.3% reported transportation problems and marketing problems as the problems they encountered in bee farming respectively Onwbuya (2004) found several factors limiting bee farmers adoption of extension services on bee keeping, the factors included lack of funds 65%, poor storage facilities 60%, in accessibility to modern harvesting techniques 50%, poor awareness of profitability 40%, low seasonal demand 45.3%, poor knowledge of management of bee hive 48.3%, long distance to extension training 71.7%, in availability of dressing materials 41.7%, inadequate market 65% among many other factors.

Implication of findings for extension activities in the study area

A high percentage of the respondents have one type of education or the other, the implication is that extension organization such as the Agricultural Development Programme (ADP) should intensify efforts on extension coverage of bee farmers. This could be achieved through involvement of workshops, field days and Small Plot Adoption Techniques (SPAT) on bee keeping and hive management as well as harvesting and preservation and marketing. In addition, this can be facilitated by adoption and modifying the existing bee keeping practices of the farmers to enhance their social acceptability, motivate farmer's interest in bee keeping as a profitable and lucrative occupation.

CONCLUSION

This study is a comparative study of bee hunters and bee keepers of Oyo State, Nigeria. Majority of the bee hunters and beekeepers were males. Very high number of bee hunters neither had bee farms nor use bee sting prevention methods, unlike the beekeepers that had farms of their own and prevent bee sting by using bee dress/suit. Bee hunters indicated bee sting as major problem they were encountered with while inadequate working space of land was indicated by beekeepers as the major problem they were encountered with. Also, the beekeepers have a better yield than the bee hunters. The highest money realized by the bee hunters is not even up to the least money made by the beekeepers.

Based on the results of this study, it is recommended that extension agencies should endeavour to teach farmers bee keeping techniques and try to solve some of the problems encountered by bee farmers. Also, bee hunters should be encouraged to move from being hunters to keepers. This involves both the extension workers and policy makers making useful inputs to bee farming and motivating farmers to take it is a lucrative occupation.

Table 1: Socio-Economic Characteristics of Bee Hunters and Beekeepers.

Socio-economic Characteristics	Number of bee farmers		Percentage (%)	
Age (Yrs)	Hunters	Keepers	Hunters	Keepers
≤50	6	23	30.0	76.7
51-60	9	7	45.0	23.3
≥61	5	-	25.0	-
Gender				
Male	18	24	90.0	80.0
Female	2	6	10.0	20.0
Educational Level				
No formal education	5	-	25.0	-
Adult education	1	-	5.0	-
Primary education	9	2	45.0	6.7
Secondary education	5	4	25.0	13.3
Post Secondary education	-	24	-	80.0
Experience as Bee Farmer (in years)				
1-3 years	-	5	-	16.0
4-9 years	8	23	40.0	76.7
≥10 years	12	2	60.0	6.7

Table 2: Bee sting prevention by Beekeepers and Bee Hunters.

Bee sting prevention	Number of bee farmers		Percentage (%)	
	Hunters	Keepers	Hunters	Keepers
No prevention	15	-	75.0	-
Honey to cover hands	1	-	5.0	-
Fire to kill bees	4	-	20.0	-
Bee dress/suit	-	30	-	100
Total	20	30	100.00	100.0

Table 3: Distribution of Respondents Based on Honey Output

	Number of farmers		Percentage (%)	
Honey output per harvest (N)	Bee hunters	Beekeepers	Bee hunters	Beekeepers
5000-6000	11	-	55.0	
7000-8000	7	-	35.0	
9000-10000	2	-	10.0	
20000-30000	-	4	-	13.3
40000-50000	-	11	-	36.7
60000-70000	-	8	-	26.7
80000-90000	-	6	-	20.0
Above 90000	-	1	-	3.3
Total	20	30	100.0	100.0

Table 4: Distribution of respondents according to the number of hives cultivated

	Number of bee farmers		Percentage	
No. of hives	Bee hunters	Beekeepers	Bee hunters	Beekeepers
10-13	15	-	75	-
14-17	5	4	25	13.30
18-21	-	11	-	36.70
22-25	-	7	-	23.30
26-29	-	3	-	10.00
30-33	-	4	-	13.30
34-37	-	1	-	3.33
Total	20	30	100.0	100.0

Table 5: Problems encountered by Bee Hunters and Bee Keepers.

Problems encountered	Number of bee farmers		Percentage (%)	
	Hunters	Keepers	Hunters	Keepers
Bee sting	12	-	60.0	-
Inadequate working space	2	14	10.0	46.7
Inadequate information	4	4	20.0	13.3
Transportation	-	6	0	20.0
Pest and predator attack	2	2	10.0	6.7
Marketing problem	-	4	0.0	13.3
Total	**20**	**30**	**100.00**	**100.0**

REFERENCES

Adegoke, M.A (2002): Training Needs of Bee Farm Management and Products Marketability in five selected Local Government Areas of Oyo State. Unpublished B. Agric Project Department of Agricultural Extension and Rural Development, University of Ilorin.

Adejare, A. (1991): "Bee keeping Africa" A Fod and Agricultural Organization (FA)) of United Nations Quarterly Publication, Rome.

Akachuku, E.A. (1993): "Bee keeping for honey and wax production in Nigeria" *The Green*: Magazine of National Association of Agricultural Students, University of Ibadan.

Centre for Bee Research and Development (1998): The Bee keepers No.1 JSSN 1119-0841 No.2 JSSN 1119-0841.

Chukwuemeka, U.O. (1999(: Impact of Bee keeping/Honey hunting on forest species in the Guinea Savannah of South Easter Nigeria. *Journal of Agricultural Extension* Vol.3, Published by Agricultural Extension Society of Nigeria.

Farinde, A.J, Soyebo, K.O. and Oyedokan, M.O. (2005): Exploration of Bee keeping as a coping strategy in a deregulated economy. *Journal of Agricultural Extension* Vol.8, Published by Agricultural Extension Society of Nigeria

Jean-Marie Jullienne (2004) "From Bee hunters to Beekeepers" South Africa. info reporter. www.southafrica.info/doing business/ trends/newbusiness/beekeeping-makonde.htm-37K.

New Encyclopedia Britannica (1997): Encyclopedia Britannica Inc. 1.1. 15th education P.687.

Ole Hertz (2007): "How to Find Wild Bees" *BfD Journal 60.* www.beesfordevelopment.org/info/ info/managing/how-to-find-wild-bees.shtml-23k.

Onwbuya, E.A. (2004): Improving Rural Household through Bee keeping in Nsukka Local Government Area of Enugu State. Paper presented at the 9th Annual conference of Agricultural Extension Society of Nigeria (AESON) held at the Conference Hall Obafemi Awolowo University, Ile-Ife, 8th – 11th March.

Oluwole, J.S. (1999): "Completing farm children programme development through Agricultural Education in Nigeria" in Williams, S.B., Ogbimi, F.E., and Farinde, A.J. (Eds) Farm Children and Agricultural Productivity in the 21st century, Book of proceedings, pp1-6.

Winnie the Pooh (2008): History of Beekeeping in Texas. www.roundrockhoney. com/index.php?main

ROLE OF CHILDREN IN COMMUNAL ACADJA FISHING METHOD IN BADAGRY LAGOON

Olopade O.A
Department of Renewable Resources, College of Agricultural Sciences,
Olabisi Onabanjo University, Ago-Iwoye, Ogun State.

ABSTRACT

This paper examines the role of Children in Communal Acadja fishing method in Badagry Lagoon, Ogun State. The study covered 60 respondents (children) involved in community based acadja fishing. Data were obtained with the use of structured interview schedule and analyzed with the use of descriptive statistics such as means, percentages and inferential statistics such as Chi-square was used to determine the relationships between the demographic characteristics of the children and tasks assigned to them. The result of the study shows that the majorities (55%) of the children interviewed were male, 38.3% were within the age group of 14 -16 years, 43.3% had no formal education and about 76.6% of the children had more than 5 years in communal acadja fishing.

Most of the respondents (63.3%) showed willingness to become professional fishers in future. Further result showed that the tasks assigned to children vary according to ages and sex. The boys were fully involved in construction, harvesting of acadja while girls were involved in post harvest operations.

All the respondents claimed that they did not gain financially from the communities run fishery even though the work is carried out in abusive conditions.

Chi-square analysis results showed that no significant relationship between children Involvement in communal fishing and demographic characteristics. The study concluded that children play considerable role in communal fishing and government should recognize the role of the children in fishing communities.

INTRODUCTION

It is generally accepted that without management, the benefits that most fisheries produce will diminish. This is the tragedy of the "commons" (Hardin, 1968) argument, and it is now clear that a tragedy will occur in the absence of management, whether come from central government or local communities.

In several regions of the world, the new emphasis on grassroots, community – based management has been reflected in new alliances, which seek to promote effective management in an indigenous perspective. It is also obvious that, for thousands of years, resources users have organized themselves to manage common resources such as fisheries (Ostrom, et al 1999).

Ostrom (1990) has also identified characteristics that have enabled groups to manage commons over long periods without bringing about a tragedy of overexploitation. She found, for example that boundaries must be well defined, rules must be linked to local conditions and sanctions must be imposed when rules are violated. Many of these systems have been documented in detail especially those in Japan and parts of Oceania (Melanesia, Micronesia and Polynesia) (Ruddle and Akimichi, 1984; Freeman et al 1991). The bedrock of the coastal and riverine population is constituted of communities that have been in existence for several generations. The main function of these centuries old generations is to guide on harmonious fishing operations and functioning.

There is a wide division of labour within fishing communities, with children playing various roles under conditions of assisting their parents bordering on blatant exploitation, because, in most cases they do not gain economically from participation in labour force.

The fisheries – related work that children do may according to Nieuwenhujs (1994) be classified into four broad categories (a) Fishing and Foraging for subsistence (b) Small – scale fish vending (c) Rendering Services to a boss and its crew during operations on a beach and (d) work in a shore – scene crews.

Children occupy strategic position in agriculture, forestry and fisheries. Globally, the latest estimate suggest, these primary sectors account for 69% of all child labour, while services account for 22% and industry 9% (ILO, 2006), the contribution of children is most widespread in small-scale fishing where it can be critical for the profitability of enterprise.

Knowledge of the contributions of children in fisheries sector is only evolving slowly and

still lacks behind. It is against this background that the paper investigates the roles of children in communal acadja method of fishing on the Badagry Lagoon in Ogun State.

MATERIALS AND METHODS

The study was carried out on the Badagry Lagoon located in the western Part of the Ipokia Local Government Area of Ogun State, Nigeria. It stretches from Yewa Lagoon to the Republic of Benin (Lat 5^0 26^1 and 2^0 45^1E). The communal acadja systems consist of bamboo poles, twigs and tree branches implanted on the muddy bottom in water up 1.5m deep estimated at 5.6ha. They are found scattered on the lagoon in an irregular pattern mainly from Akere fishing village and stretches to Republic of Benin. The acadja is left for between 2 to 6 months. Afterward they are carefully fished with a seine net.

The population for this study was defined as children aged between 5 and 16 years old (Ikenga-Metuh 1995). In order to have a good spread of the respondents for this study, six of the seven fishing villages surrounding the lagoon were investigated namely Akere, Ajano, Hausa, Soken, Wekan and Tongeji. A multistage sampling technique was used to select respondents in the six fishing villages. The first stage involved identification of fishing villages in the study area while the second stage involved random selection of five households per villages and the third stage involved selecting two children in the household. The total respondents for the study therefore, came to be 60.

An interview guide was used to obtain information on respondents demographic characteristics, tasks assigned to children and gravity of hazards. Both descriptive and inferential statistics such as chi-square were used to determine relationship between the demographic characteristics of the children and their involvement in communal acadja fishing method.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents in table 1 showed that 55% were male and 45% were female, this shows that both boys and girls are involved in fishing activities at early stage. The table also shows that 38.3% of the respondents were within the age range of 14 – 16 years, 25% were 11 – 13 years and 28.3% were within the age range of 8 – 10 years. The remaining 8.3% were within age group of 5-7 years. The large numbers of children in the study area could be attributed to lack of alternative employment in the study area. Generally child worker is seen in a positive light, particularly in fishing communities, where it is considered an important part of preparing children for adulthood and taking up future responsibilities (ICSF, 2006). The level of education among respondents was low. About 43.3% of the respondents were not attending any school. The main reason given by the children for not going to school was precarious family poverty situation. Poverty and irregular income are leading causes of low education attainment in Africa (Bene and Heck 2006). Also majority of the respondents (41.7%) were Moslems, 33.3% of them were Christians while 25% were traditionalists. The children population comprises of the indigenes (Awori 31.7% and Yewa 20%) and migrant fishermen children from Republic of Benin accounting for 35% of the respondents.

Table 1 shows that about 40% of the respondents had more than ten years experience. Most of the respondents (63.3%) showed willingness to become professional fishers while about 16.7% of them were uncertain.

The tasks assigned to children vary according to ages, nature of the operations and sex (Table 2). The boys were fully involved in construction and harvesting of the acadja while the girls engaged in processing and selling of the fishes. Ages 5 – 7 years boys were involved in the collection of twigs and tree branches while the girls were assigned with the tasks of sorting of fishes and hawking of fishes. Ages 8-10 years boys group were mostly involved in collection of twigs and tree branches. The same age group was also involved in unloading and guarding of catch during harvesting. The female children of ages 8-10 were involved sorting of fishes, collecting of fire wood for fish smoking, and hawking of fishes. Male children of ages 11-13 years were involved in cutting of tree branches, collection of tree branches, and construction of acadja. During cropping the same age group played vital role in diving into water to guide fishes into the nets, hauling of net, collection of fishes from the nets, and other cropping operations .The female children of ages 11-13 years were involved in sorting of fishes, washing and cutting of fishes into small sizes and fish smoking. Table 3 shows that the ages 14-16years male were fully involved in installation, construction and cropping of acadja. They also involved in hauling of nets and crafts, management of the acadja systems. The female of ages 14-16 were mainly involved in cleaning, gutting, scaling, cutting of fishes into small sizes for smoking and hawking of the

fishes. The sex roles in terms of division of labour are instilled in the children by parents from generation to generation. Other tasks assigned to children include surveillance and reporting defaulters.

As regards Remuneration of work all the respondents claimed there was no remuneration undertaken during community run fishery (Table 2). Nieuwenhuys (1995) noted that much of the fisheries and other work that children do has very low returns yet is till argued to be of critical importance.

From an occupation-health and safety perspectives, children engaged in communal acadja fishing are exposed to various hazards related to fishing operations. Table 3 shows that about 38.3% of the respondents claimed that they were drowned at one time or the other during community run fishery. About 66.7% of them reported bites and stings from reptiles and insects. Furthermore, about 30% of them reported that they have been beaten, while 41.7% of the children reported physically abuse and about 56.7% of them have been harassed. These issues of occupational health and safety are clearly important and need to be addressed in order to encourage involvement in community acadja fishing.

Chi-square result indicates no significant relationship between the respondents demographic characteristics and their involvement in Communal Fishing ($p>0.05$) (Table 5).

CONCLUSION

Based on the findings of this study. It could be concluded that children play considerable role in communal acadja fishing method, even though they did not gain financially. The task assigned to children is hazardous and vary according to their ages and sex with the boys involved in construction and cropping of acadja system while the girls mainly participated in post harvest operation.

RECOMMENDATIONS

(i) Special attention should be given to education of children in fishing villages to keep children at school.

(ii) Fisheries development programmes should recognize that children play an important role in fishing communities and the consideration should be made for enhancing that role. They should be including in all appropriate training activities and where necessary, special training should be designed for them.

REFERENCES

Bene, S and Heck, S. (2005) Fisheries and the Millennium Development Goals: Solutions for Africa. *NAGA World Fish Center Quarterly* Vol. 28 (3 x 4): 14 - 18

Freeman, M.M.R., Matsuda, Y. Ruddle, K. ed. (1991) Adaptive Marine Resource Management Systems in the Pacific. Special issue of *Resources management and Optimization*, 8 (3/4), 127 – 245.

Hardin, G. (1968) The Tragedy of Commons Sciences 162, 1243 – 1248

International Labour Organisation ILO (2006); The End of Child Labour Within Reach http://www.ilo.org

Nieuwenhugs, O (1994) Children's Lifeworlds, Gender, Welfare and labour in the developing world. London, Routledge

Johannes, R.E (1982) Traditional Conservation Methods and Protected Marine Areas in Oceanic Ambio (2) 5p. 258 – 61.

Ruddle, K, Akimichi, T., ed. (1984) Maritime Institutions in the Western Pacific National Museum of Ethnology, semi Ethnological Studies 17, Osaka, Japan.

Ostrom, E (1990) Governing the Commons. The evolution of institutions for collective action Cambridge: Cambridge University Press.

Ostron, E. Burger, J., Field, C. B., Norgoard, R.B., Policarnsky, D. (1999) Revisiting the Commons: Local Lessons, global Challenges. Science 284, 278 – 282.

International Collective in support of Fishworkers (ICSF) (2006) Child Labour: Growing Pains SAMUDRA report NO. 44 July 2006 pp8.

Table 1: Socio – Economic Characteristics of the Children

Input	Parameters	Frequencies	Percentage
Sex	Male	33	55
	Female	27	45
Age	5 – 7 yrs	5	8.3
	8 – 10 yrs	17	28.3
	11 – 13 yrs	15	25
	14 – 16 yrs	23	38.3
Educational Level	No Formal School	26	43.3
	Primary School	10	16.7
	Secondary School	24	40
Religion	Moslem	25	41.7
	Christianity	20	33.3
	Traditional	15	25
Tribe	Egun	21	35
	Awori	19	31.7
	Yewa	12	20
	Others	8	13.3
Experience in Community fishing	Less than 5 yrs	14	23.3
	5 – 10 yrs	22	40
	10 yrs above	24	63.3
Future Profession	Fishing	38	63.3
	Others	12	20
	Uncertain	10	16.7

Table 2: Tasks Assigned to Children

Age	Sex	Tasks Assigned
5 – 7 yrs	Male	Collection of twing and tree branches
	Female	Sorting of fishes hawking of fishes
8- 10 yrs	Male	Collection of twigs and tree branches, surveillance and reporting defaulters of laws and regulations.
	Female	Sorting of fishes, hawking of fishes, reporting defaulters.
11 – 13yrs	Male	Cutting of tree branches, collection of tree branches diving into water to guide the fishes in to the nets, hauling of nets, cleaning of nets and cropping of acadja.
	Female	Sorting of fishes, hawking of fishes, smoking of fishes, reporting defaulters.
14 – 16 yrs	Male	Installation and construction of acadja, cropping of acadja, hauling of net, cleaning of nets, hauling of canoe and management of the acadja.
	Female	Smoking of fishes and hawking of fishes

Table 3: Gravity of hazards associated with communal acadja fishing

Gravity of hazards	Frequency	Percentage
Drown	17	39.5
Bites and Sittings From Reptiles and insects	28	65.1
Beaten	13	30.2
Physical abused	16	39.2
Harassed	25	58.1

Multiple response

Table 4: Chi – Square analysis of the relationship between socio-cultural characteristics of respondents and children involvement in communal acadja fishing method.

Variable	Chi – square χ^2 cal.	Chi – Square (χ^2) tab	Remarks
Sex	5.82	8.87	N.S
Age	3.41	4.89	N.S
Education	3.92	11.34	N.S
Tribe	5.51	11.23	N.S
Religion	2.23	5.12	N.S

P < 0.05 *N.S = Not Significant*

SUSTAINABLE MANAGEMENT OF FLOODPLAIN FISHERIES THROUGH AQUACULTURE IN NIGERIA

A. E. Falaye and T. S. Olaniran
Department of Wildlife and Fisheries Management, University of Ibadan, , Nigeria

ABSTRACT

Fish and fish products are important sources of valuable protein and also provide essential nutrients for balanced human diets. The production of animal protein is insufficient to meet demand in many developing countries of the world. The extent to which Nigeria, a developing country faces protein shortage is alarming. This situation underscores the need to exploit all avenues of protein supply including aquaculture, in the floodplains which has been estimated to cover about 21,300km^2. Fish production in the floodplains has been an integral part of domestic fish supply in Nigeria over the years. However, the integrated fish farming during the dry season in floodplains and wetlands "fadama" is gaining more popularity among the local fishing communities. This is not only boosting fish production, but also contributes to sustainability of floodplain fisheries resources.

This paper therefore, reviews fisheries resources and various forms of aquaculture in the floodplains. The strategies to improve and sustain the fish production are also provided.

Key words: Floodplain, fish production, sustainable management, Nigeria

INTRODUCTION

The production of animal protein is insufficient to meet demand in the developing countries of the world. In Nigeria for example, Ibe (1989) reported an animal protein consumption of only 7.5g/caput/day against 28g/caput/day that was recommended. Fish and fish products are important sources of valuable protein and also provide essential nutrients like oils and minerals, which are vital in balanced human diets. Across Africa, artisanal fisheries and aquaculture supply high quality food at low cost to millions of people. Income generation is also enhanced for farming and fishing households and play a central role in many local and national economies. Capture fisheries, is a dominant source of fish harvest providing well over 90 per cdent of fish supply in the region (FAO, 1999). However, aquaculture has grown steadily in recent years with production increasing from 60,000t in 1990 to 340,000t in 2000 in Egypt and from 7000t in 1990 to over 20,000t in 1998 in Nigeria (FAO, 1999). However, in Nigeria there is still a wide gap between demand and supply of fish due to increasing demand. The Federal Office of Statistics of Nigeria reported a gap of 789,000 tonnes between fish demand and supply in 1991 and projected a deficit of 1,276,000 tonnes for the year 2000 and the trend has not significantly changed even currently. The per caput demand for fish is determined by increase in income, increase in population and relative substitution of fish for meat. Nigeria, with the highest population in Africa, has the largest markets for fish in the continent. Artisanal fisheries activities that supply about 90% of Nigeria"s domestic fish production are practiced directly or indirectly in fresh and coastal water bodies and their associated floodplains. The floodplains are highly productive in terms of fish production and characterized by annual flooding and inundation. Ajayi (1991) reported about 2 million hectares of floodplain areas known as "fadama" adjacent to major river systems in Nigeria where integrated farming, fish-cum-crop and livestock farming is practiced.

This paper therefore examines fisheries resources in Nigeria with particular emphasis on floodplain fish production and provides strategies to improve and sustain the resources through integrated fish farming.

Fisheries resources in Nigeria

Nigeria is located between Longitudes 2^0 49' East and 14^0 37' East and Latitudes 4^0 16' North and 13^0 52' North of the equator with estimated total surface area of 94,185,000 hectares. West and Biney (1991) reported that Nigeria has about 1280Km^2 marine area and about 124,878.2Km^2 of inland waters. The country has a coastline of 850Km and territorial sea of 30 nautical miles (nm) in addition to an Exclusive Economic Zone of 200 nm. According to Mabawonku (1986), Nigeria's continental shelf is estimated at 37,943Km^2, which ranges from 12.8Km wide off Lekki

lagoon to 80km off the Opobo River estuary. Nigeria is also blessed with good river networks that are perennial including the Niger, Benue, Ogun, Osun, Owena, Imo and Sokoto river systems. In addition, large number of natural and man-made lakes and reservoirs are located in different parts of the country. Ita (1993) revealed that Nigeria's inland water bodies cover about 12 million hectares including rivers, lakes, reservoirs, floodplains, and artificial ponds. (Table 1). The potential fish production was estimated at about 512,000 and 1000 metric tonnes per annum from Nigeria inland capture fisheries and aquaculture respectively. Furthermore, Falaye (1992) reported that in Nigeria all lakes, reservoirs and dams, fisheries activities often form a significant source of income and livelihood, which contribute to the rural development of the communities.

Fish supply in Nigeria comes mainly from artisanal fishermen that exploit the coastal waters and the inland rivers and lakes including their adjacent floodplains. In the last two decades the trends of domestic fish production indicate a declining trend of fish supply from the capture fisheries sector. According to Tobor (1990) total domestic fish production in 1980 was 462,567 metric tonnes, which declined to 303,454 metric tonnes in 1989. Currently the annual total domestic production from capture fisheries sector is about 300,000 metric tonnes.

The major fish species landed from the pelagic and semi-pelagic zones of the coastal area of Nigeria area bonga (*Ethimalosa fimbrata*), Sardines (*Sardinella spp*). The croakers (*Pseudotolithus spp*) and pink shrimp (*Paneus notialis*) are the dominant demersal species of economic importance in Nigeria. Other important fish include grunters (Pomadasys sp), sole (*Cynoglossus spp*), thread fin (Pentanemus sp). The freshwater fish species in Nigeria include *Tilapia, Clarias, Heterobranchus, Synodontis, Chrysichtyys, Mormyrus, Lates, Gymnarchus, Alestes, Labeo* and *Heterotis spp.*

Characteristics of floodplains fisheries

There are diversity of fish species in Nigeria floodplain ecosystem. The exploitation of floodplain fisheries is largely artisanal, which involves the use of both passive and active fishing gears. The passive grears are set during the rising and falling flood for the capture of migrating fish while active gears are used to harvest the stranded fish stock as the flood receded. The high water level period is characterized by intensive biological activity for the fish stock in terms of breading, feeding and growth with a consequence increase in fish biomass hence making the floodplain habitat highly productive. According to Lowe-McConnel (1977) most floodplain fish species have annual or short life cycles, maturing within one year and ready to spawn by the next flood season. However, seasonality is the dominant feature of the fisheries of floodplains which gives rise to high and low water periods with corresponding periods of low and high fish catches respectively.

Utilization of floodplain for aquaculture and culture-based fisheries

Aquaculture as a management measure is being practiced in the floodplain to maximize fish exploitation and sustainability of the fisheries resources. Fish culture is carried out in both excavated ponds and natural floodplain. The aqua-cultural practices help in keeping the largest possible area of the floodplain under high level of water during the dry season in order to increase fish production. The natural production from the floodplain can be exceeded by various forms of husbandry and extensive or semi-intensive aquaculture.

From the vast potentials of the floodplains of up to 3 million hectares comprising of about of 858,000 Ha of estuaries and 2,130,000 Ha of freshwater floodplains, a modest amount of 10% could be utilized for aquaculture and cultured based fisheries. This will obviously increase domestic fish supply in the country.
The widespread of floodplains in Nigeria is associated with various extensive techniques of aquaculture systems, which include:

Drain-in Ponds: These involve the use of simple ditches or depressions excavated into the surface of the floodplain which help to aggregate and concentrate the fish as the waters recede. It is possible to stock additional fish fingerlings or juveniles and feed artificially in order to boost their natural production.

Akadjas: In this method the parks of branches or floating vegetation are installed in large floodplains lakes to serve as collectors for fish. The Akadjas not only provide refuge, but also increase the chance of breeding and growth of the trapped fish stock.

Blocking of Natural Floodplain Depressions: The existing canals from natural floodplain depression are blocked to retain water depression fro a longer period of dry season so that the fish stock can be conserved for harvesting when the fish have grown to a reasonable size.

Cages: Installation of fish cages for rearing stocked fish species is possible in floodplain areas with high water levels. The fish is harvested at the end of the culture period.

According to Moses (1990), flooding has potential of increasing the size of associated aquatic habitat up to 50%. The effects of the flooding are two fold. Firstly it brings in nutrients that stimulate the rapid growth of micro-organisms and invertebrates which may be eaten directly by fish. Secondly the water expands into the forest or savanna and engulfs animals including insects, insect larvae, mollusks as well as higher plant materials.

