Online ISSN: 2249-4626
Print ISSN: 0975-5896

Global Journal

of Science Frontier Research: D

Agriculture and Veterinary

Evaluation of Pond Fish

Risk Mitigation of Poultry

Highlights

Poultry Industry Pollutants

Spatial Distribution of Agro

Discovering Thoughts, Inventing Future

VOLUME 14 ISSUE 1 VERSION 10

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

Global Journal of Science Frontier Research: D
Agriculture & Veterinary
Volume 14 Issue 1 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: Open Association of Research Society
Open Scientific Standards

Publisher's Headquarters office

Global Journals Headquarters
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Including by Air Parcel Charges):

For Authors:
22 USD (B/W) & 50 USD (Color)
Yearly Subscription (Personal & Institutional):
200 USD (B/W) & 250 USD (Color)

Integrated Editorial Board
(Computer Science, Engineering, Medical, Management, Natural Science, Social Science)

Dr. Bart Lambrecht
Director of Research in Accounting and FinanceProfessor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD (Cambridge)

Dr. Carlos García Pont
Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management), Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE, University of Navarra
Degree in Industrial Engineering, Universitat Politècnica de Catalunya

Dr. Fotini Labropulu
Mathematics - Luther College
University of ReginaPh.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windso

Dr. Lynn Lim
Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD, FHEA

Dr. Mihaly Mezei
ASSOCIATE PROFESSOR
Department of Structural and Chemical Biology, Mount Sinai School of Medical Center
Ph.D., Etvs Lornd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram
Department of Accounting and FinanceLancaster University Management SchoolPh.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño
Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso
Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.
Director, EP Laboratories, Philadelphia VA Medical Center
Cardiovascular Medicine - Cardiac Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng
MD., Ph.D
Associate Professor and Research
Department Division of Neuromuscular Medicine
Davee Department of Neurology and Clinical NeuroscienceNorthwestern University
Feinberg School of Medicine

Dr. Pina C. Sanelli
Associate Professor of Public Health
Weill Cornell Medical College
Associate Attending Radiologist
NewYork-Presbyterian Hospital
MRI, MRA, CT, and CTA
Neuroradiology and Diagnostic Radiology
M.D., State University of New York at Buffalo,School of Medicine and Biomedical Sciences

Dr. Roberto Sanchez
Associate Professor
Department of Structural and Chemical Biology
Mount Sinai School of Medicine
Ph.D., The Rockefeller University

Dr. Wen-Yih Sun
Professor of Earth and Atmospheric SciencesPurdue University Director
National Center for Typhoon and Flooding Research, Taiwan
University Chair Professor
Department of Atmospheric Sciences, National Central University, Chung-Li, TaiwanUniversity Chair Professor
Institute of Environmental Engineering, National Chiao Tung University, Hsin-chu, Taiwan.Ph.D., MS The University of Chicago, Geophysical Sciences
BS National Taiwan University, Atmospheric Sciences
Associate Professor of Radiology

Dr. Michael R. Rudnick
M.D., FACP
Associate Professor of Medicine
Chief, Renal Electrolyte and Hypertension Division (PMC)
Penn Medicine, University of Pennsylvania
Presbyterian Medical Center, Philadelphia
Nephrology and Internal Medicine
Certified by the American Board of Internal Medicine

Dr. Bassey Benjamin Esu
B.Sc. Marketing; MBA Marketing; Ph.D Marketing
Lecturer, Department of Marketing, University of Calabar
Tourism Consultant, Cross River State Tourism Development Department
Co-ordinator , Sustainable Tourism Initiative, Calabar, Nigeria

Dr. Aziz M. Barbar, Ph.D.
IEEE Senior Member
Chairperson, Department of Computer Science
AUST - American University of Science & Technology
Alfred Naccash Avenue – Ashrafieh

President Editor (HON.)

Chief Author (HON.)

Dr. R.K. Dixit
M.Sc., Ph.D., FICCT
Chief Author, India
Email: authorind@computerresearch.org

Dean & Editor-in-Chief (HON.)

Contents of the Volume

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Spatial Distribution of Agro Dealers in Peri-Urban Area of Ibadan and its Implication on Seed Distribution System

By Adetumbi J. A., Omodele T, Akintoye N. A. & Amusat A. S.
Obafemi Awolowo University, Nigeria

Abstract- The agricultural input sectorinfluences farmers' access to use productivity enhancing inputs.Among all these inputs, seeds are the most crucial in production cycle because it is the only biological input upon which all other components are applied.Information about agro-dealers in Nigeria, in terms of types of products sold as well as the number of dealers and how they are dispersed across the country has not been accurately documented, therefore this study attempts to show the distribution pattern of the agro-dealers in some semi-urban area of Ibadan, Oyo State Nigeria with a view to understanding their specific locations, determine the proportion that deal with seed as well as sources of their seeds.Six local government areas (Akinyele, Egbeda, Ido, Lagelu, Oluyole and Ona-ara)within semi -urban area of Ibadan where urbanization has not completely eroded farming activities were selected.One hundred and twenty-five agro-dealers,reached through snowballing research technique were interviewedusing structured questionnaire.

Keywords: *agro-input dealers, seed distribution.*

GJSFR-D Classification : *FOR Code: 300999p*

Strictly as per the compliance and regulations of:

Spatial Distribution of Agro Dealers in Peri-Urban Area of Ibadan and its Implication on Seed Distribution System

Adetumbi J. A. [α], Omodele T [σ], Akintoye N. A. [ρ] & Amusat A. S. [ω]

Abstract- The agricultural input sectorinfluences farmers' access to use productivity enhancing inputs.Among all these inputs, seeds are the most crucial in production cycle because it is the only biological input upon which all other components are applied.Information about agro-dealers in Nigeria, in terms of types of products sold as well as the number of dealers and how they are dispersed across the country has not been accurately documented, therefore this study attempts to show the distribution pattern of the agro-dealers in some semi-urban area of Ibadan, Oyo State Nigeria with a view to understanding their specific locations, determine the proportion that deal with seed as well as sources of their seeds.Six local government areas (Akinyele, Egbeda, Ido, Lagelu, Oluyole and Ona-ara)within semi -urban area of Ibadan where urbanization has not completely eroded farming activities were selected.One hundred and twenty-five agro-dealers,reached through snowballing research technique were interviewedusing structured questionnaire.Descriptive statistics such as frequencies and percentages were used to analyse the data obtained through the questionnaire. Also, EtrexTMGlobal Positioning System (GPS) was used to take the coordinates of the locations of the agro-input stores after which, the vector-based system (topological map overlay) was used to combine the features from agro-dealers and land-use polygons maps to create a new output feature, thus creating a new attribute relationship.The survey revealed regional variation in the density of agricultural input dealers and the types of products sold. Most agro-dealers are interested in selling agro chemicals because of quick turn-over, interest in sales of seed of some crops is still low and number of agricultural input dealers is grossly low compared to the land mass being used for agricultural purposes. The project presented a broad overview of the agricultural input sector in the study area and information provided can serve as a starting point upon which much needed analysis of various aspects of the sector can be based.

Keywords: *agro-input dealers, seed distribution.*

I. Introduction

The agricultural input sector has critical impact on the agricultural productivity of a nation. It influences farmers' access to use productivity enhancing inputs. The African Agricultural market Information Network (AFAMIN) has described Agricultural inputs in form of improved seeds, seedlings, brood stock, feed, vaccines, fertilizers, agro-chemicals, machineries and implements (Ogunlade et al, 2012). Among all these inputs, seeds are the most crucial in production cycle because it is the only biological input upon which all other components are applied, therefore quality and quantity of a crop yield is heavily dependent on the quality of the seed used for production. In many rural communities where active farming activities take place, small-scale farmers are unable to access clean varieties of seed; partly due to distance to seed dealers as well as affordability of quality seed (FAO, 2009). Some farmers often travel at least 20 to 30 kilometers to purchase fertilizer, seeds, and other inputs, which raises the cost of production (Morris et al. 2007).Agro dealers are the people selling seeds, implements, fertilizer etc. They are sometimes rural entrepreneurs who some time are lead farmer themselves that have undergone basic business skills (Ogunlade et al, 2012). They play a very crucial role in servicing farmers need as it relates to agricultural inputs. For example, during the implementation of the Growth Enhancement Support (GES) scheme in Nigeria, agro-dealers were assigned a critical role to tackle the inefficiencies in the distribution of key agricultural inputs. Despite critical role played by agro-dealers in the agricultural input sectors, they are still small in number and limited in geographic dispersion in most African countries. Uganda had fewer than 100 input dealers in 2001 while Tanzania had only 500 input dealers in 2003, (Morris et al. 2007).Information about agro-dealers in Nigeria, in terms of types of products sold as well as the number of dealers and how they are dispersed across the country has not been accurately documented, therefore this study attempts to show the distribution pattern of the agro-dealers in semi-urban area of Ibadan, Oyo State Nigeria with a view to understanding their specific locations, determine the proportion that deal with seed as well as sources of their seeds

II. Materials and Methods

The study was carried out between March and October, 2013 insix local governments within semi - urban area of Ibadan land in Oyo state, Nigeria. The local government areas are Akinyele, Egbeda, Ido, Lagelu, Oluyole and Ona-ara (Figure 1). The local governments were purposively selected for good

Authors α σ ρ ω : Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B. 5029, Moor Plantation, Ibadan. Nigeria. e-mail: jaadetumbi@yahoo.com

coverage of the work and also because urbanization has not completely erodedfarming activities in the selected area.Data collection involved use of interviews based on structured questionnaire according to Harris et al. (1995). One hundred and twenty-five agro-dealersreached through snowballing research technique were interviewed. Questions were asked on their socio-economic characteristics, type, size and years of experience in agro-input sales as well as source of seed sold.Descriptive statistics such as frequencies and percentages were used to analyse the data obtained through the questionnaire. EtrexTMGPS was used to obtain the geographical coordinates of the locations of the agro-input stores. The use of recent high resolution satellite imageries of the area was adopted by use of google earth for the determination of generalized land use/land cover classes. The downloaded images were geo-referenced in a Geographical Information System (GIS) environment (ArcMap) and analysed through digitization of the land use pattern for the identification of spatial distribution of the agro-dealers over respective land use category in the study area. Thereafter, spatial and attribute datasets of both the agro-dealers and land-use layers were subjected to logical structuring with the view to integrate them into structured database for the study area. The vector-based system (topological map overlay) which allowed the point features of agro-dealers layer to be overlaid on the polygon features of the land-use layer was used to combine the features from agro-dealers and land-use polygons to create a new output feature thus creating a new attribute relationship.

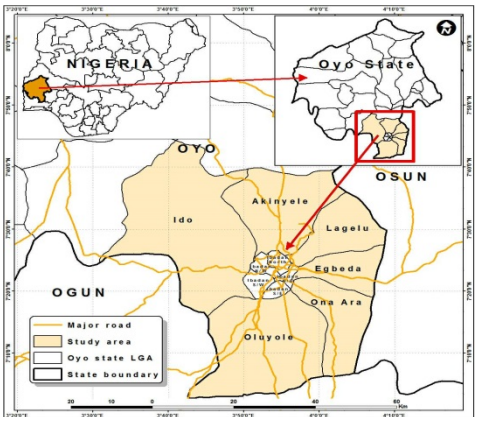

Figure 1 : Study area surrounding Ibadan city

III. Results and Discussions

Land classification of the study area: The total area of the study area is 3205.61SqKm.(Table 1). The largest portion of the study area (52.90%) is under intensive small holder rain fed agriculture which covers 1,695.68sqkm followed by area under distributed forest (24.15%) while the remaining portion (735.86sqkm) which represents 22.95% of the study area were under various uses ranging from tree crop plantation, residential, reservoir and natural occupiers such as water bodies like stream, rivers and grassland. This implies that agricultural activities arestill prominent and predominantly handled by small holder farmers that rely on rain-fed agriculture in the study area.

Table 1 : Land use classification of the study area

S/N	LANDUSE CLASSES	AREA (SqKm)	PERCENTAGE (%)
1	Agricultural Tree crop plantation	0.74	0.02
2	Disturbed forest	774.07	24.15
3	Forest plantation	27.81	0.87
4	Grassland	164.61	5.14
5	Intensive(row crops) small holder rain-fed Agriculture	1,695.68	52.90
6	Major urban	197.43	6.16
7	Minor urban	281.61	8.78
8	Natural water bodies (river and streams)	8.40	0.26
9	Reservoir	2.51	0.08
10	Teak/ Melina plantation	52.75	1.65
	Total	3205.61	100.00

a) Demographic Characteristics of the Agro- Inputs Dealers in Semi-Urban Area of Ibadan

In the study area, agriculture input dealership are majorly owned and managed by male (Table 2). Fifty-six percent (56%) of the agro-dealers were male while forty-four percent (44%) were female indicating that agro-input sales are dominated by male. This result is similar to the report obtained in Ghana as reported by Marika and Afua (2010) and in Kwara state of Nigeria (Ogunlade et al, 2012). Majority of the operators of the business (84%) uses rented apartment while only 16% of the operators owned their places of business.The centres were of various types. Forty-seven dealers (37.6%)operate from in-built shops followed by thirty

dealers (24%) that operate from shops within shopping complex. Twenty eight dealers (22.4%) uses wooden kiosk while twenty dealers (16%) operated from metal containers.High rate of shops recorded in shopping complex is an indication why high percentage was recorded for those operating from rented apartment. Most of the centers (55.2%) were in medium category and 80% of the dealers have spent less than five years in the business with large proportion (51.2%) spending less than one year. This suggests that most of the agro-dealers are new entrants and this indicate very little experience. However it signifies gradual recognition of the importance of the sector in agricultural development in the study area.

Table 2 : Demographic Characteristics of Agricultural Inputs Dealers in Semi-Urban Area of Ibadan

Characteristics	Categories	Frequency	%
Gender	Male	70	56
	Female	55	44
Mode of ownership	Rented	105	84
	Owned	20	16
Type of centre	House with in-built shop	47	37.6
	Wooden kiosk	28	22.4
	Metal container	20	16.0
	Shops within shoppingcomplex	30	24.0
Size of the centre (Sqm)	Extra Large (Above 35)	6	4.8
	Large (26 – 35)	18	14.4
	Medium (11 – 25)	69	55.2
	Small (Less than 10)	32	25.6
Agro input business experience (No of years)	Above 20	4	3.2
	15 – 19	1	0.8
	10 – 14	9	7.2
	5 – 9	11	8.8
	1 -4	36	28.8
	Less than 1	64	51.2

b) Types of products sold by Agro-dealers

The percentage of agro-input dealers selling each type of product is presented in Table 3. Across the local government areas, sales of chemical recorded the highest attention as average of 91 % of the dealers sell agro-chemical. Sales of chemical have received such high attention because of diverse use of the chemicals which are not necessarily for agricultural purpose, hence it brings quick return. For instance,some dealers mentioned the use of herbicide for land clearing for housing purposes.Seed sales were recorded from eighty-three percent of the agro-dealers across the local government areas with agro-dealers from Lagelu and Ido recording 97% and 91% respectively. This means that there was a ready access to seed supply in Ido and Lagelu local government areas. This is understandable as two National Research Institutes (Institute of Agricultural Research and Training (IAR&T) and National Institute of Horticultural Research and Training (NIHORT)) as well as National Agricultural Seed Council is very close to the two local government areas, therefore the impact of these organisations might have contributed to seed diffusion. Fertilizers were sold by only eighty (80%) percent of the agro-dealers in the surveyed area. The reasons that account for low interest in sales of fertilizer were high cost of investment and large space requirement for stocking Lack of affordability to stock has been reported as the key reason for not stocking fertilizer by agro dealers in Ghana in 2007(Marika and Afua, 2010)

Table 3 : Percentage of Agricultural Inputs Dealers by Type of Inputs Sold

L. G.A.	Seed		Fertilizer		Chemicals		Implements		Others	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Akinyele	13	65	10	50	17	85	14	70	0	0
Egbeda	8	90	9	100	9	100	8	90	0	0
Ido	29	91	23	72	24	75	12	38	4	13
Lagelu	36	97	37	100	37	100	37	100	0	0
Oluyole	6	46	7	54	13	100	12	92	7	54
Ona ara	12	86	14	100	14	100	13	93	2	14
Total	104	83	100	80	114	91	96	77	13	10

L. G.A. = Local Government Area

c) *Crop type and sources of seed sold by agro-input dealers*

Percentage of agro-inputs dealers by seed crop typeand their sources are presented in Table 4. All the agro dealers (104) selling seed sell maize seed while only three of them (2.9 %) do not sell vegetable seed. Seventy-one agro-dealers (68.3%) source their maize seed from government institutions while twenty-one of them (20.2%) bought their maize seed from private seed company. Adetumbi et. al., (2010) has reported similar situation. Conversely, seventy agro-dealers (67.3%) sourced vegetable seed from private seed company, while only nineteen agro-dealers (18.3%) rely on government institutions for vegetable seed being sold. Otheragro-dealers either sell self-grown seed of maize and vegetable or seed sourced from other individuals. This implies that about 11.5 % of the agro dealers are selling uncertified seeds of maize and vegetable that its quality cannot be ascertained.Also, it is shown in this result that private seed companies either within the country or abroad are still dominating vegetable seed business in the study area.Almost half of the agro-dealers are not selling cowpea and soybean seed. Fifty-seven percent (57%) and fifty-six percent (56%) of the agro-dealers selling cowpea and soybean respectively were sourcing it from government institutions while less than one percent (0.95%) of the agro-dealers were sourcing them from private seed companies. This might be attributed to the fact that soybean seed losses viability easily and are more delicate to handle while cowpea seed are highly susceptible to storage pest.

Table 4 : Percentage of Agricultural Inputs Dealers by seed crop type and their sources

Seed source	Crop Type							
	Maize		Cowpea		Soybean		Vegetable	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Government Institutions	71	68.3	57	54.8	56	54.7	19	18.3
Private Seed Company	21	20.2	1	0.95	1	0.95	70	67.3
Individual	9	8.7	1	0.95	2	1.90	11	10.6
Self-grown	3	2.8	0	0	0	0	1	0.95
Not selling	0	0	45	43.3	45	43.3	3	2.9
Total	**104**	**100**	**104**	**100**	**104**	**100**	**104**	**100**

d) *Spatial distribution of agricultural input dealers*

The spatial distribution of the agricultural input dealers per area showed that most of the agro-input dealers are located along the major roads within the major urban, while few of them are located in the minor urban centers (Figure 2). Seventy-four agro-dealers (59%) were located in the minor urban categories based on land use map while forty-seven agro dealers (38%) are located in the major urban, Only four (3%) of the agro-dealers were located within intensive small holder rain-fed agricultural area. This implied that most farmers still move long distance to get agricultural inputs. The implication of this on seed is that most of the farmers will still be planting farmer saved seed, which may contribute to low yield and low returns on investment.

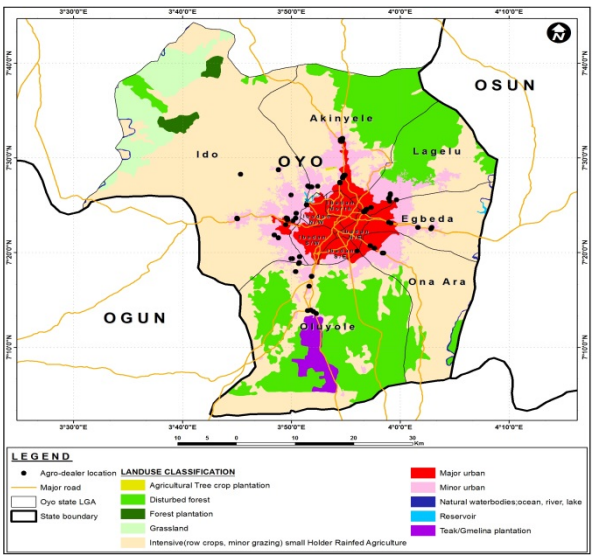

Figure 2 : Spatial distribution of agro-dealers overlaid on land use classification map of the study area

e) *Proximity of agro-dealers to seed source*

Four possible sources of quality seed closed to the study area were identified as International Institute of Tropical Agriculture (IITA), Institute of Agricultural Research and Training (IAR&T), National Institute of Horticultural Research and Training (NIHORT) and National Agricultural Seed Council (NASC) (Figure 3). The result showed that seventy-one of the agro-dealers

(57%) are within 5 km distance to at least one of the research centres, while thirty-six agro-dealers (29%) are within 10km distance. Thirteen and five agro-dealers were within 15 and 20 km distance respectively to at least one of the centres. The result implies that agro-dealers are clustered around the research centres where the seed are produced and are not very close to the farmers who are the ultimate users of the seed.

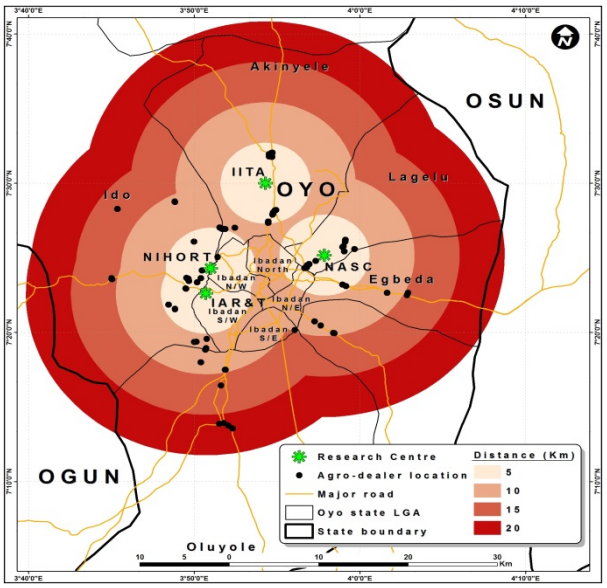

Figure 3 : Spatial distribution of agro-dealers in relation to government institutions dealing with seed production

IV. Conclusion

The survey hasrevealed that there is regional variation in the density of agricultural input dealers and the types of products sold. The data showed that most people in the business are interested in selling agro chemicals and the number of agricultural input dealers is grossly low compared to the land mass available in the local government areas. Interest in sales of seed of some crops is still low and needs to be aroused and encouraged. This project has therefore presented a broad overview of the agricultural input sector in some local government area in Oyo state. The information provided can serve as a starting point upon which much needed analysis of various aspects of the sector can be based.

V. Acknowledgement

The authors acknowledge the effort of Miss Adeniyi A. B. and Miss Egunjobi F. D. for assisting in questionnaire administration during the study.