Aquaculture is still at its developing stage in Nigeria, with great attention being focused on finfish farming in the last few decades. Pond fish culture trials are carried out with some indigenous fish species such as Tilapia spp, Clarias gariepinus, Heterobranchus bidosalis, Heterotis nitoticus, Chrysichthys spp and some exotic breeds like Cyprinus carpio and Ctenopharyngodon idella. Jamu and Ayinla (2003) reported that although erthen fish pond culture has continued to be the dominant aquaculture production system in Africa, the potential of other production systems such as culturebased fisheries in floodplains, lagoons and small water bodies needs to be fully explored. Also, simple management interventions in floodplains can increase fish yields, ranging from 300 to 1,700kg. ha-^{1} in floodplain fish culture systems in Bangladesh, Malawi and Vietnam, according to them (Jamu and Ayinla 2003).

Estimated Fish Production and Revenue

It will be possible to increase fish production from aquaculture yields using one-tenth of existing floodplains to generate up to 600,000 tonnes of fish per annum in Nigeria. Potential revenue from the above fish yields amounting to 1.2 billion Naira would therefore be achieve from the fish culture venture in the floodplain area every year. This would be a significant contribution to the income earnings of the local community as well alleviate their poverty and improve their social economic well being.

DISCUSSION

Floodplain aquaculture and culture based fisheries have high production potential in developing countries because the practices are amenable to the rural poor and landless people and with little initial capital investment. The culture practices also provide good options for supplying high quality protein and additional income to the local fishing communities. In order to realize this potential, the traditional aquaculture technologies that are practiced in the floodplains need to be aggressively reviewed and refined to evolve better control of fish production and management. Development of aquaculture in floodplains should therefore concentrate on simple management interventions including stocking and supplemental feeding of fish in enclosures, temporary pools and channels. Different co-management strategies that optimize social and economic benefits to the communities which depend on these resources should also be adopted.

Hence from the aquaculture strategies the fish yield in the floodplain ponds would be improved and sustained by the integration combining fish farming with livestock and crop farming. The fish are feed with supplementary feeds and agricultural by products, while the livestock leftovers and wastes are used to feed fish and or fertilize fishponds, t obtained flourishing fish harvests. The enhanced fish production from floodplains could be attained if adequate fish culture techniques and management are implemented.

REFERENCES

Ajayi (1991): A report on the Environmental Assessment study of National Fadama Development Project in Bauchi, Kano, Katsina and Sokoto states and the Hadejia-Nguru Wetlands M.A.N.R. (FACU) Ibadan, Nigeria 45p.

Akegbejo-Samsons, Y. (1995); Ecology of the fisheries resources of coastal wetlands of Ondo State, Nigeria and its management implications. Ph.D. Thesis, Federal University of Technology, Akure, Nigeria. 297 p.

Falaye, A.E. (1992): Fish Production from Reverine Lake and Forest Swamp of Nigeria.

Nigeria journal of Forestry Vol.24 No. 112: 48-50.

F.A.O. (1999): Fishery Statistics: Aquaculture production FAO Fisheries Series No.58, FAO, Rome, 178p.

Ibe, S. N. (1989): Structural Adjustment Programme and Self Sufficiency in Animal Production. Proceedings of Nationall Conference in Impact of SAP on Nigeria Agriculture and Rural Life NISER, Ibadan, Nigeria.

Ita, E. O. (1993): Inland fishery resources of Nigeria *CIFA Occasional Paper* No.20 Rome, FAO 1993. 120

Jamu, D.M. and Ayinla O.A. (2003): Potential for the development of aquaculture in.Africa NAGA, *WorldFish Centre Quarterly* Vol.26 (3): 9-13

Lowe-McConnel,, R. H. (1977): *Ecology of fishes in Tropical Waters*. London, Edward Arnold 64p.

Mabawonku, A.F. (1986): Fisheries in the Nigerian Economy – The challenges ahead. *Journal of West African Fisheries* 2 No.1: 89-99.

Moses (1990); Distribution, Ecology and Fisheries Potentials of Nigerian Wetlands in I.V.I. Akpata and D.U.U. Okali (Eds). Nigerian Wetlands, UNESCO/MAB Port Harcourt, Nigeria.

NEST (1991): *Nigerian Threatened Environment; A National Profile*. Nigerian Environmental Study/Action Team Publication 154p.

Tobor, J.G. (1990): The Fishing Industry in Nigeria: Status and Potential for Self Sufficiency in Fish Production *NIOMR Tech.Pap*. No.54.

West, W.Q.B. and Biney, C.A. (1991): African Fisheries and the Environment *RAFR Publication* F1/91/1. 26p.

LIVESTOCK HUSBANDRY AND ITS IMPACT ON EMPLOYMENT GENERATION IN ALIGARH DISTRICT, U.P. (INDIA)

Nizamuddin Khan* and Md.Asif Iqubal**
*Associate Professor, Department of Geography, Aligarh Muslim University, Aligarh,202002
nizammudin_khan@rediffmail.com
** Research Scholar, Department of Geography. Aligarh Muslim University Aligarh, 202002
daialig@rediffmail.com

ABSTRACT

Livestock husbandry is an important sector of agriculture economy. It plays a vital role in household nutritional security, increased income, and employment generation. Livestock farming, however, has been one of the most important value adding farming systems adopted in different countries. The animal husbandry and dairying sectors have come to play an increasingly significant role in the development of the India. Though milk, meat and egg production has grown manifold since independence, there is need for further increasing production from this sector.

Present study was aimed to find out the structure of the livestock development and livestock oriented employment for various socio- economic groups in Aligarh district of Uttar Pradesh. It was found that the level of employment generated or workforce absorption in livestock sector is determined by the size of operational holding as well as social level of the livestock rearers. It revealed that marginal, small and medium size of holding farmers employed about 27- 28% of total workforce in different operations of livestock husbandry. Similarly, socially backward category of farmers like other backward caste (A Category of backward group of the people in India) showed highest percentage (52.85 %) of workforce involve in this sector to cropping system.

Key words: Buffalo, Growth, Employment, Livestock, Socio-economic composition.

INTRODUCTION

Livestock is an important form of agriculture in the world. It is practiced in various forms like mixed farming, nomadic herding, commercial grazing and traditional activities in different global agro-climatic conditions. It plays a vital role in socio-economic development of a region/country. It is considered as a source of employment, involving the people in various operations for the rural population in developing world (Inforesources, 2007). Food security and health improvement have been also solved through the development of this sector as animal derived food intake is increasing over the decade (Rollefson 2001).

The livestock sector recently emerged an important form of diversification of agriculture in many developing countries like India. The demand of livestock products like meat ,milk and eggs rose up tremendously at global level because of increasing urbanization, burgeoning middle class population as well as improvement in level of income and socio economic transformation and consumption of food of high calorie (Rollefson, 2001, Chindola and Otte 2006).

This form of agriculture is moving very fast and achieving a standard of revolution known as livestock revolution (Conroy 2004). The revolution has been accelerated after liberalization of agri-business and increasing demand of livestock in global market due to price competiveness of livestock products originated in tropical monsoon developing countries where product cost is rather low due to low wage rate (Padamkumar 2007).

However the increasing intensity of livestock husbandry and scaling up this industry opened an opportunity for the poor farmers to be employed and enhance the income. The sustainability of cropping system may be also enhanced through the adoption of livestock-cropping integrated agricultural practices especially in those countries where traditional small scale livestock husbandry is done by small and marginal farmers (Pratap, Birthal and Rao 2004).

Livestock husbandry is also well developed in India since antiquity but in very traditional form. The country has largest number of cattle and buffalo of the world. She also ranked second in goat and third in sheep and seventh in poultry sector. In term of milk she is the largest producer (Hegde 2006). This sector got a breakthrough at rather faster rate after adoption of policies of WTO and liberalization of agribusiness recently. The share of this sector to GDP as well as agricultural income

has been improving year after year. The availability of animal derived food like milk and meat at national level are also increasing because of change in food habits, enhancement of middle income groups, urbanization and larger proportion of Muslim population who demand livestock especially for meat on various social and religious occasion/festival (Khan, Ahmad, Hasmi and Hoda 2006).

The significance of livestock husbandry in socio-economic transformation as well as maintaining the agricultural sustainability and the economic viability of poor farmers in developing countries like India in general and Aligarh district in particular was the focus of the study. Also the researchers intend to find out the structure of the livestock development and livestock oriented employment for various socio- economic groups in Aligarh district of Uttar Pradesh.

MATERIAL AND METHODS

To evaluate the growth of livestock development and employment generation for various groups of the rural population in the study area (Aligarh) a village was selected from each of the five subdivisions of the district. 70 livestock rearing household of various socio-economic conditions were interviewed for detail enquiry regarding different issues of the study. The farmers are classified as landless, marginal, small, middle and big on the basis of size of landholdings. Zero hectare, less than 1 hectare, 1-2 hectare, 2-4 hectare and more than 4 hectares of land were the categories for the group of farmers. Primary data were collected through field survey of the sampled villages. Secondary data were collected from published record available in different national and international journals, various reports and from various offices of agricultural statistics located at district headquarter. Collected data were processed and presented in tabular form and analysed well for deriving the concrete and precise results.

RESULTS AND DISCUSSION

Present Scenario of livestock

The present era is the reflection of livestock revolution not only in developing countries at national level but the study area at grass root level witnessed a remarkable level of livestock rearing during 2003-2004. Data reveals that 1056092 heads of livestock are reared at different scale of economy along with highly developed cropping system in Aligarh district. The livestock consists of various species like buffalo cattle, sheep and goat .The buffalo accounted for highest share /proportion of livestock with 67.78 % (715774 heads) followed by goat 17.72 % (187111 heads) cattle 13.59 % (143620) and sheep 0.90 % (9587) as evident from table -1. Buffalo also exhibited dominant position over the other species even in terms of number of livestock per unit hectare land as well as per thousand population. The cattle ranked third after goat, which was in considerable size before 1990's.

Growth of livestock

Aligarh witnessed considerable dynamism in livestock sector. The level of structural change in production of various livestock is the reflection of physio-socio-economic milieus of the concerned area. Increasing urbanizations, social transformations, food habit changes and the increasing purchasing power appears to be very catalytic factors for livestock revolution. Number of livestock, as a whole, has improved much but a rather slower rate due to some species showed stagnation in growth process. The analysis of production of every species of livestock at individual basis exhibited contrasting features. Buffalo, in term of absolute number rose up continuously during 1993-94 to 2003-04. The buffalo-area and buffalo-population indices also have showed positive growth from 1.84 and 224.75 in 1993-94 to 2.39 and 239.20 in 2003-04 respectively. Government policies to increase milk production in the form of flood operation, increasing demand of milk and meat at national and international level as well as the installation of meat and dairy processing units in the area have been attributed to high rate of growth of buffalo production.

Table 1.Proportion of composition of various species of livestock in Aligarh district

Year	Livestock Species (in percentage)				Total
	Buffalo	Cattle	Goat	Sheep	
1993	58.14	20.33	19.56	1.95	100
1997	65.06	15.85	16.91	2.17	100
2003	67.78	13.59	17.72	0.90	100

Source: District Statistical Magazine

However, the goat, a small ruminant also showed an improvement during the discussed period but at rather slow rate than the buffalo. The rearing of this species became very popular recently at household level of especially poor families involving larger interest of females. Goat rearing emerged as new option for enhancing the economic power of women irrespective of any social class in rural areas of the district. It is low capital intensive

and can be fed on some grasses and straw of crops grown. The demand for goat meat (mutton) is increasing day by day as it is widely acceptable in all ethnic groups of Indian population unlike beef in the country.

Table 2. Species–wise distribution of livestock in Aligarh district

Species	1993		1997		2003	
	Livestock/ 1000pop.	Livestock/ Hect	Livestock/ 1000pop.	Livestock/ Hect	Livestock/ 1000pop.	Livestock/ Hect
Buffalo	224.75	1.84	220.04	1.80	239.20	2.39
Cattle	7978.62	0.64	0.43	90.43	58.63	0.48
Sheep	7.56	0.06	7.34	0.06	0 3.20	0.032
Goat	75.62	0.62	57.20	0.469	187.51	0.70

Source: District Statistical Magazine

Contrary to this, the cattle, once very popular among the farmers, recorded a negative growth in their number as well as cattle- land and cattle-population indices in study region (Table 2 and 3). Moreover, the cattle rearing experienced a setback due to mechanization of agriculture. They were mainly used in various agricultural operations as draught animals. Their number over the time declined from 192593 heads in 1993-94 to 143620 heads in 2003-04 recording negative growth with a tune of -25.42 % (Table- 3). The low milk productivity per cow and prohibition of their slaughter for meat purpose on account of religious consideration has led to discouragement among farmers to rear them (Khan, Ahmad, Hasmi and Hoda 2006).

However the sheep an important meat producing livestock declined at a very fast rate since 1993 both in absolute term and in percentage growth. It decreased from 18532 heads in 1993 to 9587 heads in 2003 showing the highest negative growth (-48.26) among these livestock in the study area. The traditional form of sheep rearing and their selling and purchasing caused the downturn of this activity. Besides, low socio-economic status of the sheep rearers was also one of the major factors for the backwardness of growth of this particular species of livestock.

Table 3.Growth of livestock husbandry in Aligarh district during the period1993-2003

Species	1993-94	2003-04	Difference	% increase or decrease
Buffalo	550551	715774	165223	+ 30 %
Cattle	192593	143620	-48973	-25.42 %
Goat	185259	187111	1852	+1.00 %
Sheep	18532	9587	-8945	-48.26 %
Total	946935	1056092	109157	11.53 %

Source: District Statistical Magazine

Livestock oriented employment in different socio-economic groups of population
In Aligarh in sampled village

Livestock husbandry is an important source of economic activity in agriculture sector which contributed a major portion to GDP at the country and improved the socio-economic condition of the people in general and rural population in particular. The livestock farming activities appeared as a new source of employment in the study area. All the people who were interviewed are employed directly or indirectly in various activities of livestock husbandry like rearing, marketing and collection/ processing of animal and animal products. Tables **4** and **5** reveal the level and number of persons employed in different economic activities relating to livestock husbandry.

The economic stratification on the basis of landholding of the farmers is an important controlling factor of employment level generated through various operations of animal husbandry in the study area. The study revealed that the level of employment generated or workforce absorption in livestock sector is controlled by size of operational holding of the farmers. Marginal, small and medium size holding farmers had larger proportion of 27- 28% of their total workforce in each category employed in different operations of livestock husbandry in selected villages of the district. They employ livestock-cropping integrated agricultural system in which crop residues is consumed as animal feed and livestock wastes used in crops as manure for good production. The family members of these groups of farmers involve themselves in both cropping and livestock husbandry simultaneously and become able to enhance their incomes. The limited land and high agricultural population pressure compelled the poor farmers to be involved in livestock sector. While the landless and big farmers on the other

hand showed a low level of participation in this sector with about 8.57 % of total workforce. The low rate of participation of landless category of population is due to the fact that this group does not have sufficient capital for purchasing the livestock which may be very costly especially buffalo and cattle. Besides, the absence of fodder or crop residue needed for livestock feeding also increase the production cost for them as they have to purchase from the farmers. They are only involved in rearing of small ruminant like goat which and goat rearing require less capital. Goat rearing also needs only a few hectare of land for crop residue to fulfill the fodder requirement. Contrary to this, big farmers, though have much capital and crop residue, show low participation because they hire labours from landless and marginal farmers. The family members of big farmers also do not prefer to work in livestock husbandry.

The work-wise analysis of farmers (Table 4) also reflected the impact of size holding on shares of their participation in various categories of work like rearing, marketing and collection and processing. The highest percentage (83.33) in rearing went to the big farmers because in general they had the facilities of animal rearing at maximum level. But they do not have much time for marketing and collection or processing. In marketing sector the highest percentage of workers involved are from marginal farmers (27.07 %) and medium farmers (20 %) respectively while in collection/ processing landless farmers were involved in largest percentage (66.66%).

The rearing however is the most attractive economic activity in livestock farming system. It employed 50 persons out of 70 engaged in livestock husbandry. On an average livestock oriented employment shared 71.42% in rearing, 17.14 % in marketing and only 11.42 % of the selected population in collection or processing.

Table- 4. Proportion of workers in different operations of livestock husbandry in Aligarh district.

Category of farmers	Workers in Animal husb. to the Total workers (in percent)	Operations of livestock husbandry			
		Rearing producer	Marketing	Collection/ Processing	Total
Landless(0 hact.)	8.57 %	4(66.66)	1(16.66)	1(66.66)	6(100)
Marginal (0-1 hect.)	27.14 %	13(68.42)	4(21.05)	2(10.52)	19(100)
Small(1-2 hect)	27.14 %	14(73.68)	2(10.52)	3(15.780	19(100)
Medium(0-1hect.)	28.57 %	14(70.00)	4(20.00)	2(18.00)	20(100)
Big (>4 hect.)	8.57 %	5 (83.33)	1(16.66)	------	6(100)
Total	100 %	50(71.42)	12(17.14)	8(11.42)	70(100)

Field survey 2007

Table-5. Caste wise employment structure in different sectors of animal husbandry in study area

Category of farmers	Workers in Animal husb. to the Total workers (in percent)	Operations of livestock husbandry			
		Rearing producer	Marketing	Collection/ Processing	Total
High Caste	13(18.57)	10(76.92)	2(15.38)	1(7.69)	13(100)
Other Backward Caste	37(52.85)	24(64.86)	7(18.91)	6(16.21)	37(100)
Schedule Caste	20(28.57)	13(65)	4(20)	2(15)	20(100)
Total	70(100 %)	47(67.14)	13(18.57)	10(14.28)	70(100)

Field survey 2007

Somehow, the social structure of the population has also shown a paramount effect on the level of employment generation through livestock husbandry. Study revealed that some specific castes belonging backward group are specialized in particular kinds of livestock husbandry operations. Other backward castes (OBCs) politically recognized social groups, including Rajput, Lodha Yadau etc. showed highest proportion (52.85 %) of workforce involved in this sector (Table- 5). It is followed by scheduled caste (SCs) the most socially deprived class and high castes. The high level of employment of OBC group in livestock husbandry is mainly attributed to their traditional experience of animal rearing as well as the scarcity of land for fulltime involvement of all family members for whole year. They practice mixed farming system in which both cropping and livestock rearing are mixed together with a view to increase economic viability of their family members and sustainability of different crops grown in limited land.

The work wise discussion also showed variation with social stratification. High castes showed the highest participation in rearing. They accounted for 76.92% of total person involved in animal husbandry. The highest share of this group in animal rearing is attributed to the easy availability of capital for investment in animal husbandry .The land for fodders is easily available to the high castes as they were usually having big size of landholding in the study area is also attributing the highest percentage share of high caste in livestock rearing (Khan et al 2006). After high castes, schedule caste was the second big livestock rearers because they were either employed as a labour of high castes or they keep their own livestock for rearing.

Marketing involves the transaction of livestock and their products through different channels from producers to consumers. In this activities SC were the largest shareholder (20 %) because the marketing of livestock of high castes are done by the schedule castes as they serve as hired labour. It was followed by OBC (18.91%) and high castes (15.38 %) respectively.

Moreover collection/processing activities are mostly done by OBC and its share is 16.21% of the total workforce in OBC while least share is of the privilege group i.e. high caste because they hardly do this job and it also differs from individual caste to caste among high castes.

CONCLUSION

The study revealed certain interesting features regarding the livestock husbandry and its effect on employment generation and economic development of livestock rearers in the study area.

1. Buffalo and goat recorded positive growth due to increasing demand of milk and meat recently at local, regional, national and international level.
2. Cattle dropped in number at a faster rate because high level and mechanization of agriculture and prohibition of cattle slaughter for meat production due to religious taboos.
3. Livestock husbandry generated employment and absorbed workforce especially from socially and economically deprived population.
4. This sector of agricultural economy generated not only nutritive food and health improvement but also employed a large number of people in various operations especially from socio-economically deprived rural population

However the livestock husbandry is emerged a boon and blessing for rural poor especially for landless, marginal and small farmers. The development of livestock and cropping integrated farming system would be an important method for agricultural sustainability and economic viability of poor farmers in the study area as well as in the country, if adopted well.

REFERENCES

Conroy C 2004 Livestock Sector Growth and Poverty, with particular reference to India. Natural Resource Institute, pp. 1-2, from http://www.dfidagriculturecconsultation.nri.org/theme1/keypapaers/livestockrevolution

Hegde N.G 2006 Livestock Development for Sustainable Livelihood of Small Farmers, Souvenir of the 39th Annual General Meeting and 48th National Symposium on " Emerging Rural India- A Challenge to livestock Industry."Compound Livestock Feed Manufactures Association of India (CLFMA), Manesar, Haryana.August 26, 2006: 50-63, p.1. from http://www.baif.org.in/aspxpages/pdf/dairy/Providing%20Sust.Llhd%20to%20small%20farmers-CIFMApdf

Inforesources 2007 The Livestock Revolution: An Opportunity for Poor Farmers, Focus, No. 1/07, pp. 3-4 from http://www.inforesources.ch/pdf/focus07_1_e.pdf

Khan N, Ahmad A, Hasmi N I and Hoda M 2006, Livestock Marketing and Diversification of Agriculture, Vista International Publishing House, Yamuna Vihar, Delhi, pp. 169-171.

Chindola P and Otte J 2006. Indicators to monitor trends in Livestock Production at National ,Regional and International level, Livestock Research for Rural Development, Volume18, Article # 8 from http://www.lrrd.org/lrrd18/8/chil18117.htm.

Padamkumar V 2007, Livestock-Livelihood-Environment, The Policy Context and Challenges, Lead India Platform, from www.india.org

Pratap S, Birthal and Rao P. P 2004, Intensification of livestock Production in India: Patterns, Trends and Determinants, Indian Journal of Agriculture Economics, Vol. 59, No.3, pp.555-556.

Rollefson K.I. 2001 Livestock Development for Food Security, Annual Report of the League for Pastoral Peoples, 2000/2001.

ECONOMIC ANALYSIS OF HONEY PRODUCTION IN EDO STATE, NIGERIA.

[1]Bifarin J. O, [2]Akanni D. I. and [2]Kayode B. O.
[1]Department of Agricultural Extension and Management, Federal College of Agriculture, Akure.
[2]Department of Agronomy, Federal College of Agriculture, Akure.

ABSTRACT.

This research work was carried out to analyze the economics of honey production in Edo State. The objectives of the study were to examine the demographic characteristics of honey production, assess the profitability of honey bee and the problems facing honey production .The list of honey farmers in the state was compiled and 50% of them were randomly sampled. Questionnaire was administered on them to elicit information socio- economic and cost tracing variables. The data were analyzed using frequency counts and percentages while gross margin was used to analyze the profitability.

The findings showed that the majority (98%) of the respondents were male, all (100%) of the respondents are married and were literate. The study further revealed that 76% of the respondents had less than 5 years of experience. And that there is inadequate link between the extension workers and the honey bee producers as only 6% were visited. The study further revealed that high cost of hive/lack of fund, absconding of bees, effects of weather, ants infestation and lack of flowering plants were the major problems encountered in the honey production. The regression analysis revealed that the level of education, years of experience, the visit of extension worker and number of flowing season in honey production are all positively related to profitability of honey production.

It was therefore recommended that government assists interested bee farmers with loan and provide the necessary inputs at subsidize rates.

INTRODUCTION.

Apiculture (beekeeping) is the domestication of honey bees, it involves the rearing and hunting of honeybees for the production of honey; and other products of high economic importance such as beewax, propolis, bee venom, royal jelly, bee bread and apilarnils and prop for purpose of utilization for man kind (White and Collins, 1980)

Honey production and harvesting do not require formal education or qualification before it cam be embarked upon; it could therefore be an enterprise that will have positive implication for reduction of unemployment and poverty alleviation in Nigeria given the low literacy level in the country.

Apiculture which is now modernized is not only unique, it yields huge economic returns which compares favorably with those of some mineral resources (Ibok-Hojan 1986). Wherever you may be at any time is not critical to apiculture business. The fact of the matter is that one, two or three million bees may be working slavishly for you all the time with a higher sense of industry, loyalty, love, solidarity and accuracy unknown to human beings. The management of beehives makes all the differences between primitive honey hunter and commercial honey production.

Beekeeping has been able to conserve most of the Nigeria forestry from been invaded by illegal fellers and helped in the area of agroforestry practices (simultaneously) to mention a few. The economic value of honey production can be justified on the basis of its profitability and materials needed for a start. The business is easy to set up because it requires little capital, (FAO 1986).In countries like Kenya, Uganda and Tanzania, both sexes of nearly 80years and primary school pupils keep bees. It is like setting traps for game, with visits at interval to crop their catches (Johansion1993). It is widely practice in Nigeria and other countries of the world as a result of the extensive and magnificent importance of honey in the areas of food and medicine. (Ojeleye, 1999).

Honey has been so useful to medical practitioners in treating stubborn ulceration (after surgical operation for breast cancer) and other related wounds. Also experience has shown that honey with sooth sore throats, provide major relief for coughs, calm nerves, help the digestion system, beautify the skin and general outlook, provide solution to sleeplessness, useful as an antiseptic; and effective as killer of germs and bacteria, honey is the best natural health food. (Ikediobi et al 2000).

Kale (1977) submitted that honey and beewax which are the main products are in great demand both in local markets of many third world countries and the international markets. Unfortunately, there is a shortage of these products amidst an ever increasing demand.

METHODOLOGY.

The study was carried out in Edo State, Nigeria. Edo State is bounded in the North by Kogi State, on the west by Ondo State, South by Delta State and east partly by Kogi and Anambra States. Major occupation of the people in the state is farming; there are common tree plants such as rubber, oil palm, kola, cocoa, mango, citrus guava e.t.c all scattered around the area which provide good flora for bees. Edo North Local Government Area (LGA) was sampled because of the intensity of honey production in the LGA.

The list of honey farmers was compiled and 50% of them were randomly sampled. Primary data were collected through the use of structural questionnaire and it elicited information on demographic and cost tracing variables such as age, educational status, years of experience, number of bee hives, cost of return e.t.c. The data were analyzed using descriptive statistics like frequency distribution and percentages. Gross margin analysis was used to measure performance. Multiple regression analysis was run to determine the factors that affect profitability of honey production in the state.

GM = TR-TVC
Where
GM = Gross margin
TR = Total Revenue
TVC = Total Variable Cost
The implicit specification of the regression equation run is
$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, e_i)$
$Y = f(x_{1,.....,} x_{7, e})$
Where
Y = Gross Margin
$x_{1=}$ Age
$x_{2=}$ family size
$x_{3=}$ Level of Education
$x_{4=}$ Years of Experience
$x_{5=}$ Extension of visit
$x_{6=}$ Number of Hiving season

Table 1 shows that from the study, the age ranged, in the majority (97%), from 40-50 years. This could mean that they are still in the active and energetic and prove to taking risk. With regards to gender, 98% of the respondents are males. This may be because of the nature of the vocation since the honey farmers are exposed to the risk of being stang by the bees. Also, it was revealed that all (100%) respondents had one form of the formal education or the other. This could mean that education had liberalized their mind hence their readiness to take risk.

The study further revealed that all (100%) of the respondents are married. This may imply that vocation can sustain or help to sustain or help. (est diversification option) the family by ensuring steady flow of income. It was also revealed that 84% of the respondents had a maximum of family size of 5. This may be so because the vocation is not a labour intensive venture wherever one is, millions of bees will keep on slaving on for the farmer. About 74%of the respondents are farmers hence they diversify with honey production to ensure optimum and continuous flow of income.

Table 2 revealed that 76% of the respondent had a maximum of five (5) years of experience in honey production. This may suggest that the people are just getting attracted to the venture because of its latest profitability potentials. With respect to the type of technology used, 60% used traditional methods. This will have implication on their scale of production and level of profit. The study further showed that majority 54% had 2-4 hives with a mean of 3 hives. This implies that they are small scale operators.

For optimum production there is the need to adopt innovations. This study revealed that only 6% had the opportunity of interacting with extension workers and the honey producers. In terms of output, the study revealed that 54% of the respondents produce 1-10 litres of honey. This quantity produced could be described as small, since the farm size is small. The quantity a farmer may realize depends on the number of hives.

Further, the study showed that 76% of the respondents produce honey for commercial purposes. This may be an indication that the vocation could yield enough returns to keep people in the business. Also 82% depends on personal savings as a source of funding for the venture. This could imply that they do not have access to formal credit and there is little that personal savings.

The major problem faced by the respondents is the high cost of hives (50%). This may have implications for their scale of production.

The profit analyses using the gross margin principles are as stated below

Total Variable Cost (TVC) = #52,000.00
Total revenue (TR) = #786,320.00
Gross Margin (GM) = TR- TVC
= #786,320.00 - #52,000.00
= #734,320.00
No of respondents (N) = 50
Gross Margin per annum per farmer =

$$\frac{\#734,320.00}{50} = \#14,686.40.$$

The result revealed that the Gross Margin realized make the enterprise a worthwhile venture. This could be because of the relative low variable cost of production since according to Awah (2002) 70% of bees feed are locally sourced and they are not required for human consumption.

Table 3 shows the summary of the regression results. The double log form provided the best fit where level of education (x_3) and the extension visit (x_5) were significant at the conventional level of 5%. All the parameter estimates of each of the variables carried positive sign except age (x_1) that carried negative sign. This conforms with a priori expectation and it indicate that family size, level of education, years of experience, extension visit and number of flow season per year positively affect the gross margin. All the explanatory variables together explained about 58% of the variations observed in gross margin.

SUMMARY AND CONCLUSION.

The finding of this study shows that all (100%) of the respondents were literate but only 6% had exposure to extension services. Further, it was revealed that honey production could be a viable enterprise with a gross margin of #14,686.40 per farmer per annum. The regression result shows that the double log form is the best fit model with R^2 value of 0.526 signifying that 52.6% of total variation in gross margin were due mainly to the level of education (x_3) and extension visit (x_5). Therefore policy measures should be put in place to enhance and sustain the educational status of honey farmers; and intensify extension activities especially with respect to the vocation.

REFERENCES

Awah A.A. (2002): Beekeeping and Honey production as attractive small scale Agricultural Enterprises. Delivered at the workshop on appropriate technology for small scale farmers in Niger Delta Region. Benin city, Nigeria Dept 4-6

FAO (1986) : *Tropical and sub- tropical apiculture.* FAO Press Pp 101-168

Ibok Hogan B(1986) : *Beekeeping Digest selected literature on beekeeping.* Library Services limited. University of Lagos. Akoka lagos. Nigeria Pp 35-47, and Pp 67-70

Ikediobi C.C, Obi V.C and Achoba I.A (2000): Bee keeping and honey production in Nigeria. *Nigeria field: 50-70.*

Johansion S.K (1993) : Bee keeping in rural community. *Journal of Appropriate Bee Keeping* 4p

Kale V.E. (1777): World prospects for honey production. *FAO World Annual Review.*

Ojeyele B. (1999); *Foundation of Beekeeping in the Tropics* CEDAR press. Pp 110-213

White Y.P and Collins A.M (1980): Honey production and underling nectar harvesting activities of Africanized and European Honey bees. *Journal of Apicultural Research* 23: 70-79.

Table 1: Socio economic characteristics of the respondents (n=50).

Variables	Frequency	Percent
Age (Yrs)		
40-44	22	44.0
45-49	25	50.0
50 and Above	3	6.0
Gender		
Male	49	98.0
Female	1	2.0
Level of Education		
No formal education	-	-
Primary Education	30	60.0
Secondary Education	16	32.0
Tertiary Education	4	8.0
Marital Status		
Married	50	100.0
Household Size		
1-5	42	84.0
6-10	8	16.0
Primary Occupation		
Farming	37	74.0
Public Service	12	24.0
Honey Production	1	2.0

Table 2: Production activities of respondents

Variable	Frequency	Percent
Years of experience		
1-5	38	76.0
6-9	11	22.0
10-14	1	2.0
Type of technology		
Traditional	30	60.0
Modern	20	40.0
Farm Size(no of hives)		
1-4	27	54.0
5-8	19	38.0
9-15	4	8.0
Extension Worker Visit		
Number Visited	3	6.0
Number not visited	47	94.0
Quantity of honey harvested		
1-10	27	54.0
11-20	5	10.0
21-30	12	24.0
31-40	6	12.0
Production Purpose		
Consumption	11	22.0
Commercial	38	76.0
Hobby	1	2.0

Table 3: Summary of the regression results.

Functional form.	β_0	B_1	B_2	β_3	β_4	β_5	β_6	R^2	$\overline{R}^2$	F
Linear.	-4.613 (1.883)	-0.04836 (0.219)	0.678* (0.405)	1.402* (0.209)	0.08992 (0.292)	1.411 (0.586)	0.466 (0.301)	50.5	43.6	7.303
Semi log.	-2.004 (0.953)	-0.04328 (0.111)	0.336* (0.205)	0.533* (0.106)	0.03435 (0.148)	0.683* (0.222)	0.222 (0.153)	50.0	43.0	7.163
Double log.	-1.194 (1.370)	-0.211 (0.725)	0.425 (0.291)	1.502* (0.278)	0.115 (0.221)	0.955* (0.417)	0.297 (0.214)	52.6	46.0	7.965

AFRICAN SWINE FEVER CONTROL IN IBADAN, NIGERIA: PROBLEMS, NEEDS AND VETERINARY EXTENSION OPPORTUNITIES

Babasola O. Olugasa
Department of Veterinary Public Health and Preventive Medicine, University of Ibadan. Nigeria

ABSTRACT

African swine fever (ASF) is a widely discussed disease in Ibadan, Nigeria, where high mortality losses occurred in outbreaks in the city between 2001-2006. To study the level to which ASF containment technologies were adopted and factors associated with adoption behavior, a sample of 60 pig farmers was selected from six local government areas in and near Ibadan. Essential data were collected using a questionnaire. Assessment criteria in forms of frequency, percentage, mean and product moment correlation coefficient were calculated. Results showed that the majority of pig farmers did not adopt ASF biocontainment technologies, since 86.7% (52/60) were at a low level of adoption behavior, 10% (6/60) at a medium level, and 3.3% (2/60) at a high level. A farmer's income from piggery, knowledge of biocontainment technologies, and frequency of extension contact had positive and highly significant relationships ($r \geq 0.787$) on levels of adoption. Specific needs and emerging opportunities for farmer participatory learning were indicated. It was recommended that Pig Farmers Association should constitute Farmer Field Schools, where the State Ministry of Agriculture and Natural Resources (MANR) would be involved in production of ASF virus-free pigs, and the current services by University-based officers to the early detection of pigs infected with the ASF virus will be optimized.

Keywords: African swine fever, control, extension opportunities, Ibadan Nigeria.

INTRODUCTION

Pig production is a source of employment and livelihood in Nigerian agriculture (Olufemi and Agbede, 1999). During the past decade (1997-2007) pig rearing that had been one of the livestock industries growing most quickly in southwest Nigeria (Dixie and Jaeger, 2001) became one at a high risk of losses from African swine fever (ASF), an infectious disease recently introduced into Nigeria (El-Hicheri, 1998; Babalobi *et al*, 2003; Babalobi *et al*, 2007; Olugasa and Ijagbone, 2007). In East and South African countries ASF is one of the most serious obstacles to the development of pig production (Plowright *et al*, 1994). West Africa has recently had the same experience as Southern Africa (Ayoade and Adeyemi, 2003).

ASF is a severe viral disease of pigs that can result in a mortality rate of nearly 100% and can have devastating effects on a country's economy, agriculture and food security (Vapnek, 1999). It is a transboundary disease, being highly contagious and has the potential for very rapid spread causing serious socioeconomic and possibly public health consequences (EMPRESS, 2007:). There is as yet no vaccine against ASF. Hence, a slaughter policy with adequate compensation, and the strict quarantine of pigs and their products at borders and on farms are necessary to stop the current outbreaks of ASF in southwest Nigeria (El-Hicheri, 1998).

The first outbreak of ASF was reported in Ibadan in June 2001 (Babalobi *et al*, 2003). The disease continued to spread from farm to farm through contact with infected and carrier pigs during stock trade, breeding activities and farm visits (Olugasa and Ijagbone, 2007). The cost of mortality losses in Ibadan and environs owing to ASF outbreaks in 2001 alone were estimated to be US$ 941,491.67 (Babalobi *et al*, 2007). This severe and devastating disease of domestic pigs requires a firm control and eradication programme to ensure profitable agriculture.

All available strategies to prevent the escape of a disease agent currently on a farm or in an operation are collectively termed biocontainment practices. Biocontainment technologies include providing a facility to isolate pigs on farms, testing for ASF infection, removing infected pigs, disposing of dead pigs, disinfecting premises, and other indirect containment techniques, such as ensuring the hygiene of feed delivery vehicles. Biocontainment practices are emphasized in infectious diseases that are enzootic in a population of animals, such as ASF is in Ibadan (Esuruoso *et al*, 2005). This author therefore embarked on a multidisciplinary research project to implement early detection, tracking and technology transfer for the biocontainment of ASF-infected pigs in Ibadan, southwest Nigeria, in 2007. The objective of the research

and education project was to develop and disseminate to pig farmers effective and acceptable biocontainment technologies for ASF control in collaboration with Oyo State Agriculture Development Project (ADP) in Ibadan, southwest Nigeria. (MacArthur Re-entry Grant Ref No: 800/406/54/2006/ REG/1 and Multidisciplinary Grant Ref. No: 800/406/54/2006/MRG/3).

The establishment in the 1990s of ADPs in all states of the Federation reformed extension services in Nigeria through the use of Training and Visit System (T and V) (Ogunsumi, 2008). This was in response to the meeting of the National Council on Agriculture held at Maiduguri in 1990. The use of the T and V approach in reaching farmers recognized the small-scale farmers as the focus to realizing the desired development in agriculture (Idachaba, 1980). The process of technology development, transfer and use is dynamic (Eponou, 1993; Esuruoso and Olugasa, 1997a and 1997b). Thus, biocontainment technology development and transfer to pig farmers must consider the needs, problems and behavior of pig farmers to ensure sustainable implementation. T and V however does not have the same proven farm-level disease control empowerment as Farmer Field School (FFS). FFS was first designed and managed by the UN Food and Agriculture Organization in Indonesia in 1989 to actualize acquisition and diffusion of knowledge among crop farmers to control an endemic crop pest (Feder *et al.*, 2004; Berg H van den and Knols, 2006). Since then more than two million farmers across Asia have participated in this type of learning. This paper presents an analysis and evaluation of the factors that influence the adoption of ASF biocontainment technologies among pig farmers in Ibadan, Nigeria.

MATERIALS AND METHODS

The study area was the city of Ibadan and its environs in Oyo State (Latitude 7^{o} 23^{1} and Longitude 3^{o} 56^{1}), where outbreaks of ASF had been reported by members of the Pig Farmers Association of Nigeria (601 registered members in Ibadan) and the Ministry of Agriculture and Natural Resources (MANR). Ten percent (60) were selected. In the first stage, six local government areas (LGAs) were selected out of 12 in Ibadan. The second stage was a random selection of ten farmers in each of the six LGAs selected. The sample size of 60 respondents was obtained, comprising both farmers having contact with the ADP in Ibadan and those without extension contact. Questionnaire was developed to obtain relevant information covering all aspects of the objective of the study.

Primary and secondary data were employed. Secondary data were obtained from the literature, project reports, official documents, publications, and personal consultations. Primary data were collected through the use of a validated questionnaire consisting of both open and closed-ended questions to obtain information from the target respondents. Three trained enumerators who have the knowledge of the dialect of the farmers were used to assist in the collection of the information required.

The survey instrument was divided into four parts;

A: Socio-personal characteristics

B: Income from piggery, ASF mortality losses and state compensation

C: Sources of information on biocontainment practices and extension activities

D: Biocontainment technologies adopted

The instrument for data collection was subjected to preliminary testing at the University of Ibadan Teaching and Research Farm, Ibadan, among farmers that were not included in the sample. Validity and reliability tests were carried out on the pre-test evaluation group. Validity tests were as follows:

(i) Face validity: To determine the extent to which the instrument measured what it was designed to measure, according to the subjective assessment of experts and researchers in veterinary extension, rural development, agricultural economics, and rural sociology in the University of Ibadan.

(ii) Content validity: This was to measure the adequacy of the contents and rating scales. The reliability test was employed on six respondents with two different methods of test and re-test, in which the questionnaire was administered to the same respondents (in the pre-test) on two occasions at a 4-week interval. The collected scores were subjected to Pearson Product Moment Correlation test statistics. The second method was the split-half method that gave the measures of the internal consistency of the instrument. The administered questionnaire had its items divided into two on an odd and even number basis. The data collection instrument was modified where necessary.

The study was carried out with seven independent characteristics of the pig farmers, (socio-personal, income from piggery and ASF mortality losses, biocontainment communication) and one dependent variable (y = Adoption of biocontainment technologies in

piggery practices). The following independent variables were selected for the study: age, sex, educational level completed, occupation, mortality losses, state compensation, and extension contact.

The dependent variable of the study was the adoption of biocontainment technologies. To ascertain the extent of adoption of biocontainment technologies, the responses of respondents, were collected on five selected practices; isolation facility, testing for ASF, removal of ASF-infected pigs, disinfection and disposal of dead pigs, indirect ASF containment facility. The score was assigned for the adoption of each of the practices in the following way:

Adoption pattern	Score
Non-adoption	0
Partial adoption	1
Complete adoption	2

The total score for a respondent was obtained by summing up the score obtained on all practice. The minimum possible score was 0 and the maximum was 52. The adoption level of the respondents was measured by making use of the adoption index earlier used by Rahman, (2007).

$$\text{Adoption index} = \frac{\text{Respondent's total score}}{\text{Maximum possible score}} \times 100$$

Depending upon the extent of adoption of biocontainment practices, the respondents were categorized as follows:

1. Low adopters (up to 33%)
2. Partial adopters (34 – 66%)
3. High adopters (67 – 100%)

RESULTS AND DISCUSSION

The majority of the respondents were within the ages of 31 and 50 years (58.33%) (Table 1). These pig farmers usually had between 1 and 5 years of experience and had other jobs apart from pig production. Their other jobs included artisanship, civil service, and trading. All the high-level adopters were full-time pig farmers aged between 41 and 60 years. The majority of the low adopters were part-time pig farmers aged between 31 and 50 years (59.62%). The majority of respondents were male farmers (73.1%). Female pig farmers were less than half the number of male farmers (Table 1). Among the respondents, 78.8% (47/60) of the farmers had experienced ASF outbreaks on their farms at least once in the past 6 years. None of the farmers (0/60) had ever received State financial assistance in the form of compensation for mortality losses from ASF outbreaks between 2001 and 2006. This result agrees with an earlier report (Ogunsumi, 2008) that indicated the majority of livestock farmers in contact with ADP extension officers in the State were male.

This result also indicates that the greater the financial and socio-economic dependence on piggery, the higher the behavioral disposition to adopt biocontainment technologies. The majority of low-level adopters reckoned that ASF-recovered pigs were more resistant to the disease, and more suitable for production purpose than ASF-naïve pigs. Hence, they had no reasons to adopt biocontainment technologies that has cost implications and imposed some strictness on pig farmers and their workers (Babalobi *et al*., 2007).

Two major problems emanated from this position. First was the immediate scarcity of ASFV-free pigs in Ibadan. The second was the long-term adverse effect on pig production that encouraged further spread of the virus, thus causing more outbreaks and losses (El-Hicheri, 1998). There is need to educate pig farmers on the already compromised health status of pigs surviving ASF and that those pigs were not really immuned. This situation confirms earlier findings by this author on the high prevalence of ASF virus (ASFV) antibodies among pigs in Ibadan (Olugasa, 2007; Olugasa and Ijagbone, 2007). Continued presence of the virus in pigs will only lead to greater economic losses (Babalobi *et al*, 2007).

Pig Farmers' Association of Nigeria (PFAN) (93.3%) and friends/neighbors (83.3%) were the most important sources of biocontainment information to pig farmers in Ibadan (Table 2). These sources provided weekly information (friends/neighbors, 73.3%) and monthly information (Pig Farmers, Association, 86.7%) to the respondents. Members of the PFAN met once a month during which they discussed relevant issues for improving their practices. Invited resource persons also informed and trained farmers on new topics.

ADP officers did not visit many of the respondents (36.7%) in 2007 (Table 3). This appeared to be in conformity with current policy of the agency to visit the sub-urban (outskirt) farmers more often than urban (city) farmers. (Personal Communication). This also agrees with Ogunsunmi (2008) that farm visits by ADP officers were on the decline.

As a result of the disposition of pig farmers, the overall adoption behavior was low. Majority of the respondents 86.7% (52/60) were at low level of adoption behavior. Only 10% (6/60) of the respondents showed partial adoption

behavior, and a minority of 3.3% (2/60) showed high level of adoption behavior (Table 4). All the biocontainment practices had cost implications to the pig producers (Babalobi et al, 2007).

Table 1: Distribution of respondents according to age, sex and farming experience

Variable	N = 52 Low adopter		N = 6 Partial adopter		N = 2 High adopter		N = 60 All respondents	
	Freq	%	Freq	%	Freq	%	Freq	%
Age group								
21-30	8	15.4	2	33.3	0	0	10	16.7
31-40	18	34.6	2	33.3	0	0	20	33.3
41-50	13	25.0	1	16.7	1	50	15	25.0
51-60	10	19.2	1	16.7	1	50	12	20.0
61-70	3	5.8	0	0	0	0	3	5.0
Sex								
Female	14	26.9	1	16.7	0	0	15	25
Male	38	73.1	5	83.3	2	100	45	75
Farming experience (year								
1 ≤ 5	37	71.2	2	33.3	1	50	40	66.7
> 05 ≤ 10	15	28.8	2	33.3	0	0	17	28.3
> 10 ≤ 15	0	0	2	33.3	1	50	3	5.0
ASF outbreaks in 2001-2006	41	78.8	4	66.7	2	100	47	78.3

Table 2: Sources of information on ASF biocontainment among respondents

Source of information	Not usually informative		Weekly information		Monthly information		Yearly information	
	Freq	%	Freq	%	Freq	%	Freq	%
Contact farmers	14	23.3	33	55	7	11.7	6	10
Extension agents	31	51.7	0	0	6	10	23	38.3
Friends/neighbors	10	16.7	44	73.3	6	10	0	0
Pig Farmers' Association (PFAN meetings	4	6.7	0	0	52	86.7	4	6.6
Newspapers/magazines	51	85	0	0	1	1.7	8	13.3
Radio	17	28.3	0	0	8	13.3	35	58.3
Television/video	45	75	0	0	0	0	15	25
Research institutes/ Universities	21	35	0	0	8	13.3	31	51.7

Table 3: Frequency of extension visit to farmers within 2007

Frequency of visit within 1 year	N = 52 Low adopter		N = 6 Partial adopter		N = 2 High adopter		N = 60 All responden	
	Freq	%	Freq	%	Freq	%	Freq	%
No visit	22	42.3	0	0.0	0	0	22	36.7
1-4 times	16	30.8	2	33.3	0	0	18	30.0
5-8 times	0	0.0	2	33.3	0	0	2	3.3
9-12 times	12	23.1	0	0.0	1	50	13	21.7
> 12 times	2	3.8	2	33.3	1	50	5	8.3

Table 4: Overall adoption of biocontainment technologies by respondents

S. No.	Level of adoption	Score index	Frequency (N=60)	Percentage (%)
1	Low adopter	Up to 33%	52	86.7
2	Partial adopter	34-66%	6	10
3	High adopter	67-100%	2	3.3

The most adopted practice was disposal of dead pigs and disinfection of premises. The range was from 3.3% at high, and 75% at partial levels (disposal of dead pigs and disinfection of premises) (Table 5); 1.7% at high, and 23.3% at partial levels (indirect spread containment facilities); 5% at high, and 16.7% at partial levels (removal of infected pigs); and, 5% at high, and 10% at partial levels (isolation facility); to 0% at high, and 5% at partial levels (testing for ASF, that was the least adopted practice).

The unit cost for testing of pigs prior to purchase was N533:00 (about $44.44) in 2001 (Babalobi *et al*, 2007). This amount was a relatively high cost in view of the number of animals to be tested. This cost may be a major reason for low adoption of this practice. Likewise, setting up an isolation facility required an initial investment that was spread over time with relatively little operating cost (Babalobi, *et al*, 2007); which explains why this practice was last but one on the scale of low adopted practices. Others, including the disinfection of premises, disposal of dead pigs, ensuring hygiene of farm workers, and feed delivery vehicles, and other indirect spread containment facilities were operating expenses incurred on ongoing basis. They had minimal initial investment requirements (Babalobi *et al,* 2007).

The job experience and age were not significantly related to adoption behavior of a pig farmer (r = 0.299 and -0.095 respectively) (Table 6). However, a farmer's income from piggery, the frequency of extension contact and the knowledge of biocontainment technologies were positively and significantly related to adoption level (Table 6). It is imperative to build strategies for promoting veterinary extension on this basis.

In earlier studies by this author and his colleagues, the cost of the basic inputs for biocontainment of ASF among 306 affected farms in Ibadan in 2001 was N99,302,392:00 (about US $827685.77) (Babalobi *et al*, 2007). This scenario gave a cost-benefit ratio of 1:1.5 (N99,302,392 : N113,939,000). The scenario however became 1:1 (N100,192,392 : N113,939,000), when other important biocontainment costs were added, including fencing of farm premises. Thus, the average cost of biocontainment/biosecurity per farm was N372,349:67 (or $3076.77). This was of great financial and socioeconomic consequences for a developing country like Nigeria with a low Gross Domestic Product figure (Babalobi *et al*, 2007).

Table 5: Distribution of respondents according to biocontainment technology adoption

S. No.	Level of adoption	Score index	Frequency (N=60)	Percentage (%)
A	*Isolation facility*			
	1 Low adopter	Up to 33%	51	85
	2 Partial adopter	34-66%	6	10
	3 High adopter	67-100%	3	5
B	*Testing for ASF*			
	1 Low adopter	Up to 33%	57	95
	2 Partial adopter	34-66%	3	5
	3 High adopter	67-100%	0	0
C	*Removal of infected pigs*			
	1 Low adopter	Up to 33%	47	78.3
	2 Partial adopter	34-66%	10	16.7
	3 High adopter	67-100%	3	5
D	*Disinfection of premises & disposal of dead pigs*			
	1 Low adopter	Up to 33%	13	21.7
	2 Partial adopter	34-66%	45	75
	3 High adopter	67-100%	2	3.3
E	*Indirect spread containment facility*			
	1 Low adopter	Up to 33%	45	75
	2 Partial adopter	34-66%	14	23.3
	3 High adopter	67-100%	1	1.7

Table 6: Relationship of ASF biocontainment adoption to independent variables

S. No.	Independent variables	Coefficient of correlation (r)
1	Age (X_1)	-0.095
2	Extension contact (X_3)	0.787
3	Farming experience (X_4)	0.299
4	Knowledge (X_6)	0.932
5	Income from piggery (X_7)	0.868

CONCLUSION AND RECOMMENDATIONS

Formal veterinary research has generated a vast amount of knowledge and fundamental insights into pattern of spread of ASF and ways to enhance its control (El-Hicheri, 1998; Olugasa and Ijagbone, 2007), but, their adoption by smallholder farmers, especially in Ibadan, has remained below expectations. It may be concluded that the traditional method of extending biocontainment technology to farmers is not sufficiently adequate at the moment in Ibadan in the case of African swine fever. Thus, a new approach is needed in which pig farmers are actively involved in the acquisition of biocontainment skills, geared to the specific physical, economic and social circumstances of these farmers.

First, it is recommended that the Pig Farmers Association in Ibadan should constitute FFS, where farmers through understanding, observation, experimentation and evaluation are equipped to address challenges and make appropriate changes in their farm management practices. (Feder *et al.*, 2004). This approach was used to promote malaria control among crop farmers (Berg and Knols, 2006). This is the approach necessary for ASF control in Ibadan. FFS is a form of education that uses experiential learning methods to build farmers' expertise, and has proven farm-level disease control effectiveness.

Along with the FFS approach, it is recommended that the Oyo State MANR should implement the production of ASFV-free pigs, selling them at subsidized prices to the Pig Farmers Association running FFSs. The present service by University-based officers to early detection of pigs infected with the ASF virus should be made to serve the MANR pig project and the FFSs to attain both optimal results and sustainable control of ASF.

The present non-adoption of ASF biocontainment technologies by pig farmers has indicated the need for a new dimension to veterinary extension opportunities. Pig Farmers Association may fill this gap by running FFSs effectively and efficiently. The approach is practical and compliments State ADP-based extension services which is Government coordinated and has its own limitations in getting farmers to adopt ASF biocontainment.

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REFERENCES

Ayoade G.O. and Adeyemi I.G. 2003: African swine fever: an overview. *Rev Élev Med Vét Pays Trop*, **56** (3-4), 129-134.

Babalobi O.O., Ayoade G.O., Olugasa B.O., Oluwayelu D.O. and Oyedele O. 2003: Differential diagnosis of a swine epizootic of unknown aetiology in Ibadan, Oyo State, Nigeria. *Isr J Vet Med*, **58** (2/3), 86-89.

Babalobi, O.O., B.O Olugasa, D.O Oluwayelu, I.F Ijagbone, G.O Ayoade, and S.A Agbede 2007: Analysis and evaluation of mortality losses of the 2001 African swine fever outbreak, Ibadan, Nigeria. *Trop Anim Health Prod* **39**: 533–542

Berg H van den and Knols, B.G. 2006: The Farmer Field School: a method for enhancing the role of rural communities in malaria control? *Malaria Journal*, 5:3. 1-6

Dixie, G. and Jaeger, P. 2001: Global Market Assessment: RAISE Agricultural Development Assistance in Nigeria. Task Order 812, United States Agency for International Development/Nigeria Contract No. PCE-I-00-99-00003-00. 55pp

Eponou, T. 1993: Partnership in agricultural technology generation: Linking research and technology transfer to serve farmers". Research Report No. 1 ISNAR. The Hague pp. 25-35

El-Hicheri K. 1998: Emergency Assistance on Control and Eradication of an outbreak of African swine fever in Western Nigeria. Report of the FAO Consultancy Mission to Nigeria: Technical Cooperation Programme

TCP/NIR/7822 (E), Food and Agriculture Organization of the United Nations, Rome, December 1998.

EMPRES 2007: (Emergency Prevention System for Transboundary Animal Pests and Diseases). http://www.fao.org/EMPRES/default.htm

Esuruoso, G.O., Ijagbone, I.F. and Olugasa, B.O. 2005: Introductory Epizootiology, 2nd Edition. 322pp. Published by VetAcademic Resource Foundation, U.I.P.O. Box 14400, Ibadan, Nigeria.

Esuruoso, G.O. and Olugasa, B.O. (1997a) Social responsibilities of professionals in Nigeria. *VARF Quarterly Bulletin Vol. 1: 1-25*.

Esuruoso, G.O. and Olugasa, B.O. (1997b) Actualization of strategies for privatized preventive veterinary services to nomadic herdsmen in southern Nigeria. *Epidemiologie et Sante Animale 31. 2.22.1-3*

Feder, G., Murgai, R. and Quizon, J.B. 2004: The acquisition and diffusion of knowledge: the case of pest management training in farmer field schools, Indonesia. *Journal of Agricultural Economics 55 (2): 221-243*

Idachaba, F.S. 1980: Concept and strategies of integrated rural development: Lessons from Nigeria. Food Policy Technical Research Paper No. 1, Department of Agricultural Economics, University of Ibadan, pp. 23-24.