References Références Referencias

1. Adetumbi J.A., Saka J.O. and Fato B.F. (2010): Seed handling systems and its implication on seed quality in South Western Nigeria. Journal of Agricultural Extension and RuralDevelopment (JAERD). 2(6) 133-140
2. FAO (2009): Seed Marketing: Accessed at: http://betuco.be/marketing/Seed%20marketing%20FAO.pdf
3. Harris R., Guthrie H., Hobart B. and Lundberg D. (1995): Competency-based education and training: Between a rock and a whirlpool. MacMillan Educational Australia, South Melbourne.
4. Marika, K. and Afua, B. B (2010): Overview of the agricultural input sector in Ghana, IFPRI discussion papers 1024, International Food Policy Research Institute (IFPRI).
5. Morris M., Kelly V.A, Kopicki R. J. and Byerlee D. (2007): Fertilizer use in African agriculture. Lessons learned and good practice guidelines. World Bank directions in development report. Washington, D.C.: The World Bank.
6. Ogunlade I., Atibioke O.A., Ladele A.A. and Adumadehin G. S. (2012): Capacity of agro-input dealers in advisory service delivery to maize farmers in Kwara State, Nigeria. International Research Journal of Agricultural Science and Soil Science. Vol. 2 (10). 426-435,

This page is intentionally left blank

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Influence of Bioprotector Produced by Interspecific Microbial Inoculation on Green Pepper Characteristics and Nutrient Uptake

By Rosângela Souza Santana, Newton P. Stamford, Carolina Etienne R. S. Santos, Sebastião Silva Júnior, Ana Dolores S. Freitas & Thatiana Montenegro S. Arnaud

University Federal Rural of Pernambuco, Brazil

Abstract- The aim of this study was to evaluate PK rock biofertilizer mixed with earthworm compound inoculated with free-living diazotrophic bacteria (NPKB). The bioprotector achieved by the introduction of fungi chitosan by the addition of Cunninghamella elegans was also studied. In a field experiment were evaluated the effects of this biofertilizer and bioprotector (NPKB + *C.* elegans) on characteristics and nutrient uptake by green pepper (*Capsicum annuum*). The experiment was conducted at the Horticultural Experimental Station of the Agronomic Institute of Pernambuco – IPA during the rainy season (March-August, 2011). The study was a factorial (8x2) split plot design with eight fertilizer treatments and two sub treatments (with and without crustaceous chitosan applied to leaves) and with four replicates. The fertilizer treatments were as follows: NPKF mineral fertilizers applied at the recommended rate (RR); Biofertilizer - NPKB at 50% RR; NPKB at 100% RR; NPKB at 150% RR; NPKP (Bioprotector with fungi chitosan from C. elegans) at 50% RR; PNPK at 100% RR; PNPK at 150% RR; Control treatment (cow manure applied at 2.4 L plant^{-1}). The best fruit yield was obtained with the highest rate of PNPK and NPKB application. There were significant differences in nutrient uptake between the different fertilization treatments.

Keywords: *capsicum annuum, cunninghamella elegans, biological fertilizers, fungi chitosan, nutrient absorption, organic agriculture.*

GJSFR-D Classification : *FOR Code: 309999p*

Strictly as per the compliance and regulations of:

Influence of Bioprotector Produced by Interspecific Microbial Inoculation on Green Pepper Characteristics and Nutrient Uptake

Rosângela Souza Santana [α], Newton P. Stamford [σ], Carolina Etienne R. S. Santos [ρ], Sebastião Silva Júnior [ω], Ana Dolores S. Freitas [¥] & Thatiana Montenegro S. Arnaud [§]

Abstract- The aim of this study was to evaluate PK rock biofertilizer mixed with earthworm compound inoculated with free-living diazotrophic bacteria (NPKB). The bioprotector achieved by the introduction of fungi chitosan by the addition of *Cunninghamella elegans* was also studied. In a field experiment were evaluated the effects of this biofertilizer and bioprotector (NPKB + *C.* elegans) on characteristics and nutrient uptake by green pepper (*Capsicum annuum*). The experiment was conducted at the Horticultural Experimental Station of the Agronomic Institute of Pernambuco – IPA during the rainy season (March-August, 2011). The study was a factorial (8x2) split plot design with eight fertilizer treatments and two sub treatments (with and without crustaceous chitosan applied to leaves) and with four replicates. The fertilizer treatments were as follows: NPKF mineral fertilizers applied at the recommended rate (RR); Biofertilizer - NPKB at 50% RR; NPKB at 100% RR; NPKB at 150% RR; NPKP (Bioprotector with fungi chitosan from *C. elegans*) at 50% RR; PNPK at 100% RR; PNPK at 150% RR; Control treatment (cow manure applied at 2.4 L plant^{-1}). The best fruit yield was obtained with the highest rate of PNPK and NPKB application. There were significant differences in nutrient uptake between the different fertilization treatments. In the experiment, no case of soft rot disease was observed; therefore, it was impossible to compare the treatments in this respect. The results indicate a great potential for PK rock biofertilizer with free-living diazotrophic bacteria (NPKB) and bioprotector with fungi chitosan (NPKB + *C. elegans*) as an alternative to NPK fertilization.

Keywords: *capsicum annuum, cunninghamella elegans, biological fertilizers, fungi chitosan, nutrient absorption, organic agriculture.*

I. Introduction

The growing world population and increased demands for fertilizers and pesticides have led to sensible changes in agricultural systems and the use of new techniques to maximize yields (Goy et al., 2009). Fertilization with NPK affects horticultural productivity and nutrient absorption; this increases yield and maximizes the productivity of the agricultural crop system (Stamford et al., 2008).

Authors α σ ρ ω ¥ §: University Federal Rural of Pernambuco, Department of Agronomy, Av. D. Manoel de Medeiros, s/n°, Dois Irmãos, 52171-900, Recife, Pernambuco, Brazil.
e-mails: newtonps@depa.ufrpe.br, Etienne@depa.ufrpe.br

Soluble fertilizers are important for plant yields; however, they are less available to low-income farmers due to their high prices. In modern and sustainable agriculture, the use of fertilizers can incrementally increase food production to meet economic criteria and increase biodiversity to minimize environmental damage (Stamford et al. 2008).

Biofertilizers produced from powdered P and K rocks are treated with elemental sulfur inoculated with *Acidithiobacillus*, which metabolically produces H_2SO_4. Such an arrangement increases the availability of the nutrients contained in the rocks. It is known that N is not supplied by powdered rocks in an amount sufficient to improve plant growth. To increase the N content in PK rock biofertilizer with low pH, it is necessary to add organic matter (OM) inoculated with free-living diazotrophic bacteria as proposed by Lima et al. (2010). In biological studies, crustaceous chitosan is frequently used to increase resistance to plant pathogens. Moreover, chitosan has chelating properties greater than those of other natural polymers due to the presence of amino groups, and it may release nutrients into the environment (Boonlertnirun et al. 2008; Goy et al., 2009). In this study, fungus biomass (*Cunninghamella elegans*) was applied to an NPKB biofertilizer for the production of a bioprotector that promoted chitin deacetylation through the acidity promoted by the sulfur oxidative bacteria *Acidithiobacillus.* The use of fungi chitosan has advantages over crustaceous chitosan, such as an independence from seasonal factors and the simultaneous extraction of chitin and chitosan (Franco et al., 2004).

The use of fungi chitosan application in agriculture as a bioprotector does not appear in the literature. No published research on the use of *C. elegans* to produce biofertilizer with the addition of fungi chitosan was found. This study describes the production of a bioprotector and evaluates the stimulating effects of this biofertilizer and bioprotector with fungi chitosan on green pepper yield, nutrient uptake and in some commercial characteristics. The main objective of this study was to determine the feasibility of using PK rocks with organic matter enriched in N by free-living

diazotrophic bacteria and with fungi chitosan as an alternative to conventional fertilizers. Furthermore, this product could potentially be used as a bioprotector against phytopathogenic microorganisms in further studies.

II. Materials and Methods

a) The Production of Biofertilizers (NPKB) and Bioprotector (NPKP)

Biofertilizers from phosphate and potash rocks were produced at the Horticultural Experimental Station of the Federal University Rural of Pernambuco (UFRPE). Two furrows (each 10.0 m long, 1.0 m wide and 0.5 m deep) were constructed. For each biofertilizer, 4000 kg of natural phosphate with a total P of 240 g kg^{-1} purchased from Irecê (Bahia), Brazil, and 4000 kg of potash rock (biotite) with a total K of 100 g kg^{-1}, purchased from Santa Luzia (Paraiba), Brazil, were mixed with 400 kg of elemental sulfur and inoculated with *Acidithiobacillus* bacteria; the biofertilizers were prepared following the procedure described by Stamford et al. (2007).

The sulfur oxidizing bacteria were grown in 2000 ml Erlenmeyer flasks that contained 1000 ml of a specific culture medium (El Tarabily et al., 2006). The media were sterilized for 30 min at 120 °C. The Erlenmeyer flasks were shaken (150 rev/min) for 5 days at 30 °C. The materials (phosphate and potash rocks mixed with elemental sulfur) were incubated for 60 days; the humidity was maintained at a level that was near the field holding capacity. To avoid the effects of excessive humidity due to rain and to increase the efficiency of the oxidizing bacteria, the furrows were covered daily using black plastic.

The analysis of the P and K rock biofertilizer (PKB) was performed with extraction by (A) Mehlich 1 solution and (B) citric acid, according to Embrapa (2009). This analysis yielded the following results: (P-biofertilizer)-pH = 3.8, the available P for (A) = 60 (g kg^{-1}) and for (B) = 48 (g kg^{-1}); (K biofertilizer-BK)-pH = 3.3, the available K for (A) = 10 (g kg^{-1}) and for (B) = 0.5 (g kg^{-1}).

The biofertilizer (NPKB) was produced under field conditions using PK rock biofertilizer (PKB) and organic matter (OM) obtained from sugar cane cake; these components were mixed in a proportion (PKB:OM) equivalent to (1:4) and inoculated with the free living bacteria (NFB 10001) selected in the previous assays. The diazotrophic bacteria were cultured in LG liquid media (50 ml) in 125 ml Erlenmeyer flasks and shaken (180 rpm) for 96 h at 28 ± 5 °C temperature, according to the methodology described by Lima et al. (2010). After the inoculation, the material was incubated for 30 days following the process described above for the PK rock biofertilizer. The humidity was maintained near water holding capacity. Samples were collected; the total N was determined using the Kjeldhal method with a Kjeltec auto analyzer (1030 Model). The results of the chemical analysis of the mixed biofertilizer (NPKB) are as follows: pH was 6.90; the organic carbon equaled 120.7 g kg^{-1}; the total N equaled 19.8 g kg^{-1}; the total sulfur equaled 10.9 g kg^{-1}; the total P equaled 10.1 g kg^{-1}; and the total K equaled 15.1 g kg^{-1}.

The protector (PNPK) was the biofertilizer (NPKB) with the addition of the mycelial biomass of the fungus *Cunninghamella elegans* (UCP 542). This fungus contains a considerable amount (7-8%) of chitosan in its cell wall. The fungus *C. elegans* was purified in Petri dishes on PDA medium and grown for 10 days at 28 °C. The monosporic *C. elegans* culture was obtained from the Mucorales fungus in Potato-Dextrose (BD) medium as recommended by Franco et al. (2004). Erlenmeyer flasks with volumes of 2000 mL were shaken (180 rotations per minute) at 28 °C for 96 h. The mycelial biomass was diluted (1 L culture per 10 L of distilled water) and added to the substrate by manual application. The mixture was incubated for 35 days. Samples were collected weekly for chemical analyses (pH, total N, and available P and K) as described for NPKB production.

b) Experimental conditions and soil analyses in the field experiment

A field experiment with sweet pepper (cv. All Big) was carried out at the IPA Experimental Station located in the rainforest region of Pernambuco State, Brazil. The District of Vitoria de Santo Antão is situated at 8º 8' 00' S and 35º 22' 00" W at an altitude of 146 m.

During the course of the field experiment (December 2010–March 2011), the photoperiod remained close to 12 h of darkness and 12 h of light. The temperature oscillated between 28°C and 36°C, and the relative humidity was 60-80%. The soil was prepared for the crop by cutting and removing all of the vegetation from the experimental area. Soil was prepared by conventional tillage with one plowing and two diskings; the rows were then opened to transplant the green pepper seedlings. The rows were made systematically to maintain a declivity of approximately 0.2-0.5% to avoid soil run-off.

Seeds were pre-germinated in trays (128 cells per tray) and transplanted in the field 38 days after the seeds were initially planted. The fertilizers were mixed with the surface soil (10 cm deep) before the seedlings were planted. The subplots (8.4 m^2) measured 2.8 m long and 3 m wide. Plants were placed with a spacing of 1.0 m x 0.40 m. To estimate yield, 10 plants were collected from the central rows of each sub plot. Plants were collected weekly for four harvests. The total fruit yield, the number of fruits and nutrients in fruits were analyzed.

The NPKF fertilizer mixed with ammonium sulfate, simple superphosphate, and potassium sulfate

was prepared based on the recommended rate (RR) following soil analyses and the recommendations for irrigated green pepper in the state of Pernambuco, Brazil (IPA, 2008). NPKF fertilizers were applied at seedling transplantation. For N and K, ammonium sulfate and potassium sulfate were applied. The NPKB and NPKP treatments were as follows: 50, 100 and 150 (g plant^{-1}), which correspond to 50% RR, 100% RR and 150% RR, were applied at seedling transplantation and in the two fertilization dressings. In the control treatment, farmyard manure (2.4 L plant^{-1}) was applied at seedling transplantation, and the same amount was applied in the two fertilization dressings.

The soil used was classified as Red Yellow Latosol (Embrapa, 2006) and was located in the rainforest region in Pernambuco state, Brazil. The soil analysis (Embrapa, 2009) revealed the following: pH (H_2O) = 6.1; total N = 0.55 g kg^{-1}, available P = 2.7 mg dm^{-3}, available K= 10.4 mg dm^{-3}, and the exchangeable cations (mmol$_c$ dm^{-3}) Ca = 16 and Mg = 4.1.

c) Experimental design and statistical analyses

The field experiment was set up in a factorial (8x2), randomized split plot design with 4 replicates. The treatments were as follows: (1) NPKF soluble fertilizers applied at the recommended rate - RR; (2) NPKB at 50% RR; (3) NPKB at 100% RR; (4) NPKB at 150% RR; (5) NPKP at 50% RR; (6) NPKP at 100% RR; (7) NPKP at 150% RR; and (8) the control treatment (farmyard manure). All fertilizer treatments were applied with or without shrimp chitosan (90% purity, 95% deacetylation) purchased from Sigma Industry. Shrimp chitosan was applied to the leaves at seven days after seedling transplantation. The natural occurrence of root pathogenic fungi was observed.

The statistical calculations for the production of the bioprotector and for the field experiment parameters were achieved using the Program SAS software version 9.2 (SAS Institute 2011). Analyses of variance and averages were compared using the Tukey test at a probability of $p<0.05$.

III. Results

a) Biofertilizer and Protector with diazotrophic bacteria and C. elegans

The chemical analyses of the products (pH, total N, available P and available K) are shown in Table 1. The pH results demonstrated significant differences. In both products, an effect of the time of incubation, especially from 10 to 20 days, was observed. A reduction in pH was evident in the biofertilizer NPKB treatment with the inoculation of free-living bacteria (NFB 10001) and in treatments with the addition of *C. elegans*. The effects on total N, available P and available K by the biofertilizer were inversely proportional to the observed pH values (Table 1). The best results for the biofertilizer NPKB were obtained when the substrate was incubated for 28 days. The pH stabilized between 6.0-6.5, the total N was 10 (g kg^{-1}), the available P was 1.39 (g kg^{-1}), the available K was 1.2 (g kg^{-1}), the exchangeable Ca^{+2} was 0.34 (g kg^{-1}) and the exchangeable Mg^{+2} was 0.45 (g kg^{-1}).

The available P contained in NPKB was significantly different depending on the period of incubation (Table 1). The highest available P was obtained at 30 days of incubation; an increase of up to 100% compared to the initial measurement was observed. The increase in available K was significant. In the NPKB biofertilizer, the highest available K values were obtained after 30 days of incubation. However, the bioprotector with *C. elegans* increased the available K by up to 20% more than obtained in the NPKB biofertilizer.

b) Green pepper productivity

Rock biofertilizers mixed with an earthworm compound, inoculated with diazotrophic bacteria (NPKB) or mixed with *C. elegans* (NPKP) were more effective than the conventional fertilizer (NPKF) and increased the sweet pepper yield (Table 2). The fertilization with NPKP (150% RR) resulted in a greater green pepper fruit yield of 21.36 t ha^{-1}. The fruit yields with NPKP (100% RR) and NPKB (150% RR) were 19.14 and 19.07 t ha^{-1}, respectively. The treatment with soluble fertilizer (FNPK) produced a yield of 17.38 t ha^{-1}. The control treatment (farmyard manure applied at 2.4 L plant^{-1}) had the lowest fruit yield (15.65 t ha^{-1}). Interestingly, all of the fertilizer treatments applied showed yields greater than the average yield of irrigated green pepper for the state of Pernambuco (15 t ha^{-1}).

c) Fruit commercial characteristics

The green pepper fruit commercial characteristics are presented in Table 3. The yields of green pepper increased with the application of different fertilizer treatments. The best results were obtained when the bioprotector (NPKP) was applied at the highest rate (150% RR). In this case, green pepper yield increased by 28% and 19% compared with the control treatment and the fertilizer (NPKF) treatment, respectively. The largest number of fruits was observed when NPKB was applied at the highest rate (68,000 fruits ha^{-1}) and when NPKP was used (67,500 fruits ha^{-1}). The smallest number of fruits was observed for the control (29,250 fruits ha^{-1}).

The effects of the different fertilizer treatments on the commercial characteristics of green pepper are outlined in Table 3. The commercial characteristics of green pepper fruits and the yield and number of green peppers showed the same pattern among the different fertilization treatments. The effects of the fertilization treatments on the length, diameter and thickness of the green pepper fruits were greatest when NPKB (150% RR) and NPKP (150% RR) were applied.

d) Nutrients in the green pepper fruits

The nutrients contained in the green pepper fruits are presented in Table 4. The greatest increase in the amount of total N in the leaves was observed when NPKP was applied at the highest rate (150% RR), followed by NPKB (150% RR), and NPKF (100% RR). When NPKB (150% RR) was applied, the response was not significantly different from the response observed in the NPKF application; these treatments are not significantly different than the NPKP (100% RR) and NPKB (100% RR) treatments. Plants grown under the control treatment, NPKB and NPKP applied at 50% RR had the lowest amount of total N in the leaves. An effect of the inoculation with free-living diazotrophic bacteria (NFB 10001) was observed; the microorganisms caused an increase in the N content of the biofertilizer NPKB, especially when the product was applied at higher rates. The total P found in the green pepper fruits revealed significant differences based on the fertilizer treatment applied (Table 4). The highest total P values were observed when NPKP was applied at 150% RR, followed by NPKB applied at 150% RR (Table 4). The total K in green pepper revealed that the NPKP treatment at application rates of 150% and 100% RR resulted in significant differences compared with the other fertilization treatments. The total P found in fruits under the control treatment and the NPKF treatment were not significantly different. Thus, the NPKB and NPKP treatments resulted in the best nutrient status in green pepper fruits.

The total N observed in the green pepper fruits was highest when the NPKP fertilizer was applied. Compared to the mineral fertilizer (NPKF) treatment, the application of mixed biofertilizer (NPKB) applied at the highest rate (150% RR) increased the total N content up to 50%, and NPKP applied at 150% RR increased the total N content by 100% (Table 4).

The best results were observed when NPKP was applied at the highest rate (150% RR), followed by NPKB (150% RR) and NPKF (100% RR). When NPKB (150% RR) was applied, the response was not significantly different than that observed for the NPKF application; these treatments were not significantly different than the NPKP (100% RR) and NPKB (100% RR) treatments. The lowest total N values were observed with the control treatment and the NPKB and NPKP treatments applied at 50% RR.

The total P observed in the green pepper fruits was significantly affected by the fertilizer treatment (Table 4). The highest total P value was observed when NPKP was applied at a rate of 150% RR, this was followed by NPKB application at a rate of 150% RR. Significant differences in the total K in the green pepper fruits were observed in the PNPK application at rates of 150% and 100% RR compared to other fertilizer treatments. The control and NPKF treatments did not display significant differences. Thus, the NPKB and NPKP treatments resulted in the best nutrient status in the green pepper fruits.

These results suggest that the biofertilizer obtained from PK rocks with the addition of the earthworm compound and the bioprotector inoculated with *C. elegans* chitosan may be applied to soil with low nutrient content as an alternative fertilization method for increment green pepper productivity.

IV. Discussion

a) Production of the biofertilizer-bioprotector

A reduction in pH values was observed when the biofertilizer NPKB was applied along with an inoculation of the free-living bacteria (NFB 10001) and the addition of *C. elegans*. The P and K rock biofertilizers present with pH values of 3.0 and 3.5, respectively. However, the observed pH values in the NPKB and NPKP treatments were satisfactory for tropical plants and mostly likely do not result in harmful effects.

As a result of biofertilizer and bioprotector production, both substrates showed substantial increases in the N, P and K contents. The enrichment in N content in the earthworm compound was similar to that observed by Lima et al. (2010), who obtained an increase in total N content of up to 100%.

The highest available P content was obtained after 30 days of incubation; the P content increased up to 100% relative to the initial time point. The bioprotector (NPKP) inoculated with *C. elegans* increased the available K up to 20% compared with the natural earthworm compound; this was likely due to the release of this nutrient from the biotite rock and the organic matter.

The biofertilizer-bioprotector may release all of the macronutrients necessary for plant growth and increased yield. Free-living diazotrophic bacteria increase the N content through the effectiveness of the process of nitrogen fixation. As reported by Kowalski et al. (2006) and Goy et al. (2009), chitosan may increase the levels of N, P and K in the substrates due to the formation of charged amino groups due to chitosan deacetylation. Furthermore, *C. elegans* contains chitosan in the cellular wall and produces polyphosphates (Franco et al., 2011) that increase the solubility of P and others nutrients.

The nutrients P and Ca are liberated from the P and K rocks by the oxidative bacteria *Acidithiobacillus*. These bacteria act on the natural P rocks that contain high P and Ca content and, in the same manner, release the nutrients K and Mg from the biotite mineral. In the production of the PK rock biofertilizers, the oxidative bacteria *Acidithiobacillus* use the elemental sulfur and produces sulfuric acid through a metabolic reaction; the

soluble S-SO_4^{-2} released during this process may be utilized for plant nutrition.

Furthermore, the interactive processes carried out by these microbial organisms release micronutrients contained in the earthworm compound. In this way, a complete biofertilizer is produced. In addition, the chitin and chitosan from *C. elegans* may protect plants against damage by inhibiting pathogenic microorganisms (Berger et al*.,* 2011).

b) Green pepper productivity

Moura et al*.* (2007) obtained similar results on melon yield comparing P and K rock biofertilizers and organic matter (earthworm compound) with P and K mineral fertilizers in a Brazilian Argisol. Oliveira et al. (2010) applied organic matter to castor bean (10 t ha^{-1}) and observed an increase in melon yield, reporting that this effect occurred because the organic matter increases nutrient solubilization.