Ogunsumi, L.O. 2008: Analysis of extension activities on farmers' productivity in southwest, Nigeria. *African J. Agricultural Research Vol*. **3** (6), 469-476

Olufemi, B.E. and Agbede, S.A. 1999: Opportunities for pig practice, production and related business packages. *In*: Gateway to Effective Management of Modern Veterinary Services and Privatization of Veterinary Functions in Nigeria. Esuruoso, G.O. Ed. VetAcademic Resource Publishers and Consultants, Ibadan, 45-61

Olugasa, B.O. 2007: Serological evidence of African swine fever infection in commercial pig herds in south-west Nigeria. *Afric. J. Liv. Ext. 5: 61-66*

Olugasa, B.O and Ijagbone I. F. 2007: Pattern of spread of African swine fever in southwestern Nigeria, 1997– 2005 *Veterinaria Italiana* **43** *(3)* 621-628

Plowright W., Thomson G.R., Neser J.A., 1994: African swine fever. In: Coetzer J., Thomson G., Tustin R. Eds, *Infectious diseases of livestock*. Oxford, UK, Oxford University Press, 568-599.

Rahman, S. 2007: Adoption of improved technologies by the pig farmers of Aizawl district of Mizoram, India. *Livestock Research for Rural Development. Volume 19, Article #5.* Retrieved from http://www.cipav.org.co/lrrd/lrrd19/1/rahm19005.htm

Vapnek J. 1999: Institutional and legal measures to combat African swine fever. *FAO Legal Papers Online* #3, May 1999).

USE OF AQUACULTURE TECHNOLOGIES IN OSUN STATE, NIGERIA

Fregene Tosan and Tejiri Digun-Aweto
Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan

ABSTRACT

Aquaculture has been identified as a major means of meeting the domestic fish demand in Nigeria, though predominately practised at subsistence level through extensive culture system. The Training and Visit (T&V) extension system of Agricultural Development Program (ADP) in various states has ensured that improved production technology reach a larger proportion of the fish farmers for increased aquaculture production. The study was therefore aimed to investigate types of improved aquaculture technology used by the fish farmers in Osun State. A structured questionnaire was used to collect data from 50 fish farmers randomly selected from the three Agricultural Development Programme (ADP) zones in the state for the study. The data were analyzed using descriptive statistics and chi-square. Results show that 56% of fish farmers use less than 8 aquaculture technologies introduced by extension agents. These include earthen ponds for rearing fish (66%), culture of *Clarias lazera* (84%), stocking of 4-5 fingerlings per m^3 (54%), the use of compounded feed (82%), NPK as inorganic fertilizer (58%), lime as neutralizer (72%) and drag net for cropping production ponds (78%). The training and visit approach was the main method used by extension agents for the dissemination of information. The test of hypothesis result revealed that usage of aquaculture technology is influenced by sources of credit and type of labour ($p<0.01$), frequency of cropping operations in a year ($p<0.05$), while level of education and age of farm were significant at $p<0.1$. Major constrains of fish farmers are lack of credit and reliable sources of fingerling (48%). It was recommended that fish farmers should be linked to reliable sources of credit and private producers encouraged to produce quality fingerlings and fishing feed. Extension agents should be provided with motorcycles to enable them visit fish farmers more frequently with aquaculture technologies, thereby increase production of cultured fish.

Keywords: Aquaculture, technologies, Osun State, fish farmers

INTRODUCTION

The Nigerian fisheries data in 2007 reveal that demand for fish at 2.66 million metric tons (m mt) exceeds the domestic supply of 0.62m mt which has resulted in 0.74m mt fish importation to meet the short fall (FDF, 2008). An increase in the domestic fish production through aquaculture has been identified as a means of conserving the foreign exchange used in importing fish. During the NEPAD Fish for All Summit, African leaders were informed that 30 percent of global fish supplies come from aquaculture, but African aquaculture production amounts to less than 0.2% of the world's total (ENS, 2005). In Nigeria aquaculture fish production was 16.87% of the total domestic fish production for 2007 (FDF, 2008). This is because her aquaculture is predominantly an extensive land-based system practised at subsistence levels in freshwater (Fagbenro, 2005).

Benefits of aquaculture were publicized more in Nigeria with the advent of the now defunct Directorate of Food, Roads and Rural Infrastructure in 1986. Prospects for fisheries extension development became brighter with the advent of nationwide Training and Visit (T&V) extension system of Agricultural Development Program (ADP) in various states. The T&V system of extension services adopted by the ADP in the country has established a linkage between research and extension in the agricultural sector to ensure that improved production technology reach a larger proportion of the fish farmers for increased aquaculture production to meet the national fish demand (Bolorunduro and Fregene, 2000). Example of these aquaculture technologies include stocking of improved fish species; increased stocking density, poly-culture, integrated fish farming and feed formulation among others.

In Osun State, there has been a growing interest in fish farming in the last ten years and a large number of private individuals embarking on intensive fish farming with emphasis on production of *Clarias species* (Osun state Government, 2006). Though there are some measures of aquaculture practices in the State but the output has not yielded encouraging results due to the method used. It is on this basis that the study aims to identify types of improved technology used by fish farmers and to identify the factors influencing their usage. It was hypothesized in this study that there is no

significant relationship between demographic and economic variables with usage of aquaculture technology.

METHODOLOGY

The study area, Osun State is located in the South-Western part of Nigeria and covers an area of approximately 14,875 square kilometers. It lies between longitude 04° 00'E and latitude 05° 56'; bounded by Ogun, Kwara, Oyo and Ondo States in the South, North, West and East respectively (Osun Sate Government, 2006). Osun State is a landlocked state with many perennial rivers, riverlets, streams, springs sources and wetlands that are suitable for fish farming.

Simple random sampling was used to sample 50 fish farmers in the three ADP zones (Ife/Ijesa, Iwo and Osogbo), 12 Local Government Areas and 18 communities. The respondents were interviewed using an interview schedule. The data was analyzed using descriptive statistics and chi-square.

RESULTS AND DISCUSSION

Personal Characteristics of Fish Farmers

Data presented in Table 1 reveal that the level of involvement of men (94%) in fish farming is very much higher than that of women (6%). This could because women are mostly involved in processing and marketing of fish although some of them also culture fish. Majority of the fish farmers were between the ages of 30-50 years (72.0%), are married (94%), have household sizes ranging between 5 and 10 members (60%) and 60% have attained university degree.

Table 1: Respondents' Characteristics

Household Characteristics	Freq.	Percent
Sex: Male	47	94
Female	3	6.0
Age: <30	3	6.0
30-50	36	72.0
>50	11	22.0
Marital Status: Married	47	94.0
Single	3	6.0
Number of Children		
None	3	6
<3	5	10
3-5	35	70
>5	7	14
Household Size		
1-5	20	40
5-10	30	60
Level of education		
None	3	6
Primary	1	2
Secondary	12	24
Post Secondary	4	8
University	30	60

Economic Characteristics of Fish Farmers

Most of the fish farms visited were owned (88%) by fish farmers (Table 2) and have existed for more than five years (40%). The main source of their startup capital was through co-operatives (38%) and 34% from personal savings. Farm pond density or number of ponds per farm was less than 5 (70%) due to their involvement in other income generating sources. The fish farmers are of the view that fewer numbers of ponds are easier to handle because they are not full time fish farmers. Hired labour (52%) is used mostly on part time bases except for a few who have the labourers doing alternative chores apart from fishery purposes. Their ponds are cropped (harvested) once a year (64%) and twice a year (34%). Annual income earned is between ₦ 10, 000- ₦ 50, 000 (30%), while 26% earn more than ₦200, 000.

Table2: Economic characteristics of fish farmers

Characteristics of fish farmers	Freq.	Percent
Ownership of fish farm		
Yes	44	88
No	6	12
Years of Farm Establishment		
<5	17	34
3-5	12	24
>5	20	40
Not Known	1	2
Years of experience in Fish Farming		
<5	21	42
≥5	29	58
Source of Capital		
Bank loan	4	8
Cooperative society	19	38
Contribution from family	10	20
Personal savings	17	34
No. of ponds on farm		
<5	35	70
5-9	11	22
10-14	4	8
Cropping frequency		
Once a year	32	64
Twice a year	17	34
Not Applicable	1	2
Source of labor		
Family	24	48
Hired	26	52
Annual Income Earned		
₦ 10,000 - ₦ 50,000	15	30
₦ 50,001 - ₦ 100,000	11	22
₦ 100,001 - ₦ 200,000	11	22
> ₦ 200,000	13	26

Aquaculture technologies used by fish farmers

Table 3 shows that earthen ponds (66%) and concrete tanks (30%) are used for the culture of *Clarias lazera* (84%) at a stocking

density of 4-5 per m³ (54%). This could be because the fish species is hardy, not prone to diseases and can survive well with the prevailing climatic conditions in Nigeria (Omitoyin, 2007). The semi-intensive culture system is practiced. Fish feed used are agro industrial waste (brewery waste, 28%), compounded feed (82%) and 12% use farm residues from their farms. Fertilizers used include poultry waste (24%), animal dung (18%), and inorganic-NPK (58%). Lime is the main neutralizer used by 72% of the fish farmers. Among the several options for integrated fish farming, 24% practice fish/poultry integration. Dragnet is used for harvesting fish (78%); others use pumping (4%), pumping and handpicking (14%) and handpicking alone (6%). In terms of total aquaculture technologies used by fish farmers, 56% use less than 8, while maximum number used by a fish farmer is 18.

TABLE 3: technologies used by fish farmers

Aquaculture Practices	Used	Not Used
Fish Enclosure		
Earthen pond	33 (66%)	17 (34%)
Concrete tank	15 (30%)	35 (75%)
Fish Tank	7 (14%)	43 (86%)
Type of fish cultured		
Clarias lazera (Catfish)	42 (88%)	8 (16%)
Oreochromis niloticus (Tilapia)	8 (16%)	42 (88%)
Stocking Density		
3 per m^3	11 (22)	39 (78%)
4-5 per m^3	27 (54)	23 (46%)
More than 5 per m^3	12 (24)	38 (76%)
Fish feed		
Agro industrial waste	14 (28%)	36 (72%)
Compounded feed	41 (81%)	9 (18%)
Farm residue	6 (12%)	44 (88%)
Fertilizer		
Poultry Waste	12 (24%)	43 (76%)
Animal dung	9 (18%)	41 (82%)
NPK	29 (58%)	21 (42%)
Neutralizer		
Lime	36 (72%)	14 (28%)
Wood ash	2 (4%)	48 (96%)
Carbon waste	3 (6%)	47 (92%)
Type of Integration		
Fish/crop	9 (18%)	41 (82%)
Fish/poultry	12 (24%)	38 (76%)
Fish/pig	9 (18%)	41 (82%)
Fish/duck	4 (8%)	46 (92%)
Method of Harvesting		
Dragnet	39 (72%)	11 (22%)
Pumping	2 (4%)	48 (96%)
Pumping/dragging	5 (10%)	45 (90%)
Hand picking	3 (6%)	47 (94%)
Total Practices Used		
<8 Low	28 (56%)	22 (44%)
≥8 High	22 (44%)	28 (56%)

Constraints of Fish Farmers

Major problems confronting fish farmers are lack of capital and reliable sources of fingerlings (48%) and 20% experience inadequate water (Table 4). Though some existing fish farms produce their own feeds, others have difficulty in getting quality feed. Feed quality and availability remain critical issues for fish farmers targeting higher yields. When combined with the problem of fingerling supply, it leads to poor yield.

According to Fagbenro (2005), bank officials consider aquaculture a high-risk venture, thereby discourage loan processing. In the rural areas, because of bureaucratic procedures, delays and strict terms, these financial institutions are not trusted. Formal sources of credit like banks and cooperatives lending at regulated interest rates normally require some collateral, which fish farmers may not have.

Extension Agent Contact with Fish Farmers and Dissemination Methods Used

Table 5 show that 54% of fish farmers have known extension agents for a period of 2-5 years through extension visit (52%) and radio (30%). Adekunle *et al* (2002) reported that radio and television services regularly disseminate information on fish production practices including fish farming. Fish farmers are visited by the extension agents fortnightly (34%) and once a month (22%). This is because of the lack of adequate extension agents and the large number of farmers to visit. In 2007, there were 191 extension agents to 256, 000 farm families, giving a ratio of 1:1340 (NAERLS, 2008). Majority of the fish farmers (68%) receive information by Training and Visit which they perceive is the most efficient mean of disseminating information because it provides opportunity for the farmer to be taught, ask questions and to be guided. According to Benor and Baxter (1984), the T and V method of dissemination was designed to achieve rapid results at less cost.

The fish farmers' perception of extension agents is that they have been effective in the transfer of improved fish farming practices to them through organized demonstration. They have also assisted them in procurement of high quality fish seed and in fish marketing. It was observed that extension agents lack appropriate transport facilities to reach some of farming communities due to poor access roads.

Table 4: Constraints Encountered by Fish Farmers

Constrains Encountered	Frequency	Percentage
None	3	6
Lack of credit and reliable sources of fingerling	24	48
Inadequate water	10	20
Lack of poultry by-products and storage facilities	9	18
Lack of adequate transport	3	6
Weed infestation and poachers activities	1	2

TABLE 5: Extension Agent Contact with Fish Farmers and Dissemination Methods Used

	Frequency	Percentage
Length of time of knowing extension agents		
Less than 2 yrs	9	18
2-5 yrs	23	46
More than 5 yrs	16	32
None	2	4
Means of knowing Extension agents		
Extension visit	26	52
Radio	15	30
Through co-farmers	8	16
None	1	2
Frequency of extension agents visit to fish farm		
Once a week	20	40
Fortnightly	17	34
Once month	11	22
Never	2	4
Dissemination Method		
Personal visit	9	18
Training and visit	34	68
Contact farmers	5	10
None	2	4

Tests of Hypotheses

Result of the chi-square analysis that tested for relationship between demographic characteristics (gender, age, level of education and number children) and usage of aquaculture technologies is presented in Table 6. Only level of education had a significant relationship with the number of aquaculture technologies being used by the fish farmers ($p<0.1$). This is because 60% of them had a university degree and this enhanced their propensity to use improved methods for fish production. Similar result was also observed by Ofuoku *et al* (2008) in which level of formal education was positively correlated with the usage of fish farming technologies in Delta State. Average level of education was identified as an advantage for easier dissemination of extension information on Tilapia improved technologies among the tilapia producers (Alfred *et al*, 2008).

There was a significant relationship between number of aquaculture technology used by fish farmers with source of credit and type of labour used on the farm ($p<0.01$); frequency of cropping ($p<0.05$) as shown in Table 7. The implication of this finding is that fish farmers who use capital contributed by family members or from their personal savings are more likely to use more aquaculture technologies compared to those who source from banks or cooperatives. This could be due to the untimely release of credit given after the production period, which can be diverted to other areas of need. Owners of fish farms using hired labour rather than family and cropping once a year are also more likely to use more aquaculture technologies. Fish Farms that have existed for more than five years were more likely to use more fish culture technologies ($p<0.1$) compared to new farms.

Table 6: Chi-Square Analysis of Relationship between Demographic Characteristics of Fish Farmers and Total Aquaculture Practices Used

Variable	N	X^2	df	*P*-values	Decision
Gender	50	0.665	1	0.415	Not Significant
Age	50	0.715	2	0.700	Not Significant
Education	50	8.266	4	0.082	Significant*
Number of children	50	1.840	3	0.606	Not Significant

Table 7: Chi-Square Analysis of Relationship between Economic Characteristics of Fish Farmers and Total Aquaculture Practices Used

Variable	N	X^2	df	*P*-values	Decision
Years of Farm Establishment	50	6.646	2	0.084*	Significant
Source of Capital	50	11.986	3	0.007***	Significant
Number of ponds	50	5.171	2	0.160	Not Significant
Type of Labour	50	6.762	1	0.009***	Significant
Frequency of cropping	50	8.013	1	0.018**	Significant

* (*p<0.1*), ** (*p<0.05*), *** (*p<0.01*)

CONCLUSION AND RECOMMENDATION

Conclusion

Factors influencing the use of aquaculture technologies in Osun State have been presented in this paper. The Training and Visit approach is used by extension agents along with other methods in the dissemination of messages to fish farmers. Educational level was the only demographic characteristics that affected the propensity for fish farmers to use aquaculture technology. The source of credit, type of labour, cropping frequency and year of establishment of the fish farm had significant relationship with the number of improved aquaculture technologies used.

Recommendation

The following recommendations are made based on the findings in this study:

Fish farmers should be enlightened more on the importance of fish farmers' cooperative and encouraged to join. The extension agent can facilitate linking fish farmers with sources of credit for the procurement of required inputs. Private producers have to be encouraged by the Osun State Government to invest in hatchery production of fingerlings in the State. Quality of local feeds can be upgraded so that farmers can use as imported feeds as supplement. Commercial aquaculture must also be encouraged through the dissemination of existing research results to entrepreneurs via extension agents. Projects must be market-driven as much as possible, with government subsidies kept to a minimum.

There is the need for the Osun State Government to employ more extension agents so that they can visit the fish farmers more frequently. The Government should provide extension agents with transport facilities like motorcycles to enable them reach fish farmer who live in communities which have poor access routes. It is important to enhancement note that mobility of extension agent is crucial for their job performance.

REFERENCES

Adekunle, O.A. and Alfred, S.D.Y. (2002) Effects of Agricultural Radio Programme on Farm Production in Ondo State, *Proceedings of the 8th Annual National Conference of the Agricultural Extension Society of Nigeria* pp 83-90

Alfred S.D., G. M. Adebo and O. A. Fagbenro (2008) Tilapia Farmers' Perception of Rural Health Care Delivery System in Ondo State of Nigeria, 8th International Symposium on Tilapia in Aquaculture, p. 709-716

Bolorunduro, P. I. and Fregene, Tosan; (2000) Fisheries Technology Transfer in Nigeria: Institutional Structures, Problems and Determinants of Appropriate Technologies, The *Nigerian Journal of Agricultural Extension*, Vol. 12 No. 2, p. 69-83.

Benor, B. and Baxter, M. (1984) *Training and Visit Extension*, The World Bank, Washington, D. C., U. S. A. 215p

Environmental News Service ENS (2005) Abuja, Nigeria, August 23, 2005 (ENS) -

Fagbenro, O. A. (2005). *Aquaculture in Nigeria: history, status and prospects.* A report FAO World Fish Centre Workshop, Cameroon

FAO (1996) Expert Consultation on Small-scale Rural Aquaculture, Rome, Italy, 28-31 May 1996 compiled by Manuel Martinez-Espinos, FAO Fisheries Report No. 548, 182p

Federal Department of Fisheries (FDF) (2008) *Fishery Statistics of Nigeria, Published by Federal Department of Fisheries, Nigeria*, Fourth Edition, 48p

Lathern, M C. (1997) Human Nutrition in the Developing World *FAO Food and Nutrition Series No. 29* Rome, 508p

National Agricultural Extension and Research Liaison Services (NAERLS) (2007) National Agricultural Extension Review and Planning Meeting (2007/2008) NAERP Report, No. 009 86p

Ofuoku A. U.; Olele N. F. and Emah, G. N. (2008) Determinants of Adoption of Improved Fish Production Technologies among Fish Farmers in Delta State, Nigeria', The Journal of Agricultural Education and Extension, 14:4,297 — 306, http://dx.doi.org/10.1080/13892240802416186

Omitoyin, B. O. (2007) Introduction to Fish Farming in Nigeria, Ibadan University Press, University of Ibadan, 90p

Osun Sate Government (2006) *Bankable Feasibility Studies,* Osun State Publications, Oshogbo, Nigeria, 69p *www.**osunstate**.gov.ng/.../BANKABLE%20FEASIBILITY%20STUDIES.pdf -*

INFORMATION SEEKING BEHAVIOUR OF FISH FARMERS IN OYO STATE

Akinbile L. A. and Alabi Olufolake Eunice
Department of Agric Extension and Rural Development, University of Ibadan
lakinbile@yahoo.com

ABSTRACT

The technical nature of fish farming requires that the knowledge of practitioners are constantly updated and this can be achieved through their enhanced information seeking behaviour as information use of fish farmers is crucial for effectively meeting their information needs. This study, thus, determined the information seeking behaviour among fish farmers in Oyo – State. One hundred and twenty respondents were interviewed for the study. These were selected from Ibadan/Ibarapa zone of Oyo State ADP using simple random sampling for registered farmers and snowball technique to compile list from which equal number of unregistered farmers were chosen as respondents. The relationship between personal characteristics such as age, educational attainment, marital status and information seeking behaviour was determined using chi-square. Also, the significant difference between level of production of respondents with high and low information seeking was determined using t-test statistics. Results showed that 89.2 percent of the respondents were married and 84.2 percent had formal education, and with mean age of 46 years. Fish farming was their main income generating activity. The registered farmers updated their knowledge often from different sources most especially from extension agents. Age (X^2 =87. 083, $p<0.05$), marital status ($X2=168.35$, $p<0.05$), and educational status ($X2=86.97$, $p<0.05$) were significantly related to information seeking behaviour of respondents.. There existed a significant difference between level of production of respondents with high and low information seeking behaviour ($t = 3.48$, $p < 0.05$). This may be attributable to most respondents updating their knowledge on fish farming.

The study concluded that fish farmers' attitude to information is not poor as a result of the majority of respondents updating their knowledge often. This indicates a positive attitude to information seeking. Also, the level of production of respondents with high information seeking behaviour is higher than those with low information seeking behavior.

INTRODUCTION

Information seeking behaviour can be referred to as the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking and information use. Seeking behaviour is the purposive seeking of information as a consequence of a need to satisfy some goals, to move from level of uncertainty to certainty. Atkin (1973) cited by Yahaya (2003) asserted that there exists cognitive uncertainty in individuals and this represents what the individual information seeker does not already know. In this case, the individual's level of knowledge about certain aspects of agricultural practices varies along a continuum from total uncertainty to total certainty. Therefore, affected persons may resort to actively or passively seeking solutions to the varying degrees of uncertainty or certainty. Hence, whenever the individual farmer is in doubt of what to do in a particular situation, he or she is forced to search for the best way to address the issue.

Information seeking behaviour is a strategy for gathering sufficient data to address the received "information gap" which is the agricultural information needs of farmers or inadequacies in their knowledge of certain basic practices with particular reference to technical, marketing, social and legal agricultural information (Yahaya, 2003). In the course of seeking information, the individual may interact with manual information systems (such as newspaper or a library) or with computer-based system. It could even be face-to-face communication with others as well as the passive reception through watching T.V and adverts on issues of importance to them such as their agricultural and other activities.

Generally, farmers have seen the usefulness of research in the improvement of their livelihood and this accounted for the increase in pro-activity of the farmers in their search for answers to many problems in the sector from researchers, especially more educated people who are into the farming profession and agro-based industries. Fish farmers are growing in number daily so also

their thirsts for information that will enable them have effective and fruitful production. Fish farmers thus present different attitudes to information. While some have rapid information seeking behaviour, some do not. This attitude also affects the type of information sought, the medium explored, preferred time of exposure among others.

Researchers have been interested in information behaviour for over 40years, although in the beginning the concept was mostly connected with information centres. However, Wilson (1997) considers the concept of information behaviour more suitable because it also includes other behaviours along with seeking behaviour. Wilson is of the opinion that a general information behaviour model should at least include the following three elements.

- Information needs and its drivers, i.e., the factors that give rise to an individual's perception;
- The factors that affect the individual's response to the perception of need; and
- The processes or actions involved in that response. (Wilson 1997: 39).

Information needs, information-seeking and information behaviour are intertwined concepts which make the concept information behaviour very complex. Information behaviour is a broad term encompassing the ways individuals articulate their information needs, seek, evaluate, select, and use information. In other words, information-seeking behaviour is purposive in nature and is a consequence of a need to satisfy some goals (Gholamreza and Naser, 2005). It follows that information seeking behavior are those activities a person may engage in when identifying their own needs for information, searching for such information in any way, and using or transferring that information. Information-seeking behaviour involves personal reasons for seeking information, the kinds of information which are being sought, and the ways and sources with which needed information is being sought (Gholamrza and Naser, 2005). Information use is a behaviour that leads an individual to the use of information in order to meet his or her information needs. Information use is an indicator of information needs, but they are not identical. Fish farmers do not use all the information they need, partly because they are not always able to obtain what they need, or because the materials may not be relevant when they obtain them, and also because fish farmers do not know what they need. In addition, sometimes, fish farmers do not need all the information they intend to use. Knowledge about the information-seeking behaviour and information use of fish farmers is crucial for effectively meeting their information needs. This knowledge may also lead to the discovery of novel information behaviour and users profiles that can be used to enhance existing information models or even develop new ones. It is against this backdrop that this study set out to address the following objectives:

Objectives of the Study

The main objective of the study is to determine the information seeking behaviour of fish farmers in Oyo State. The specific objectives were to:

i) describe the socio - economic characteristics of fish farmers in the study area;
ii) identify which information is being sought by fish farmers in the study area;
iii) determine the level of production of fish farmers in the study area.

Hypotheses of the Study

i) There is no significant relationship between personal characteristics of respondents and their information seeking behaviour
ii) There is no significant difference in the level of production of respondents with high and low information seeking behaviour

METHODOLOGY

The study was carried out in Oyo State, Nigeria. Oyo State is situated in Latitude 7^0241N and Longitude 3^054E as well as altitude 234m above sea level. The target population was all registered and unregistered fish farmers in Oyo state.

Oyo State Agricultural Development Programme (OYSADEP) is divided into 4 zones i.e. Ibadan/Ibarapa, Oyo, Ogbomoso and Shaki zones. Ibadan-Ibarapa zone was purposively selected as it has more fish farmers registered with OYSADEP than in other zones. The list of registered fish farmers in Ibadan-Ibarapa zone was obtained from the zonal office and simple random sampling was used to sample sixty out of the 160 fish farmers on the list. Also, snowball technique was used to compile list of fish farmers that were not registered with ADP in the zone. Sixty farmers were randomly selected from the list of 89 farmers compiled. Data were collected from respondents using structured questionnaire. The questionnaire included two sections. The first section was on the respondents' personal characteristics while the second was on information seeking behaviour of respondents. The dependent variable of the study is to determine the information seeking behaviour of fish farmers in

Oyo State and it was measured by asking them to indicate where they get information on fish farming, whether they update their knowledge on fish farming, the source(s) from which they update their knowledge and the frequency of update, while independent variables include the socio – economic characteristics of the respondents. The tools used in analyzing data in this study were descriptive and inferential statistics. The former includes tables, frequency counts, mean, median etc. while the latter includes chi-square, and t-test.

RESULTS AND DISCUSSION

Distribution of respondents according to their socio-economic characteristics

The age distribution of respondents as shown in table 1 indicates that many (40.0%) of the respondents are within the age group of 36 – 45 years, while the least group is composed of respondents whose age range between 66 and 75 years (0.8%). The implication is that majority of the fish farmers are in their middle age, therefore they have the ability to search for information on fish farming and are more ready to take risk. They also have the agility required for effective fish farming. Table 1 also shows that many of the respondents had either OND/NCE (31.7%) or HND/B.Sc./M.Sc (32.5%). The implication is that most of the respondents have formal education and are likely to have a positive behaviour towards information seeking. This may be because of the technicality of fish farming which involves the intricacies of fish culture. This is in line with the findings of Adeleke (2006) that most of the fish farmers have formal education. 89.2 percent are married, 5.0 percent are widowed and 5.8 percent are single. This implies that married people are more involved in fish farming and this could be as a result of more responsibilities they are saddled with as married people who have responsibility for the provision of household needs of their families.