The difference observed in green pepper productivity when the bioprotector was applied is due to the effect of adding the fungus *C. elegans* to the biofertilizer (NPKP); the fungus produced inorganic polyphosphate and increased P and N due to the amino acid changes observed in the deacetylation of chitosan (Franco et al. 2011). The large amount of N in chitosan (6.9 to 8.7%) may increase both vegetative and reproductive plant growth. Such growth is consistent with reports by Otha et al. (2004) and Rabea et al. (2003). These authors observed that when chitosan was applied to the soil as a mixed fertilizer, the resulting high levels of nitrogen, phosphorus, and potassium increased plant growth compared with the control treatments.

Boonlertnirun et al. (2008) reported that the period of chitosan availability in the soil may increase when it is applied to the biopolymer at the shoot; prolonged contact of the plant root and the soil favored the interaction between the positive charges of the chitosan and the negative charges of the nutrients contained in the soil, which may influence nutrient absorption by plants and contribute to increased plant yield.

c) Green pepper characteristics

Oliveira (2010) observed significant effects of PK rock biofertilizers mixed with an earthworm compound on the characteristics of melon. Lima et al. (2007) reported that PK rock biofertilizers affected the commercial characteristics of lettuce grown in an Argisol soil in Ceará state, Brazil. However, the locus number of the fruits did not differ significantly, as this is a genetic characteristic that varied with species and is not influenced by environmental effects such as fertilization treatments.

The greater effects of the bioprotector with fungi chitosan application (NPKP) most likely occurred because the treatments with PK rock biofertilizers plus elemental sulfur are inoculated with *Acidithiobacillus*. The oxidative bacteria produce sulfuric acid, which increases the release of available P and K from the rocks, as proposed by Stamford et al. (2006; 2007; 2008). Chitosan also increases the levels of N, P and K in the substrates, as proposed by Kowalski et al. (2006) and Goy *et al*. (2009).

In an Argisol from a semiarid region (the San Francisco Valley), Stamford et al. (2009) observed that P and K rock biofertilizers had significant effects on melon characteristics compared with conventional soluble fertilizers. Lima et al. (2007) evaluated the effectiveness of biofertilizers from P and K rocks with elemental S and inoculated with *Acidithiobacillus* bacteria. The authors reported that the rock biofertilizers mixed with an earthworm compound improved yield and promoted higher residual effects on two consecutive lettuce crops compared with conventional fertilizers in a Yellow Latosol.

d) Nutrients uptake

The effects of the bioprotector with fungi chitosan application (NPKP) in nutrients uptake probably occurred because in the treatments with higher amounts of PK rock biofertilizers plus elemental sulfur inoculated with *Acidithiobacillus* the oxidative bacteria produced sulfuric acid which increase the release of available P and K from the rocks, as proposed by Stamford et al. (2006; 2007; 2008). In the other hands, chitosan also increase the levels of N, P and K in the substrates as proposed by Kowalski et al. (2006) and Goy et al. (2009). The results suggest that the biofertilizer from PK rocks plus earthworm compound and the bioprotector inoculated with *C. elegans* produced chitosan and applied in soil with low nutrients content may be alternative for green pepper fertilization.

The results in nutrients uptake were in accord with Lima et al. (2010) who observed an increase in total N up to 100% when applied the free living diazotrophic bacteria (NFB 10001) inoculating the earthworm compound. It was verified the effect of the bioprotector due to the inoculation with free living diazotrophic bacteria (NFB 10001) because the microorganism increment N in the biofertilizer NPKB, especially when applied the product in higher rates, and the addition of chitosan increase N content as described by Oliveira et al. (2010).

V. Conclusions

The use of biofertilizers from PK rocks mixed with an earthworm compound (NPKB) and enriched in N content by inoculation with diazotrophic bacteria (NFB 1001) and the NPKB inoculated with *C. elegans* (NPKP) increased fruit yield compared with mineral fertilizers. The use of NPKB and NPKP resulted in positive increases in some important commercial characteristics

of green pepper and its nutrient status; the nutrient availability in the soil also increased. We conclude that NPKB and NPKP are a possible alternative to NPK mineral fertilizers applied to green pepper.

VI. Acknowledgements

The work in part was supported by CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brasil), CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nivel Superior) and FACEPE (Fundação de Apoio a Ciência e Tecnologia do Estado de Pernambuco, Brasil), and also we would like to acknowledge CNPq to the fellowships.

References Références Referencias

1. Berger. L.R.R., Stamford, C.M., Stamford, N.P. 2011. Perspectivas para o uso da quitosana na agricultura. Rev. Iberoamer. Polim. 12, 195-215.
2. Berger, L.R.R., Stamford, N.P., Santos, R.E.R.S., Freitas, A.D.S., Franco, L.O., Arnaud, T.M.S. 2013. Plant and soil characteristics affected by rock biofertilizers from rocks and organic matter inoculated with diazotrophic bacteria and fungi that produces chitosan. J.Soil Sci. Plant Nutr. 13: 1-11.
3. Boonlertnirun, S., Boonraung, C., Suvanasara, R. 2008. Application of chitosan in Rice production. J Metals Mat. Min. 18, 47-52.
4. El Tarabily, K.A., Soaud, A.A., Saleh, M.E., Matsumoto, S. 2006. Isolation and characterization of sulfur-oxidizing bacteria, including *Rhizobium* from calcareous sandy soils and their effects on nutrient uptake and growth of maize (*Zea mays* L.). Aust. J. Agric. Res. 57, 101-111.
5. Embrapa – Empresa Brasileira de Pesquisa Agropecuária. 2009. Sistema Brasileiro de Classificação de Solos. Rio de Janeiro. pp. 412.
6. Embrapa – Empresa Brasileira de Pesquisa Agropecuária. 2006. Manual de métodos de análise de solo, plantas e fertilizantes. Rio de Janeiro. pp. 627.
7. Franco, L.O., Maia, R.C.C., Porto, A.L.F., Messias, A.S., Fukushima, K., Takaki, G.M.C. 2004. Heavy metal biosorption by chitin and chitosan isolated from *Cunninghamella elegans* (IFM 46109). Braz. J. Microbiol. 35, 243-247.
8. Franco, L.O., Albuquerque, C.D.C., Stamford, N.P., Lima, M.A.B., Takaki, C.G.M. 2011. Avaliação da atividade ácida e alcalina e acúmulo de fosfato inorganico em amostras de *Cunninghamella elegans*. Analytica 54, 70-78.
9. Goy, R.C., Britto, D., Assis, O.B.G. 2009. Review of the Antimicrobial Activity of Chitosan. Polym. Sci. Technol. 9, 241-247.
10. IPA – Instituto Agronômico de Pernambuco 2008. Recomendação de adubação para o estado de Pernambuco. Recife, Brazil. pp. 122.
11. Kowalski, B., Terry, F.J., Herrera, L., Peñalver, D.S. (2006). Application of soluble chitosan in vitro and in the greenhouse to increase yield and seed quality of potato minitubers. Potato Res. 49, 167-176.
12. Lima, F. S., Stamford, N.P., Sousa, C.S., Lira Júnior, M.A., Malheiros, S.M.M., Van Straaten, P. 2010. Earthworm compound and rock biofertilizer enriched in Nitrogen by inoculation with free living diazotrophic bacteria. World J. Microbiol. Biotechnol. 27, 1-7.
13. Lima, R.C.M., Stamford, N. P., Santos, C.E.R.S., Dias, S. H. L. 2007. Rendimento da alface e atributos químicos de um Latossolo em função da aplicação de biofertilizantes de rochas com fósforo e potássio. Braz. J. Hortic. 25, 224 – 229.
14. Moura, P., Stamford, N.P., Duenhas, L.H., Santos, C.E.R.S., Nunes, G.H.A.S. 2007. Eficiência de biofertilizantes de rochas com *Acidithiobacillus* em melão, no vale do São Francisco. Braz. J. Soil Sci. 2, 1-7.
15. Oliveira, A.E., Sá, J.R., Medeiros, J.F., Nogueira, N.W., Silva, K.J. 2010. Interação da adubação organo-mineral no estado nutricional das plantas. Rev. Verde, 5, 53-58.
16. Otha, K., Morishita, S., Suda, K., Kobayachi, N. and Horoski, T. 2004. Effects of chitosan soil mixture treatment in the seedling stage on the growth and flowering of several ornamental plants. J. Japan Soc. Hort. Sci. 73, 66-68.
17. Rabea, E.I., Badawi, M.E.I., Stevens, C.V., Smagghe, G. and Steurbaut, W. 2003. Chitosan as antimicrobial agent: Applications and mode of action. Biomacromol. 4, 1457-1465.
18. SAS Institute. *The SAS System for Windows*. CD – ROM for Windows 32 – bits. 1999.
19. Stamford, N.P., Moura, P.M., Lira Junior, M.A., Santos, C.E.R.S., Duenhas, L.H., Gava, C.A.T. 2009. Chemical attributes of an Argisol of the Vale do São Francisco after melon growth with phosphate and potash rocks biofertilizers. Braz. J. Hortic. 27, 447- 452.
20. Stamford, N.P., Lima, R.A., Lira Junior, M.A. and Santos. C.E.R.S. 2008. Effectiveness of phosphate and potash rocks with *Acidithiobacillus* on sugar cane yield and their effects in soil chemical attributes. World J. Microbiol. Biotechnol. 24, 2061-2066.
21. Stamford, N.P., Santos, C.E.R.S., Santos, P.R., Santos, K.S., Freitas, A.D.S. Dias, S.H.L.; Lira Junior, M.A. 2007. Agronomic effectiveness of biofertilizers with phosphate rock, sulphur and *Acidithiobacillus* in a Brazilian tableland acidic soil grown with yam bean. *Bioresour. Technol.* 98, 1311-1318.
22. Stamford, N.P., Lima, R.A., Santos, C.E.R.S. and Dias, S.H.L. 2006. Rock biofertilizers with *Acidithiobacillus* on sugarcane yield and nutrient uptake in a Brazilian soil. *Geomicrobiol. J.* 23, 261-265.

Table 1 : pH values, total N and available P and K in the production of biofertilizer (NPKB) in a previous assay, incubated during 28 days in field conditions [(a)].

Period (days)	pH H_2O	Total N	Available P	Available K	Exchangeable Ca	Exchangeable Mg
			g kg^{-1}			
P_0	6.04[b] ± 0.01	4.8[b] ± 0.01	0.82[b] ± 0.06	0.8[b] ± 0.04	0.35[a] ± 0.03	0.39[b] ± 0.06
P_7	6.28[a] ± 0.02	5.6[b] ± 0.01	1.23[a] ± 0.16	1.2[a] ± 0.15	0.36[a] ± 0.04	0.41[a] ± 0.01
P_{14}	6.29[a] ± 0.01	7.2[ab] ± 0.03	1.36[a] ± 0.09	1.2[a] ± 0.17	0.34[a] ± 0.01	0.45[a] ± 0.06
P_{21}	6.36[a] ± 0.02	8.5[a] ± 0.03	1.37[a] ± 0.18	1.2[a] ± 0.17	0.36[a] ± 0.01	0.46[a] ± 0.04
P_{28}	6.40[a] ± 0.01	10.3[a] ± 0.04	1.39[a] ± 0.12	1.2[a] ± 0.05	0.34[a] ± 0.04	0.45[a] ± 0.01

[(a)] Means with the same letter are not different by the Tukey test ($p \leq 0,05$).

Table 2 : Green pepper productivity and number of green pepper fruits, as affected by the different fertilization treatments [(a)]

Fertilization treatments[(b)]	Fruits of green pepper Productivity	Number
	t ha^{-1}	Unit ha^{-1}
NPKB (50% RR)	16.42±1.12[cd]	53750±9.07[ab]
NPKB (100% RR)	17.98±2.03[c]	51750±9.13[ab]
NPKB (150% RR)	19.07±1.55[b]	68000±5.83[a]
NPKP (50% RR)	16.32±1.97[c]	51750±9.12[ab]
NPKP (100% RR)	19.14±2.21[b]	67500±15.24[a]
NPKP (150% RR)	21.36±2.00[a]	60000±5.28[a]
NPKF (100% RR)	17.38±2.50[c]	51250±10.16[ab]
Control	15.65±1.90[d]	29250±7.73[b]
CV (%)	13	3

[(a)] Means with the same letter are not different by the Tukey test ($p \leq 0,05$).

[(b)] NPKB = Organic matter (earthworm compound) plus PK rocks biofertilizer inoculated with free living diazotrophic bacteria; PNPK = Protector (NPKB with fungi chitosan from C. elegans); FNPK = soluble fertilizers (RR recommended rate), control (earthworm compound 2.4 kg $plant^{-1}$). CV= Coefficient of Variation.

Table 3 : Green pepper characteristics: Fruit length (FL), fruit diameter (FD) and skin thickness (ST) affected by fertilization with biofertilizer (NPKB) and bioprotector (NPKP) in three rates, mineral fertilizer (NPKF) in recommended rate (RR) and the control treatment (earthworm compound – 2.4 kg $plant^{-1}$) [(a)]

Fertilization Treatments [(b)]	Green pepper Commercial Characteristics[(a)] Fruit length (FL)	Fruit diameter (FD)	Skin thickness (ST)
	cm		
NPKB (50% RR)	88.1±4.16[bc]	71.2±3.41[b]	5.1±0.25[b]
NPKB (100% RR)	91.1±6.95[ab]	74.7±1.78[ab]	5.6±0.45[ab]
NPKB (150% RR)	93.7±4.30[a]	76.8±1.61[a]	5.9±0.26[a]
NPKP (50% RR)	86.7±4.11[b]	71.6±2.34[b]	5.4±0.37[ab]
NPKP (100% RR)	93.0±2.61[a]	74.6±2.53[ab]	5.7±0.35[ab]
NPKP (150% RR)	93.7± 3.25[a]	76.9±3.13[a]	6.0±0.14[a]
NPKF (100% RR)	84.5±5.75[c]	71.4±2.72[b]	5.5±0.44[ab]
Control	75.6±5.86[d]	70.0±2.63[c]	4.5±0.36[b]
CV (%)	3	3	7

[(a)] Means with the same letter are not different by the Tukey test ($p \leq 0,05$).

[(b)] NPKB = Organic matter (earthworm compound) plus PK rocks biofertilizer inoculated with free living diazotrophic bacteria; PNPK = Bioprotector (NPKB with fungi chitosan from C. elegans); control (earthworm compound 2.4 kg $plant^{-1}$). CV= Coefficient of Variation.

Table 4 : Total N, P and K in green pepper fruits as affected by fertilization with biofertilizer (NPKB), bioprotector (NPKP) applied in three rates, mineral fertilizer (NPKF) in recommended rate and the control treatment (earthworm compound – 2,4 kg plant^{-1}) [(a)]

Fertilization treatments [(b)]	Nutrient in green pepper leaves[(1)]		
	Total N	Total P	Total K
	kg ha^{-1}		
$NPKB_{50}$ (50% RR)	23,7^{c} ± 2.21	2,27^{b} ±0.31	8,62^{b} ±1.11
$NPKB_{100}$ (100% RR)	26,5^{b} ±2.54	2,49^{b} ±0.25	10,20^{b} ±1.52
$NPKB_{150}$ (150% RR)	28,0^{ab} ±2.55	2,65^{ab}±0.14	11,18^{ab} ±1.24
$NPKP_{50}$ (50% RR)	23,4^{c} ±2.38	2,08^{b} ±0.20	9,10^{b} ±1.31
$NPKP_{100}$ (100% RR)	28,2^{ab}±2.44	2,54^{b} ±0.31	12,03^{a} ±1.42
$NPKP_{150}$ (150% RR)	31,5^{a} ±2.33	3,06^{a} ±0.28	13,53^{a} ±1.26
$NPKF_{100}$ (100% RR)	28,4^{ab} ±2.71	2,38^{b} ±0.29	10,08^{b} ±1.20
Control (farmyard manure)	22,4^{c} ±2.84	2,08^{c} ±0.31	8,04^{b} ±1.55
CV (%)	9	13	18

[(a)] Means with the same letter are not different by the Tukey test ($p \leq 0,05$).
[(b)] NPKB = Organic matter (earthworm compound) plus PK rocks biofertilizer inoculated with free living diazotrophic bacteria; PNPK = Protector (NPKB with fungi chitosan from C. elegans); FNPK = soluble fertilizers (RR recommended rate), control (earthworm compound 2.4 kg plant^{-1}). CV= Coefficient of Variation.

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Public Perceptions of Urban Forests in Okitipupa Nigeria: Implication for Environmental Conservation

By Faleyimu, O. I
Ondo State University of Science and Technology, Nigeria

Abstract- The paper assessed the public perceptions of urban forest in Okitipupa' Nigeria with a view to recommending appropriate management strategies. Two hundred respondents were purposively selected from the study area with structured questionnaire. Results revealed that 90.2% of the respondents has preference for trees and 85.4% will be willing to participate in a project to plant trees. More than 50% of the respondents would like to contribute 1-2 hours per week to the project while 31.7% would like to contribute #500-1000 annually for tree planting and maintenance. Most of the respondents love to live and work in a green environment and would like to pay extra cost to rent property located in it. Most of the respondents planted trees around their houses for purpose of providing fruits, nuts and vegetable. 50% indicated that it is for the purpose of making their environment to be more beautiful, attractive and for the provision of medicinal plants. There are no statistically significant differences ($p>0.05$) of opinions in the respondents' education, age, family size and type of employer and participation in urban forestry project. There should be frequent inventory and survey of trees to note the distribution and density as well as structural and physical changes necessary for management practices. Also a survey of tree preference when planning for a tree planting programme should be carried out.

Keywords : *urban forest, management strategies, willingness to contribute.*

GJSFR-D Classification : *FOR Code: 620399*

Strictly as per the compliance and regulations of:

Public Perceptions of Urban Forests in Okitipupa Nigeria: Implication for Environmental Conservation

Faleyimu, O. I

Abstract- The paper assessed the public perceptions of urban forest in Okitipupa' Nigeria with a view to recommending appropriate management strategies. Two hundred respondents were purposively selected from the study area with structured questionnaire. Results revealed that 90.2% of the respondents has preference for trees and 85.4% will be willing to participate in a project to plant trees. More than 50% of the respondents would like to contribute 1-2 hours per week to the project while 31.7% would like to contribute #500-1000 annually for tree planting and maintenance. Most of the respondents love to live and work in a green environment and would like to pay extra cost to rent property located in it. Most of the respondents planted trees around their houses for purpose of providing fruits, nuts and vegetable. 50% indicated that it is for the purpose of making their environment to be more beautiful, attractive and for the provision of medicinal plants. There are no statistically significant differences ($p>0.05$) of opinions in the respondents' education, age, family size and type of employer and participation in urban forestry project. There should be frequent inventory and survey of trees to note the distribution and density as well as structural and physical changes necessary for management practices. Also a survey of tree preference when planning for a tree planting programme should be carried out.

Keywords: urban forest, management strategies, willingness to contribute.

I. Introduction

Urban forests are ecosystems characterized by the presence of trees and other vegetation in association with human developments (1). Increasing urbanization and development have placed urban forests under extreme pressure, threatening their ability to maintain the basic ecological functions, including water and air purification, upon which human existence depends (2). Community involvement is critical for the continued vitality of the urban forest (3). To encourage and ensure this involvement, it is important to understand the public's shared beliefs and attitudes toward trees that promote their care, management, and protection. According to (4), the urban environment is generally characterized by impervious surfaces, highly reflective and radiating materials like concrete, and metals. These are in addition to the presence of economic activities, such as heating, cooking, and transportation. All of these have inherent capacities to produce immense heat, smoke, and dust, which severally and collectively degrade the urban environment. Urbanization, which is occurring most rapidly in developing countries, is causing major social and economic changes (5), carrying along with it increasing demand for basic needs as fuelwood, low-cost construction materials, drinking water and water for household use. These are in addition to huge and growing social and environmental problems such (i) air, land and noise pollution (ii) non-conducive local microclimatic conditions and (iii) a stressful social and psychological living environment, resulting from inadequate, dilapidated and overstretched infrastructure, degraded urban physiognomy, increasing levels of unemployment, crime, insecurity and other social vices inherent in many arears of the developing world. Urban forestry- a major component of management of trees outside forests offers a variety of benefits capable of mitigating these problems. These benefits include; providing the urban dwellers, (especially the urban poor) with some essential forest produce, mitigation of the ecological effects of urban sprawl, improving the living environment in urban areas, attraction of tourism, provision of avenue for recreation and solitude fort activities, encouragement of investment, as well as creation training and employment opportunities (6). Urban forests have a positive impact of air quality through deposition of pollutants to the vegetation canopy, sequestration of atmospheric CO_2 in woody biomass, and reduction of temperature. Furthermore, urban forests are one of the most cost-effective means of mitigating urban heat islands and associated expenditure for air conditioning (7). Trees also intercept and store rainfall on leaves and branch surfaces, thereby reducing runoff volumes and delaying the onsets of peak flows. Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow. Urban canopy reduces soil erosion by diminishing the impact of raindrops on barren surfaces. By virtue of their proximity to people, urban forests can provide substantial environment and recreational benefits to urban dwellers. Trees as a solar-powered technology can help restore balance to dysfunctional urban ecosystems. Besides, urban forests are strands in the

Author: Dept. of Biological Sciences, Ondo State University of Sciences and Technology, Okitipupa. e-mail: orimoloyespecial@yahoo.com

urban fabric that connect people to nature and to each other (7).

The Society of American Foresters has developed the following definition of urban forestry: "Urban forestry is a specialized branch of forestry that has as its objective the cultivation and management of trees for their present and potential contribution to the physiological, sociological, and economic well-being of urban society. Inherent in this function is a comprehensive program designed to educate the urban populace on the role of trees and related plants in the urban environment. In its broadest sense, urban forestry embraces a multimanagerial system that includes municipal watersheds, wildlife habitats, outdoor recreation opportunities, landscape design, recycling of municipal wastes, tree care in general, and the future production of wood fiber as raw material."

Urban forestry is a specialized branch of forestry and has as its objective the cultivation and management of trees for their present and potential contribution to the physiological, sociological. and economic well being of urban society. These contributions include the over-all ameliorating effect of trees on their environment, as well as their recreational and general amenity value (8). (14) defined urban forestry as an integrated citywide approach to the planting, care, and management of trees in the city to secure multiple environmental and social benefits for urban dwellers while (9) viewed urban forestry as the management of trees for their contribution to the physiological, sociological and economic well being of the urban society. He also stressed that urban forestry includes the management of individual as well as groups of trees and is not restricted to planted trees alone, but also includes naturally grown trees within urban areas. Regardless of the divergent, yet interrelated above conceptualisations, an apparent holistic concept of urban forestry will have to be a planned, integrated, and systematic approach to the management of entire tree and woodland (forest) resource in urban and peri-urban areas (10) for their contributions to the physiological, sociological, psychological and economic well being of the urban society. Sustainable urban locality, to ensure continuous tree cover, vis-à-vis the production of benefits for current and future generations. Urban forestry encompasses all the typical activities involving trees which occur principally, but not exclusively in urban areas. At its most comprehensive level it involves the management of an entire urban tree population (15). Beings a mixture of naturally occurring and planted trees in specific locations, the creation and preservation of urban forests require active planning and management by diverse groups of owners, managers, and stakeholders (11). Planning is important because successful incorporation of trees into the physical and social fabric of towns and cities requires incorporating forestry into overall urban planning. This paper assessed the public perceptions of urban forest in Okitipupa Nigeria with a view to recommending appropriate management strategies.

II. Methodology

a) Study area

Fig. 1a. Map of Nigeria showing Ondo State

Fig :1a. Map of Nigeria Showing Ondo State

The research was carried out in Okitipupa area of Ondo State. The present Okitipupa Local Government came into being after splitting Ikale Local Government into Irele and Okitipupa Local Governments in 1991. The Old Okitipupa Division is now split into Okitipupa, Irele, Ilaje and Ese-Odo Local Governments. The Local Government lies between Longitudes 4^0 .3" and 6 00" East of Greenwich Meridian and latitudes 5^0 45" and 8^0 15" North of the Equator. It has a population of about 233,565 as at 2006 census and covers a land area of about 803 km^2. It is bounded on the east by Irele and Ese-Odo Local Government while to its west lies Odigbo Local Government and part of Ogun State. To its north lies Odigbo Local Government while it is bounded in the south south by Ilaje Local Government. The Inhabitants of the Local Government Area are mainly Yoruba of Ikale ethnic group. Yoruba is therefore widely spoken, while English is the official language. The area is mainly an agricultural society planting both cash and food crops. The Local Government has a high literacy level with a pool of highly skilled manpower covering all spheres of endeavours (http://en.wikipedia.org/w/index.php?title=Okitipupa&oldid=49735356)

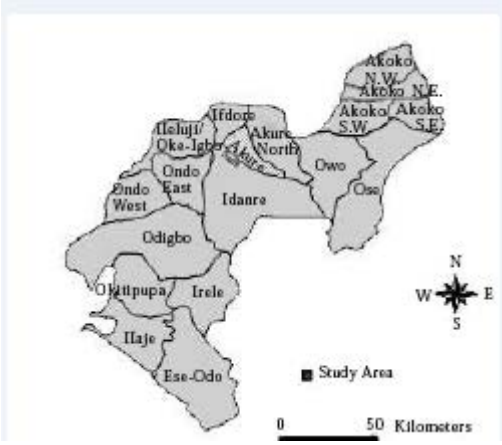

Fig :1b. Map of Ondo State showing Okitipupa

b) Data Collection and Procedures

To know public attitudes toward urban trees and to formulate a financial strategy for urban forest programs acceptable to the public, a survey was conducted with a questionnaire. Two hundred respondents were randomly selected for the study. Questions related to the following aspects were asked:

- Perceived importance of urban trees on personal and community property
- Perceived benefits and negative features of urban trees and forests
- Attitudes toward public funding of urban forests
- Participation in urban forestry activities
- Willingness to donate money or volunteer time to urban tree activities
- Socio-demographic information such as age, education, employment status, income, gender and number of children.

c) Data Analysis

The primary data collected was be processed into suitable format for analyses. Data were analysed using descriptive statistics and non-parametric test.

d) Chi-square (χ^2) test

Chi-square is a non-parametric inferential statistics that can be used to test the hypothesis that two systems of classification are independent of one another. Chi-square test can be applied when;

1. There are two variables randomly drawn from independent samples, each of which is categorized in two or more ways.
2. The data are non metric; ordinal (ranking), or nominal and expressed in frequencies.
3. When the hypothesis to be tested does not involve population parameters.
4. There is no restrictive assumption of normality about the distribution of the variables (4).

The chi_square model for r x c contingency table is specified as:

$$\chi^2 = 1/G \sum \frac{(Ga_{ij} - S_i T_j)^2}{S_i T_j} \quad \text{with (r-1) (c-1) degrees of freedom equation (1)}$$

where

χ^2 = estimated chi-square value
G = sum of all the observation
a_{ij} = individual observation in ith row and jth column
S_i = sum of individual observation in ith row
T_j = sum of individual observation in jth row
r = number of rows
e = number of columns

III. Results

a) Urban Trees in Okitipupa, Nigeria

Most of the trees are sighted around houses and along roads (plate 1-8). Table 1 presents some if the identified trees and their major functions in Okitipupa.

Table 1: Some of the Identified trees and shrubs and their functions in Okitipupa

S/N	Scientific names	Common names	Family	Major functions
1.	*Annona muricata*	Sour sup	Annonaceae	Food, medicine
2.	*Alstonia boonei*	Awun	Apocynaceae	Protection
3	*Avocadro*	pea		Food, shade, medicine
4.	*Azadirachta indica*	Neem tree	Meliaceae	Shade, aesthetic, protection, medicine
5.	*Annona senegalensis*	Mahogany	Annonaceae	Timber, medicine
6.	*Bambusa vulgari*	Bamboo	Bambusaceae	Protection, firewood
7.	*Citrus sinensis*	Orange	Rutaceae	Food
8.	*Citrus limon*	Lemon	Rutaceae	Medicine
9.	*Cocos nucifera*	Coconut tree	Arecaceae	Food
10.	*Carica papaya*	Pawpaw	Caricaceae	Food
11.	*Chrysophyllum albidum*	Cherry	Sapotaceae	Food
12.	*Cola nitida*	Kola	Steculiaceae	Medicine
13.	*Dacryodes edulis*	Pea	Burseraceae	Food, medicine, shade
14.	*Elaeis guinnensis*	Oil palm tree	Arecaceae	Food
15.	*Eugenia malaccensis*	Apple	Myrtaceae	Food
16.	*Ficus exasperata*	Sand paper tree	Moraceae	Protection
17.	*Ficus vogelli*		Moraceae	Protection
18.	*Glicidia sepium*	Agunmaniye	Leguminosaei, Papilionoideae	Food for animal, protection
19.	*Gmelina arborea*	Gmelina	Verbanaceae	Timber, protection, shade
20.	*Hura crepitans*	Sand paper tree	Euphorbiaceae	Shade
21.	*Jatropha cauca*	Lapalapa	Euphorbiaceae	Medicine, protection
22.	*Mangifera indica*	Mango	Anacardiaceae	Food
23.	*Moringa oleifera*	Moringa	Moringaceae	Food , medicine
24.	*Milletia exelsa*	Iroko	Meliaceae	Timber, protection
25.	*Newbodia leavis*	Akoko	Bignoniaceae	Protection
26.	*Nuclear latifolia*		Rubiaceae	Protection
27.	*Persea americana*	Avocadro, pear	Lauraceae	Food, medicine
28.	*Psidium guavaja*	Guava	Myrtaceace	Food
29.	*Polyalthia longiflora*	Masquerade tree, police tree	Annomaceae	Aesthetic
30.	*Quercus robur*	Oak	Fagaceae	Protection
31.	*Rauwolfia vomitoria*	Asofeyeje	Apocynaceae	Protection
32.	*Senna siamia*	Cassia	Leguminosae, Caesalpiniodeae	Firewood
33.	*Spondia mombin*	Iyeye	Anacardiaceae	Food
34.	*Treculia africana*	Bread fruit	Moraceae	Food
35.	*Terminalia catapa*	Almond fruit	Combretaceae	Food, shade, aesthetic
36.	*Tectona grandis*	Teak	Verbanaceae	Timber, protection, shade
37.	*Vernomia amygdalina*	Bitter leaf	Compositae	Food, medicine

Plate 1 : OSUSTECH Mini Campus with *Tectona grandis* and *Gmelina arborea*

Plate 2 : Trees as source of shade to scrap sellers along Idepe Road

Plate 3 : Discussion on Urban Forest under shade trees in Ode Aye

Plate 4 : Shade trees in Ode aye

Plate 5 : Palm trees as shade tree in Ilutitun

Plate 6 : Palm trees shade as car park in Ilutitun

Plate 7 : A residential area beautify with trees in Ilutitun

Plate 8 : A residential area in Okitipupa

b) Demographic Characteristics of Respondents

The demographic characteristics of the respondents are presented in Table 2. More than half of the respondents are married; government employed and has a family size of between one to four. 71.3% of the respondents are male and with age ranges from 20 to 60 years. Most of the respondents are educated with 44.5% having B.Sc/HND qualification. Table 3 revealed that there is no significant relationship ($p>0.05$) between level of education and interest in planting trees. Appendix 1, 2 and 3 showed that there is no significant relationship ($p>0.05$) between age and interest in planting trees, level of education and the respondents' interest in planting trees and type of employer and participation in urban forest activities.

Table 2 : Demographic characteristics of respondents

Demographic characteristics	Frequency	Percentage
Marital status		
Married	98	59.8
Widowed	4	2.4
Divorced	1	0.6
Single	61	37.2
Level of formal education		
M.Sc/ Ph.D	6	3.7
B.Sc/ HND	73	44.5
NCE/ OND	33	20.1
School certificate	42	25.6
Primary	5	3.0
No formal education	5	3.0
Gender		
Male	117	71.3
Female	47	28.7
Age		
20 - 30 years	71	43.0
31 - 40 years	59	35.7
41 - 50 years	23	14.0
51 - 60 years	8	4.9
Above 60 years	3	1.9
Who is your employer		
Government	90	54.9
Private	31	18.9
Self employed	43	26.2
What is your family size		
1 – 4	101	61.6
5 – 8	55	33.5
9 – 12	5	3.0
> 12	2	1.8

Table 3 : Level of Education and interest in planting trees

Variable		Does Planting of trees interest you		Total	Chi-square Statistic (P-value)
		Yes	No		
What is your level of formal education	M.Sc/ Ph.D	6(100)	0(0)	6(100)	4.447 (0.487)
	B.Sc/ HND	68(93.2)	5(6.8)	73(100)	
	NCE/ OND	32(97.0)	1(3.0)	33(100)	
	School certificate	41(97.6)	1(2.4)	42(100)	
	Primary	5(100)	0(0)	5(100)	
	No formal education	4(80.0)	1(20.0)	5(100)	
Total		156(95.1	8(4.9)	164(100.0)	

c) Preference and Participation to Contribute to Urban Forest Management

Table 4 revealed that 90.2% of the respondents have preference for trees and most of them would like to participate in a project of planting trees. About 50% of the respondents would like to be involved in educating and mobilizing the people for the project.

Table 4 : Preference and participation to contribute to urban forest management

Variables	Frequency	Percentage
Do you have preference for trees?		
Yes	148	90.2
No	16	9.8
Would you therefore be willing to participate in a project to plant trees?		
Yes	140	85.4
No	24	14.6
If no, can you state the reason		
Time factor	14	8.5
Cannot obtain seedling	1	0.6
No sufficient land to plant trees	3	1.8
Maintenance could be difficult	6	3.7
Areas of Participation		
Being part of the committee that will plan and take decision on the project	60	36.6
Be involved in educating and mobilizing the people for the project	83	50.6
Be physically involved in the tree planting project	58	35.4
Join volunteer group to take care and monitor the planted trees in your neighbourhood	67	40.9

d) Willingness to Contribute to Project of Planting Trees

As indicated in Table 5, more than 50% of the respondents would like to contribute 1-2 hours per week to the project while 31.7% would like to contribute #500-1000 annually for tree planting and maintenance. Most of the respondents would like the state government to manage the fund for its proper management.

Table 5 : Willingness to contribute to project of planting trees

Variables	Frequency	Percentage
How many hours will you be personally willing to contribute weekly to the project of planting and maintaining trees		
1 – 2 hours	96	58.5
3 – 4 hours	38	23.2
5 – 6 hours	19	11.6
7 – 8 hours	6	3.7
More than 10 hours	5	3.0
Which of the following amounts of money would you be willing to contribute yearly for tree planting and maintenance		
N100 - N200	50	30.5
N300 - N400	32	19.5
N500 - N1000	52	31.7
N2,500 - N5,000	17	10.4
N10,000 and above	13	7.9
Who would you prefer to manage the project		
State government	52	31.7
Local government	31	18.9
Environmental Non-governmental organization	45	27.4
Community development unions	36	22.0
Why would you prefer this type of institution to manage such a project and funds		
To avoid fraud	22	13.4
To avoid failure	51	31.1
Proper management of fund	91	55.5

e) Urban Trees and Maintenance

Most of the respondents have trees planted around their neighbourhood, working places and houses. 80.5% maintain the trees by themselves (Table 6).

Table 6 : Urban trees and maintenance

Variables	Frequency	Percentage
Do you have trees planted around your neighbourhood?		
Yes	137	83.5
No	27	16.5
Do you have trees planted around your working place?		
Yes	120	73.2
No	44	26.8
Do you have trees planted around your house?		
Yes	133	81.1
No	31	18.9
How do you maintain these trees?		
By employing extra hands	32	19.5
By doing it yourself	132	80.5
Who takes care of trees that falls on the road		
Individual	73	44.5
Community	57	34.8
Government	34	20.7

f) Affinity for Green Environment

As shown in table 7, most of the respondents love to live and work in a green environment and would like to pay extra fee to rent property located in it.

Table 7 : Affinity for green environment

Variables	Frequency	Percentage
Do you love to live in a green environment planted with trees?		
Yes	157	95.7
No	7	4.3
Do you love to work in a green environment planted with trees?		
Yes	149	90.9
No	15	9.1
Will you like to pay extra fee to rent or buy a landed (houses) property located in green environment?		
Yes	119	72.6
No	45	27.4

g) Purpose of Planting Trees Around the Buildings

As indicated in table 8, most of the respondents planted trees around their houses for purpose of providing food such as fruit, nuts and vegetable leaves. 50% indicated that it is for the purpose of making their environment to be more beautiful and attractive and for the provision of medicinal plants.

Table 8 : Purpose of planting trees around the buildings

Purpose of tree planting	Frequency	Percentage
Provision of food such as fruit, nuts and vegetable leaves	101	61.6
Provision of employment opportunities	81	49.4
Making the environment to be more beautiful and attractive	82	50.0
Provision of firewood	28	17.7
Provision of medicinal plants	82	50.0
Provision of shade along the streets and roads	45	27.4
Provision of recreational opportunities	48	29.3
Improvement of microclimate	31	18.9
Reduction of Environmental hazards (pollution, erosion)	67	40.9
Attraction of birds	14	8.5

h) Perceived Environmental Hazards that Can Be Remedied with Urban Forest

As shown in table 10, 47% of the respondents indicated that water erosion/flooding can be remedied by planting trees, reduced erosion (31.1%), lower high temperature (12.2%), deforestation (4.3%) and prevent desertification (3.7%).

Table 9 : Perceived environmental hazards that can be remedied with urban forest

Which of these environmental hazards do you think can be remedied by planting trees	Frequency	Percentage
Water erosion/ Flooding	77	47.0
High temperature	20	12.2
Wind erosion	51	31.1
Desertification	6	3.7
Drying up/ scarcity of underground water	2	1.2
Acid rain	1	0.6
Deforestation	7	4.3

i) Disadvantages of Planting of Trees

More than 40% of the respondents indicated that fallen leaves dirty the environment and the roots damages houses. To others, it causes obstruction on roads when it falls.

Table 10 : Disadvantages of planting of trees

Disadvantages of planting of trees	Frequency	Percentage
Danger to life and property	24	14.6
Fallen leaves dirty the environment	71	43.3
Roots damages roads	27	16'5
Roots damages houses	68	41.5
Causes obstruction if fallen on roads	46	28.0

IV. Discussion

The study has shown that Okitipupa city is rich with different trees. About thirty five different trees were identified as urban trees. Many of these trees are located in the respondents' compound and around their houses. According to the Council of Tree and Landscape Appraisers (5), well-maintained landscapes can contribute up to 20% to the value of an improved residential property." The major functions performed by the identified trees in okitipupa include provision of shade, aesthetics and other beautification functions, protection of buildings from wind and water erosion, production of edible fruits and vegetables, utilization of the parts as medicine and utilization of dead and fallen branches as firewoods. According to (11) and (1), a prime focus in the past for developed countries was the management of urban forest for aesthetic purposes, whereas now, as urban population have grown, intensified, and expanded, it has shifted to management for enhancing ecosystem services. In developing countries, a more important focus may be managing vegetation to provide materials such as firewood, fruits and timber at local scale. Over time, each city and region may manage its urban forest for an increasingly broader and more inclusive range of benefits. (11) opined that in defining the bounds of urban forestry as a discipline, it is important to consider the current developmental needs of a population as they establish urban forestry goals most suited to their city's social, economic and geographical context. The respondents in Okitipupa do not just want trees of any kind in their environment, but have specific preference for the trees. The diversity, stability, and functionality of urban forests

are directly influenced by the type of trees selected to plant. Findings from this study may be instructive also for those features that showed no statistically significant differences of opinions, such as respondents' education, age, family size and type of employer and participation in urban forestry project (14). This data alone could be useful to any future urban forestry efforts within the State. An overwhelming majority of the respondents are willing to participate in project of planting trees. Most of respondents were willing to volunteer some of their time to help maintain street trees planted along the street that they lived on. About thirty-two percent of respondents reported a willingness to contribute money (#500-#1000 per year) toward a fund to be used solely for the care of street trees in Okitipupa. According to (12, 15) financial assistance is the most effective means to promote urban forestry programs and different kinds of activities in urban and community forestry programs are provided through various funding. The most important activities include tree planting, and public awareness. Studies have shown that people develop emotional attachments to trees that give them special status and value. For many, a feeling of attachment to trees in cities influence feelings for preservation of trees (13) The respondents indicated that water erosion/flooding can be remedied by planting trees, reduced erosion, lower high temperature, prevent deforestation and desertification.

V. Conclusion and Recommendations

The study has shown that Okitipupa residents have a strong attachment and appreciation of trees. It also showed the unique ways trees are valued for a variety of uses including medicine, food, fuel, beauty and shade.

For effective and sustainable management of trees in Okitipupa, there is need for the following:

1. Frequent inventory and survey of trees to note the distribution and density as well as structural and physical changes necessary for management practices. This will enabled the concerned tree manager to note and mark weak trees on time before they cause damage to property or take life. Weak trees that pose to life and property should be removed and replaced with minimum of two seedlings.
2. Survey the tree preference when planning for a tree planting programme. This is most important in residential areas where the fate for the survival of the trees will be determined by the residents living close to them.
3. There is need to establish tree management committee in Okitipupa who will be in-charge of maintenance and care of street trees, particularly in pruning and when the tree fell on roads.

VI. Acknowledgments

I gratefully acknowledge the financial support of the OSUSTECH (Ondo State University of Science and Technology, Okitipupa, Nigeria) RESEARCH GRANT Committee. Comments from two anonymous reviewers are also greatly appreciated.

References Références Referencias

1. Nowak, D.J., M.H. Noble, S.M. Sisinni, and J.F. Dwyer. 2001. People and trees: Assessing the U.S. urban forest resource. J. For. 99(3):37–42.
2. U.S. Department of Agriculture, Forest Service. July, 1996.Urban and Community Forestry on Course into the Future: Vital Communities Through Healthy Ecosystems—A Strategic Direction. U.S. Department of Agriculture, Forest Service. Washington, DC. 12 pp.
3. Dwyer, J.F., D.J. Nowak, and G.W. Watson. 2002. Future directions for urban forestry research in the United States. J. Arboric. 28:231–236.
4. Ajewole, O.I (2005): Social and Institutional Determinants of Urban Forestry Development in Lagos. An Unpublished Ph. D Thesis. Submitted to the Department of Forest Resources Management, University of Ibadan. 206pp.
5. Council of Tree and Landscape Appraisers. 2000. Guide for Plant Appraisal (9th ed.). International Society of Arboriculture. Champaign, IL. 143 pp.
6. Xie, et al (1998): Research on integrated Environmental Efficiency from Urban Circulating Forest in Fushun City. Journal of Plant Resources and Environemt.7:2, 42-47.
7. FAO (2000): Urban Forestry Issues in North America and Their Globa Linkages. North America Forest Commission; Item 6 (a) of the Provisional Agenda.
8. Jorgensen, J. (1993): Urban land growth in the United States http://www.treecanada.ca/site/?Page=programs_urbanforestry_history&lang=en
9. Carter, E.J (1994): The Potential of Urban Forestry in Development Countries: A Concept. Paper. FAO Forestry Department Rome 90pp.
10. Popoola and Ajewole (2001): Public *Perceptions* of Urban Forests in Ibadan, Nigeria: Implication for Environmental Conservation. Arboricultural Journal 25, 1-22.
11. Babalola F.D (2010): Issues and option for appropriate management strategies of campus tree at university of Ibadan, Nigeria. Nigerian Journal of Ecology. 11:33-42
12. Straka, T.J., A.P. Marsinko, and C.J. Childers. 2005. Individual characteristics affecting participation in urban and community forestry programs in South Carolina, U.S. Journal of Arboriculture 31:131–137.
13. McPherson, E.G, Simpson, J.R, and Scott, K (2002): Actualising microclimate and air quality benefits with parking lot sgade ordinance. Wetter and Leben 4:98

14. Rouchiche, S. (1999): Urban and Peri-Urban Forestry in Africa; A case study of the Sahel. In Urban and Peri-Urban Forestry. Case Studies for Developing Countries. FAO, 2-28.
15. Lewis, D. 1991. Urban forestry: management for local authorities. Arboricultural Journal, 15: 265-277.

This page is intentionally left blank

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Biological Diversity and Fodder Richness of Palm Oil Tree Agro Systems in the District of Toffo, Southern Benin

By Akouehou S. G., Katchon P., Orou Matilo A. & Tente B.

Université D'abomey- Calavi, Benin

Abstract- In Benin in general and especially in the district of Toffo Atlantic department, traditional systems of agricultural production don't permit farming to conform itself to land pressure, market demand, to minimize poverty, to satisfy population food needs and to preserve environment. This study focused on fodder importance of forest palm oil agro systems (Elaeis guineensis) in the district of Toffo, Southern Benin. The aim of this study is to analyze agro pastoral diversity importance of palm oil agro systems in the district of Toffo. Specifically to: i) identify the different types of forest palm oil agrosystems ii) identify fodder species diversity in agrosystems, iii) to census diversity of plant species and, vi) to study agronomic and ecological importance of agrosystems in the district of Toffo.

Keywords: *forest agro system, palm oil tree, biological diversity, fodder diversity, toffo, benin.*

GJSFR-D Classification : *FOR Code: 070302*

Strictly as per the compliance and regulations of:

Biological Diversity and Fodder Richness of Palm Oil Tree Agro Systems in the District of Toffo, Southern Benin

Akouehou S. G. [α], Katchon P. [σ], Orou Matilo A [ρ]. & Tente B. [ω]

Abstract- In Benin in general and especially in the district of Toffo Atlantic department, traditional systems of agricultural production don't permit farming to conform itself to land pressure, market demand, to minimize poverty, to satisfy population food needs and to preserve environment. This study focused on fodder importance of forest palm oil agro systems (Elaeis guineensis) in the district of Toffo, Southern Benin. The aim of this study is to analyze agro pastoral diversity importance of palm oil agro systems in the district of Toffo. Specifically to: i) identify the different types of forest palm oil agrosystems ii) identify fodder species diversity in agrosystems, iii) to census diversity of plant species and, vi) to study agronomic and ecological importance of agrosystems in the district of Toffo.