Majority of respondents (70.0%) are Christians while 30.0 percent are Muslims. Religion plays a key role in the income generating activities of both rural and urban dwellers.

Level of production

Table 2 shows that 16.9 percent of the respondents have production output of between #15,000 and #175,000, 15.8 percent have production output of between #377,000 and #497,000. The maximum level of production ranges from #1,303,000 – #1,463,000 with 6.8 percent while the average output is #388,608.33. The implication is that majority of the respondents produce at low level this may be as a result of lack of useful information which could help them increase their production output.

Table1: Distribution of respondents according to their socio-economic characteristics (N 120)

Characteristic	Frequency	Percentage
Age		
26 – 35	14	11.6
36 – 45	48	40.0
46 – 55	32	26.6
56 – 65	25	20.8
66 – 75	1	0.8
Educational Attainment		
Pry school not completed	4	3.3
Pry school completed	9	10.8
Sec.school not completed	6	5.0
Senior school certificate	21	17.5
OND/NCE	38	31.7
HND/B.Sc/M.Sc	39	32.5
PHD	3	2.5
Marital Status		
Married	107	89.2
Single	7	5. 8
Widowed	6	5. 0
Religion		
Christianity	84	70.0
Islam	36	30.0
Total	**120**	**100.0**

Table 2: Level of production of respondents

Output	*Frequency*	*Percent*
15,000 – 175,000	20	16.9
176,000 – 336,000	9	7.5
377,000 – 497,000	19	15.8
498,000 – 658,000	13	10.8
659,000 – 819,000	6	5.1
820,000 – 980,000	13	10.8
981,000 – 1,141,000	12	9.9
1,142,000 –1,302,000	12	9.9
1,303,000 – 1,463,000	8	6.8

Frequency of knowledge update

Table 3 shows that 34.2 percent of the respondents frequently update their knowledge, 2.5 percent update once in 3 months, 19.2 percent update their knowledge occasionally while 41.7 percent update their knowledge fortnightly. Only 2.5 percent do not update their knowledge at all. Thus, majority of the respondents have positive attitude to information seeking since information is necessary to increase productivity. This corroborates the findings of Meyer (2005) that information plays an important role in almost every human activity.

Table 3: Distribution of respondents' frequency of knowledge update by respondents

Frequency of update	*Frequency*	*Percent*
Frequently	41	34.2
Once in 3 months	3	2.5
Occasionally	23	19.2
Fortnightly	50	41.7
None	3	2.5
Total	**120**	**100**

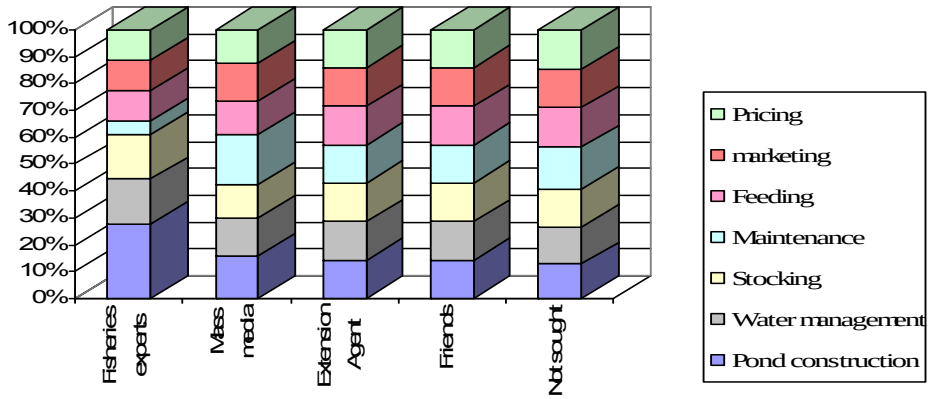


Figure 1: Sources of Information of respondents

Sources of information of respondents

Figure 1 reveals that respondents' source for information from four major sources; fisheries experts, mass media, extension agents and friends. Majority of the respondents' source for information from extension agents on all the activities involved in fish farming. On pond construction, 4.2 percent seek information from fisheries experts, 11.7 percent from mass media, 47.5 percent from extension agents and 5.0 percent from friends. On stocking, 2.5 percent, 10.0 percent, 48.3 percent and 5.0 percent seek information from fisheries expert, mass media, extension agents and friends respectively. Also, 47.5percent of the respondents, source for information on water management from extension agents, 2.5 percent from fisheries experts and 10.0 percent from mass media. This suggests that most of the respondents source for information on the various fish management practices from extension agents. This finding corroborates the significance of one-on-one contact of extension agents as the second most readily accessible source of agricultural information as found in the study of Yahaya (2003).

Information seeking score of respondents

The information score was obtained based on the sources from which the respondents seek for information and the frequency at which they use these sources. The score obtained ranged from 0 – 27 with a mean of 15.1 and standard deviation of 5.7. Information score was later categorized into 3 based on the mean, Respondents with score of 1-10 are regarded as low information seekers while those with a score 11-20 are moderate information seekers. Those with scores of 21-30 are categorized as high information seekers. Low information seekers constitute 21.6 percent while only 13.3 percent are high seekers. The majority (64.9%) are moderate information seekers. Thus, majority of the respondents are moderate information seekers and need to be encouraged to become high seekers after information.

Table 4: Information seeking score

Score	Frequency	Percent
1-10	26	21.6
11-20	78	64.9
21-30	16	13.3

Information sought by fish farmers

Information sought by fish farmers are those they would want to update their knowledge on and it includes information on stocking, maintenance, general management, pricing, marketing, and pond construction as shown in Table 5. The table shows that most of the respondents seek for information more on marketing, pricing and general management

are greatly sought by respondents. This corroborates the position of Meyer (2005) who affirms that information is seen as a resource with which to solve particular problems. So also, Aboyade (2001) stressed that the need for information is important in any meaningful developmental effort, especially in the building of the wealth of nations.

Table 5: Distribution of respondents according to the Information they sought

Practices	*Not sought*	*Partially sought*	*Greatly sought*	*Mean*
Stocking	15 (12.5)	42 (35.0)	63 (52.5)	1.4
Maintenance	9 (7.5)	50 (41.7)	61 (50.8)	1.43
Feeding	30 (25.0)	34 (28.3)	56 (46.7)	1.22
Cropping	18 (15.0)	46 (38.3)	56 (46.7)	1.32
Marketing	10 (8.4)	45 (37.5)	65 (54.2)	1.46
Pricing	11 (9.1)	41 (34.2)	68 (56.7)	1.48
General management	12 (10.0)	27 (22.5)	81 (67.5)	1.58
Pond construction	21 (17.5)	25 (20.8)	74 (61.7)	1.44
Water management	17 (14.1)	42 (35.0)	61 (50.8)	1.37

*Percentages in parenthesis

Relationship between personal characteristics and information seeking behaviour of respondents.

Age: χ^2 value of 87.083 and P value of 0.000 shows that there is a significant relationship between age and information seeking behaviour of the respondents. This implies that both young and old people seek information but old people are likely to seek for more information than young people, even if they are more active than the old people. The experience of old people may be responsible for this.

Marital Status: Relationship test between marital status and information seeking behaviour indicates a significant relationship (X^2 = 168.35, P = 0.000). The result implies that married and unmarried men seek information but married men are likely to seek for information more than single men. This could be as a result of the responsibilities the married respondents have to shoulder.

Religion: Religious practice plays an important role in agricultural development. The study reveals that a significant relationship exists between religion and information seeking behaviour of the respondents (X^2 = 19.20, P = 0.000). The result implies that some religion may prevent people from seeking information on agricultural practices that are against their religion, as against others.

Educational attainment: People seek information that will bring improvement to their knowledge about a particular practice. X^2 value of 86.97 and P value of 0.000 depicts that there is a significant relationship between level of education and information seeking behaviour of the respondents. The result implies that a farmer with high level of education has more tendency to seek for information than a farmer with low level of education.

Test of difference in level of production of low and high information seekers

There is no significant difference in the level of production of respondents with low and high information seeking. It was analysed using T-test analysis as shown in Table 7. The table reveals that there is significant difference in the level of production of respondents with high information seeking behaviour and those with low information seeking behaviour.(t = 3.48; P= .0001). This shows that level of production of respondents with high information seeking behaviour is greater (mean = 4475) than those with low information seeking behaviour (mean = 2703). Therefore, the null hypothesis which states that there is no significant difference in the levels of production of respondent with high and low information seeking behaviour is rejected. Thus, respondents that seek information more have the tendency of achieving higher level of production.

Table 6: Chi-square analysis of information seeking behaviour and personal characteristics of respondents.

Variables	x^2	df	P value	Decision
Age	87.083	34	0.000	S
Marital Status	168.350	2	0.000	S
Religion	19.200	1	0.000	S
Educational attainment	86.967	6	0.000	S

Table 7: T-test analysis of level of production and information seeking behaviour.

Information seeking category	N	df	mean	std	Std Error	t-value	P value	Decision
Total output								
Low	56	118	2703.39	2442.57	326.40	3.48	0.0001	S
High	64		4475.00	3054.37	381.80			

CONCLUSION AND RECOMMENDATION

The study concluded that majority of the respondents update their knowledge often, which indicates a positive attitude to information seeking. So also, the level of production of respondents with high information seeking behaviour is higher than those with low information seeking behavior. It was also revealed that majority of the fish farmers source for information from extension agents on various fish farming management practices. Since the information use of fish farmers is crucial for effectively meeting their information needs, it is recommended that efforts should be made by the extension agents to guide fish farmers in adequately and properly using the acquired information in order to meet their information needs. Fish farmers should also be sensitized and adequately trained on how to use Information Communication Technologies (ICTs) to seek information by establishing training centers in strategic locations in the state. This should be made available and affordable to them. This has the tendency of encouraging them to develop a positive attitude to seeking information that are relevant to their needs.

REFERENCES

Adeleke B.A (2006): Aquaculture Technology Awareness, Transfer and Adoption among Fish Farmers in Oyo Town and its Environs. An unpublished M.Sc thesis University of Ibadan. Ibadan. Pp 35

Gholamreza. P and Naser.Z. (2005): Information-Seeking Behaviour of Iranian Extension Managers and Specialists. Pp 36

Meyer H.W.J (2005): *The Nature of Information, and the Effective Use of Information in Rural development.* National Agriculture Extension & Research Liaison Services (NAERLS, 2001): Field Situation Assessment of 2001 Wet Season Agriculture Production in Nigeria Ahmadu Bello University, Zaria.

Rutger. J.E. (2000):. Proceedings of a CTA Seminar: *Technical. Policy and Institutional Trends in Information and Communication.*

Wilson T.D (1997): 'Information Behaviour: An Interdisciplinary Perspective'. In Information Seeking in Context. Proceedings of an International Conference on *Research in Information Needs, Seeking and use in Different Contexts* 14-16, August, 1996. Tampere. Finland. London, Taylor Graham.

Yahaya M. K. (2003): Development Communication. Lessons from Change and Social Engineering Projects. Corporate Graphics Ltd, Ibadan. Nigeria.

NUTRITIONAL EVALUATION OF WATER HYACINTH AS RUMINANT FEED TO CURTAIL ITS ENVIRONMENTAL MENACE IN NIGERIA

A .A. Mako* and O. J. Babayemi
Department of Animal Science, University of Ibadan, Ibadan, Nigeria
*Corresponding author: *jokemako2006@yahoo.com*

ABSTRACT

The suitability of water hyacinth for feeding livestock was studied. The nutrient compositions of stacked water hyacinth for different days were determined. The stacked water hyacinth was incubated for in vitro gas production for 24 hrs. The total gas volume (ml/200 mg DM) at post incubation was measured. Methane (mmol/200 mg DM) was evaluated by introducing 10M NaOH into the content. Metabolize energy (MJ/kg DM) and organic matter degradability (%) were calculated. Acceptability of the forage to livestock was assessed using a cafeteria method in 8 adult small ruminants. (Babayemi *et al* 2006). Result showed that the crude protein CP (g/100 g DM) ranged between 10.20 – 10.77, while the neutral detergent fibre NDF (g/ 100 g DM) range from 51 -63, the days of stacking increased the Dry matter of the forage, Total gas production (ml) of stacked water hyacinth varied significantly ($P<0.05$) ranging from 14.25 – 18.00, the metabolize energy and methane also showed significant variation ($P<0.05$) ranging from 4.81 – 5. 32 and 3.5 – 6.5 respectively. The short chain fatty acids also varied significant ($P<0.05$) ranging from 0.28 – 0.37. The acceptability of stacked forage was similar for water hyacinth stacked for 5, 10, 15 and 20, days but poor for fresh water hyacinth. It is concluded that water hyacinth can serve as fodder for ruminants.

Keywords: Acceptability, degradation, fermentation, forage, incubation, methane, protein, water hyacinth.

INTRODUCTION

The major constraint of livestock production in the developing countries is the inadequate qualitative and quantitative feed supply year round. Availability of pastures and herbaceous legumes are known to be dependent on the season of the year, where ruminant animals obtain most of their nutrients from herbages growing on poor soils resulting in slow growth rate and poor performances of these animals. The grass is low in crude protein and insufficiently available in the dry season (Bamikole and Babayemi 2004), suggesting a need for supplementation. Makkar 1997 reported that large areas of land in the World are degraded and the amount is increasing every year, limiting available area for herbage production. A lot of Agro industrial by – products e.g. cocoa seed, crop residues e.g. maize stover, browse plants e.g. Ficus spp. has been used to supplement grasses, but there is still animals with slow growth rate and poor performances, therefore the sustainability of livestock on Agro industrial by-product, herbaceous legumes and crop residues become difficult. This has called not only for better utilization of non-conventional feed resource but also for identification and introduction of lesser known plants capable of growing without tillage or cultivation with less Agronomic care.

Water hyacinth is an important class of this plant. It is an evergreen perennial aquatic plant, growing freely in ponds, rivers, dams etc throughout the year. It does not compete with other agricultural useful vegetation for growing space and it is of no use to man. In recent times, in vitro Fermentation Techniques (Fievez *et al* 2005) has been employed to predict the nutritive value of tropical forage. Although gasses produced during fermentation are colossal waste products and of no nutrient value to the animals, but gas production tests are used routinely in feed research, as gas volumes are related to both the extent and rate of substrate degradation (e.g Blummel *et al* 1997). In vitro methods of evaluation of feeds are important tools as they allow quick assessment of nutritional value of the feed samples. There is need to furnish basic information on the suitability of water hyacinth as feed for ruminants. In this study, an assessment of its relative acceptability as fodder, nutrient composition and in vitro gas fermentation attributes were carried out.

MATERIAL AND METHODS

Water hyacinth (*E.crassipes*) (Plate 1) samples used for the study were harvested from Awba dam University of Ibadan in the month of July 2006. The collection was in batches of 50 Kg per batch such that each batch was kept for an upward of 5, 10, 15 and 20 days under a shed. The collection was strategic such that 5, 10, 15 and 20 days old water hyacinth samples were used each day.



Plate 1: Diagram showing water hyacinth in a canal



Plate 2: Showing acceptability of water hyacinth as forage by West African Dwarf Goats.

The study of the relative acceptability of the stacked water hyacinth (whole plant) was carried out at the sheep and goat unit of the University of Ibadan Teaching and Research Farm. Eight adult female WAD goats (Plate 2) were used in a cafeteria feed preference study, which lasted for 2 weeks including a week for the animals adaptation to the forage (Babayemi 2006).

The average pre-experimental weight of the goats was 10.13 kg and they were between 18 and 24 months old. They were housed in a group pen within the small ruminant house constructed to achieve good ventilation. The floor of the house was made of concrete covered with wood shavings for easy cleaning of the faeces and urine, 3 kg of five samples of water hyacinth stacked for 0, 5, 10, 15 and 20 days was introduced on a free choice basis to the animals in five different wooden feeders, each measuring 90 x 35 x 50 cm so that all the animals had free access to each of the forage species in the troughs. The positioning of the forages in the pen was changed daily to prevent the adaptation of animals to a particular type of forage. The consumption was monitored for 8 h per day and the quantity consumed was recorded. Dried samples (about 200 g) of each of the stacked water hyacinth taken during the 14-day acceptability trial were used to determine the Dry matter content. Forage preference was determined from the coefficient of preference (COP) values, calculated from the ratio between the intakes of individual forage, divided by the average intake of the five-stacked water hyacinth (Karbo *et al* 1993). On this basis, a forage was taken to be relatively preferred if the COP was greater than unity.

In vitro gas fermentation

Stacked water hyacinth for 0, 5, 10, 15 and 20 days was separated into anatomical parts (stems and leaves) for further analysis. (The roots were discarded because the animals did not accept them). Rumen fluid was obtained from three West African dwarf female goats through suction tube (Babayemi and Bamikole, 2006) before morning feed. The animals were fed with wheat offal and Guinea grass.

Incubation was as reported (Menke and Steingass, 1988) using 120ml calibrated syringes in three batch incubation at 39^0C into 200mg samples in the syringe was introduced 30ml inoculums cheese clot strained rumen liquor and buffer ($NaHCO_3$ + Na_2HPO_4 + KCl + NaCl +MgS_{04}. $7H_20$ + $CaCl_2$. $2H_{20}$) (1:2 v/v) under continuous flushing with CO_2. The gas production was measured at 3, 6, 9, 12, 15, 18, 21 and 24hr and after 24hr incubation. 4ml of Na0H (10M) was introduced into the incubated samples as reported (Fievez *et al*., 2005) to estimate the amount of methane produced. The average volume of gas produced from the blanks was deducted from the volume of gas produce per simple. The metabolizable energy (ME, MJ/Kg DM) and organic matter digestibility (OMD %) were estimated as established (Menke and Steingass, 1988) and short chain fatty acids (SCFA) were calculated as reported (Getachew *et al*., 1999).

Proximate composition

Nitrogen (N) content of the stacked water hyacinth was determined by the standard kjeldah method (AOAC, 1990) and the amount of crude protein was calculated (N x 6.25) organic matter was obtain by ash determination using muffle furnace. Neutral detergent fibre and acid detergent fibre were calculated as reported (Van Soest *et al*., 1991).

Statistical analysis

Data obtain were subjected to analysis of variance (ANOVA) and mean separations where there are significant differences was separated by Duncan multiple range F-test using statistical Analysis system (SAS 1995) package.

RESULTS

Table I presents the nutrient composition of stacked water hyacinth for 0, 5, 10, 15 and 20 days. All the parameters varied from fresh samples to 20days stacked samples. The dry matter, crude fibre and neutral detergent fibre increased with days of stacking, while the crude protein, ash and ether extract content decreased with days of stacking.

The forage preference of the animals fed on water hyacinth stacked for different days is presented in Table II. Based on their coefficient of preference (COP) values, of more than unity, all the stacked water hyacinth except the fresh sample were accepted by the animals, but the water hyacinth stacked for 5 days was more preferred.

Table III presents the amount of methane (CH4), the organic matter digestibility (OMD), metabolized energy (ME), short chain fatty acids (SCFA), and total gas volume (GV) of the stacked water hyacinth. There was significant variation (P>0.05) among treatment means, it was observed that the water hyacinth stacked for 5 days produced the highest gas volume,

ME, OMD and SCFA ranging in the order 5>10>15>20>fresh sample. The amount of methane produced did not follow a particular trend with the forage stacked for 20 days producing the least amount of methane of 3.5ml, while sample stacked for 10 days give the highest amount of methane 6.5ml.

Figure I shows the in vitro gas production of stacked water hyacinth. From this table the extent of degradation of the forage after 24 hrs incubation was high enough which is indicated by the gas volume produced. This may imply a better degradation of the forage.

Table I. Proximate composition (g/100 g Dm) of stacked water hyacinth

Stacking duration	DM	CP	CF	EE	ash	NDF
0 day	8.00	10.8	18.5	2.05	16.1	51.0
5 days	10.9	10.5	22.0	2.00	15.7	55.0
10 days	12.5	10.3	26.8	1.90	15.0	56.5
15 days	14.4	10.2	29.3	1.75	14.3	59.0
20 days	17.3	10.2	31.3	1.60	13.1	63.0

DM = Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract, NDF = Neutral detergent fibre

Table 2. Preference of experimental animals introduced to stacked water hyacinth

Days of stacking (day)	Mean daily consumption of all animals (Kg DM)	Coefficient of preference
0	0.91	0.74
5	1.46	1.20
10	1.28	1.04
15	1.25	1.02
20	1.23	1.00

Table 3. Methane (ml) Gas volume (ml), metabolize energy (MJ/KgDM), organic matter digestibility (%) and short chain. Fatty acids of slacked water hyacinth

	Stacking duration (days)					
	0	5	10	15	20	SEM
CH_4	5.0_b	5.0_b	6.5_a	4.0_c	3.5_C	0.09
GV	14.3_b	18.0_a	17.3_{ab}	15.5_{ab}	15.0_{ab}	0.64
ME	4.81_b	5.32_a	5.24_{ab}	4.97_{ab}	4.91_{ab}	0.09
OMD	41.9	45.8	44.5	42.5	42.3	0.57
SCFA	0.58_b	0.37_a	0.35_{ab}	0.31_{ab}	0.30_{ab}	0.02

a, b, c, = means on the same row with different subscript are significantly different (P<0.05)

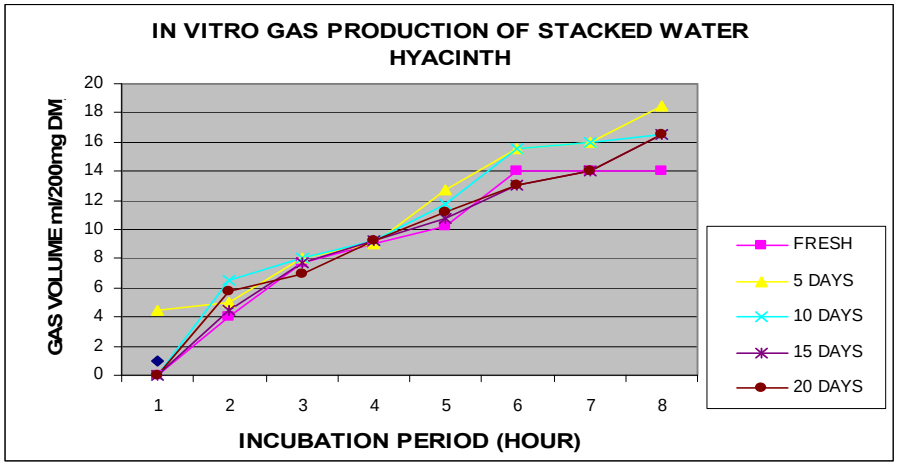


Fig 1: In vitro gas production kinetics of stacked Water hyacinth

DISCUSSION

Variations observed in the nutrient composition of stacked water hyacinth as the days of stacking progresses could be attributed to seepage or wash off of nutrients. This is because the plant contains a lot of water i.e. 95 % moisture which means, the animals will have to take on a lot of the forage before they can be satisfied, but the animals can only take what their digestive tract can accommodate. The dry matter increased with days of stacking which improves the Dry matter from 8.00 g / 100 g DM – 17.25 g / 100 g DM. This is an indication that the plant can be useful as feed for ruminants if the moisture content can be removed mechanically. The crude protein of 10.2 – 10.77 / 100 g DM is however higher than the CP of some grasses like panicum maximum which 8 g / 100 g DM is. This level of CP also meets the protein requirement for ruminant's which is 8 g / 100 g Dm. The value of crude protein recorded for fresh samples however agrees with the value recorded by Dairo (1999) and Dada (2000) but lower than the values of 12 – 19.9 % recorded by Reza (1981). The level of CP was also higher than the critical level of 7.0 g / 100 g DM, below which the feed intake of the animal is depressed (Minson 1990). The CP ranges were sufficiently high to warrant utilization of the plant as a protein supplement to low quality diet. The NDF (g / 100 g DM) level of all stacked water hyacinth agrees with the level reported for some browse plants (Bayes 1990, Larbi *et al* 1996). All stacked water hyacinth has NDF concentrations that were within the reported value of 55.0 – 66.0 g / 100 gm DM above which can limit the intake of forages (Meissner *et al* 1991). The ash content of all stacked water hyacinth was high enough to meet the requirement of ruminant animals. This result agrees with the findings of Khan et al 2002.

High gas production recorded by the stacked water hyacinth can be linked to the extent of organic matter degradation, high gas volume and short chain fatty acids indicates availability of energy which is needed by the animals.

The volume of methane produced by all the stacked water hyacinth is however low, this is an advantage because methane production is a colossal waste to the animal.

CONCLUSION

Nutrient composition of water hyacinth (leaf and stem) and its availability through out the year indicate that the plant might be useful protein supplement in ruminant feeding. Although the moisture content of the plant is very high resulting in very low dry matter, but this can be improved by removing the moisture mechanically. The enhanced values of metabolizable energy and short chain fatty acids in the plant connote its ability to meet the energy requirement of tropical ruminants.

REFERENCES

AOAC 1990 Official Methods of analysis, Association of official analytical chemists 14th edition Washington DC, 11411pp

Babayemi O J, Demeyer D and Fievez V 2004a Nutritive value and qualitative assessment of secondary compounds in seeds of eight tropical browse, shrub and pulse legumes comm.. Applied Biological Science Ghent University 69/1: 103 – 110

Babayemi O J and Bamikole M A 2006 Effect of Tephrosia Candida DC leaf and its mixture with guinea grass on in vitro fermentation changes as feed for ruminants in Nigeria. Parkistan Journal Nutrition. 5 (1): 14 – 18

Blummel M, Makkar H P S and Becker K 1997 In vitro gas production: a technique revisited. Journal of Animal Physiology and Animal Nutrition. 77, 24 – 34.

Dairo F A S 1999 The Performance of Rabbits fed diets containing water hyacinth (Eichhornia Crassipes) leaf meal. Tropical Journal Animal Science. 2 (1) 79 – 83

Fievez V, Babayemi O J and Demeyer D 2005 Estimation of direct and indirect gas production is syringes: a tool to estimate short chain fatty acid production that requires minimal laboratory facilities. Animal feed science and Technology. 123-124, 197-210

Khan M J, Steingass H and Drochner W 2002 Nutritional evaluation of some aquatic plants for animal feeding. Bangladesh Journal Agricultural Science 29(2): 317-324

Karbo N, Brnes P and Rudath 1993 An evaluation of browse forage preference by sheep and goats in the Northern Guinea Savannah zone. Ghana . In: J Ndikumama and P de Leeuw (editions). Proceedings of 2nd African Feed Resources Network (AFRNET) on sustainable feed production and utilization for small holder livestock enterprises in sub-saharan Africa, Harare, Zimbabwe, 107 – 110.

Larbi A, Smith J W, Adekunle I O and Kurdi I O 1996b. Studies on multipurpose fodder trees and shrubs in West Africa variation in the determination of forage quality in Albizia and

paraserianthes. Agroforestry systems, 33, 29 – 39.

Makkar H P S, Blummel M and Becker K 1997: - In vitro rumen apparent and true digestibility of tannin-rich fingers. Animal feed Science. Technology 67: 245 - 251

Meissner H H, Viljoen M D, Van Nierkeki W A 1991: Intake and digestibility by sheep of Anthephora, Panicum, Rhodes and Smuts Finger grass pastures. Proceedings of the 10th international Rangeland Congress, September 1991, Montepellier, France. 648 – 649.

Menke K H and Steingass H 1988. Estimation of the energetic feed value obtained from chemical analysis and gas production using rumen fluid Animal Reserve. Development. 28: 7 – 55

Minson D J 1990: Forage in Ruminant Nutrition, (Academic Press, New York)

Reza A and Khan J 1981: Water hyacinth as cattle feed. Indian Journal of Animal Science 51: 702 – 706

SAS (1999): Statistical Analysis System Institute User's Guide. SAS institute, cary. North Carolina. USA.