To meet this objective, method of quadrats points aligned were adopted. On a plot chosen randomly in each type of forest agro system, hundred (100) measurements were performed every 10 cm along a metal rod tapered edge. This collect of information has been supplemented by semi structured interviews related to agrosystems. Thus, 176 farm households selected randomly were surveyed on modern forest agro systems adopted, animals bred, fodder species grazed, the crops produced and income that come from it .The collected data were processed by SPHINX Plus v. 4.5 and EXCEL 2007. Data analysis revealed that there are three forest agro systems in the district of Toffo: palm oil forest agrosystems, palm oil forest agrosystems associated to banana tree, and forest teak agrosystems. The first one is the most economical, the most ecological and the most performed by farm households of Toffo (56.25%). Considering the importance of those forest agrosystems seem important and deserved topics of research. Moreover, 10 fodder species are present in teak forest agrosystems; 16 fodder species in palm oil agrosystems and 14 fodder species in palm oil forest agrosystems associated to banana. Otherwise, in observed forest agrosystems, a diversity of plant species were used to cure animals touched by some diseases and also are grown for food production and for the protection of the environment.

Keywords: forest agro system, palm oil tree, biological diversity, fodder diversity, toffo, benin.

I. Introduction

In southern Benin, palm oil forest agrosystems (Elaeis guineensis) in the district of Toffo are preferred places for pasture by agropastoralist due to the heavy population and land pressures. This area is found in Dahomey Gap characterized in general by a subequatorial climate with four (4) seasons, of whom two raining seasons which go from March to mid-July and from September to November with two dry seasons that go from mid-July to August and from November to February. The annual average of rainfall is 1,100 mm. The annual average of temperature varies between 25 and 29°C. Minimum temperature is recorded in December during the harmattan (Adomou, 2005). This is the area that lies at the interface conflict between growers, farmers and cattle-breeders. The southern part of Benin where this study is conducted is characterized by agrosystems and dominated by palm oil (Elaeis guineensis) in combination with other species that are for communities food sources and additional income to current agricultural activities (Sokpon et Lejoly, 1996 ; Nakou. 2011 ; Akouehou et al. 2013). In fact, population growth in Africa is one of the strongest in the world (AEO 2, 2006). According to Jouve (2006), under the effect of different factors and especially population growth, the opening of the market and the changes of agricultural politics, there has been in recent decades rapid changes in farming methods and more generally in farming systems in Sub-Saharan Africa. Benin doesn't make the exception from this reality shared by all countries in Sub-Saharan Africa. It's determinant to find a speed way to restore agro bio-diversity at the national level in general and especially in the district of Toffo (Baco et al., 2007).

The district of Toffo, rich in biological diversity (flora) with his physical environment (geology, geomorphology, climatology, soil) is suitable for farming and his agrosystem preferred places for pasture is not spared by human pressure

To control this destruction, several adjustments were made. In 1992, modern agrosystems have been introduced in resettlement centers of Lama (Konetche, 2009). Those modern forest agrosystems associate breeding to trees and especially to palm oil tree (Akouehou et al. 2011a). The goal of this study is to analyze the importance of agropastoral diversity of palm oil tree agrosystems in the district of Toffo. The central question to respond is to: i) identify the different types of forest palm oil agrosystems, ii) identify fodder species diversity in the agrosystem, iii) identify diversity of plant

Authors α ρ : Direction Générale des Forêts et des Ressources Naturelles, 02 BP 1422 Gbégamey, Cotonou, Bénin.
e-mail : akouehougas@yahoo.fr
Authors σ ω : Laboratoire de Biogéographie et Expertise Environnemental, Université d'Abomey- Calavi (Bénin).

species and, vi) determine of important are agronomical and ecological studies of agrosystems in the district of Toffo.

a) Study area

Located in southern Benin in the northern area of department of Atlantic between 6°43'06'' and 6°57'48'' of North latitude and 2°02'09'' and 2°20'56'' and East longitude. The district of Toffo covers a surface of 492 km2. It's limited in the North by district of Zogbodomey, in the department of Zou, in the East by the district of Zê, in the South by the district of Allada, in the West by the Couffo River and serves as natural border to the district of Lalo in the department of Couffo (figure1). The district of Couffo is compounded of ten (10) localities and fifty four (54) villages.

II. Material and Methods

- Data collected

The agrosystem diversities were estimated through perennial plantations identified. Concerning their importance, it has been evaluated according to activities carried out. Thus, the following data were collected in each agrosystem: vegetal species planted, fodder species of the agrosystems, animal species bred, the height of the livestock, the advantages of the agrosystems.

- Data collect technique

Plant species and the animal species bred have been identified by direct observation of agrosystems. Individual interviews with farm managers have permitted to determine the livestock's height, the method of acquisition of agrosystems and advantages that come from it.

- Identification of fodder species present in the agrosystems

a) Material used

- A penta decameter (50 m) for the delimitation of plots and the distance measurements at plots level,
- A fluorescent tape to show the boundaries of lines sampling,
- A metal rod of 10 m long tapered edge,
- A machete and boots for layonnage operations and making of stakes to fix the limits of the lines,
- Gardener pruning shears and a knife for collecting samples of harvested plants,
- Newspapers for drying and conservation of harvested plants samples,
- A digital photo camera
- GPS Garmin Map 60 to mark some point of sampling fodder
- Inventory sheets, a notebook, a clipboard and a document holder do keep records.

b) Inventory technique of fodder species

With an inventory sheet, the fodder species occurred in the forest agrosystems were inventoried. The lined up quadrats points method of Daget and Poissonnet mentioned by Boudet (1991) were adopted. Indeed, on a plot chosen at random in each type of forest agrosystem, hundred (100) measurements were performed on a long of a decameter stretched above the herbaceous stand. A vertical reading was made every 10 cm, long of the metal rod tapered edge. At each step of reading, and the long of the rod tapered edge, every contact with leaf and straw were taken into account, but a species has been noted once by step of reading to provide a better image of the species proportion projecting to the ground

Some fodder species were identified directly in the land whereas others were collected, codified in other to be identified with the Benin flora's help. Tome 3 (de Souza, 1988)

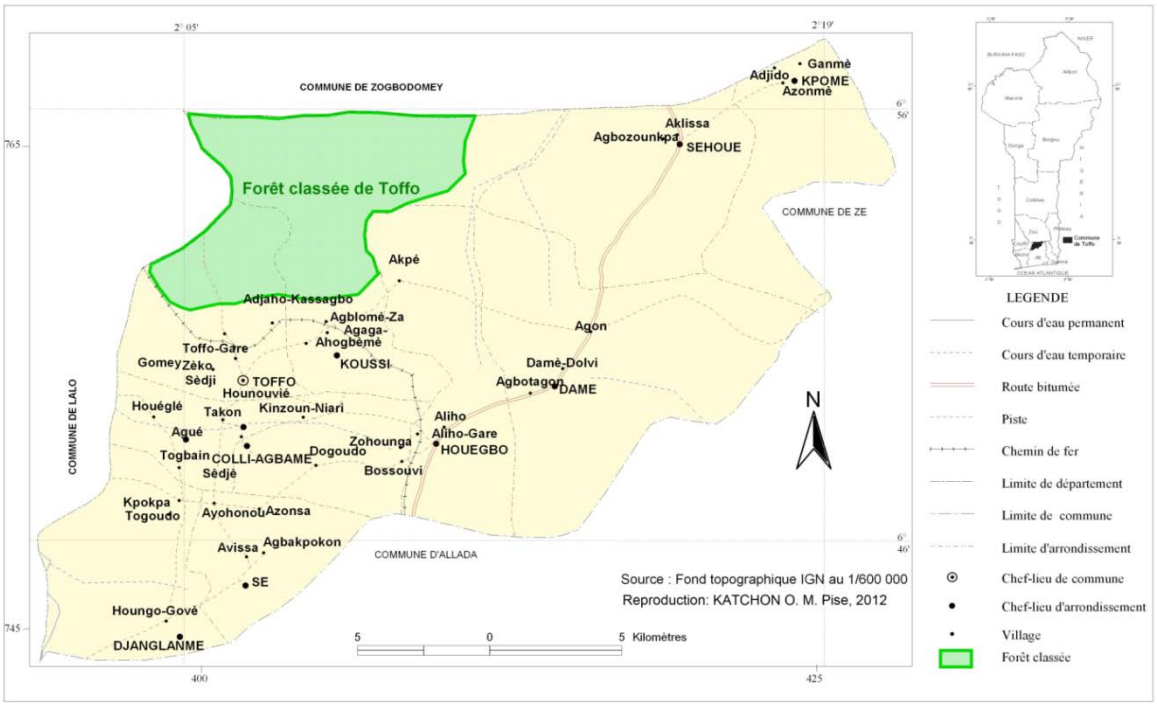

Figure 1 : Location of the district of Toffo

c) *Data processing related to the inventory of fodder species and calculation of specific quality Index*

Tabulation of the inventory sheet was manual. Software Excel 2007 were used for the data processing of the inventory. The species collected were codified and sorted out with the help of that software. This method helps to know the diversity of the fodder species.

Calculation of the specific frequencies of the fodder species

The specific frequency Fsi represents how the species were identified. It is an absolute value.

Calculation of the specific contribution of the fodder species

The specific contribution (Csi) is calculated by the formula:

$$Cs_i = \frac{Fs_i}{Fs_1 + Fs_2 + \cdots Fs_i + \cdots + Fs_n} \times 100$$

The proportion of each species was expressed in percentage by a relative value. Where:

Cs_i=specific contribution of the species

Fs_i=specific frequency of the species

Fs_1; Fs_2; Fs_n = frequencies of the other species.

To bring out the proportion of fodder species in the forest agrosystems, crossing between fodder species of the underground and the forest agrosystems were made. Also to bring out the proportion of the population by forest agrosystems, a crossing between the sex of population and the forest agrosystems were made.

Determination of pastoral values of fodder species inventoried

After identifying all the fodder species as a result of the survey made with breeders, we determine:

- Specific frequency (FS) or absolute frequency of a fodder species in survey is the number of point where this species is met
- Specific contribution (CS) of the species in a survey is the connection of the FS of forest agrosystems to the sum of FS of all the species identified (fodder and no fodder) on hundreds (100) points sampled.

$$CSi = \frac{FSi \times 100}{\square \partial Si}$$

It allows to appreciate the importance of fodder agrosystems (Daget and Poissonet, 1975).

- Specific quality index (IS) or values of coefficient

It is attributed to each fodder species according to some data among which the growth rate, grazing, taste, assimilability and nutritional value. (Boudet, 1972; 1984). L'IS certifies zootechnic interest of each vegetal species. (Daget and Poissonet, 1975).

Table 1 : values of specific quality index (IS) and class of fodder values

Species	Is	Fodder values VF (in UF/Kg of dry matter)
Non grazed (NA)	0	-
Little grazed (PA)	1	VF ≤ 0,45
Grazed (A)	2	0,45 <VF <0,5
Well grazed (AA)	3	0,5 <VF <0,6
Very Well grazed (TA)	4	VF ≥ 0,6

SPHINX Plus² version 4.5 software was used to make of those crossing variables, make pictures and graphic out. The result of the crossing variables has been described in picture made by Word 2007 software and in figures with Excel 2007 software. The calculation of means and standard errors was done with the SPHINX software Plus² version 4.5.

III. Results

a) Typology of forest agrosystems

Three types of forest agrosystems have been identified in the district of Toffo namely as: palm oil tree agrosystems, (Elaeis guinennsis); palm oil agrosystems (Elaeis guinennsis) associated with banana trees. (Musa sp.) and the teak agrosystem, (Tectona grandis) (photos 1,2,3)

Photo 1 : Forest agro system at Elaeis guineensis

Photo 2 : Banana tree forest agro system

Photo 3 : Teak forest agro system

b) Diversity of fodder and trees species in the agrosystems

Several fodder species were identified and their number varies by agrosystem.

- Fodder species and palm oil agroecosystems

Palm oil agrosystems overflow a diversity of fodder species (figure 2)

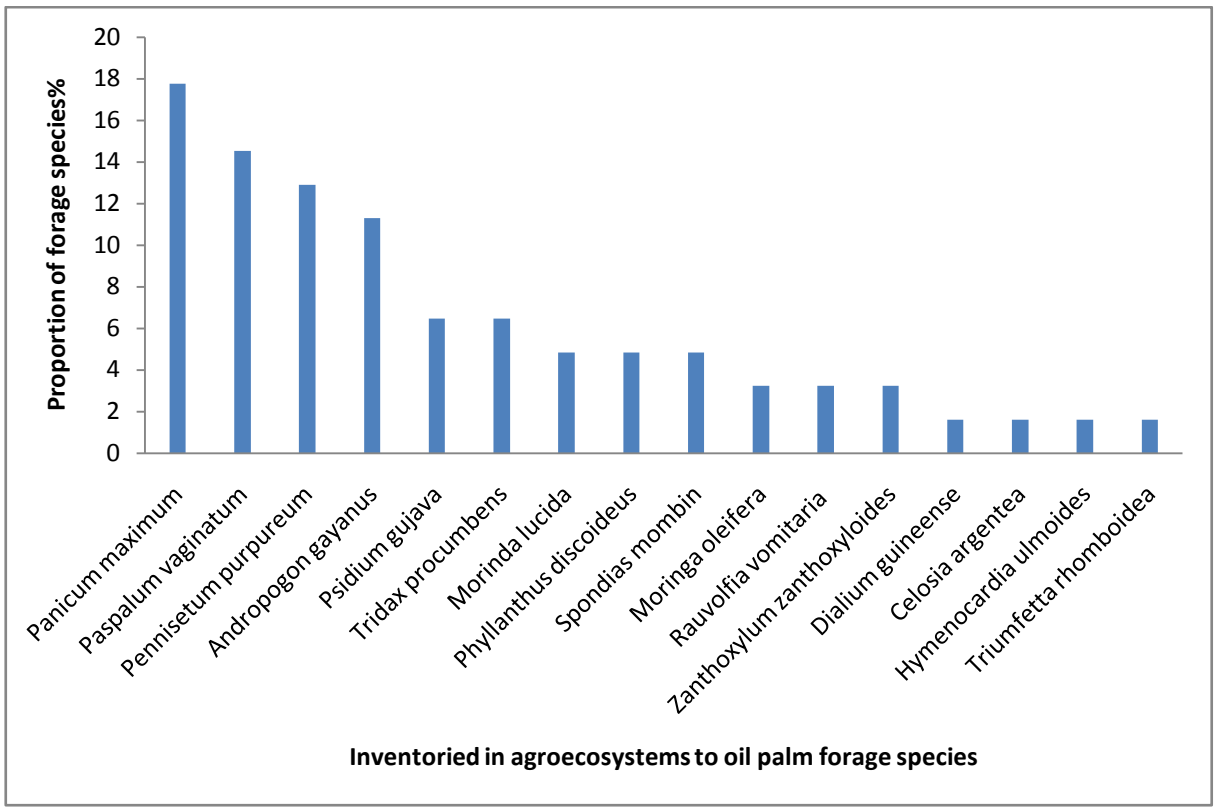

Figure 2 : Fodder species in palm oil forest agrosystems

Source : Fieldwork, April 2012

Analysis of figure 2, revealed that 16 fodder species occurred in the palms oils forest agrosystems. The most represented are: Panicum maximum (17.74%), Paspalum vaginatum (14.52 %), Pennisetum purpureum (12.90 %) and Andropogon gayanus (11.29 %). Those that are fairly represented are: Psidium gujava (6.45 %), Tridax procumbens (6.45 %), Morinda lucida (4.84 %). Phyllanthus discoideus (4.84 %) and Spondias mombin (4.84 %). The less represented are : Moringa oleifera (3.23 %), Rauvolfia vomitaria (3.23 %), Zanthoxylum zanthoxyloides (3.23 %), Dialium guineense (1.61 %). Celosia argentea (1.61 %), Hymenocardia ulmoides (1.61 %) et Triumfetta rhomboidea (1.61).

- Fodder species to palm oil agrosystems associated with banana trees

Forest palm oil tree agrosystems associated with banana trees also hold a diversity of fodder species (figure 3).

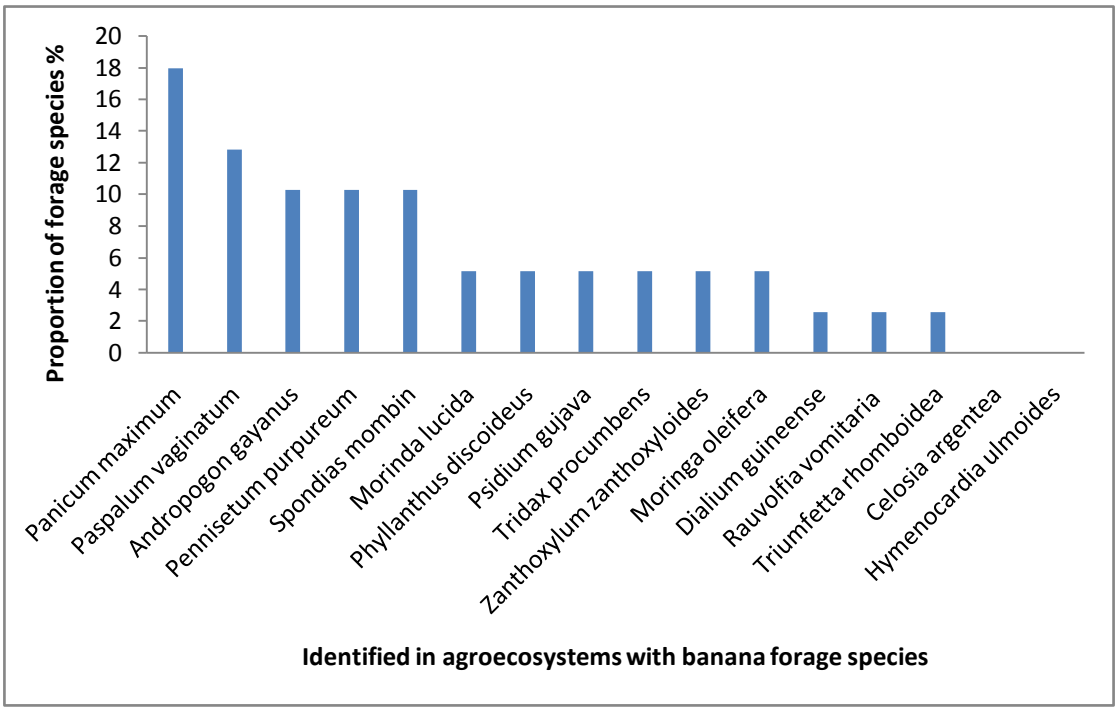

Figure 3 : Fodder species in forests palm oil agrosystems associated with banana trees

Source : Fieldwork, April 2012

The analysis of data showed (figure 3) that 14 fodder species are present in the forest palm oil agrosystems associated with banana trees. The most represented are: Panicum maximum (17.15 %), Paspalum vaginatum (12.82 %), Andropogon gayanus (10.26 %), Pennisetum purpureum (10.26 %) and Spondias mombin (10.26 %). Those that are fairly represented are: Morinda lucida (5.13 %), Phyllanthus discoideus (5.13 %), Psidium gujava (5.13 %), Tridax procumbens (5.13 %), Zanthoxylum zanthoxyloides (5.13 %) and Moringa oleifera (5.13 %). The less represented are : Dialium guineense (2.56 %), Rauvolfia vomitaria (2.56 %) and Triumfetta rhomboidea (2.56 %). Otherwise, species such as: Celosia argentea and Hymenocardia ulmoides were not observed in the forest palm oil agrosystems associated with banana trees whereas they were inventoried in the forest palm oil agrosystems.

- Fodder species of forest Tectona grandis agrosystems

Forest teak agrosystems hold less fodder species than the first two agrosystems (figure 4)

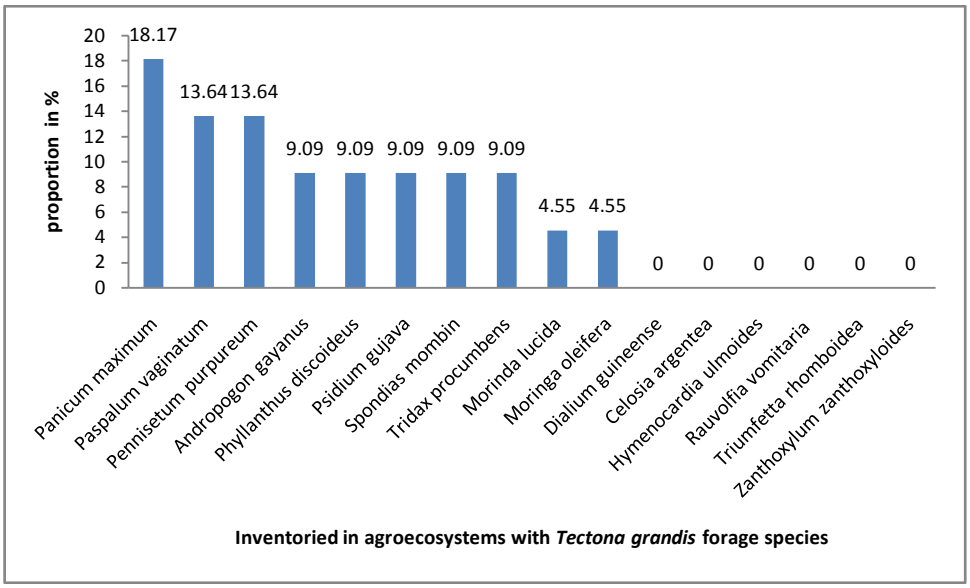

Figure 4 : Fodder species of forest Tectona grandis agrosystems…..

Source : Fieldwork, April 2012

From analysis of the data (figure 4), it was observed that 10 fodder species appeared in the forest teak agrosystems. The most represented are: Panicum maximum (18.18%), Paspalum vaginatum (13.64%) and Pennisetum purpureum (13.64 %). Those that are fairly represented are Andropogon gayanus (9.09%), Phyllanthus discoideus (9,09%), Psidium gujava (9,09%), Spondias mombin (9.09%) and Tridax procumbens (9.09%). The less abundant are Morinda lucida (4.55%) and Moringa oleifera (4.55%).