Sunday A Dada 2002: The utilization of water hyacinth (Eichhornia crassipes) by West African dwarf goats. African Journal Biomedical. Reserved Vol 4: 147 – 149.

Van Soest, P J Robertson J B and Lewis B 1991. Methods for dietary fiber, neutral detergent fibre, and non starch polysaccharides in relation to animal nutrition. Journal of Diary Science. 74, 3583 - 3597

TRACE METAL CONCENTRATIONS IN WATER AND EDIBLE MUSCLE OF SOME COMMERCIALLY IMPORTANT FISH SPECIES IN WARRI RIVER, NIGERIA.

***Omitoyin, B. O. and Aghoghovwia, A. O.**
Department of Wildlife & Fisheries Management, University of Ibadan, Nigeria.
*Correspondent author: bo.omitoyin@mail.ui.edu.ng or bam_omitoyin@yahoo.co.uk

ABSTRACT

Concentrations of Iron, Copper, Cadmium, Chromium, Manganese, Nickel, Lead and Zinc were determined in surface water, edible muscle of some commercially important fish species, water hyacinth and soil sediments in Warri river, Nigeria. The results revealed that there were no significant differences between sampling stations and concentration of metals were independent of size of fish sampled. Only Iron (Fe) and Manganese (Mn) were detected in water sample from Warri river and Mn was found to exceed the WHO allowable limit for drinking water. This suggests that water in Warri river is polluted and is therefore unfit for drinking. Trace metal values in all fish samples analyzed from Warri river were below the allowable limit in food as recommended by WHO. However, higher levels of trace metals in water hyacinth and soil sediment above the WHO recommended levels are further confirmation that Warri river is polluted.

Key words : Trace metals ; Edible muscle ; Warri river ; Niger Delta

INTRODUCTION

Trace metal pollution of the aquatic environment has been attributed to a number of anthropogenic activities in many countries (Ashraf and Jaffar, 1990; Ajani *et al.,* 2002 and Omitoyin *et al.*, 2003). The occurrence of trace metal element in excess of natural loads in most part of the Niger Delta area of Nigeria arising from oil exploration and other anthropogenic activities have become a problem of increasing concern. The Warri river in particular receives industrial and domestic effluents from Warri metropolis, which will not only have adverse effects on the aquatic organism but may pose danger to human health. Forstner and Wittman (1979), Laws, (1981) reported that heavy metals at elevated levels in natural aquatic systems are toxic to organisms and accumulate and magnify along the food chain leading to man. Several health hazards caused by consumption of aquatic foods contaminated by heavy metal pollution have been reported (Golldwater, 1971; Laws, 1981). In spite of the hazardous nature of heavy metals in aquatic environment, regular assessment of heavy metal in Nigeria Inland and Coastal ecosystem are scanty (Mombeshora *et al*., 1981; Ajayi and Osibanjo, 1984; Kakulu *et al*., 1987; Okoye *et al*, 1991; Ezemonye, 1992; and Egborge, 1994).

The objective of the present study is to provide information on the level of some trace metal such as cadmium, chromium, copper, iron, lead, manganese, nickel and zinc in water, sediments, plants, whole and edible muscle of some commercially important fish species caught in Warri river and consumed around the Niger Delta region of Nigeria.

MATERIALS AND METHODS

Study Area

This study was carried out in Warri river, Nigeria (fig. 1). Warri river stretches within latitudes 5° 21' – 6° 00' North and longitudes 5° 24' – 6° 21' East. Its' sources is around Utagbauno and flows in southwest direction passing between Oviorie and Ovu Inland and southwards at Odiete through Agbarho to Otokutu (Egborge, 1994).

Three sampling sites were chosen for this study based on different activities along the river stretch. Location I was near Nigeria Ports Authority (NPA), with high human activities. Location II was about 3 and half Km from location I, with Aladja Delta Steel industry, residential quarters and Aladja Market while location III was at Ugbolokposo about 5Km from location II where there was relatively less human activity with no industries (fig. 1).

Sampling Techniques

Collection of water, fish, sediment and water hyacinth samples were carried out from July to September 2002. Fish sample were caught using 2½ - 5'' fleets of gill nets and traps set over night at each sampling station along

the Warri river. Fish species were selected based on the average weight which was most popular with fish consumers. Fish specimens were identified to species level using the keys and description of Boulenger (1909-1916), Reed *et al.,* (1967), Holden and Reed, (1972). Samples of fish caught were however frozen at -10^{o}C until when analysed. Water samples along the Warri river within the sampling sites was also collected in triplicates in 25 ml capacity plastic bottles with screw caps at 30cm depth and acidified using 5ml 10% nitric acid before taken to the laboratory for analysis. Soil sediments were collected with Van Veen grab from depths of between 0.5-5m and stored into clean polythene bags. While samples of water hyacinth (*Eichornia crassipes*) found along the river were collected and properly rinsed with distilled water and allowed to drain before taken to the laboratory for analysis.

Analytical Techniques

Water samples were not subjected to further treatment but were absorbed directly in the flames of the Varian Techtron B atomic absorption spectrometer.

Sediment samples were oven dried at 105^{o}C and ground to powder and passed through 2mm diameter sieve. Fish samples were allowed to thaw at room temperature and separated into species which was further divided into whole samples and edible muscles and oven dried at 105^{o}C to a constant weight. Water hyacinth was oven dried at 75^{o}C to a constant weight and grounded to fine powder. 2.5g of the ground sediment, whole fish, edible muscles and water hyacinth, were separately weighed and 10ml of nitric/perchloric acid mixture (ratio 2:1 by volume) was added to each sample and digested at 150^{o}C until a clear solution was obtained. 10 ml of distilled water was added to digested samples to prevent formation of complex compounds and filtered. The filtrates were diluted with distilled water to 50ml and analysed using atomic absorption spectrometer Buck 200A model with air acetylene flame after standardization. Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel and Zinc were determined at the following wavelength 228.8, 357.9, 324.8, 248.7, 283.3, 279.9, 232.0, and 213.5 nanometers respectively.

Statistical Analysis.

Trace metal in water, water hyacinth, sediments, whole and edible muscle of fish species caught in each sampling site throughout the sampling period were pooled together and averaged. Analysis of variance option of statistical version 5.1 was used to test for the differences in fish species diversity in sampling sites and trace metals concentration in different species of fish, edible muscle of fish, soil sediment and water hyacinth (Steel *et al*, 1997). Descriptive statistic (bar chart) was used to show the concentrations of trace metal in water in various sampling sites.

RESULTS AND DISCUSSION

Fish Diversity of the Study Area

In terms of fish diversity, more fish were caught in location I belonging to three families and four species, followed by location III with three families and three species and location II with two families and two species (table 1). This finding can be justified by the fact that location I is close to the Forcados river and the Bright of Benin hence there is free entry of fish from the sea. This agrees with the report of NEDFCO, (1961) and Egborge, (1994). This could also partly explain reason responsible for lowest level of trace metal in this location. Lowest fish diversity and higher levels of trace metal in location II could be as a result of high anthropogenic activities and effluent from the steel industry. While relatively high fish diversity and low trace metal level in location III may be attributed to low human activities and absence of any industry.

Trace Metal Concentration in Water Sample

Trace metal concentration in water are presented in figure 2. Only Fe and Mn were detected in water samples collected at the three locations. Values of Fe were 0.3 μgg^{-1} , 1.5 μgg^{-1} and 0.4 μgg^{-1} in locations I, II and III respectively, while Mn values were 2.0μgg^{-1}, 1.5μgg^{-1} and 0.0μgg^{-1} in locations I, II and III respectively. In general location II had the highest values of Fe, while location I had highest value of Mn. High levels of Fe and Mn in water in this study is an indication that Warri river is polluted. The values obtained in this study compares favourably with those reported by Oguzie, (2000) for Fe and Mn for lower Ikpoba river, Benin city but were lower than those reported by Fufeyin, (1994), Oguzie, (1996) and Obasohan and Oronsaye, (2000). The level of Fe shows that it is within the allowable limits in drinking water as recommended by WHO, (1984) but the level of Mn exceeded the 0.1 - 0.5 μgg^{-1} recommended which is an indication that the water is polluted.

Trace Metal Concentration in Edible Muscle, Plant and Sediment.

The mean trace metal concentrations in edible muscle of fish samples collected from

Warri river at different locations are presented in table 2. In general, all fish species analysed in this study accumulated trace metals, although the levels varied from species to species but there were no significant differences between samples in the three stations, and the metal concentrations were independent of the size of fish samples. This deduction agrees with previous report of Alexander and Young, (1976) and Kpee *et al,* (2000). Iron (Fe) content ranged between 0.026 and 0.118μgg^{-1} among species, minimum Fe value was recorded in *Gymnarchus niloticus* and highest in *Sersema angolense.* Copper (Cu) levels ranged between 0.0022 and 0.048μgg^{-1} and the least Cu levels was obtained in *G. niloticus* while the highest in *S. angolense*. *C. nigrodigitatus* and *T. zillii* had similar Cu content. The lowest Cadmium (Cd) level was 0.0006 in *C. nigrodigitatus* and maximum was 0.0036 μgg^{-1} in *S. angolense.* Lead (Pb) values ranged between 0.0064 and 0.106 μgg^{-1} in *C. nigrodigitatus* and *P. elongates* in a ratio of 1:16. This suggests a much higher species specificity of Pb. Zinc (Zn) and Nickel (Ni) levels were consistent for all species but lower than values reported by Ashraf and Jaffar, (1989). Chromium (Cr) values recorded were very low with range of 0.0001 μgg^{-1} to 0.0024 μgg^{-1}. Minimum value of Cr was detected in *P .elongatus* and the highest in *S. angolensis* and *C .laticep* respectively. Manganese (Mn) level of 0.0045 μgg^{-1} was detected in *X. nigri* and highest value of 0.209 μgg^{-1} *in S. angolense*. There was a direct relationship between the concentration of trace metal in fish and the level detected in water. According to Lowman *et al*, (1971) concentration of essential trace metals is generally higher in organism than water. Luoma and Bayan, (1982), Tressier *et al,* (1984) further reported that contaminants bioavailability tends to be proportional to its concentration in organism which was the observation in this study.

Level of six trace metals Cd, Cr, Cu, Ni, Mn and Zn in water hyacinth (*E. crassipes*) in this study were higher than those detected in sediment, edible muscle and water (table 3). Sediment had the highest concentration of Cu while edible muscle had the highest concentration of Pb. Lower concentration of trace metal in water as observed in this study shows that analysis of water only for trace metal may give a highly misleading result of metal pollution status thus underestimating the total metal concentration in aquatic environment (Yamazaki *et al*, 1996; Kpee *et al*, 2000). Drastic reduction and complete elimination of some trace metals in water as observed in this study compared with previous studies (Mombeshora *et al*; 1981; Kakalu *et al*; 1987 and Ezomoye, 1992) may be due to the presence of water hyacinth in the river which Egborge, (1994) and The World Book Encyclopedia, (1999) reported has the capacity to absorb chemicals, heavy metals and clean up polluted water body. This also justify the high levels of these trace metals in water hyacinth. The levels of the eight trace metals detected in edible muscles of fish samples in this study was below the acceptable limit in food fish (WHO, 1984) and are also lower than levels previously reported by Kakulu *et al*; (1987) and Ezemonye, (1992). (table 4)

CONCLUSION

Fe and Mn were detected in water sample of Warri river and Mn was found to exceed the WHO allowable limit for drinking water. This suggests that water in Warri river is polluted and is therefore unfit for drinking. Although, trace metal values in all fish samples analyzed from Warri river were below the allowable limit in food as recommended by WHO, further proof of pollution level was signified by higher levels of trace metals in water hyacinth and soil sediment.

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REFERENCES

Ajani E.K, Omitoyin B.O; Adebusoye F. and Ajani F. 2002. Bioaccumulation of Copper, Lead and Zinc in the Organs and Tissue of *Tilapia zillii* in Eleiyele Lake, Ibadan Nigeria. *Nigerian Journal of Forestry Vol.32 NO.2 p.76-78*

Ajayi, S.O. and Osibanjo, O. 1984. Self purification constants for a Nigerian stream. *Water Res. 8(14)*:505-506

Alexander, G.V. and Young, D.R. 1976. Trace metals in southern Califonian mussels. *Marine Pollution Bulletin, 7-9*

Ashraf, M. and Jaffar, M. 1990. Trace metal concentrations in edible muscle of of six species of fish from the Arabian Sea. *Fisheries Research 8*:287-291

Boulenger, G.A. 1906-1916. Catalogue of the Freshwater Fishes of Africa in British Museum (Natural History) Volume 5: I-IV. British Museum Natural History, London.

Egborge, A.B.M. 1994. Water pollution in Nigeria Volume 1. Biodiversity and Chemistry of Warri river. Ben Miller Books Nigeria Ltd, Warri. Pp 1-34

Ezemonye, L.I.N. 1992. Heavy metal concentration in water, sediment and selected fish of Warri river and its tributaries. P.hD thesis, University of Benin, Benin City, Nigeria.

Forstner, U. and Wittman, G.T.U. 1979. Metal pollution in the aquatic environment. Springer Verlag, Berling pp. 99-118

Fufuyen, T.P. 1994. Heavy metals concentration in water, sediments and fish species of Ikpoba reservoir in Benin City, Nigeria.. P.hD thesis, University of Benin, Benin City.

Goldwater, L. 1971. Mercury in the environment. Sci. Am. 224(5): 15-39

Kakulu, S.E; Osibanjo, O. and Ajayi, S.O. 1987. Trace metal content of fish and shell fishes of the Niger Delta area of Nigeria. *Environ. Inter. Vol. 13*:247-252

Kpee, F; Horsfall, M Jrn.and Spiff, A.I. 2000. Determination of trace metal levels in the shellfish Dogwhelk (*Thais haemostoma*) from Brass river Nigeria. *J. Appl. Sci. Environ. Mgt Vol. 4(2)*:91-94

Laws, E.A. 1981. Aquatic pollution. John Wiley and Sons, New York. Pp.301-369

Lowman, F.G; Stevensonn, R.A; McClin Escalera, R. and Lugo Ufret, S. 1971. The effects of river outflows upon the distribution patterns of fallout radioisotopes in marine organisms. In: Radioecological Concentration Processes, Pergamon Press, Oxford and New York. Pp735-752

Luoma, S.N and Bryan, G.W. 1982. A statistical studies of environmental factors controlling concentrations of heavy metals in the burrowing bivalve *Scrobicularia plana* and the polychaete *Nereis diversicolor*. *Estuarine ,Coastal and Shelf Science, 97/98*:595-615

Mombeshora, C; Ajayi, S.O. and Osibanjo, O. 1981. Pollution studies on Nigerian rivers. Toxic heavy metal status of surface waters in Ibadan city. *Environmental International 5:* 49-53

NEDECO (Netherlands Engineering Consultants). 1961. The Waters of the Niger Delta. The Hague, 2nd revised edition, 317p

Norris, R.H. and Lake,P.S. 1984. Trace metal concentrations in fish from the South Esk river, North eastern Tasmania, Australia. *Bull. Environ. Cont. Toxicol. 33*:348-354

Obasohan, E.E. and Orosanye, J.A.O. 2000. Heavy metals in water, sediments and some important fish species from Ikpoba river, Benin City; *Nigeria J. Appl.Sc. Environ.Mgt. Vol. 4(2):* 63-68

Oguzie, F.A. 1996. Heavy metals and freshwater and effluents of lower Ikpoba river in Benin City. P.hD thesis, University of Benin, Benin City.

Okoye, B.C.O; Afolabi, O.A. and Ajao, E.A. 1991. Heavy metals in the Lagos Lagoon sediments. *Intern. J. Environmental Studies, Vol.37*: 35-41

Omitoyin B.O, Ajani E.K. and Adebusoye F. 2003. Bioaccumulation of Copper, Lead and Zinc in the Organs and Tissue of *Clarias gariepinus* (Burchell1822) in Eleiyele Lake Ibadan, Nigeria. *Journal of Environmental Extension Vol.4 p74-78*

Reed, W; Burchard, J; Hopson, A.J. and Jenness, J. 1967. Fish and Fisheries of Northern Nigeria. 226pp

Reed, W. and Holden, M. 1972. West Africa Freshwater Fishes. Longman group, London.68pp

Steel, R.G; Torrie, J.H. and Dickey, D.A. 1997. Principles and procedures of statistic: A biometrical approach, Mcgraw-hill, Singerpore.

The World Book Encyclopedia. 1999. *WXYZ Vol.21* World Book Inc. 525 west Monroe Chicago, 11, 606661.

Tressier, A; Campbell, P.G.C; Auclair, J. C. and Bisson, M. 1984. Relationships between the partitioning of trace metals in sediments and their accumulation in the tissues of freshwater mollusk *Elliptio complanata* in a mining area. *Geochimica et Cosmochimica Acta, 49*: 183-194

World Health Organization. 1984. Guide for drinking water quality and food Volume recommendation Geneva, WHO 130p

Yamasaki, M; Tanizaki, Y. and Shimkawa, T. 1961. Silver and other trace elements in freshwater fish *Carasius auratus langsodorfill*, from Asakawa river in Tokyo, Japan. Environmental Pollution 94(1):83-90.

Table 1: Mormphometric data of fish samples from Warri river

Location	Family	Fish species	Total length(cm)	Standard length(cm)	Average weight(kg)	S.D
I Nigeria Ports Authority	Bagridae	*Chrysicthys nigrodigitatus*	32.50	25.50	0.36	±0.416
	Bagridae	*Clarotes laticep*	38.00	31.00	0.64	±0.739
	Cichlidae	*Tilapia zillii*	26.50	23.50	0.15	±0.174
	Grapsidae	*Sersma angolense*	6.00	4.00	0.06	±0.070
II Aladja Steel town	Cynoglossidae	*Cynoglosus browni*	55.00	50.00	0.6	±0.687
	Scianidae	*Pseudotolinthus elongatus*	30.00	25.00	0.23	±0.236
III Ugbolokposo	Gymnarchidae	*Gymnarchus niloticus*	53.00	46.00	0.37	±0.421
	Channidae	*Parachanna obscura*	33.00	30.00	0.35	±0.405
	Notopteridae	*Xenomystus nigri*	33.00	28.00	0.21	±0.239

Table 2: Mean concentration of trace metals in different fish species from Warri river (µgg^{-1} wet weight)

Species	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
C. laticep	0.0017±0.020	0.0024±0.028	0.0028±0.032	0.0780±0.090	0.0205±0.237	0.0140±0.016	0.0118±0.137	0.0696±0.402
C.nigrodigitatus	0.0006±0.072	0.0012±0.002	0.0040±0.005	0.092±0.106	0.0185±0.021	0.0076±0.009	0.0640±0.074	0.0756±0.087
T. zilli	0.0007±0.001	0.0020±0.003	0.0040±0.005	0.090±0.104	0.0345±0.040	0.0080±0.009	0.0096±0.011	0.0836±0.097
S. angolense	0.0036±0.004	0.0024±0.003	0.0480±0.056	0.1180±0.136	0.2095±0.121	0.0180±0.021	0.0202±0.023	0.0816±0.094
C. browni	0.0014±0.003	0.0008±0.001	0.0020±0.003	0.0500±0.058	0.0770±0.089	0.0092±0.106	0.0840±0.097	0.0576±0.067
P. elongates	0.0002±0.002	0.0001±0.000	0.0022±0.003	0.054±0.062	0.0315±0.036	0.0124±0.014	0.1060±0.122	0.0536±0.062
P. obscura	0.0174±0.202	0.0022±0.026	0.0026±0.030	0.090±0.105	0.0300±0.018	0.0130±0.015	0.0150±0.017	0.1476±0.170
X. nigri	0.0011±0.129	0.0022±0.026	0.0024±0.028	0.050±0.020	0.0045±0.052	0.0104±0.012	0.0148±0.171	0.0696±0.804
G. niloticus	0.0011±0.129	0.0012±0.015	0.0022±0.026	0.026±0.034	0.0171±0.029	0.0084±0.097	0.0074±0.086	0.0416±0.480

Table 3: Mean concentration of trace metals (µgg^{-1}) in Water, Edible muscle of fish, Water hyacinth and Sediment in Warri river.

Parameters	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Water	0.0000^{a}	0.0000^{a}	0.0000^{a}	0.730^{a}	1.1700^{b}	0.000^{a}	0.000^{a}	0.000^{a}
Fish	0.0013^{a}	0.0014^{a}	0.0064^{a}	0.0673^{a}	0.0467^{a}	0.0111^{a}	0.0398^{a}	0.0732^{a}
Water hyacinth	0.0017^{a}	0.0102^{b}	0.0047^{a}	11.0237^{c}	8.5070^{c}	0.0197^{b}	0.0880^{a}	0.2374^{b}
Sediment	0.0003^{a}	0.0052^{a}	0.0134^{a}	3.7792^{b}	0.9000^{b}	0.0046^{a}	0.0352^{a}	0.0983^{a}

Means with the same letter along the vertical row are not significantly different from each other ($p>0.05$).

Table.4: Mean metal concentrations in edible muscle of commercial fish species in Warri river (Present study) with recommended values by WHO, (1984); Kakulu *et al*; (1987 for Niger Delta) and Ezemonye, (1992 for Warri river)

Trace metals(µgg^{-1})	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Present study	0.0013	0.0014	0.0064	0.0673	0.0467	0.0111	0.0398	0.0732
WHO, (1984)	2.00	0.05-0.15	1-3	1-3	0.1-0.5	0.5-0.6	0.1-0.2	10-75
Kakulu *et al*, (1987)	0.055	-	0.187	8.805	-	-	-	-
Ezemonye, (1992)	0.19	0.225	0.038	1.130	0.442	-	0.152	-

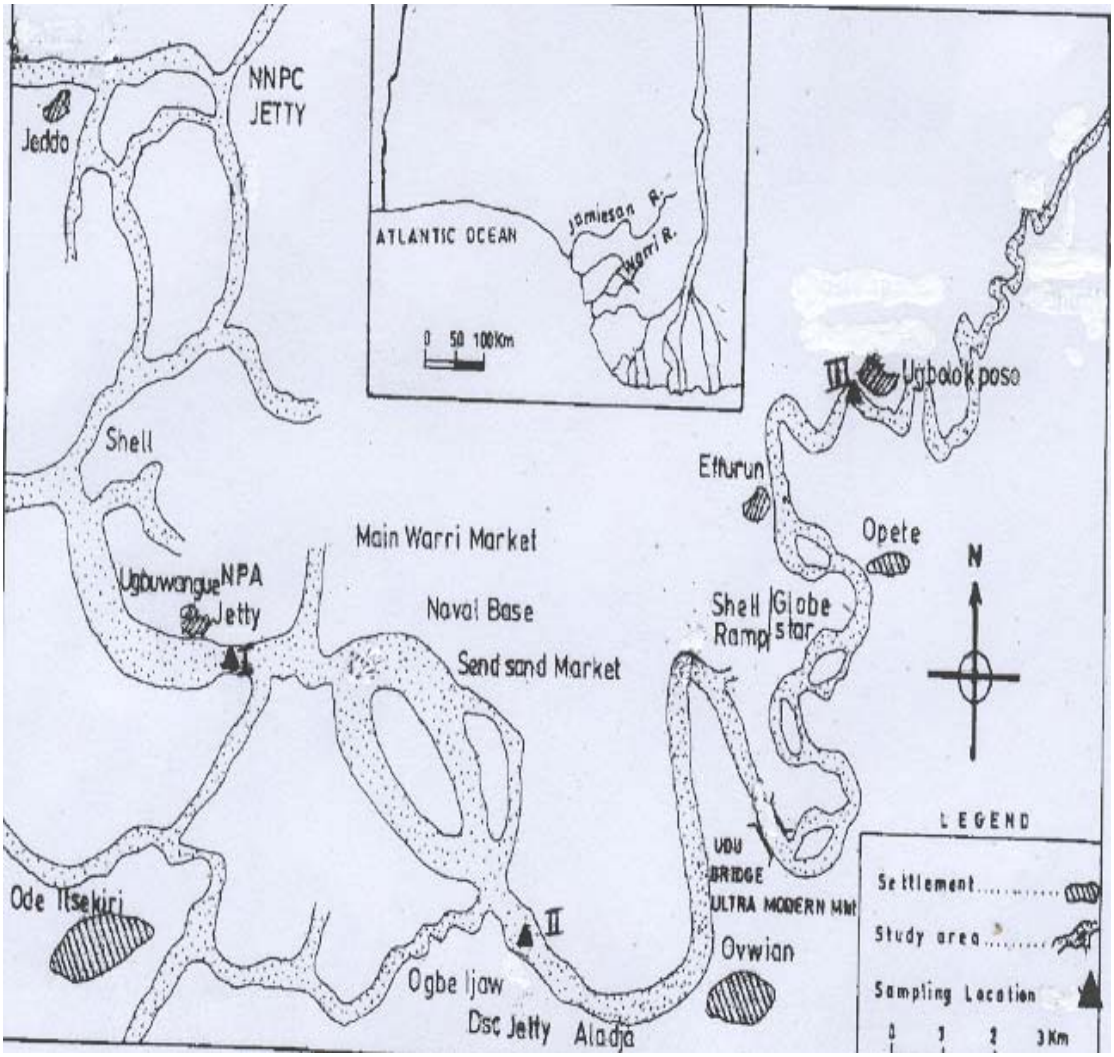


Figure 1: Map of Warri River showing sampled stations

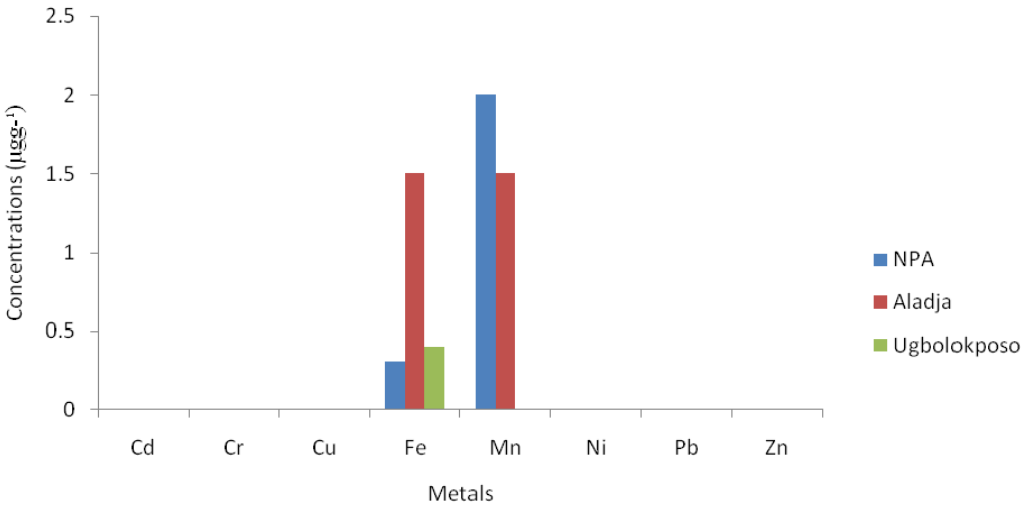


Fig. 2: Mean trace metal concentrations in water at different sampling locations

TOLERANCE LEVEL AND METABOLIC RESPONSE OF *CLARIAS GARIEPINUS* FINGERLINGS TO POTASSIUM PERMANGANATE TOXICITY.

Ajani, E. K. and Ajani F.
Department of Wildlife and Fisheries Management, University of Ibadan, Nigeria
Email: ekajani@mail.ui.edu.ng.