Otherwise, species such as: Dialium guineense, Rauvolfia vomitaria, Triumfetta rhomboidea and Zanthoxylum zanthoxyloides did not occur in the forest teak agrosystems whereas they are inventoried in forests palm oil agrosystems on the one hand and to palm oil associated to banana trees on the other hand. Forests palm oil agrosystems were richer in fodder species than forest palm oil agrosystems associated to banana trees and to teak plantation. This will be certainly linked to the characteristics of species planted in each agrosystems. Indeed, at a certain age, teak no longer allowing the development of another species. These roots absorb a large amount of water; its leaves are certainly bulky and when they fall, could strew the ground with a thick corver of dead leaves that prevent the development of fodder species .As for palm oil tree, it's less bulky what allow the development of fodder species.

c) Diversity of plant species

Overall, 171 plant species have been identified distributed into 63 families (Figure 5). Approximately 44% of these families are mono-specific and 38% are very little diversified. Data analysis showed that their usage must be rational for the biodiversity preservation in its livestock trip. Euphorbiaceae were the most dominant and most diverse (16 species), as well as the Fabaceae and Poaceae (12 species), Asteraceae (9 species), Ceaesalpiniaceae and Mimosaceae (8 species).The less numerous families observed are: Zingiberaceae, the Passifloraceae, the Dioscoreaceae the Violaceae etc.

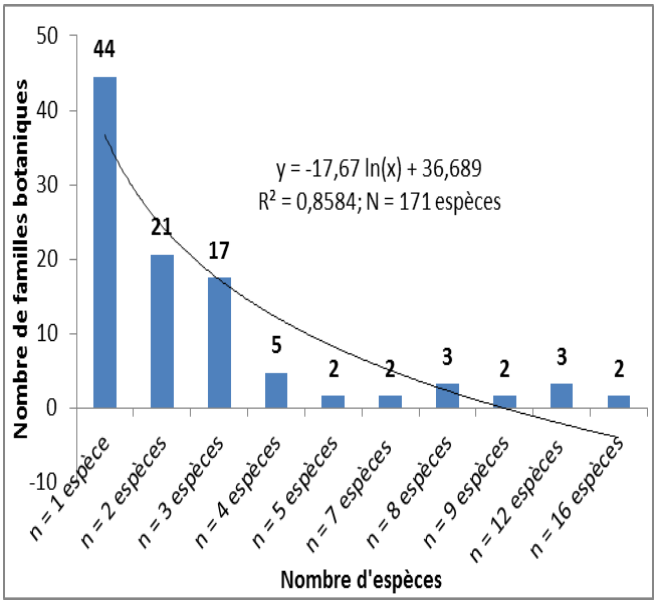

Figure 5 : Distribution and development of botanical families according to the species number

The analysis of figure 5 shows a logarithmic distribution, this expresses a regressive development. Indeed, there are a large number of botanical families which are only represented by a single species. For example, the Combretaceae the Dioscoreaceae the Irvingiacea the Passifloraceae, the Zingiberaceae, etc. As the number of species per family increases, families' diversity decreased to cancel as soon as the number of species reached 9 per family. Families that remain with over 9 species are Poaceae and Fabaceae (n = 12 species) and Euphorbiaceae (n = 16 species). A significant proportion of this flora has been reported as fodder and variously grazed

d) Diversity of species used as fodder

The analysis of the semi-structured interviews and the determination of Specific Quality Index showed (Figure 6) that the diversity and distribution of fodder species used and indicated by the farm managers come from 20 botanical families. Fodder species of Specific quality Index (IS) equal to 2 (n = 20 species) within 16 families. These IS equal to 3 (n = 14 species) are compiled in 10 families. These results indicate that the grazed fodder species represent only 41% of the flora available in the locality.

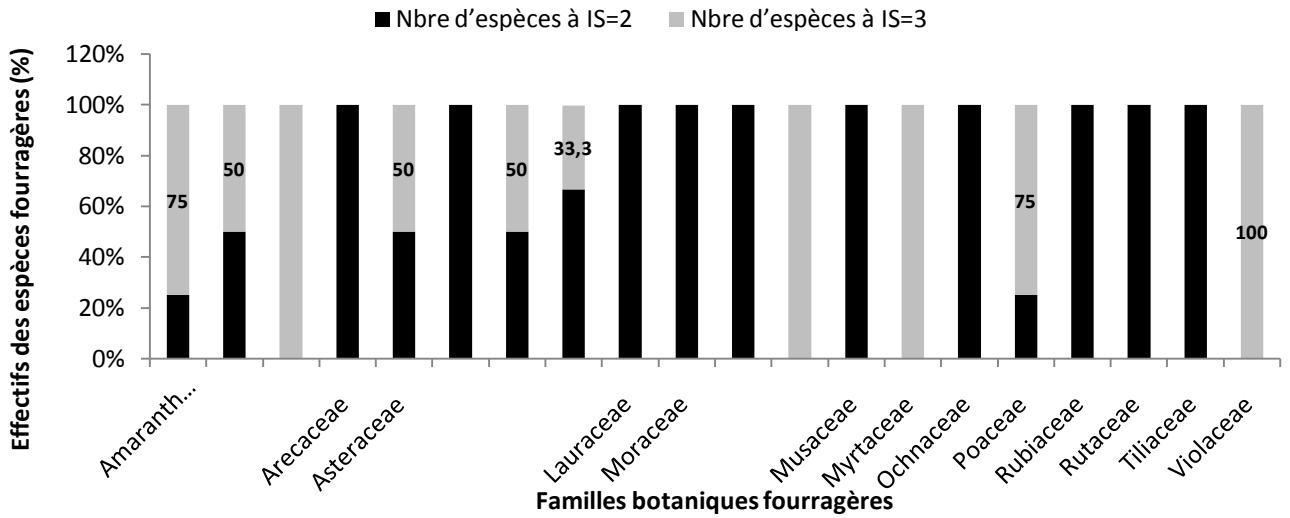

Figure 6 : Diversity and distribution of fodder species following indices quality and botanical families

e) Importance of Agrosystems in the Municipality of Toffo

Modern agricultural systems allow people to grow crops, to breed animals, exploit products and by-products from plantations.

f) Forest Agro System a Favorable Space for Crop Production

Data analysis of observations showed that: i) crops (maize, cowpea, cassava and groundnuts) were grown in three farming systems (Figure 7), ii) the populations have grown more in the forest palm oil agrosystem than in the other , iii) maize, cowpea and cassava were more appeared because these items constitute the staple diet of population and export products in large urban centers such as Cotonou, Ouidah and Calavi and iv) the sale of the surplus of these products would give them a substantial income.

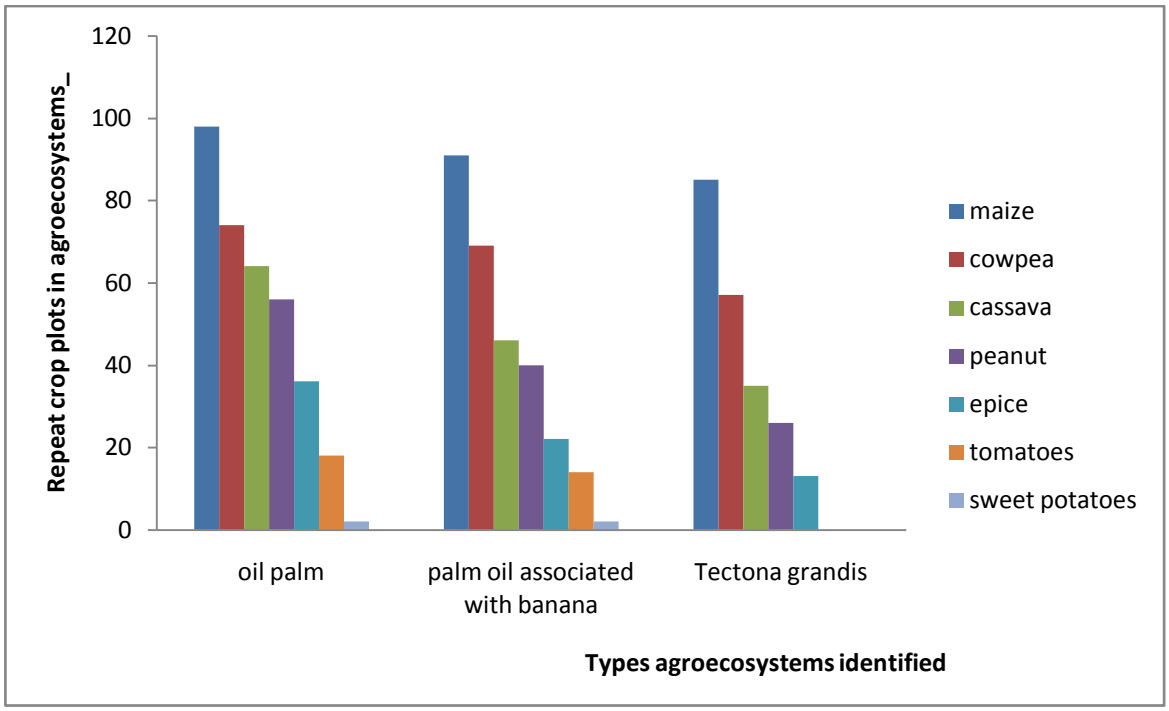

Figure 7 : Distribution of food crops in the farming systems

Source : Fieldwork, April 2012

g) Forest Agrosystem an Ecosystem Favorable to Breeding

Several domestic animal species were bred and interested cattles (Bos taurus), goats (Capra spp), sheep (Ovis spp) and poultry. However, the size of the livestock observed changed from one agrosystem to another (Figure 8).

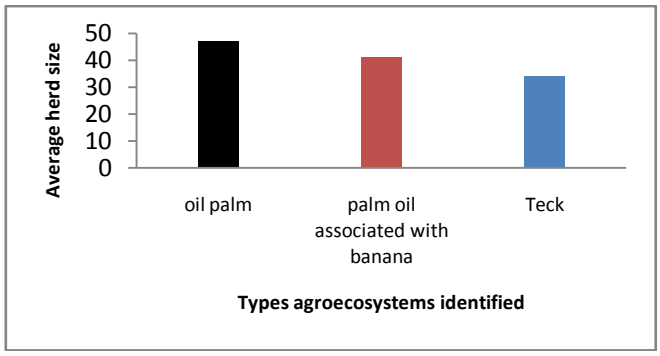

Figure 8 : Number of livestock by agrosystem

Source : Fieldwork, April 2012.

Interviews showed that (Figure 9) the population of the district of Toffo bred animals in all agrosystems. The average livestock size was higher (47 animals) in palm oil agrosystems associated with banana trees (41 animals) and teak forest agrosystems (34 animals). This could be explained by the abundance of fodder species in the palm oil forests agrosystems and of the availability of space for animal breeding. Palm oil forest agrosystems were therefore more favorable for breeding.

h) Frequency of animal species by agrosystem

The number of animal species bred varies by agrosystems (Figure 9).

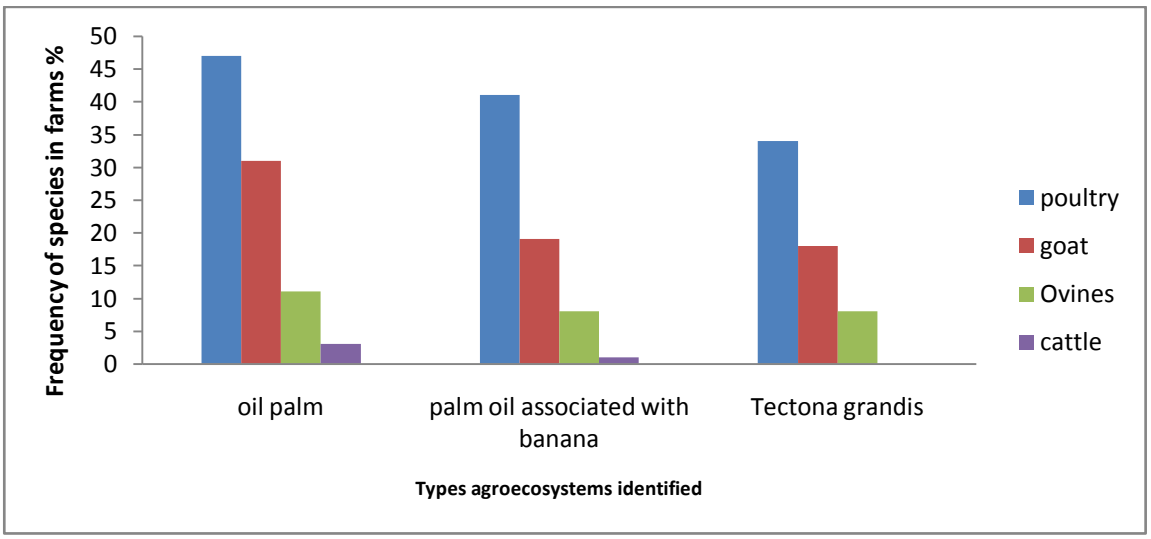

Figure 9 : Frequency of animal species by agrosystem

Source : Fieldwork, April 2012

The analysis of the survey data also showed that the size of animals varies depending on agrosystems. Poultry, goats and sheep were respectively higher than cattle in three agrosystems. In the teak agro system, cattle are not at all high.

i) Forest agrosystems, an ecosystem rich in medicinal species

Forest agrosystems that have been observed abounded a diversity of plants used to cure animals affected by some diseases (Table 2).

Table 2 : Traditional treatments of animals

Plants used	Parts used	How to use	Cured diseases
Sida acuta	Whole plant	Powder + water orally	belly bloat animals
Capsicum annuum	Fruits	Powder + water orally	Distension of the abdomen, drowsiness
Mangifera indiça	Leaves, stems	Supply	Slimming animals
Carica papaya	Seeds	Powder + water, the mixture on the infected part	Ringworm, intestinal worms, infection
Cocos nucifera	Nuts	Extract oil on the infected part	Ringworm
Zanthoxylum zanthoxyloides	Leaf	Supply	intestinal worms
Moringa oleifera	Leaf	Supply	

Source : Fieldwork, April 2012

Ultimately, agrosystems observed were favorable to the development of agrosylvopastoral system. They help people to meet their nutritional and financial needs. In addition, the animals presence contribute to soil fertility through their droppings. This would increase crop yields and reduce land conflicts.

IV. Discussions

a) Forest agrosystems importance in the District of Toffo

In the District of Toffo, forest agrosystems are rich in fodder species which is an advantage to the breeding grasses are dominant, especially in palm oil tree agrosystems. These results are similar to those obtained by Zinsalo (2011), which emphasizes on the

graminaceous as the dominant fodder category across the complex Zè-Allada-Toffo. From this point of view, undergrowth pasture of Toffo forest agrosystems is graminaceous. which is generally sought by pets according to Boudet (1991). Thus, in the three forest agrosystems of the District of Toffo, small ruminants were identified. This result was also made by Aquino et al. (1995), in wet areas and African sub humid, Aliou (2010) in Ouagadougou and Assogba (2011) in the District of Toffo where three breeding of small ruminants is generally favorable in agrosystems.

In Toffo's breeding systems, animals (cattle, goats, sheep and poultry) are bred to meet the food needs of the family, and raised capital. Animals play a socio-economic role in the farm managers' household. In fact, they are used in the diet of the family (milk, meat), for ceremonies (sacrifices, dowries) and in the plant production (manure). According to Landais and Lhoste (1990), in the regulation of monetary flows and different time scales, breeding represents households' "savings bank", allowing to defer the use of resources for consumption and in particular to cover the period food non existence to cope with unexpected expenses.

Several crops are grown mainly in agrosystems and especially in forest palm oil tree agrosystem. This is by preference ranking: corn, cassava, cowpea and groundnut. Djegui et al. (1992) obtained the same result at Toffo. This shows that the cultural manners of Toffo population remained unchanged for two decades. The forests agrosystems are places of conservation for cropping systems.

Except grazed gramineous by animals, other fodder species exist in forest and agricultural systems and are used to treat naturally ruminants. These are: Zanthoxylum zanthoxyloides (30%), Moringa oleifera (34%) and Phyllanthus discoid (36%). According Mass (2007), these woody species are known for their fodder and medicinal value. They could be implemented in production systems.

Regarding lands, investigations carried out in this region by Tandjiekpon (2004) and Lakoussan (2004) show that inheritance is the main way to get land especially in the districts of Zè-Allada-Toffo. This observation was also made in Sudano-Sahelian savanna in the northwest of Benin by Akouehou et al., (2011b). Minorities own lands of a minority (13% of the surveyed population). However, decentralization and the alarming demographic pressure related to the breakup of the family structure, called for a relatively equitable distribution of land for agricultural purposes. A promising alternative could be the Rural Land Plan, first pioneered and successfully tested since 1997 by projects and development programs reported by Adjovi et al. (1997).

Moreover, 55 years old is the average age of farmers in the districts of Zè - Allada - Toffo This is similar to the agrosystems producers age in Tanzania (51 year old) according to Topper and Kassuga (2003). Likewise, agrosystems operators of Abomey-Plateau have an average age of 51 years (Gouvide, 2010). These results suggest that the use of palm oil agro-ecosystems remains an exclusive activity or the privilege of producers whose age is relatively advanced. The microphanerophytes and meophanerophytes are the dominant biological types of agrosystems. In fact, it would be an old fallow evolving in thicket-woodland. Regressive dynamics of botanical families in palm oil tree agrosystems in the districts of Zè-Allada-Toffo are explained by spatial competition between species within the plant community. This can be enhanced by anthropogenic factors (grazing, collection of medicinal plants, agricultural and phytochemical pressure) and abiotic factors (climate change). In addition, species such as P. maximum, P. guajava, T. procumbens, P. discoid, are dominant and have a high pastoral value, whereas P. maximum, A. viridis, M. lucida, P. guajava, and H. enneaspermus contribute most with high pastoral values. Considering this, P. maximum is the predominant species throughout the study area. But, given to the ratio plots inventoried / plots inventoried containing fodder species, 9/36 = ¼, we noticed that in general, agrosystems studied contain little fodder species. This is then an ecological area with a low pastoral potentially. Agrosystems are relatively old, causing grasses, likely to provide the most value fodder less dominant. This explains the lower pastoral values observed. These agricultural systems are not really reservoirs of pastoral items. The limited presence of drovers in this area is an example.

V. Conclusion

Teak agrosystems poverty in fodder species explains the absence of cattle in this type of agro-system. In agronomic context, faeces from these animals fertilize the soil. Economically sale of animals provides income to producers, allowing them to pay workers and to meet their daily needs. 93% of the sampled population sells their animals to meet the daily needs of the family. 7% mostly made up of women, slaughter animals including poultry for consumption.

Forest agrosystems are favorable to domestic animals breeding, food crops and to the protection of environment. The establishment of an account cash immediately mobilized in emergency, is the fundamental reason of breeding in forest agrosystems particularly those of palm oil. In sum, the sustainability of livestock breeding in forest agrosystems, goes by the introduction of fodder crops in the agricultural households practices, improving by this way, farming techniques by the introduction of fallow and forest resource management.

References Références Referencias

1. ADJOVI A. 2006. Monography of Toffo District. 43p.
2. AEO 2, 2006. Our environment, our wealth. Second report on the future of the environment in Africa UNEP. 36 p. [Online] Available on http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers12-05/010019200.pdf (accessed August 2, 2011 at 19h15min51s).
3. AKOUEHOU S. Gaston, ASSOGBA Doris O., HOUNDONOUGBO Aimé and SINSIN A. B. 2013. Floristic diversity, land security and management of agro forestry systems to oil palm (Elaeis guineensis) in peri-urban and rural areas of the Department of the Atlantic southern Benin. In Int. J. Biol. Chem. Sci, October 2013, Volume 7, Number 5:. 1180-1189.
4. AKOUEHOU S.G., Agbahungba G., HOUNDEHIN J. Mensah G.-A. and SINSIN B.-A. 2011a. Socio-economic performance of Agro forestry system Acacia auriculiformis Lama southern Benin. June 2011. Int. J. Biol. Chem. Sci. 5 (3). pp. 1039-1046
5. AKOUEHOU S. Gaston, GBOZO Edward TENT Brice HOUNDONOUGBO Aimé, Jean GANGLO Cossi. 2011b. Systems of agricultural production and management of community forest in the town of tfoungou Djougou Donga (Benin) In Revue de Géographie du Bénin, University of Benin Abomey (Benin) No. 11, June 2011. pp. 21-39.
6. ALIOU I., 2010. Contribution of livestock and livestockers in the coherence and effectiveness of policy actions for territorial development. Regional Conference: territorial development and social cohesion within the UEMOA. APES, Ouagadougou, 9 p.
7. ASSOGBA O. D. I., 2011. Socio-economic performance of forest agrosystems in oil palm (Elaeis guineensis) in peri-urban and rural areas of the Atlantic. Unpublished Master thesis. FSA, University of Abomey, Benin. 68 p.
8. BACO N. M, BIAOU G., PINTON F., 2007. Do the knowledge of traditional farmers still maintain the agro biodiversity in Benin? Biotechnol. Agron. Soc. Environ. , 11 (3), pp. 201-210.
9. BOUDET G., 1991. Tropical pasture and fodder crops. Paris, Editions of the Ministry of Cooperation, 266 p.
10. De Souza, 1988. Flora of Benin Volume 3: Names of plants in the Beninese National languages. Cotonou: Editions National University of Benin, 424 p
11. DJEGUI N., DE BOISSEZON P., GAVINELLI E., 1992. Organic status of a southern Benin ferralitic soil under forest and different cropping systems. Cah. Orstom, ser. Ped. , Vol. XXVII, No. 1: pp. 5-22.
12. GODRON M. et al. 1968. Code for the systematic survey of the vegetation and environment, CNRS, Paris, 296p.
13. GOUVIDE B. D. 2010. Economic and environmental performance of agrosystems in oil palm (Elaeis guineensis) on the Abomey plateau. Engineering thesis, 76P.
14. JOUVE P., 2006. The game crossed land and agrarian dynamics in sub-Saharan Africa in the South. International Symposium [2] borders of the land question [2]. CNEARC, Montpellier, 14 p.
15. KONETCHE R. R., 2009. Ecological and socio-economic agro-ecosystems and natural formation of the classified forest of LAMA in Benin. Master's thesis in Planning, DGAT, University of Abomey, Benin, 75 p.
16. Nakou L. 2011. Characterization and economic and environmental performance of agrosystems to palm oil in the Department of the plateau. Mission Statement: 36p.
17. SOKPON N; LEJOLY J.1996. Properties of wood in traditional agro forestry systems in Benin. Fac. Sc Kisangani Spé. PP No. :115-222.
18. Tandjiekpon A. 2005. Characterization of agro forestry system based cashew (Anacardium occidental L,) in savannah in Benin. 98p.
19. TOPPER C., L. KASSUGA. 2003. Knowledge transfer for sustainable tree crop development. A case history of Tanzanian cashew integrated management program. Agrisystem Ltd. RG6 5FY, UK ISBN 0-9545192-0-5. 46p.
20. ZINSALO R., S., 2011. Phyto ecological and pastoral agrosystems characterization dominance in oil palm (Elaeis guineensis), in the department of the Atlantic: District of ZE ALLADA and Toffo. Internship report for graduation professional license, EPAC, University of Abomey Calavi. 48 p.