ABSTRACT

Potassium permanganate is one of the widely used chemicals in aquaculture, its usage if not properly controlled may stress the cultured fish. This study examined the metabolic responses of *C. gariepinus* fingerlings to stress due to potassium permanganate toxicity.

Fingerlings of *C. gariepinus* of the same parental stock were placed randomly in six plastic tanks; ten fingerlings were placed in each of the tanks. Each tank was exposed to 1.5mg/l of potassium permanganate. The exposure time served as treatments and it was varied as follows: 0 (control), 6, 24, 48, 72 and 96 hours. The blood samples were collected at each time interval as listed above. These samples were analyzed for heamatological and biochemical parameters.

The Red Blood Cell (RBC) value decreased significantly ($p< 0.05$) from 3.45 ± 0.69 10^6l recorded in fish exposed to 0 hour of potassium permanganate to 2.30 ± 0.47 10^6l in 24 hour of exposure, this latter gradually increased in 48 hours of exposure to 3.91 ± 0.21 10^6l at 96 hour of exposure. The plasma glucose level in the *C. gariepinus* exposed to potassium permanganate increase significantly ($p< 0.05$) to 98.20 ± 2.09mM under 6 hour of exposure from 94.15 ± 1.87mM, this was followed by rapid but significant reduction to 56.00 ± 2.34mM at 96 hour of exposure.

Potassium permanganate is relatively nontoxic to cultured fish species, however at certain concentration level, this study has shown that it may affect the physiological state of the fish. It is therefore recommended that the fish farmer should have clear understanding of the mechanism of using potassium permanganate so as to minimize the possible toxic effect of potassium permanganate.

Keywords: Toxicity, metablolic response, Potassium permanganate, *Clarias gariepinus*

INTRODUCTION

Potassium permanganate is one of the widely used chemicals in aquaculture where it is used to kill parasites on fish and also used to improve water quality (Straus, 2004). Potassium permanganate has the abilities to oxidize organic matters and kill bacteria; as a result, it reduces chemical oxygen demand and biological oxygen demand of pond waters. The end product of the oxidation reaction between KMnO4 and organic substances, manganous dioxide (MnO2-) is also toxic to animals (Chanratchakool *et. al.* 1994). The treatment using potassium permanganate is not always effective for the intended purposes. Chanratchakool *et.al.* (1994) reported that at certain concentration, potassium permanganate acts as toxicant.

Tierney *et. al.* (2004) and Liu *et. al.* (1995) observed that oxygen consumption, lipid metabolism, lactic acid, tissue glycogen and blood glucose levels are usually altered after fish exposure to a toxicant. These physiological parameters can be used to detect the impact of different toxicants to fish and how they affect production potential of the fish. Stress due to toxicant application may have specific actions as they target specific physiological systems (Schreck *et. al.* 2001).

There was a growing body of knowledge about the fish health, based on these normal values of the physiological characteristics have been sufficiently established so that departure from normal can be used as indicators for sub lethal problems (Schreck *et. al.* 2001)

The acute toxicity and metabolic effects of potassium permanganate (KMnO4) to many species of fish has been studied (Dorzab and Barkoh, 2005). Although African catfish (*C. gariepinus*) production is a rapidly growing aquaculture industry in Africa there is presently no data on the metabolic response of *C. gariepinus* to potassium permanganate toxicity. This information will greatly help in husbandry and management of African catfish in aquaculture. This study therefore examined the metabolic responses of *C. gariepinus* fingerlings to stress due to potassium permanganate toxicity.

MATERIALS AND METHODS

Experimental Chemical

Potassium permanganate ($KMnO_4$) of molecular weight: 158.08 assay not less than 99%, chloride not more than 0.05% (Cl) and sulphide not more than 0.05% (SO_4) was used. Sub-lethal test concentration of 1.5mg/l was used for this study. This was based on the 96hr LC_{50} for potassium permanganate (3.0mg/l)for most fish species as reported by Duncan (1974).

Experimental Procedure

200 *C. gariepinus* fingerlings of the same parent stock (mean weight 8.20+ 1.20g; mean length 7.60 ± 2.85cm) were obtained from a commercial fish farm in Ibadan, Nigeria. The fish were acclimatized to laboratory condition for two weeks before the experiment. The fish were kept in a 40 litre capacity circular plastic tank containing 30 litres of dechlorinated tap water. A 12 hour photoperiod (light from 08 to 20hours) was maintained (Ajani 2006). The fish responded to feeding (40% commercial diets – Durantee Fish feed) in the laboratory and were in good health under acclimatization.

The fish were starved for 24 hours before the commencement of the experiment.

10 fingerlings of *C. gariepinus* were placed in six experimental tanks (40 litres capacity circular tank containing 20 litres of water). Each tank was exposed to 1.5mg/l of potassium permanganate. The exposure time serves as treatments and it was varied as follows: 0 (control), 6, 24, 48, 72 and 96 hours. The treatments were replicated thrice.

Semi-static renewal method was used during which water was changed and replaced with fresh toxicant every 24 hours.

Blood collection and preparation

Fish were anaesthetized with buffered MS222 (50 mg/L) and blood was collected with a hypodermic syringe from the caudal vein (Barton and Iwama 1991). The blood collection lasted less than 3 min in order to avoid cortisol rise induced by the manipulation during sampling. The extracted blood was divided in two sets of eppendorf tubes. The first set contained heparin, used as anticoagulant, for hematology analysis

The second set (serum collection), without anticoagulant, was left to clot at 4 ^oC and centrifuged at 5000 rpm for 10 min at room temperature. The collected serum was stored at –20 ^oC for serum biochemical analysis.

Physiological measurements:

Hemoglobin levels (Hb, g/dl) were determined colorimetrically by measuring the formation of cyanomethaemoglobin according to Kelly (1979). Red blood cells (RBCs, cells/μl) were counted under the light microscope using a Neubauer hemocytometer after blood dilution with phosphate-buffered saline (Kelly, 1979). PCV was read through the use of haemocrit reader (Kelly 1979). Total leucocyte count was determined through use of method described by Schalm *et. al.* (1978).

Glucose was determined colorimetrically using glucose kits according to Barton and Iwama (1991). Total protein content in plasma was determined colorimetrically according to Henry (1964). The plasma sodium and potassium levels were determined by using flame photometer (Corning EL. 400) according to Ogunsanmi *et. al.*(1994).

Statistical analysis:

Data obtained were subjected to two-way ANOVA and the differences between means were at the 5% probability level using Duncan's new multiple range test. The software SPSS, version 10 (SPSS, Richmond, USA) was used as described by Dytham (1999).

RESULTS

Table 1 shows the haematological parameters of *C. gariepinus* subjected to sub–lethal concentration of potassium permanganate toxicity.

The RBC value decreased significantly ($P< 0.05$) from $3.45 \pm 0.69\ 10^6$l recorded in fish exposed to 0 hour of sub-lethal level of potassium permanganate to $2.30 \pm 0.47\ 10^6$l in 24 hour of exposure, this was followed by gradually increase in 48 hours of exposure to $3.91 \pm 0.21\ 10^6$l at 96 hour of exposure.

The PCV level in fish exposed to sub lethal level of potassium permanganate increase from $29.69 \pm 0.20\%$ (treatment 1) to $30.80 \pm 1.05\%$ (treatment 2); this was followed by significant decrease ($P<0.05$) to $28.40\pm 0.89\%$ in treatment 3 after which there was a gradual but significant increase ($P< 0.05$) to $30.12 \pm 0.55\%$ in treatment 6.

The WBC value recorded a decrease from the value of $2.42 \pm 0.60\ 10^9$l obtained in fish exposed at 0 hour of sub- lethal concentration of potassium permanganate to 1.65 ± 0.0410^9l in 6 hour of exposure, this value rose significantly ($P<0.05$) during 24 hour of exposure to $3.80 \pm 1.08\ 10^9$l at 96 hour of exposure.

The plasma glucose level in the *C. gariepinus* exposed to sub-lethal level of potassium permanganate increase significantly ($P< 0.05$) to 98.20 ± 2.09mM under 6 hour of exposure from 94.15 ± 1.87mM, this was followed by rapid but significant reduction to 56.00 ± 2.34mM at 96 hour of exposure (table 2).

The plasma protein value reduced from 3.40 ± 0.05g/dl in 0 hour of exposure to 2.40 ± 0.62g/dl at 24 hour of exposure, this was followed by 60% increase in the plasma protein at 96hour of exposure.

DISCUSSION

The initial decline experienced in RBC and PCV concentrations of the fish on exposure to sub-lethal concentration of PM is not unconnected with the presence of the stressor (PM) which led to hemodilution due to impaired osmoregulation. The subsequent increase in RBC and PCV levels agreed with the observations of Ajani (2006) and Alkahem *et. al.* (1998) that a stress – medicated condition triggered the release of new erythrocytes from erythropoietic tissue to improve the oxygen carrying capacity of exposed fish blood with resultant higher values of erythrocyte count. Adeyemo *et. al.* (2003) reported that a reduced quantity and quality of erythrocytes and a decreased haemoglobin level lead to a deteriorated oxygen supply. In addition to the transport of oxygen, erythrocytes have other functional tasks in the body, an insufficient quantity and quality of red cells would therefore consequently have several additional effects on metabolism beyond the simple oxygen supply for tissue metabolism, decrease plasma protein level has also been reported to be suggestive of malabsorption (Gross *et al*, 1996).

The count of red blood cells is quite a stable index and the fish body tries to maintain this count within the limits of certain physiological standards using various physiological mechanisms of compensation. Haemoglobin concentrations reflect the supply of an organism with oxygen and the organism itself tries to maintain them as much stable as possible.

Haematological indices (erythrocyte count, concentration of haemoglobin, per cent of haematocrit, and concentration of glucose) can be secondary responses of an organism to irritants (Barton 1997). A short-term exposure to low concentrations of heavy metals mostly induces an increase of these haematological indices (Vosylienë 1999).All that reflects the beginning of stress reaction in fish caused by chemicals.

Fish stress reaction causes an osmotic disbalance and changes in the regulatory system of ionic interchange which can diminish pH of blood and increase the volume of erythrocytes and, subsequently, the per cent of haematocrit. This index, however, can change because of other reasons too. Under the stress, the secreted epinephrine causes the contraction of spleen and erythrocytes from this organ are released to blood. Their higher count correspondingly increases the share of haematocrit. A decrease in the erythrocyte count or in the per cent of haematocrit indicates the worsening of an organism state and its developing anaemia. A decrease in the concentration of haemoglobin in blood, which is usually caused by the effect of toxic metals on gills, as well as a decrease in oxygen also indicates anaemia or confirms negative changes occurring in fish.

The white blood cell of the experimental fish decreases in the value on exposure to sub-lethal concentration of PM, this may be due to the reaction of the fish to the toxic effect of PM. Alkatiem (1994) reported reduction in the number of circulating thrombocytes and lymphocytes of fish on exposure to toxicant is due to a diminution in delivery of lymphocytes to circulatory system through a reduced lymphocyte production and rapid destruction of cells, which leads to an increased rate of peripheral removal of lymphocytes such lymphopenias to the lysis of lymphocytes after exposure to toxicants (Murad and Houston 1988; Ajani 2006).

An increase in the leucocyte count is mostly observed during the first days of stress reaction when fish tries to restore disturbed homeostasis, however later a decrease of leucocytes count can be observed, which shows the weakening of the immune system.

The initial increase recorded in the plasma glucose level may be due to the stress response to the toxicant by the fish in order to provide energy to the fish for the “fight or flight” reaction (Colombo *et. al.* 2000). Fish has been reported to mobilize its energy reserve in attempts to avoid or overcome the immediate threat however the initial mobilization of energy could not overcome the immediate threat of toxicant (PM) leading to the gradual depletion of energy and subsequent reduction in glucose level after long hours of exposure.

Glucose is one of the most sensitive indices of the stress state of an organism: its high concentrations in blood indicate that the fish is in stress and it is intensively using its energy reserves i.e. glycogen in liver and muscles. Meanwhile, a decreased

concentration of glucose indicates the exhaustion of energy (glycogen) resources and, subsequently, the worsening of an organism status (Vosylienë 1999).

The initial reduction in plasma protein may be due to sever effect of the toxicant which led to osmotic imbalance. This is in line with the observations of Hussein *et. al.* (1996) and Alkahem *et. al.* (1998) that the reduction in the proteins to fulfill an increased energy demand by fish to cope with detrimental conditions imposed by the toxicant.

CONCLUSION

Although potassium permanganate (PM) is a widely used oxidant biocide in the aquaculture industry and potassium permanganate is relatively nontoxic to cultured fish species, at certain concentration level this study has shown that it may affect the physiological state of the fish. It is therefore recommended that the fish farmer should have clear understand on the mechanism of using potassium permanganate so as to minimize the possible toxic effect of potassium permanganate

REFERENCES

Adeyemo, O.K.; Agbede, S.A.; Olaniyan, A. O. and Shoaga, O. A. (2003): The haematological response of *C. gariepinus* to changes in acclimation temperature. *African Journal of Biomedical Research* 6: 105 - 108

Ajani F.(2006): Hormonal amd Haematological responses of adult and broodstock *C. gariepinus* (Burchell 1822) to ammonia and nitrite toxicity under different culture environments. Ph. D. thesis University of Ibadan, Nigeria 180pp.

Alkahem, H. F., Ahmed Z.; Al- Akel A. S. and Shamusi, M.J.K. (1998): Toxicity bioassay and changes in haematological parameters of *Oreochromis niloticus* induced by trichlorfon. *Arab. Gulf J. Sci. Res.* 16 (3) 581 – 593

Alkahem H. F. (1994): The toxicity of nickel and the effects of sublethal levels on haematological parameters and behaivour of the fish *O. niloticus*. *J. Univ. Kuwait* (Sci) 21: 243 - 252

Barton B. A.1. (1997): Stress in finfish- a historical perspective. *Society for experimental biology*. Seminar series 62: 12 – 13.

Barton B.A., and Iwama G.K. (1991). Physiological changes in fish from stress in aquaculture with emphasis on the response and effects of corticosteroids. *Annual Review of Fish Diseases* **1**: 3–26.

Chanratchakool, P., J.F. Turnbull and C. Limsuwan. (1994). Health management. Aquatic Animal Health Research Institute, Department of Fisheries. Kasetsart University Campus.Bangkok.

Colombo JC, Bilos C, Remes Lenicov M, Colautti D, Landoni P, Brochu C (2000). Detritivorous fish contamination in the Río de la Plata estuary: a critical accumulation pathway in the cycle of anthropogenic compounds. *Can J Fish Aquat Sci 57*:1139-1150.

Dorzab T., and A. Barkoh 2005: Toxicity of copper sulfate and potassium permanganate to rainbow trout and golden alga *Prymnesium parvum*. Pages 20-24 *in* A. Barkoh, and L. T. Fries, editors. Management of *Prymnesium parvum* at Texas state fish hatcheries. Texas Parks and Wildlife Department, Management Data Series No. 236, PWD RP T3200-1138 (9/05). Austin.

Dytham, C.(1999). *Choosing and Using Statistics: A Biologist's Guide*. Blackwell Science Ltd., Malden, Massachussetts

Gross R., Gliwitzki M., Gross P. and Klaus F. (1996). Food and Nutrition BulletinVolume 17, Number 1, United Nations University Press.

Henry, R. J. (1964): Colorimetric determination of total protein. In: *Clinical Chemistry*. Harper and Row Publ., New York, pp 181.

Hussein S.Y., El-Nasser M. A.and Ahmed S. M. (1996): Comparative Studies on the Effects of Herbicide Atrazine on Freshwater Fish *Oreochromis niloticus* and *Chrysichthyes auratus* at Assiut, Egypt. *Bulletin of Environmental Contamination and Toxicology* Volume 57, Number 3

Jain, N. C. 1986. Schalm's Veterinary Hematology, 4th ed. Philadelphia: Lea & Febiger.

Kelly W. R.(1979) : *Veterinary Clinical Diagnosis* 2nd ed. Balliere Tindall, London 266 – 279pp

Liu, J.S., J.S. Chen, and Z.T. Yu (1995): The Effect of Common Fungicides on Chinese Sucker Myxocyprinus asiaticus Eggs*. J.World Aquacult.Soc.* 26(1):84-87

Murad A. and Houston A. H. (1988): Leucocytes and leucopoietic capacity in gold fish *Carassius auratus* exposed to sub-lethal levels of cadium. *Aquatic Toxicology* 13: 141 – 154.

Ogunsanmi, A. O.; Akpavie, S. O. and Anosa, V. O. (1994): Serum biochemical changes in West African Dwarf sheep experimentally infected with *Tryanosoma brucei. Res. Elve. Med. Vet. Pays. Trop.* 49 (2): 195 - 200

Schalm, O.W., Jain N. C. and Carrol E. J. (1975): *Veterinary Haematology*. 3rd Ed. Philadelphia, Lea and Febiger 15 – 81pp

Schreck, C. B., W. Contreras-Sanchez, and M. S. Fitzpatrick. (2001). Effects of stress on fish reproduction, gamete quality, and progeny. *Aquaculture*, 197:3-24.

Straus, D.L. (2004). Comparison of the acute toxicity of potassium permanganate to hybrid striped bass in well water and diluted well water. *Journal of the World Aquaculture Society*. 35(1):55-60.

Tierney, K.B., A. Ferrel, and C. Kennedy. (2004). The differenctial leucocyte landscape of four teleosts: juvenile Onchorhynchus kisutch, Clupea pallasi, Culdea inconstans and Pimephales promelas. *J. of Fish Biology*. 64(4): 906-919.

Vosylienë M. Z. (1999): The effect of heavy metals on haematological indices of fish (survey). *Acta Zoologica Lituanica. Hydrobiologia*. 1999. Volumen 9. Numerus 2.

Table 1: Haematological parameters of *C. gariepinus* subjected to sub-lethal concentration of potassium permanganate toxicity

Parameters\ Exposure times	RBC (10^6/l)	PCV (%)	WBC (10^9/l)	Hb (g/dl)	Platelet (10^9/l)
0	3.45 ±0.69[a]	29.69± 0.20[a]	2.42 ±0.60[a]	10.42± 0.50[a]	4.20± 0.70[a]
6	3.05 ±0.12[b]	30.80± 1.05[a]	1.65 ±0.04[b]	10.04 ±0.32[a]	4.01± 0.84[a]
24	2.30 ±0.47[c]	28.40 ±0.89[b]	1.80 ±1.02[b]	9.40± 0.22[b]	2.85± 0.12[b]
48	2.58 ±0.16[c]	28.95± 0.22[b]	2.10 ±0.63[a]	10.15± 0.59[a]	2.02± 0.30[c]
72	3.12 ±0.30[b]	28.90 ±0.15[b]	3.05 ±0.25[c]	11.16± 0.54[c]	3.48± 1.29[d]
96	3.91 ±0.21[a]	30.12 ±0.55[a]	3.80 ±1.08[d]	10.23± 0.72[a]	3.90± 1.26[d]

Means followed by the same superscript in each column are not significantly different (P > 0.05)

Table 2: Plasma Biochemistry of *C. gariepinus* subjected to sub-lethal concentration of potassium permanganate toxicity

Parameters\ Exposure times	Plasma glucose (mM)	Plasma Sodium (mg/dl)	Total Protein (g/dl)	Plasma Potassium (mg/dl)
0	94.15± 1.87[a]	125.00± 0.66[a]	3.40± 0.05[a]	3.40± 0.05[a]
6	98.20± 2.09[b]	124.80± 0.80[a]	3.00± 0.18[a]	4.90± 0.20[b]
24	80.10± 1.52[b]	120.00± 0.20[b]	2.40± 0.62[b]	4.20± 0.05[b]
48	60.00± 1.00[c]	120.05± 0.55[b]	3.10± 0.18[a]	3.80± 0.10[a]
72	58.00± 1.60[c]	123.10± 0.42[a]	3.25± 0.50[a]	3.85± 0.50[a]
96	56.00± 2.34[c]	120.00 ±0.15[b]	3.84± 0.15[c]	3.42± 0.03[a]

Means followed by the same superscript in each column are not significantly different (P > 0.05)

EFFECT OF TEMPERATURE ON SPOILAGE OF FRESH AND FROZEN FISH SOLD IN MARKETS IN IBADAN

Adeyemo*, O.K.; Aluko, O.O.; Agbede, S.A.
Fish and Wildlife Unit, Department of Veterinary Public Health and Preventive Medicine,
University of Ibadan, Ibadan, Nigeria.
*Corresponding Author: Tel: +234-805-545-45440
E-mail: olanikeadeyemo@hotmail.com; olanike.adeyemo@mail.ui.edu.ng

ABSTRACT

The study determined the progression of spoilage in response to temperature and also ascertained the wholesomeness of fish offered for sale at different times of the day from selected markets in Ibadan. Fresh and frozen fish were bought from Sango and Bodija markets in Ibadan, the temperature was recorded and the samples were transported in a Coleman cooler to the laboratory for further analysis. Upon arrival, the temperature was again recorded and samples were exposed to different environmental temperatures; assessment for spoilage was conducted on the fish samples at 3 hourly intervals thereafter. Assessment was based on physical appearance of fish and enzyme analysis through measurement of changes in trimethylamine (TMA) concentration in fish muscles using picrate method. Chemical analysis showed progressive rise in TMA during storage. TMA values revealed no statistically significant ($p=0.99$) difference at $p<0.05$ in the spoilage rate of frozen and fresh fish while the difference in the optical densities was statistically significant ($p=0.01$).The TMA value recorded in live-fish at the start of the experiment (2.2 mg TMA/100g of fresh-fish muscle) was considerably lower than that of frozen fish (4.08 mg TMA/100g of frozen-fish muscle); the reverse was the case after 9 hours of storage with TMA values rising to 10.91 mg TMA/100g in fresh-fish muscle and 7.54 mg TMA/100g in frozen-fish muscle. Safe presentation and marketing practices and establishment of fish inspection services is hereby recommended.

Keywords: Fish spoilage, Clarias gariepinus, Trimethylamine (TMA), Nigeria

INTRODUCTION

Animal protein is necessary for various body metabolisms; the absence of methionine, lysine and unidentified growing factor renders plant protein of a lower quality to animal protein, which has these amino acids. In Nigeria, increase in the price of beef and other meat types has led to a corresponding increase in the demand for the relatively cheaper fish and fish products. This demand is met by an increase in production and importation of frozen fish, dried stock fish and canned fishery products.

Fish of marine and fresh water origin constitutes about 90% of the total world catch of aquatic fauna. Fish is a highly perishable food and spoilage is rapid as a result of microbiological, enzymic and chemical activities (Alonge *et al,* 1981, Delgaard *et al*, 2006). Autolysis is rapid because the gut enzymes, which are normally responsible for digestion leads to spoilage of fish's tissue after landing; therefore fish that are not taken to the market fresh must be preserved in some ways after harvesting (Eyo, 2001) because as soon as fish is landed, the quality of fish begins to deteriorate. Deterioration is caused by bacterial action and biochemical changes, which is enhanced by the high temperature of the tropics (Moses, 1983, Singh and Malti, 2009). Apart from temperature, the type of bacteria causing spoilage also contributes to difference in rate of spoilage of fish (Shewan, 1962, Doyle, 2007, Nuin *et al*, 2008).

In Nigeria, frozen fish offered for sale are displayed in plastic containers, which are usually insulated with cardboards. This method cannot maintain the cold chain required to preserve fish in order to prevent spoilage. Furthermore fish are brought out intermittently and are freely handled by prospective buyers before being returned to the containers, if a deal is not reached.

Nigeria currently exports approximately 5 tonnes of smoked fish per month as airfreight; 60 tonnes per annum (Ward, 2003). Approximately 1 in 4 consignments of air freighted smoked fish are detained for some reason at port of entry. Of these, 70% are destroyed due to poor and inadequate packaging, insect infestation and unacceptable health certification; among other reasons. This study assessed the rate of spoilage of fresh and frozen fish exposed to ambient

environmental temperature over a 9 hour period; the peak market period when fish are offered for sale in markets in Ibadan, Nigeria. It is expected that the results of this study will give an idea of the wholesomeness of fish being purchased from these markets and the study will also create the awareness for the need for fish quality assurance. The data obtained will form the basis for an effective National Fish Hygiene and Safety Policy that will ensure that fish food supplied to the consumer is adequate, nutritious, wholesome and of acceptable quality.

MATERIALS AND METHODS

Collection of Samples

Three samples each of frozen mackerel (Scromber colias) and fresh African catfish (Clarias gariepinus) were purchased once a week for 5 weeks from Bodija and Sango Markets in Ibadan respectively. The baseline temperature (FF1) of both frozen and fresh fish was taken immediately after purchase with a resistance thermometer probe and regarded as the control. Frozen fish were transported to the laboratory on ice in Coleman cooler, while fresh fish was transported in pond water. The baseline temperature of fresh fish (Clarias gariepinus) was recorded after purchase (LF1) and then sacrificed. Frozen fish and sacrificed fresh-fish were subjected to room temperature, whereafter their temperatures were assessed after 3 hours (FF2/LF2), 6 hours (FF3/LF3) and 9 hours (FF4/LF4) of purchase and sacrificed respectively. Frozen fish was allowed to thaw at room temperature. Spoilage was assessed based on physical observation (Alonge et al, 1981) and chemical analysis in which the TMA level was measured using the standard picrate technique (Murray and Gibson, 1972a and b).

Extraction Procedure

100g of fish muscle and 100ml of trichloroacetic acid was homogenized for 1 minute and then centrifuged at room temperature until the supernatant liquid was practically clear. 5 ml of formalin (50%) was added to 20ml sample of this liquid. This resulting solution was then measured and the result was expressed as mg TMA-N/100g of fish muscle.

Analysis procedure

Depending on the expected TMA-N values, according to Hoogland, 1956; 0.5-4ml of extract were to be taken and made up to 4ml with distilled water in a test tube but this fish extractant sample was adjusted thus:

Frozen fish: 3ml extract + 1ml of water
Half thawed fish: 2.0ml extract + 2.0ml of water
Thawed fish: 1.5ml extract +2.5ml of water
Completely thawed fish: 1ml extract + 3ml of water

1ml of 50% formalin and 10ml of toluene was added in turn followed by 3ml of KOH (45% solution) in each test tube. The tube was stoppered and shaken vigorously by hand 40 times. The phase was allowed to separate for 10 minutes and 7-9ml of the toluene layer was transferred to another tube containing approximately 100mg anhydrous sodium sulphate. This tube was shaken to dry the toluene. 5ml of picric acid reagent was placed in a colorimeter tube and 5ml of dry toluene extract was added. The optical density was determined at a wave length of 410nm against a reference blank.

The blank was 4ml of water, which was taken through steps similar to the samples. The trimethylamine value of the sample expressed as mg TMA-N/100g fish muscle was calculated thus:

$$\text{TMA-N value} = \frac{\text{Optical density of sample}}{\text{Optical density of standard}} \times 3.75\text{mg}/100\text{g muscle}$$

The standard was prepared from the extract of fish analyzed on arrival at the laboratory.

Statistical analysis

Results were presented as mean ± standard deviation. Students "t"-test was used to assess the significance of the difference in the mean of Optical densities and TMA Values of Frozen and Fresh fish samples at varying stages of Spoilage. Difference in mean was considered significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

In trying to assess fish quality, great care must be taken to carefully investigate the many variables that have an impact on this protein source. One must be prepared to examine each species individually, its environment, composition, harvesting and handling. It must be understood that no single index of quality has been standardized and that there are microbiological, chemical, biochemical and physical interactive changes (Singh and Malti, 2009).

In the present study, the temperature of frozen fish based on the time of purchase (0 hour, 3 hours, 6 hours and 9 hours) was -2.6^{o}C, 20.4^{o}C, 27.6^{o}C and 28.5^{o}C respectively while the temperature of fresh fish at the same time

interval was 26.4°C, 26.9°C, 27.8°C and 30.6°C respectively. Enzymatic and microbiological activities are greatly influenced by temperature. However, in the temperature range from 0 to 25°C, microbiological activity is relatively more important, and temperature changes have greater impact on microbiological growth than on enzymatic activity. Microbial activity is responsible for spoilage of most fresh fish products. The shelf life of fish products, therefore, is markedly extended when products are stored at low temperatures (Eyo, 2001, Delgaard et al, 2006).

The present investigation also shows that frozen and fresh fish are handled by hand and exposed to environmental temperature (Figs. 1 and 2). The increased temperature of the fish aids the proliferation of putrefactive organisms. Fish bacteria are very sensitive to temperature and the rate at which bacteria multiply depends upon environmental temperature and this leads to fish spoilage (Doyle, 2007, Nuin et al, 2008). The results of assessment of spoilage of frozen and live fish by physical observation using various criteria are presented as Tables 1 and 2 respectively. The results of the chemical assessment (optical densities and TMA) of frozen fish and live-fish are presented as figures 3 and 4. The statistical correlations between the optical densities and mean TMA values of frozen fish and live-fish were 0.99 and 1 respectively.

Chemical assessment using TMA values revealed no statistically significant ($p=0.99$) difference at $p<0.05$ in the spoilage rate of frozen and live fish while the difference in the optical densities was statistically significant ($p=0.01$). However, although the TMA value recorded in live-fish at the start of the experiment (2.2 mg TMA/100g of live-fish muscle) was considerably lower than that of frozen fish (4.08 mg TMA/100g of frozen-fish muscle); the reverse was the case at the end (9 hours after) with TMA values being 10.91 mg TMA/100g of live-fish muscle and 7.54 mg TMA/100g of frozen-fish muscle respectively. This shows that spoilage of fish in a frozen state is slower when compared to fresh fish. TMA increase with bacterial load of fish during low temperature was also observed by Vyncke, 1980 and Zamir et al, 1998. This finding is important because in Nigeria; Marketing of fish is done at ambient temperature which favours the growth of natural mesophilic microflora on tropical fish species. Knowledge of spoilage patterns of tropical fish and their shelf-life in ambient temperature will therefore provide useful information for commercial transportation and marketing of fish in the tropics (Eyo, 2001, Doyle, 2007).

TMA determination has become one of the established procedures for determining fish quality (Joseph et al. 1988). The chief advantages of TMA analysis over the enumeration of bacterial numbers are that TMA determinations can be performed far more quickly and often reflect more accurately the degree of spoilage (as judged organoleptically) than do bacterial counts. Fish thaws very fast when environmental temperature is high, as the case is in the tropics, and also fish kept on the bare table are exposed to dirt which is also one of the factors that accelerate spoilage of fish,, the already present bacteria that were already in a state of suspension due to freezing becomes active again and starts the process of bacterial spoilage (Riaz and Qadri, 1990, Nuin et al, 2008). Thawing enhances the activity of spoilage bacteria hence the immense increase in level of TMA of spoiling fish sample compared with that of excellent fish and good fish samples. The difference in magnitude of TMA –N value in the different fish sample is also due to the difference in the period of exposure to external factors that influence fish spoilage. E.g. flies, dirt. Elevation of temperature as a result of thawing enhances and increases the rate of conversion of TMAO to TMA in the fish muscle. The period of exposure of the spoiling fish to these factors is longer than any of the other fish samples hence the highest value of TMA –N. It has been proposed that TMA levels between 5 and 10 mg/100g tissue should be considered the maximum allowable levels in international trading. It is therefore recommended that fish should be frozen properly stored and marketed in deep freezers. Fishmongers should also be educated through extension services and mass media on how fish should be handled in an hygienic manner to prevent multiplication of bacteria. Fish that has been thawed should not be re-frozen to reduce the risk of poisoning to the public due to unapparent bacteria multiplication.

REFERENCES

Alonge D.O., Ojo D.A and Fashina Y.A. (1981). Estimation of the level of spoilage of fresh water fish and frozen fish sold in Ibadan, Nigeria. Nigerian veterinary Journal, 10, 6-12.

Delgaard, P., Madson, H.L, Samieia, N. and Emborg, J. (2006). Biogenic Amine formation and microbial spoilage in chilled garfish (Belone belone belone) - effect of modified atmosphere packaging and previous frozen

storage. Journal of Applied Microbiology, 101, 80-95.

Doyle, E.M. (2007). *Microbial Food spoilage-Losses and Control Strategies*. Food Research Institute, University of Wisconsin – Madison, WI 53706.

Eyo, A.A. (2001). Fish Processing Technology in the Tropics. 1- 20pp. Fawole, M.O and Oso, B.A. (1995). *Laboratory Manual of Microbiology*. 1:71-81.

Joseph J., Surendran P. K. and Perigreen P.A. (**1988**). Studies on iced storage of cultured rohu (Labeo rohita). *Fishery* Technology, **25**:**105**–109

Moses B.S. (1983). Introduction of tropical fisheries, Ibadan University Press. 94 -95.

Murray C.K. and Gibson D.M. (1972a). An investigation of the Method of determining trimethylamine in fish muscle extracts by the formation of its picrate salt. Part 1. Journal of food technology.7, 35-46.

Murray, C.K. and Gibson D.M. (1972b). An investigation the method of determining trimethylamine in fish muscle extracts by the formation of the picrate salt. Part II. Journal of food Technology. 7, 47-51

Nuin M, Alfaro B, Cruz Z, Argarate N, George S, Le Marc Y, Olley J, Pin C. (2008). Modelling spoilage of fresh turbot and evaluation of a time-temperature integrator (TTI) label under fluctuating temperature. International Journal of Food Microbiology. 127(3), 193-199

Riaz M. and Qadri A.B. (1990). Time-temperature tolerance of frozen shrimp. 2-Biochemical and microbiological changes during storage of frozen glazed shrimp. Tropical Science, 30, 343-356.

Shewan J.M. (1962). The bacteriology of fresh and spoiling fish and some related chemical changes. In: J. Hawthorn & J. Muil Leitch (eds.), Recent advances in food science, 1, 167-193.

Singh, H.S. and M. Malti (2009). Postmortal changes in Clarias gariepinus (Burchell, 1822). Asian Journal of Experimental Science. 23, 199-205.

Vyncke W. (1980). Quality assessment of gutted and ungutted Gurnard (Trigla spp.) by organoleptic and objective methods. Zeitschrift Lehennn-unter forch. 171(5), 352-354.

Ward A. (2003). A study of the trade in smoked-dried fish from West Africa to the United Kingdom. FAO Fisheries Circular. No. 981. Rome, FAO. 17.

Zamir R., Qasim R.and Ullah A. (1998). Changes in physical and chemical constituents

Of crab meat during storage at refrigerator Temperature (7 ± 2^{o}C). Pakistan Journal of Pharmaceutical Sciences, 11(1), 27-33.

Table 1: Assessment of Spoilage of frozen fish By Physical Observation Using Different Criteria

Criteria	FF1	FF2	FF3	FF4
General appearance	Frozen, well iced, turgid muscles and shiny skin. No discolouration, glistening and moist slime.	Fairly turgid muscle, bright skin but not lustrous.	Fairly turgid muscle, slightly dry scales and dull skin discoloration was observed.	Dry, stale, soft to touch. Discolouration around the fills and abdomen.
Odour	Fresh and pleasant	Fresh	Slightly offensive	Offensive
Eyes	Bright, full and convex with transparent cornea.	Convex and slightly sunken, opalescent cornea.	Opalescent cornea, dull eyes.	Sunken and covered with thick slime.
Gills	Brightly coloured, firm and elastic. No slime	Less coloured, slight traces of clear mucus	Becoming discoloured.	Discoloured, flabby and pits on pressure

Source: Alonge et al, 1991

Table 2: Assessment of Spoilage of live fish by Physical Observation after sacrifice

Fish sample	Observations	Remarks
LF1	Alive, bright eyes, bright gills, smooth shining muscle.	Fit for consumption.
LF2	Dead. Skin is moist, shiny and smooth, eyes are bright. Cornea transparent. Gills bright red.	Fit for consumption.
LF3	Dead. Fairly turgid muscles.	Will spoil if further stored.
LF4	Dead. Sunken eyes; flaccid muscle	Unfit for consumption



Figure 1: Fish on Display at Bodija market, exposed to ambient temperature and Dirt



Figure 2: Fresh Fish (Clarias gariepinus) on display at Sango market, Ibadan

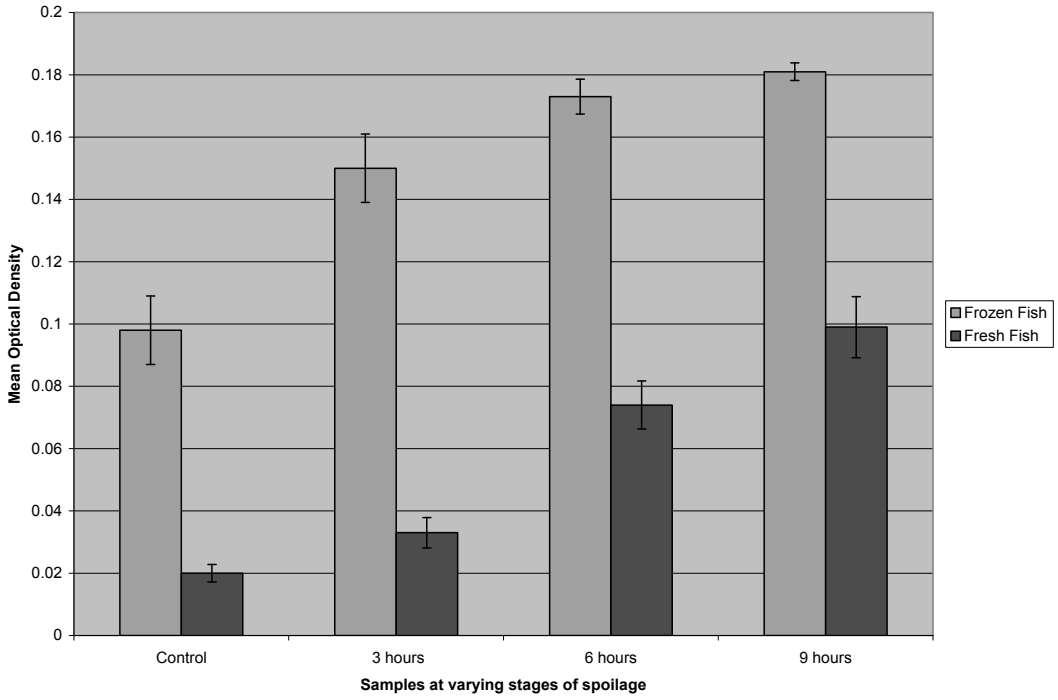


Figure 3: Optical densities of Frozen and Fresh fish samples at varying stages of Spoilage

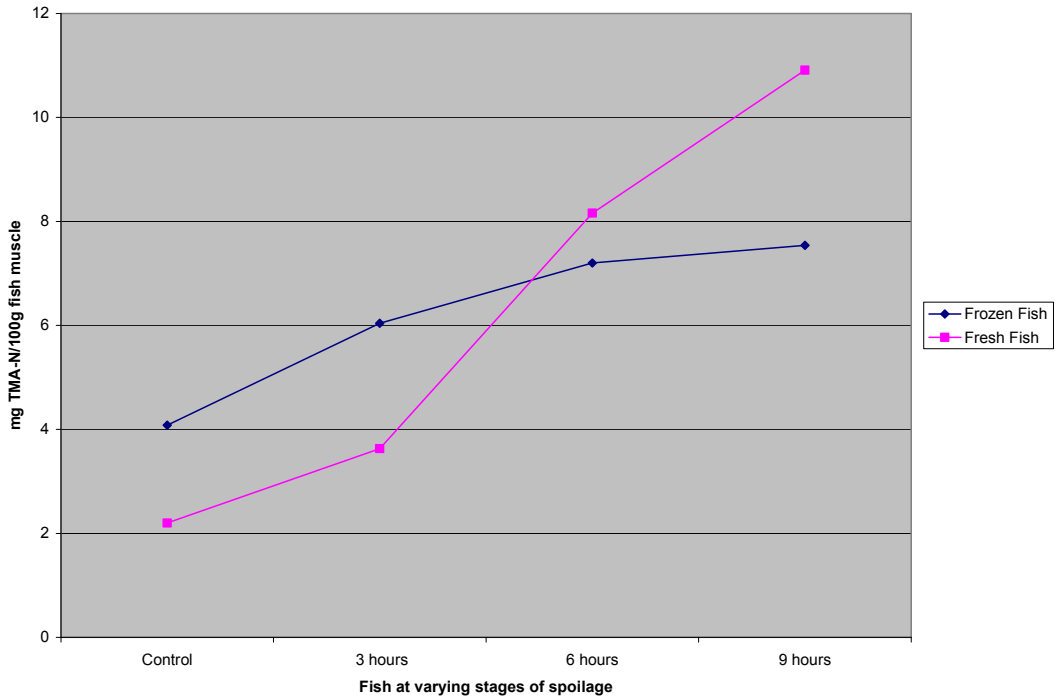


Figure 4: TMA Values of frozen and fresh fish muscle at varying stages of spoilage

WILDLIFE RESOURCES OF COASTAL WETLANDS OF LAGOS STATE

ADETOLA JENYO-ONI and ABIMBOLA ADETORO
Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan, Nigeria

ABSTRACT

Almost 35% of all rare and endangered animal species are either located in wetland areas or are dependent on them. Coastal wetlands are extremely important to coastal states such as the study area and are extensively exploited. This study gives an inventory of the wildlife resources of the study area and its utilization.

Stop count at five minutes interval along tracts and variable intersect belt was employed in the assessment of species and population of the study area. A combination of questionnaire and market survey was also used to further determine the animals that are encountered in the study area.

All four classes of vertebrate are well represented in the study area. Animals found in the study area are abundant and zoned both horizontally and vertically. Amphibian is the dominant group of aquatic vertebrates other than fish in terms of their numbers and distribution, particularly the frogs and toads. All the *Rana* species with their very long hind legs are edible in Nigeria and are harvested as wild bush meat. Grasscutter, antelopes, duicker and bush rats such as squirrel and the piscivorous mammals the marsh mangrove otter and manatee are found in all zones in the study area. Alligators are highly valued inhabitants of Lagos State coastal wetlands. The Nile crocodile is wildly distributed in the swampy areas while the commonest lizard found is the Nile monitor (*Varanus niloticus*). Amongst the aquatic birds are the common species of herons, water fowls, fish eagle and darters, king fishers (*Ceryle rudis*), strait pidgeons (*ducala bicolor*) which frequent the wetlands. Wildlife contributes immensely to the protein consumption and economy of the people of the study area, animal parts are also used in industry and medicine.

INTRODUCTION

Wetlands host a rich and diverse collection of plants and animals. They are a vast genetic resource, only a fraction of which has been studied and a smaller fraction tapped for human use. Arowomole (2000) explained that wetlands offer different niches for wildlife, not only from one place to another but from one time to another. Akegbejo-Samsons (1995) observed that attempts are now being made to increase wildlife production not only by conservation of wetlands habitat but by techniques which provides habitat for individual species requiring individual attention.

Wetlands provide refuges for wild species even in highly industrialized areas of which Lagos State is one. The role of wetland as staging grounds for waterfowl migrating across international frontiers has long been accepted. A significant population of European wild fowls winter in Africa marshes south of the Sahara extending from the Atlantic Coast to Chad Basin (Ezealor 2003). Ayeni (1993) in an address stated that the wetlands of Nigeria are extremely productive in wildlife game birds many species are sighted in large numbers along the shore line of these wetlands. He further stated that during the breeding seasons and at the peak of bird migration to Kainji Lake the white faced tree ducks and other fowls are seen in thousands similar to the Nakuru Sodar Ash Lake in Kenya.

Lagos State coastal wetland area forms an ecosystem that offers valuable natural resources and an enormous biological diversity occurs in these ecosystems. Very little is known about the nature, distribution and relationship of the animals in the study area. The extent, contribution and potentials of Lagos State coastal wetlands are yet to be extensively investigated as already done in other ecosystems such as the Fadama of Northern Nigeria: the Hadeijia-Nguru wetlands and Sokoto-Rima Basin wetland. This study aims at providing information on the wildlife resources, distribution and utilization in the study area.

METHODOLOGY

Study area

The study was carried out in the coastal wetland area of Lagos State: the coastal zone separates the mainland sedimentary basin of south-western Nigeria from the atlantic coastline. The coastal terrain is dominated by a maze of lagoons creeks and river estuaries.

The study area was divided into three based on location, the West with Badagry and Ojo as representative, the East with Ibeju-Lekki and Epe while the Central has Lagos Island and Eti-Osa. All the study sites have the marine environment common to them. The Western area also has lagoons which run parallel to the coast and sub-divides into several smaller creeks to form an intricate pattern of waterways. The sand ridges that fringe the lagoons and intertidal flats carry scrub-like bush with stunted palms, the dominant species of vegetal cover is arching stilt-rooted mangroves.

Statistical Analysis

A combination of questionnaire and market survey was used in the assessment of species and population of wild animals of the study area. Stop count at five minutes interval along tracts and variable intersect belt method was also employed. All animals encountered were recorded: hunters were also interviewed to obtain information on the most common wildlife animals in the area.

RESULTS AND DISCUSSION

Lagos State wetlands offer different niches for wildlife some of which are usually hunted to provide bushmeat and at times sources of revenue to the rural people. The skins of some animals especially those of crocodiles and snakes are useful in leather industry and for export. All the four classes of vertebrates are well represented in Lagos State Coastal Wetland. Animal found in the study area are abundant and are zoned both horizontally and vertically. Table 1 shows the wild animals encountered during the study. The heavily forested swampy areas, subject to periodic tidal inundation such as in the Eastern zone are the home of a variety of terrestrial animals such as the mammals including the grasscutter, antelopes (duicker) and bush rats such as squirrel. The piscivorous mammals which are found in all zones are the marsh mangoose, otter and manatee exclusive to the Epe lagoon. The large mammals such as manatee, otter, rodents and marsh mangoose serve as important local source of bush meat especially during the dry season (December to April).

Among reptiles are those that feed on fish and those that feed on fish predators. Crocodile and terrapins are among the first group and spend most of their time in water. The tortoises, monitor lizards and snakes which falls among the second group spend a greater part of their time on land near water. They all however contribute to the biological function of the aquatic community. Crocodiles, terrapins and monitor lizards feed on fish while snakes feed on frogs, toads, lizards and small rodents that inhabit water bodies. Active predation therefore contributes to the stabilization of the animal communities. Alligators are highly valued inhabitants of Lagos State coastal wetlands. The Nile crocodile is wildly distributed in the swamps areas. The commonest lizard found in Nigeria the Nile monitor (*Varanus niloticus*) is found in the mangrove forest of Epe. There are also tortoises and snake species found in the aquatic habitats of the study area whose distribution like their habitat are more widespread during the rainy seasons.

Birdlife is comparatively rich in mangroves but only relatively few species are endemic to wetlands as their principal habitat in Lagos State. Amongst the aquatic birds are the common species of herons, water fowl, fish eagle and darters, king fishers (*ceryle rudis*) strait pidgeons (*Ducala bicolor*) which frequent the wetlands.

Less evident, but equally important inhabitants of the wetland are the mud crabs which although are most common at the waters but are found throughout the intertidal zone. On the mud floor, brightly coloured species of amphibious mud skipper can be seen. Cursory observation reveals that frogs and toads are the most abundant amphibians having a wider distribution during the rainy season in the study area. Some snakes feed on toads and frogs and are therefore also often associated with these habitats.

Economic values of wildlife resources of lagos state coastal wetlands

Wildlife is important to the Lagos State economy both as a source of protein and for tourism and recreation. Although tourism and recreational interest have not attracted the desired awareness in terms of participation by the populace of the study area, wildlife in form of bushmeat is a recognized trade at the rural and urban centres.

Wild animal meat is the main source of cheap protein for the majority of rural communities. Among fishing communities located along the coastal areas, fish and non-fish aquatic vertebrates such as crocodiles, hippopotamus, bush rats of all sizes and types and manatee are the main source of bush meat. Falade (1994) estimated the value of bush meat consumed in Southern Nigeria at ₦20 million while the total value of the entire country was put at ₦30 million per annum. Today the value of animal protein from wild animals and fresh water fish consumed

annually is well over ₦200 million (Akegbejo-Samsons, 1995). While the inhabitants of Eastern and Western zones of the study area kill, eat or sell small wild animals, the rich and affluent in the Central zone consumers patronize the grass cutter, snails, antelopes and several other large animals where they are hoisted along road sides, choice market such as the Oluwo market in Epe or expensive hotels and restaurants.

Utilization of wildlife species in the study area

In Nigeria the value of wetland wildlife resources is determined by its availability and the social, economic and cultural preference and activities of the communities where these animals are found in abundance. Their use is at non-sustainable levels just as in the utilization of any wild species. The overall consequence is over exploitation and continuous reduction in their availability.

While in many countries aquatic birds are hunted for sport, in Nigeria and of course the study area, they are predominantly regarded as a source of meat. Body parts of aquatic birds are used in fishing communities of the study area as traditional medicine for ailments and protection against water disasters/mishaps. This was also observed by Okaeme *et al.* (1989) in their study of birds in Lake Kainji. Table 2 shows some medicinal uses of wildlife parts in the study area.

The large mammals such as manatee, otter, rodents and marsh mongoose serve as important local source of bush meat especially during the dry season (December to April). Their meat is also an important international trade commodity because of the considerable demand for the red meat of otter and manatee in rich countries such as Japan and Saudi Arabia. These animals are also hunted in Lagos fishing communities for other products such as their skins for leather, their cartilaginous parts, faeces, skin and hoofs as aphrodisiacs and for traditional medicine.

Crocodiles and monitor lizards are hunted extensively even to the point of extinction for their meat and skins which are important foreign exchange earners. The high demand for crocodile skins, meat and body parts for traditional medicine certainly have contributed to the observed decline in their population in the study area. Ita (1994) observed that during the late 1960s most large bodies of water in Nigeria harboured crocodile but now both crocodiles and monitor lizards are listed as threatened species in Nigeria. Some frog species are edible and are delicacy to some ethnic communities in Nigeria and overseas. They are highly valued in most fishing communities of Lagos State coastal wetland and are observed in all the markets around them. All the *Rana* species with their very long hindlegs are edible in Nigeria and are harvested as wild bush meat from ponds and water-logged areas in the study area. Dried, skinned meat of toads and fresh frogs has been found useful in the feeding of catfish and poultry, either as raw materials for processed feed or whole as food for catfish. In Nigeria, it is a common practice for fish farmers to supplement the feeding of *Clarias* species and *Heterobranchus hidorsalis* in pond culture by feeding them frogs and toads.

CONCLUSION

In Nigeria the value of wetland wildlife resources is determined by its availability and the social, economic and cultural preferences and activities of the communities where these animals are found in abundance. The wildlife resource of the study area is typical of the rain forest zone of tropical Africa. If Lagos State coastal wetland is to continue to serve the population that depends on its natural resources, a long-term productivity enhancement management technique will undoubtedly be practice. Such practice requires a broad view of wetlands as part of a whole basin.

REFERENCES

Akegbejo-Samsons, Y. 1995. Ecology of the fisheries resources of coastal wetlands of Ondo State and its management implication. A. Ph.D. thesis of Federal University of Technology, Akure, Nigeria, 297.

Arowomole 2000. Impact of socio-economic Activities on Biodiversity of Coastal Wetlands of Lagos State. A Ph. D. thesis in the Department of Wildlife and Fisheries Management, University of Ibadan, Nigeria. 16-87

Ayeni, J.S.O. 1993. The challenge of conservation and development of Nigeria aquatic resources. A Keynote address of the National Conference on Conservation of Aquatic Resources, 34-38.

Ezealor, U. 2003. Critical Sites for Biodiversity Conservation in Nigeria. Nigeria Conservation Foundation, Lagos, Nigeria. 110

Falade, G.O. 1994. Socio-Economic Evaluation of Wildlife based Tourism Development in Selected Conservation Area in Nigeria. A Ph.D. thesis in the Department of Wildlife and

Fisheries Management, University of Ibadan, Nigeria. 245

Ita, E.O. 1994. Aquatic plants and wetland wildlife resources of Nigeria. A CIFA occasional Paper No. 21, FAO, Rome, 52.

Okaeme, A.N., Haliru, M. & Wari, M. 1988. Survey of aquatic birds and their contribution to Lake Kainji Fisheries, NIFFER Annual Report, 40-45.

Table 1: Wildlife Species of Lagos State Coastal Wetland

	Species	Common Name	Yoruba Name
REPTILES			
Chelonia	*Kinixys bellina*	Water turtle	Ijapa Omi
	Amyda tringuis	Water turtle	Ijapa Omi
Crococodilia	*Crocodylus niloticus cataphractus*	Nile Crocodile	Oni
	cataphractus	Long nosed crocodile	Oni
Squamata	*Varanus niloticus*	Nile monitor lizard	Oni
	Alligator species	Alligator	Alegba/Oni
	Pyton regius	Royal python	Ere
MAMMALS			
Carnivora	*Atilax paludinosus*	Marsh mongoose	
	Aonyx Capensis	Otter	
	Crocuta crocuta	Spotted Hyena	Kolokolo
	Panthera pardus	Leopard	Amotekun
Sirenia	*Trichechus Senegalensis*	Manatee	Erin omi
Rodentia	*Xerus erythropus*	Squirrel	Ikun
	Cricetomys gambianas	Giant Rat	Okere
	Thryonomys Swinderionus	Grass Cutter	Okuru
Lagomorpha	*Xystrix Cristata*	Parcupine	Ehoro
	Oryctolagus cuniculus	Rabbit	Ehoro
	Lepus Zechi	Hares	Emo
		Bats	Adan
Chiroptera	*Syklvicapra grimmia*	Crowned duicker	Etu
Bovidae	*Cephalophus rufilatus*	Red-flanked duicker	Etu
	Hippotragus equines	Antelope	Etu
Primate	*Cercopithecus aethipos*	Green monkey	Obo
	Erythrocebus patas	Patas monkey	Obo
AMPHIBIA	*Rana galamensis*	Frog	Akere
	Rana Occipitalis	Frog	Akere
	Xenopus tropicalis	Frog	Akere
	Bufo regularis	Toad	Opolo
	Bufo maculakis	Toad	Opolo
AVES	*Pelecanus onocrotalus*	Pelicans	Adaba
	Ardea species	Heron	Ako
	Falco pergrinus	Falcons	Lekeleke
	Milvus migrans	Kites	Igan
	Ceryle rudius	King fisher	
	Anthinga rufa	Darters	
	Haliaeetus vocifer	Fish eagle	Idi

Table 2: Some Wild Animals By-Product And Medicinal/Cultural Uses in the Study Area

Bushmeat By-product	Yoruba Local Names	Uses
Monkey's Head	Ori Obo	Charms for chasing away evils.
Giant Rat (*Criceptonys ganibianus)*	Okere	Used for protection against witches and wizards.
Pangolin (*Mani tradactyla)*	Aaka	Part of the concoction for curing kleptomania.
Shrew (*Crocidura* species)	Asin	To prepare concoction for curing convulsion, body pains and to ensure easy delivery.
Hyrax's finger tips (*Den drohydrax*)	Ori Ika Ofafa	To prepare charm for safety during danger or accident.
Python's Head	Ori Ere	Charm for goodluck
Chameleon	Oga	To cure dizziness.
Duicker's horn (*Cephaloplus species)*	Iwo Etu	To hold charms.