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Evaluation of Pond Fish Production in Umuahia South Local Government Area of Abia State, Nigeria

By Igwe, K. C. & Mgbaja, J. U.

Michael Okpara University of Agriculture, Nigeria

Abstract- The study focused on evaluation of pond fish production in Umuahia South L.G.A. of Abia State. Data for the study were obtained from 40 pond fish farmers using a random sampling procedure. Well structured pretested questionnaire was used in data collection from the sampled farmers. Statistical analysis was accomplished by means of frequency distribution, percentages, cost and returns analysis and multiple regression analysis. The result of the study showed that there is a significant relationship between total revenue and farm size, feed cost, labour cost and cost of fingerlings. The result also showed that the cost of production was N141, 461.08 with the total revenue of N 321,400.00 and the net income of N 179,938.92 per production cycle for an average farmer indicating that pond fish production is a profitable venture in the study area. Despite its profitability, there were constraints to production which included inadequate finance, high feed cost, scarcity of good source of fingerlings and transportation cost. Based on findings of the study, development of good infrastructures and provision of minimal credit by way of public utility for the pond fish farmers could help reduce cost incurred in pond fish production. Given that animal protein especially beef has continued to be expensive yet in short supply, fish production should be encouraged to guarantee meeting the protein demand of households especially the rural poor in the study area by enhanced value chain by fish farmers.

Keywords : *pond fish, production, income, umuahia south local government, abia state.*

GJSFR-D Classification : *FOR Code: 340201*

Strictly as per the compliance and regulations of:

Evaluation of Pond Fish Production in Umuahia South Local Government Area of Abia State, Nigeria

Igwe, K. C. [α] & Mgbaja, J. U. [σ]

Abstract- The study focused on evaluation of pond fish production in Umuahia South L.G.A. of Abia State. Data for the study were obtained from 40 pond fish farmers using a random sampling procedure. Well structured pretested questionnaire was used in data collection from the sampled farmers. Statistical analysis was accomplished by means of frequency distribution, percentages, cost and returns analysis and multiple regression analysis. The result of the study showed that there is a significant relationship between total revenue and farm size, feed cost, labour cost and cost of fingerlings. The result also showed that the cost of production was N141, 461.08 with the total revenue of N 321,400.00 and the net income of N 179,938.92 per production cycle for an average farmer indicating that pond fish production is a profitable venture in the study area. Despite its profitability, there were constraints to production which included inadequate finance, high feed cost, scarcity of good source of fingerlings and transportation cost. Based on findings of the study, development of good infrastructures and provision of minimal credit by way of public utility for the pond fish farmers could help reduce cost incurred in pond fish production. Given that animal protein especially beef has continued to be expensive yet in short supply, fish production should be encouraged to guarantee meeting the protein demand of households especially the rural poor in the study area by enhanced value chain by fish farmers.

Keywords: pond fish, production, income, umuahia south local government, abia state.

I. Introduction

a) Background Information

Fish production as a major sub-sector of agriculture occupies a unique position in Nigeria's economy where the population density is increasing rapidly. In terms of Gross Domestic Product (GDP), it has recorded the fastest growth rate in agriculture to the GDP (CBN Report, 2005). In terms of nutrition, increase in the per capital consumption of fish has benefits to the health of her citizenry. Fish and fish products are known worldwide as a very important diet because of their high nutritive quality and significance in improving human health (Amao et al., 2006). Fish plays a vital role in feeding the world's population and contributing significantly to the dietary protein intake of billions of the populace (Amao et al., 2006). Fish and its products have been proven to provide more than 60% of the total protein intakes in adults especially in rural areas (Adekoye, 2004).

On a global scale, almost 16 percent of total average intake of animal protein was attributable to fish (FAO, 1990). FAO had recommended that an individual takes at least 27g of animal protein per day for sustainable growth and development. In Nigerian homes today regrettably, fish utilization is still below the recommended requirement. The animal protein consumption in Nigeria is less than 8g/head/day, which is far lower than the FAO minimum recommendation (Niang and Jubrin, 2001).

To compound the problem, the supply of fish food has been on the decline, traced to consistent decreases from the country's major source of fish food (Ugwumba and Chukwuji, 2010). Domestic fish production is put at 551,700 metric tones as against the national demand of about 1.5 million metric tonnes estimated as at 2007 (Osawe, 2007). The shortfall is said to be abridged by the importation of 680,000metric tonnes, annually accounting for about 50 billion naira in foreign exchange (Odukwe, 2007).

Nevertheless, in a meeting of the African Regional Nutrition Strategy years back, Nigeria was included as one of the countries having the lowest daily per capita supplies of nutrition requirements (Amao et al., 2006).This prompted the Federal Government of Nigeria as at 2003, to package the Presidential initiative on fisheries and aquaculture development to provide financial and technical assistance to government programmes and projects, encouraging fish production (Ugwumba and Chukwuji, 2010). In spite of these efforts of Government, fish production has remained low in Nigeria (Ugwumba and Chukwuji, 2010). Inadequate supplies from the local fish farmers due to the use of poor quality fish seeds, inadequate information, high cost of feeds, small size of holdings, inefficient resource use, poor infrastructural facilities, lack of credits, lack of extension agents, lack of veterinary doctors and lack of fish production equipments and low capital investment were posited by literature for the consistent decline (Inoni, 2007).

However, a sure means of substantially solving the demand-supply gap and achieving greater

Authors α σ: Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, P. O. Box 2, MOUAU Post Office Umudike, Abia State, Nigeria. e-mail: kayceigwe@gmail.com

improvement in fish production is by embarking on widespread homestead/ pond fish production.

b) Problem Statement

Over the years, there has been a clarion call to improve the nutritional status of developing countries in the intake of animal protein. Out of the 35grams of animal protein per day per person recommended by F.A.O., less than 7grams is consumed on the average (FAO, 2000). As a result of this, many Nigerians suffer from protein deficiency due to low protein intake. Today, Nigeria is faced with the task of providing enough protein enriched food for its population due to the vital role it plays in health and general well being of the economy.

Ugwumba et al., (2010) reported that one of the major source of animal protein in Nigeria is fish and its products, therefore the problem of inadequate protein intake needs to be addressed through increasing production and consumption of fish. The demand for fish is increasing and would continue to increase. As population grows; and with rising standard of living in urban areas, the expectation for diets richer in animal protein becomes obvious. This has led to a rising interest in fish farming in recent times particularly in Ohafia agricultural zone (Igwe et al., 2011). A similar observation in Umuahia Metropolis has led to the attempt to measure the technical efficiency of fish farming in Umuahia Metropolis specifically and in Abia State in general (Igwe et al., 2011, Igwe et al., 2012). Little wonder Umuahia South Local Government has continued to experience increasing growth in the subsector.

In spite of the emerging fishery production sub-sector, in Umuahia South Local Government Area and Abia State in general, the availability of fish is still declining, with absence of alternative and affordable animal protein source. With large population and less rivers, the demand is bound to run short of supply. Fish production is faced with the pressure of finance and poor management. This management problem for maintaining sustainable production in Umuahia South Local Government Area and Abia State in general therefore requires analysis of production cost and revenue derivable from fish production as this will help in developing the subsector in order to eliminate the problem of protein deficiency gap.

II. Objectives of the Study

The broad objective of the study was to evaluate pond fish production in Umuahia South Local Government Area of Abia State.

Specifically, the study was designed to:

i. determine the socio-economic characteristics of respondents in the study area;
ii. identify the various species of fish produced in the study area;
iii. determine the management options adopted by the respondents in the study area;
iv. determine the cost, returns and hence profitability of fish production in the study area;
v. determine the factors affecting pond fish production in the study area;
vi. identify the constraints militating against fish production in the study area

a) Hypothesis

It was hypothesized that pond fish production is profitable in the study.

b) Justification for the Study

Fish farming plays a very important role in making a country self reliant and self sufficient in animal protein production. In some areas within Abia State, where the population density is high with less surface waters, demand supply gap for fish can best be filled through pond fish production. Pond fish production affords best utilization of land and provides income to investors, while helping the nation to conserve foreign exchange. Thus, it is necessary to analyze the present production level of fish, the cost and returns to scale involvement from their operations, with a view to expanding the operation and increasing fish production in the country.

It is hoped that the result of this study will provide valuable information for both prospective and existing pond fish farmers and the government on the need for intensified fish production. The study will also inter alai provide information to the pond fish farmers on the opportunities that abound in fish production, increase output of fish in the study area as well as improve the income of pond fish farmers, enable the financial institutions assess the credibility of any proposal for financial investment in pond fish production as a business, contribute to the reduction of unemployment in the study area and in the country at large, stimulate further research on pond fish production, help government to develop appropriate statewide policy and regulations and plans that ensure an enabling environment for the operation of the industry.

III. Methodology

a) Study Area

The research was conducted in Umuahia South Local Government Area of Abia State. Umuahia South Local Government Area has a total land area of 172,913 square kilometers (Ministry of Lands and Survey, Umuahia).

The Local Government Area is situated on a relief of between 200 and 600 above sea level in capital part of Abia State. It has six notable clans which are

sub-divided into autonomous communities. The clans are Olokoro, Omaegwu, Umuopara, Old umuahia and Nwoachara. It consist of thirty-six (36) villages and twenty-three (23) autonomous communities namely; Umuajameze, Ekenobizi, Amachara, Nsirimo, Amankwo, Ehume, Ugbodiukwu, Umuihie, Ogbodi n'ihe, Ohiya, Eziama, Amuzu, Nsukwe, Umuogo, Amaibo, Umuajata, Amizi, Itaja, Itu, Okwu, Avonkwo, Agbama, and Umuoperaezora.

The total population of the Local Government Area is estimated at about 203,669 (Land survey, Umuahia). Majority of the people are agriculturists and farmers, cultivating various products like yam, cassava, maize, oil palm, rubber, cocoa. They also engage in livestock production and trading. Some are civil servants and business men.

b) Sampling Procedure

The sampling frame for this study comprised of pond fish farmers in Umuahia South L.G.A of Abia State. Ten (10) autonomous communities were purposively selected from the (23) autonomous communities in Umuahia South L.G.A. based on the availability of fish farmers in these communities. The selection of pond fish farmers was done by simple random sampling technique in which forty (40) fish pond farmers were selected and data collected from them.

c) Data Collection

Data for the study was obtained from primary source. The primary data were collected using a well structured questionnaire.

d) Data Analysis

Objectives (i), (ii), (iii) and (vi) was analyzed with the aid of descriptive statistical tools such as; tables, frequencies, percentages.

Objective (iv) was analyzed by cost and return analysis. Here, the total cost which includes the total fixed cost and the total variable cost was estimated. This was compared with the total revenue, to determine the profitability.

$TC = TFC + TVC$

$\prod = TR - TC$

Where;

TC = Total Cost
TFC = Total Fixed Cost
TVC = Total Variable Cost
$\prod$ = Profit
TR = Total Revenue

Objective (v) was analyzed using multiple regression analysis in which four functional forms were tried. The model is specified thus:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6)$ where; Y = Total Revenue from fish and fish products (N), X_1 = Farm size (Kg), X_2 = Feed cost (N), X_3 = Labour cost (N), X_4 = Cost of Fingerlings (N), X_5 = Depreciated charges (N) and X6 = Cost of Drugs (N)

IV. Results and Discussion

a) Socio-economic Characteristics of the Respondents

The socioeconomic characteristics of pond fish producers examined were basically those of age, gender and marital status. These variables are presented in Tables 1, 2 and 3.

Table 1 : Distribution of Respondents According to Age

Age range (years)	Frequency	Percentage
20-29	1	2.5
30-39	7	17.5
40-49	16	40.0
50-59	11	27.5
60-69	5	12.5
Total	**40**	**100**

Source : Field survey, 2013

From the result in Table 1, the study showed that about 60 percent of the pond fish farmers were at most 49 years old. This gives insight into the prospects there are in pond fish farming since it is predominantly in the hands of farmers in their productive age and no doubt of youthful vigour. It goes to emphasize that fish farming is not done by the aged in the study area. Thus, it has prospects of being an enterprise that if well developed could become a tool in dealing with youth unemployment in the study area. Age is an important factor in determining the productivity and adoption of an innovation by farmers (Kebede, 2001). At the youthful age, decision making for improved production and ability to take risks for expansion of production frontier by the farmers would not be too difficult for these farmers to adjust. This agrees with the findings of Eze (2002) which reported that active age of farmers is a positive factor for decision making. Nwaru (2004) also had opined that the ability of the farmer to bear risk, do manual work and be innovative decreases with increase in age.

Table 2 : Distribution of Respondents by Gender

Sex	Frequency	Percentage
Male	15	37.5
Female	25	62.5
Total	**40**	**100**

Source : Field survey, 2013

There were about 37.5 percent of the respondents who were male and 62.5 percent of the respondents that were female. Although farmlands are controlled by men being household heads and by customs in the study area, pond fish production is becoming a sub-sector that is gender friendly in favour of the female folk. This suggests the views of Moehi (2003) and Werby (2001) that women are key players in Africa's agricultural sector and their participation critical to achieving food security and economic well being of households. In the study area and for fish production, this finding is critical. With women dominating this sub-sector, expanding the value chain for pond fish production would receive better attention. Marketing activities that ensure that the pond fish produced get to their final consumers should be majorly female gender driven activities.

For the economic growth of the sampled households, the activities of women in maximizing land use for the selected livestock production cannot be overemphasized. Women as home makers would feel the nutritional impulse of members of their households and of the society more than any other group. Little wonder they seem to dominate in the fishery sub-sector in the area and would play the most significant roles in the development of its value chain.

The distribution of respondents according to marital status is presented in Table 3.

Table 3 : Distribution of Respondents According to Marital status

Marital Status	Frequency	Percentage
Single	2	5.0
Married	33	82.5
Divorced	3	7.5
Widowed	2	5.0
Total	**40**	**100**

Source : Field survey, 2013

It showed that 5 percent of the respondents were single, 82.5 percent of the respondents were married, 7.5 percent of the respondents were divorced and 5 percent of the respondents were widow. This indicates that most pond fish farmers in the study area were married. This would imply the expected support from the spouse(s) and children of these farmers with a view to improving and increasing fish production and improved management of the pond fish farm. Family members would most likely see the farm business as one that directly or indirectly contributes to the economy of the home and so, would not work against the enterprise. The farmers being married are themselves assumed to be responsible. It could mean that unmarried people rarely engage in farming as they may not have domestic responsibilities to shoulder (Nwosu et al., 2012).

b) Pond Type and Number

Pond fish production in the area was done using two basic types, namely concrete type and the earthen type. The earthen type seems to be giving way for the concrete type. Table 4 shows the distribution of the types while Table 5 shows the number of ponds owned and managed by the pond fish farmers in the study area.

Table 4 : Distribution of Respondents According to Pond type

Pond type	Frequency	Percentage
Concrete	36	90
Earthen	4	10
Total	40	100

Source : Field survey, 2013

The majority of pond fish farmers in the study area make use of concrete tank (90%) as indicated in Table 4. This might be due to its convenience, ease in cleaning and management of the pond and in particular ease of harvesting and draining. It is commonly believed by the farmers to be advantageous in the area of high profitability, absence of weed growth or bank erosion, good control of diseases and predators inter alia. It is

considered to be last longer than the earthen pond when properly built and maintained. Simplicity and inexpensiveness in its construction were the basic reasons for preference of earthen pond to the concrete by the few users (10%) who have continued to use the pond.

Table 5 : Distribution of Respondents According to Number of Ponds

Number of ponds	Frequency	Percentages
1-3	5	12.5
4-6	28	70
7-9	5	12.5
10-12	2	5
Total	**40**	**100**

Source : Field survey, 2013

The majority of the pond fish farmers had about 4 – 6 ponds, and very few had less or more of theses. To attain the full potential of pond fish production the operators should have more than 3 ponds that are being managed.

c) Farm Management Options adopted by the Respondents

The production system for producing pond fish in the study area is presented in Table 6.

Table 6 : Distribution of Respondents According to Production system adopted

Production system	Frequency	Percentages
Extensive	3	7.5
Intensive	37	92.5
Semi intensive	-	-
Total	**40**	**100**

Source : Field survey, 2013

It indicates that about 7.5 percent of the respondents adopt extensive system of production, 92.5 percent adopt intensive system of production while none of the respondents adopt semi intensive system of production. Thus, it could be said that pond fish farmers in the study area adopt mainly intensive system which is a more productive culture system.

Table 8 shows the feed types given to the fish reared in the ponds by the farmers.

Table 8 : Distribution of Respondents According to Feed type

Feed type	Frequency	Percentages
Imported feed	22	55
Local feed	12	30
Both	6	15
Total	**40**	**100**

Source : Field survey, 2013

It shows that 55 percent of the respondents use imported feed, 30 percent use local feed and 15 percent use both imported and local feed. This suggests that majority of the respondents use imported feed which can be attributed to the common belief, "if it is imported, it has to be better than locally made products".

Table 9 : Distribution of Respondents According to Water source

Water source	Frequency	Percentage
Streams/ rivers	2	5
Borehole	34	85
Rainfall	4	10
Total	**40**	**100**

Source : Field survey, 2013

In Table 9, it is shown that 85 and 10 percent of the respondents sourced water from borehole and rainfall respectively. Only 5 percent of the respondents in the study area sourced water from the streams/ rivers. This may be due to poor quality of the streams/ rivers water caused by pollution.

Table 10 : Distribution of Respondents According to Source of Fingerlings

Fingerlings source	Frequency	Percentage
Fish farms	18	45
Research centres	12	30
Self breeding	10	25
Total	**40**	**100**

Source : Field survey, 2013

From Table 10, it is shown that pond fish farmers get their fingerlings from different sources.45 percent obtain their fingerlings from fish farms, 25 percent do self breeding and 30 percent obtain fingerlings from research centres. Larger percentage of those that obtain their fingerlings from fish farms may be due to the fact that fingerlings sourced from fish farms are more likely to be healthier and well bred.

Table 11 : Response of the Respondents According to Veterinary services

Response	Frequency	Percentages
Yes	9	22.5
No	31	77.5
Total	**40**	**100**

Source: field survey, 2013

In Table 11, only 22.5 percent of the respondents received veterinary services while 77.5 percent of the respondents received no veterinary services. This could be due to the ability of the cultured fish species to resist diseases.

d) Various Fish Species Produced

Determining the various fish species produced by the respondents was done by listing out the species of fish and then using percentages and frequencies as shown below.

Table 12 : Distribution of Respondents According to fish species produced

Fish species	Frequency	Percentages
Clarias gariepinus	30	75
Tilapia spp	4	10
Heterobranchus spp	4	10
Tilapia and Heterobranchus spp	2	5
Total	**40**	**100**

Source : Field survey, 2013

The fish species cultured in the study area are Clarias gariepinus, Tilapia spp and Heterobranchus spp. The result in table 4.17 showed that 75 percent of the respondents produces Clarias gariepinus, 10 percent of the respondents produces Tilapia spp,10 percent of the respondents produces Heterobranchus spp and 5 percent produces both Tillapia & Hetreobranchus spp's. This implies that Clarias gariepinus (catfish) is largely cultured because of its high preference, good marketability, fast growth rate, good feed conversion rate, high resistance to diseases, low mortality rate and can survive in both running and stagnant water (Aromolaran, 2000; Kareen et al., 2008).

e) Cost and Returns Analysis

Usually, the cost components considered were the fixed cost and the variable cost involved in fish production. Depreciated value of the pond was the only significant fixed cost used for the analysis. The returns were the income from sales of fish per production cycle. Since there are two circles within the year, the depreciated value was divided by two in accounting for the actual cost within the production circle.

Table 13 therefore shows the cost, returns and profit for an average pond fish producer in the study area.

Table 13 : Cost, Returns and Profit of Pond Fish Production

Cost Item		Value
A) Variable Cost		
Labour		30,498.75
Fingerlings		2,915.00
Transportation		936.13
Feed		26,235.00
Medication		313.70
Water		1,800.00
Total Variable Cost (TVC)		**62,698.58**
B) Fixed Cost		
Land		-
Depreciation (Pond/Equipment)		78,762.50
Total Fixed Cost (TFC)		**78,762.50**
Total Cost (TVC + TFC)		**141,461.08**
C) Revenue		
Sales of fish		321,400.00
Total Revenue		**321,400.00**
Profit = TR-TC	**179,938.92**	

Source: Field survey, 2013
Note: Depreciation on ponds/equipments was calculated using declining balance method.

From Table 13, the cost items are labour, fingerlings, transportation, feed, drugs and depreciation. The table showed that pond fish production gives returns of about N321,400.00 for 401.9kg of fishes annually. Variable and fixed costs of production were N62,698.58 and N 78,762.50respectively. Total cost of pond fish production was N141,461.08. This implies that pond fish production in the study area is highly profitable with a profit margin of N179,938.92 per production cycle.

f) Factors Affecting Pond Fish Production in the Study Area

The factors that affected pond fish production were examined and results of the regression analysis done on that is presented in Table 14.

The Cob Douglas form was chosen as the lead equation because of relatively more number of significant variables. The result showed that four variables were statistically significant, indicating the basic factors that affect pond fish production in the study area

Table 14 : Summary of Regression Result

Variables	Cobb-Douglas	Semi-log	Exponential	Linear
Constant	-8.603 (-0.338)	-7.160E7 (-1.835)*	13.957 (10.946)***	-3.099E6 (-1.735)*
Farm size (X_1)	1.197 (1.523)*	-0.454 (-0.853)	0.681 (1.116)	0.056 (0.147)
Feed cost(X_2)	0.226 (2.584)**	0.028 (0.465)	0.173 (1.856)*	0.075 (1.295)
Labour Cost(X_3)	0.743 (1.904)**	0.470 (1.782)*	0.399 (1.631)*	0.718 (4.753)***
Fingerlings(X_4)	-1.202 (-1.727)*	0.452 (0.960)	-1.140 (-2.195)**	-0.082 (-0.256)
Depreciation(X_5)	0.004 (0.031)	-0.107 (-1.302)	0.006 (0.056)	-0.016 (-0.253)
Cost of Drugs(X_6)	0.116 (0.583)	0.539 (4.014)***	0.032 (0.271)	0.297 (4.035)***
R^2	75.9	89.0	88.0	51.05
Adjusted R^2	71.6	87.0	86.0	88.5
F-Ratio	17.363	44.491	16.10	90.3

Source : Field Survey, 2013
*Note: *** - Significant at 1 percent, ** - Significant at 5 percent, and * - Significant at 10 percent*

Farm size was significant at 10% level and was directly related to income. This implies that, the higher the farm size, the higher the income from pond fish production. Pond owners with more number of ponds had more fish stocked in their farm than those with smaller number of ponds. They consequently would make more income from their fish production business.

The estimated coefficient of feed variable was significant at 5% and has a positive relationship with income. This implies that, the more the expenditure on feed as long as the saturation stage is not exceeded, the more the weight gain and the consequent higher income to be derived from sale of the fish. Feed constitute the highest cost in fish framing. It is therefore advised that cheap sources of feed be harnessed in order to enjoy the full benefits that feeds will have on the growth of fish and consequent income of the farmer when sold to the consumers or end users. It appears that the pond fish farmers have inculcated the management practice of not feeding the fish beyond their saturation stage as that will mean more cost and decreases income for the pond fish farmers.

Labour cost was also statistically significant at 5% level and had a positive relationship with income. This indicates that as pond fish farmers engage more labourers or employ more labour in their farm operations, their income increases. This finding agrees with that of Yisehak (2008) that increase in labour enhances farm productivity. Again labour usage for fish production does not require laborious tasks as in certain crop production. This makes it possible to harness labour with little technical knowhow and without any gender bias.

Cost of fingerlings was significant at 10% and negative in its sign indicating that the higher the cost of fingerlings, the lower the income derived from fish production and vice versa. This is because sometimes if there is a case of high mortality at this stage, resulting to restocking, it would naturally have effect on the income. This makes it necessary that fingerlings be sourced from certified dealers in other to minimize risks and uncertainties related to loss of fingerlings.

g) Constraints to Production

There were seven factors identified by the fish pond producers as constraints to their fish business. These are presented in Table 15.

Table 15 : Distribution of Respondents According to Production Constraint

Production Constraint	Frequency	Percentage
High feed cost	20	50
Transportation cost	15	37.5
Inadequate capital/finance	30	75
Disease and pest	7	17.5
Lack of good source of fingerlings	16	40
Inadequate water supply	2	5
Lack of organized market	2	5

Source : Field survey, 2013 Multiple responses were received

The constraints faced by pond fish farmers in the study area include inadequate capital/finance, high cost of feed, lack of good source of fingerlings, high transportation cost, pest and disease incidence, inadequate water supply, and lack of organized market. Table 15 shows that majority (75%) of the pond fish farmers reported lack of capital/finance as a major problem challenging pond fish farming in the study area. Pond fish production is capital intensive and thus requires a relative big capital investment for reasonable profit to be made. This was indicated by Ugwumba & Chukwuji, (2010) as one of the major problems facing catfish farmers in Anambra State, Nigeria. Adeogun et al. (2007) also reported lack of capital as one of the problems affecting aquaculture in Lagos State, Nigeria. The second serious problem was the problem of high cost of feed which was accounted for by 50 percent of the pond fish farmers. The scarcity of commercial pelleted and floating fish feed mills and problems associated with production and distribution of fish feeds could be the main reasons for the hike in feed prices. Madubuike (2012) reported that high feed cost is one of the problems of livestock production in Nigeria. Lack of good source of fingerlings is the third serious problem reported by 40 percent of the pond fish farmers. This could be due to the nearly inexistence of local supplies of pond fish fingerlings in the study area. Farmers relied on the importation of most of their fingerlings from neighbouring States. The fourth serious problem to pond fish production reported by 37.5 percent of the pond fish farmers was high cost of transportation. This is due to the inadequacy of motorable roads in the study area. It is therefore expected that improvement of infrastructures in the State would favour pond fish production in the area.

V. Conclusion and Recommendation

Pond fish production could be a major strategy of government to reduce poverty, generate employment for the teeming unemployed and meet the nutritional needs of the Nigerian people. Its capacity to accomplish these hinges on the enormous potentials available in the country and the benefits that the subsector could generate for both the farming household and the economy in general. This study showed that pond fish farming is a recent phenomenon attracting younger and well educated farmers.

In spite of the constraints faced by pond fish farmers in Umuahia South Local Government Area of Abia State, the prospects of fish production is bright as it is permitted by both religious and cultural practices in the study area. Pond fish production should be accorded the needed recognition. Since most of the

pond fish farmers in Umuahia South are constrained by finance, the need for financing pond fish production is imminent.

Considering the importance of protein in building and replacement of lost tissue in both children and adults, the place of pond fish production as a possible solution to the continuous low protein intake in the developing economies cannot be over emphasized.

The following recommendations were deemed appropriate based on findings:

i. Lack of capital/finance was a major problem. Farmers should form co-operatives and should be encouraged by the government as this will enable resource poor farmers not only get loans but also to pool their resources together and overcome the inadequacy of capital.
ii. The problem of inadequate transport facilities should be given priority attention by both local and state governments. There is need to provide accessible roads in the communities of Umuahia South Local Government Area. This will help in reducing marketing challenges and reduce financial cost of transportation.
iii. Extension agents should embark on intensive educational programmes on the principles, practices and prospects of pond fish production. They should encourage and teach farmers on improved techniques in fish production.
iv. Significant variables influencing output should be taken into cognizant in formulation of policies relating to fishery sub-sector.

References Références Referencias

1. Adekoya, B.B and Miller, J.W. 2004. Fish cage culture potential in Nigeria-An overview. National Cultures. Agriculture Focus. 1(5): 10
2. Adeogun O.A., Ogunbadejo, H.K., Ayinla, O.A., Oresegun, A., Oguntade, O.R., Tanko, A., Williams S.B. (2007). Urban Aquaculture: Producer Perceptions and Practices in Lagos State, Nigeria. Middle-East J. Sci.Res. 2 (1): 21-27
3. Akegbejo, Y. and Adeoye, D. (2012). Measuring Profitability in Small Scale Aquaculture Enterprises in South West Nigeria. IIFET 2012 Tanzania Proceedings
4. Amao, J. O., Oluwatayo, I.B., and Osuntope, F.K. (2006) "Economics of Fish Demands in Lagos State, Nigeria. J.Human Ecol. 19(1):25-30
5. Amos, T.T. (2000). Sustainable Fish Culture Practice in Kano Stale Nigeria: An Economic Analysis. Unpublished Ph.D thesis. Dept. of Agric. Econs. ABU., Zaria. 120p
6. Amos T.T. and Bolorunduro P.I. (2000). Economics of Aquaculture Production. NAERLS Extension Bulletin NO 107. Fisheries Series NO 5. and Hunger by Improving Fisheries and Aquaculture. 99 p
7. Aromolaran, A.B. (2000). Analysis of resource use efficiency in fish farms: A case study of Abeokuta zone of Ogun State. Aquafield, 1(1): 12-21
8. Arthur, J.R., Bondad-Reantaso, M., Baldock, F.C., Rodgers C.J. and Edgerton B.F. (2004). Manual on Risk Analysis for the Safe Movement of Aquatic Animals (FWG/01/2002). APEC/DoF/ NACA/FAO, APEC Publ. No. APEC #203-FS- 03.1, pp: 59. Buras, N., 1993. Microbial safety
9. Ayinla, O. (2001). Economics of Fish Farming. Preceeding of the Fish Seed Propagation Course. pp 25
10. Boyd, C.E. (1998). Water Quality for Pond Aquaculture. International Center for Aquaculture and Aquatic Environment. Research and Development Pub. No. 43. Auburn University, Alabama, USA
11. CBN (2009) Statistical Bulletin Central Bank, Lagos
12. CBN Report (2005) Annual Report and Statement of Accounts, Central Bank of Nigeria Publication, Abuja
13. Emenyonu, C.A., Odii, M.A., Ohajianya, D.O., Henri-Ukoha, A., Onyemauwa S.C., Ben-Chendo G.N. & Munonye O.U. (2010). Effects of Waste Water Use on Vegetable Crop Production in Imo State, Nigeria. Res. 2(10): 47-56
14. Eze, S.O. (2002) Post Harvest Plantain Technology dissemination and Agricultural Extension Implications for poverty eradication among rural women in Amacha LGA Anambra state. In: iloje G.E. Osuji, U. Herbert and G.N Asumugha (eds) Agriculture. A basis for poverty eradication and couther resolution proceeding of 26th annual ASR FUTO Owerri Nig. pp201-204
15. FAO, (1990) Commodity Review and Outlook (1990-1991). FAO, Rome, Italy.
16. FAO; Food and Agriculture Organization(2000). The State of World: Fishery and Agriculture, Fisheries Department, Rome
17. FDF. 2009. Nigeria National Aquaculture Strategy. Assisted by FAO. Formally approved by Government. 18 p
18. FISH. (2006). Brochure with Cost Benefit on Cage Fish Farming in Uganda. USAID-assisted "Fisheries Investment for Sustainable Harvest" (FISH) project. Cooperative Agreement: 617-A-00-05-00003-00. Dept. of Fisheries and Allied Aquacultures: Auburn University, Alabama, USA. 2 p
19. Ibenne, E. (2010). A Handbook on Effective Catfish Farming, 24p
20. Igwe, K. C., Onyenweaku, C. E. and Nwaru, J. C. (2011) Application of Linear Programming to Semi-Commercial Arable and Fishery Enterprises in Abia State, Nigeria, International Journal of Economics and Management Sciences Vol. 1 (1): 75-81
21. Igwe, K. C., Echebiri, R. N., Nlewadim, A. A. and Anorue, P. C. (2011) Application of the Stochastic

Production Frontier to the Measurement of Technical Efficiency of Fish Farming in Umuahia Metropolis, Abia State, Nigeria, Journal of Agriculture and Food Sciences Vol. 9(1): 1-8

22. Inoni, O.E. (2007). Allocative Efficiency in Pond Fish Production in Delta State, Nigeria: A Production Function Approach. Agric. Tropica et Subtropica 40 (4): 127-134
23. Jauncey, K., Sorensen, P.L. and Areola, F. (2008). A short Handbook- Catfish Feed for Nigeria. Materials, Storage, Handling, Stock, Quality control, Ingredients, Feed Formulation, Feed use and Technical Aspects of Feed Manufacture. Sponsored by CDE, Brussels. 25p
24. Kebede, T. A. (2001) Farm Household Technical Efficiency: A Stochastic Frontier, A Study of Rice Producers in Mardi-Watershed in the Western Development Region of Nepal, An MSc. Thesis Submitted to the Department of and Social Sciences, Agricultural University of Norway, 56p
25. Kareem R.O., Dipeolu AO.., Aromolaran A.B. , Williams S.B.(2008) Economic efficiency in fish farming: Hope for agro-allied industries in Nigeria. Chinese Journal of Oceanology and Limnology, 26(l): 104-115
26. Madubuike F.N. (2012). Bridging the Animal Protein Supply and Demand Gap in Nigeria. Imo State University, Owerri, Nigeria Inaugural Lecture Series No. 7. Imo State University Owerri
27. Moehi, J. (2003): Gender and Aquaculture Development in the African Region, FAO Aquaculture Newsletter. No, 29 pgs 35- 36
28. Moehl, J., Brummett, R.E., Kalende, B.M. & Coche, A. (2006).Guiding principles for promoting aquaculture in Africa : benchmarks for sustainable development. CIFA Occasional Paper 28, Food & Agriculture Organization of the United Nations, Accra, Ghana
29. Niang, T. and Jubrin, S. (2001). Quaterly Newsletter of the Nigeria Agriculture Question and Answer Service, Vol. 1: 1-7
30. Nwachukwu I.N., and Onyenweaku, C.E. (2009). Allocative Efficiency among Fadama Telfaria Production in Imo State Nigeria. Online at http://mpra.ub.uni muenchen.de/27249/ MPRA Paper No. 27249, Posted 07 December 2010 / 11:46
31. Nwaru, J.C. (2004) "Rural credit markets and resource use in Arable crop production in Imo State Nigeria" PhD Thesis, Michael Okpara University of Agiculture, Umudike
32. Nwosu, C.S. and Onyeneke, R.U. (2013). Effect of Productive Inputs of Pond Fish Production on the Output of Fish in Owerri Agricultural Zone of Imo State, Nigeria. Global Advanced Research Journal of Agricultural Science. Vol. 2(1): 023-028
33. Nwosu, C.S., Onyeneke, R.U., Okoli, VBN (2012). Socioeconomic Determinants of Fluted Pumpkin Leaf (Telferia occidentalis) Production in Ezinihitte Mbaise Local Government Area of Imo state, Nigeria. Agric. Sci. Res. J. 2(6): 355 – 361
34. Odukwe, A.(2007) Fish Farming in the Tropics: A Functional Approach. Maxiprints, Awka, Nigeria. Book Review
35. Ogamba, E.N. and Abowei, J.F. (2012). Some issues in Culture Fisheries Management and Practices. British Journal of Pharmacology and Toxicology 3(5): 205-217, 2012
36. Okoye, B.C., Okorji, E.C. and Asumugha, G.N. (2004) Outlook on production Economics of paddy Rice under resource constraints in Ebonyi state. proceeding of the 38th annual conference of the Agricultural society of Nig. (ASN), 17-21 Oct 2004, Lafia Nassarawa State. pp 337-342
37. Osawe, M. (2007). Technical know-how of Catfish Grow-out for Table Size in 4-6 Months. Proceedings of a Seminar on Modern Fish Farming by Dynamo Catfish Production, pp: 1–14. Lagos, Nigeria
38. Ugwumba, C.O. and Chukwuji, C.O.(2010) The Economics of Catfish Production in Anambra state, Nigeria; A Profit Function Approach. J. Agric and Soc. Sci. 6(4):105-109
39. Werby, E. (2001) Socio-cultural Considerations when introducing a new integrated Agriculture Aquaculture Technology. In FAO Fisheries Technical 468. FAO, Rome. pp 3-8
40. Williams, S.B., Kareem, R.O., Adiegu, C.P. and Dipeolu, A.O. (2012). Resource-use Efficiency among selected Fish Farms in Lagos state, Nigeria. J. Agric. Sci., 3(2):85-94
41. World Fish Center. 2009. World Fish Medium-Term Plan. 2010-2012. Reducing Poverty
42. Yisehak, K. (2008) Gender Responsibility in small holder mixed crop livestock production system of Jimma zone, South West Ethiopia

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 1 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Risk Mitigation of Poultry Industry Pollutants and Waste for Environmental Safety

By D. Thyagarajan, M. Barathi & R. Sakthivadivu
Animal Sciences University, India

Abstract- Poultry waste such as litter, offal, feather and major micro environmental pollutants like carbon, nitrogen and phosphorous cause major threats to the micro environment, if not mitigated properly. Over the past few decades, adoption of intensive rearing of birds has increased the load of micro environmental pollutants. These could disturb the ecological balance by polluting ground water, air and soil. In poultry, excess amounts of ammonia leads to reduction in growth rate, decrease in egg production, lower air quality and damages in upper respiratory tract. It induces infectious diseases like Newcastle disease, air sacculitis and keratoconjunctivitis. Potential strategies are now available to reduce these pollutants load by physical, chemical and biological approaches. Nitrogen pollution can be managed by dietary manipulation and chemical neutralization. Methane produced by anaerobic fermentation of poultry waste can be used profitably as biogas. Phosphorous runoff in agricultural fields can be prevented mainly by using phytase enzyme, salt precipitation, and also by vegetative filter strips. Increasing emission of harmful pollutants like ammonia, phenol, toluene, methanol, etc., in the atmosphere results in obnoxious odour decreasing bird's productivity. It can be reduced by various odour reduction methods like providing proper ventilation, shed temperature, wind break walls etc. Poultry waste can also be used positively as feather meal, biodiesel, electricity generator, biodegradable plastic, vermicompost etc.

Keywords: *mitigation of poultry waste, harmful pollutants, positive utilization, ammonia, methane, phosphorous, odour.*

GJSFR-D Classification : *FOR Code: 630106, 859899p*

Strictly as per the compliance and regulations of:

Risk Mitigation of Poultry Industry Pollutants and Waste for Environmental Safety

D. Thyagarajan[α], M. Barathi[σ] & R. Sakthivadivu[ρ]

Abstract- Poultry waste such as litter, offal, feather and major micro environmental pollutants like carbon, nitrogen and phosphorous cause major threats to the micro environment, if not mitigated properly. Over the past few decades, adoption of intensive rearing of birds has increased the load of micro environmental pollutants. These could disturb the ecological balance by polluting ground water, air and soil. In poultry, excess amounts of ammonia leads to reduction in growth rate, decrease in egg production, lower air quality and damages in upper respiratory tract. It induces infectious diseases like Newcastle disease, air sacculitis and keratoconjunctivitis. Potential strategies are now available to reduce these pollutants load by physical, chemical and biological approaches. Nitrogen pollution can be managed by dietary manipulation and chemical neutralization. Methane produced by anaerobic fermentation of poultry waste can be used profitably as biogas. Phosphorous runoff in agricultural fields can be prevented mainly by using phytase enzyme, salt precipitation, and also by vegetative filter strips. Increasing emission of harmful pollutants like ammonia, phenol, toluene, methanol, etc., in the atmosphere results in obnoxious odour decreasing bird's productivity. It can be reduced by various odour reduction methods like providing proper ventilation, shed temperature, wind break walls etc. Poultry waste can also be used positively as feather meal, biodiesel, electricity generator, biodegradable plastic, vermicompost etc. This review discusses in brief about the various possible methods available to mitigate the harmful pollutants generated from poultry waste and also ways for positive utilization of poultry waste.

Keywords: mitigation of poultry waste, harmful pollutants, positive utilization, ammonia, methane, phosphorous, odour.

I. Introduction

Pollution may be defined as an undesirable change in physical, chemical or biological characteristics of air, water or land that can harm human life and the lives of other desirable species. The intention of environmental science is to reduce this pollution by Bioremediation thereby preventing its harmful effects on the ecosystem. Major methods of reduction of environmental pollution include biodegradation, biotransformation and bioaccumulation. Wastes can be utilized to produce non-conventional non-polluting energy resources like bio diesel (methanol), biogas, bio hydrogen etc. or to produce bio fertilizer, bio pesticide and bio organics.

a) Poultry waste

Poultry production generates various wastes such as hatchery waste, litter (bedding material, saw dust, wood shavings and peanut hulls), offal, processing water and bio-solids. The major environmental pollutants are Micro environment gases / pollutants like CO_2, CH_4, NH_4, and nitrous oxide.

Poultry farming activities emit considerable amounts of these four gases namely Carbon di oxide, ammonia, methane and nitrous oxide. Direct emissions from poultry come from the respiratory process of all birds in the form of carbon dioxide. Airborne acids are injurious to respiratory system. These air pollutants return to earth in the form of acid rain and snow. Ammonia volatilization is one of the most important causes of acidifying wet and dry atmospheric deposition a large part of it originating from poultry excreta.

Micro environmental pollution in poultry farming activities includes dust, odours, end toxins, microorganisms, H_2S, CO_2 and nitrogenous compounds. In most cases, ammonia emissions have the potential to contaminate surface waters and are of environmental concern on both local and global scale. These emissions in and around poultry production facilities can be a health and performance issue for birds and their caretakers. Dietary strategies can aid in the reduction of many airborne emissions, including dust and ammonia.

b) Major environmental pollutants

The potential pollutants from animal manure which pose threat to the environment in recent years are nitrogen (N) and phosphorus (P). One major concern over N is the potential for pollution of ground water and surface water supplies. When applied to soils in correct amounts, N poses little environmental threat, as it will be utilized for plant growth. But when it is in excess than the amount needed for the plant, it becomes a harmful pollutant. Soil microbes play a major role in converting nitrogen into ammonium ions which are further oxidised to nitrate and nitrite ions. Nitrates can leach through the soil and can contaminate ground water. Also, excess N excretion can increase ammonia volatilization from animal production systems, which can impact air quality (Carter and Kim, 2013).

Author α: Director of Distance Education, TANUVAS.
e-mail: drthyagu2002@yahoo.com
Author σ: Senior Research Fellow, TANUVAS.
Author ρ: Assistant professor, TANUVAS.

Unlike N, P is relatively immobile in the soil and usually does not leach into ground water. Excess P in the soil is converted into water insoluble forms, which then attach to soil particles and can erode into lakes, streams, and rivers. Erosion of soil particles containing P compounds into surface waters stimulates growth of algae and other aquatic plants. The resulting decomposition of this increased plant growth diminishes the oxygen in the water, creating an environment that is unsuitable for fish and other wildlife (i.e., eutrophication) (Carter and Kim, 2013).

II. Various Approaches to Reduce Pollutants

a) Harmful Effects of Ammonia Emissions

Ammonia is a noxious gas emitted from poultry housing systems. Uric acid present in bird's faeces is converted to ammonia through microbes. Excess amounts of ammonia causes serious effects like reduction in feed intake of birds thereby reducing their growth rate, decrease in egg production, reduction in air quality and damage in respiratory tract. This leads to several diseases like Newcastle disease, air sacculitis and keratoconjunctivitis (Xin et al. 2011).

The uric acid and organic nitrogen present in bird's excreta get converted into ammonia. Continuous exposure to even lower levels of ammonia (10ppm) could damage the bird's respiratory system. Nitrogen output in broilers was 67+ 2% of the total nitrogen inputs with secondary outputs of nitrogen accumulations in the litter 26+ 2% and TAN emissions were 13+ 0.4% of the total nitrogen inputs (Mitran et al. 2008, Ritz et al. 2004).

Another pollutant produced from poultry manure is Nitrous oxide (N_2O), which is emitted as an intermediate pollutant from nitrification and denitrification reactions (Mitran et al. 2008).

b) Mitigation of Ammonia pollutants

Potential strategies for control of NH_3 in poultry production include

- Dietary manipulation
- Chemical neutralization

c) Dietary manipulation

Feeding reduced protein diets can reduce N excretion and subsequent NH_3 volatilization. Other dietary manipulation strategies that can optimize N digestion and reduce N excretion include feed formulation based on amino acid requirements rather than CP. (Blair et al. 1999).

Enhanced conversion of dietary CP can be accomplished by fine tuning rations to better match birds' nutrient requirements, primarily by ensuring that at a given energy density there are sufficient concentrations of all limiting essential amino acids. In principle, if one knows the proper levels of amino acids (AA) to feed, then one might be able to able to achieve comparable bird growth and feed conversion efficiencies with reduced dietary CP. Optimal AA profiles depend on genetics, environment, and interactions with other nutrients. We have found that benefits of reduced CP with enhanced AA levels include improved feed utilization, and reductions in waste litter N (Ferguson et al, 1998ab).

Minimizing the dietary crude protein and enhancing the amino acid content of poultry feed is greatly helpful in reducing the excess nitrogen and ammonia emissions. Feed should be efficiently formulated with minimal crude protein to achieve maximum feed conversion, which in turn improves the bird's growth rate (Ferguson et al, 1998ab).

Blair et al. (1999) observed that reduction in dietary crude protein content resulted in a 10- 27 % reduction in the total amount of nitrogen excreted during the sixth week broiler rearing period. Also with layers 30-35% reduction was observed in daily nitrogen output.

d) Chemical neutralization

Different types of litter amendments used to mitigate ammonia pollution are as follows: acidifiers, alkaline material, adsorbers, inhibitors and microbial and enzymatic treatments.

e) Acidifiers

Numerous treatment procedures have been developed that attempt to decrease NH3 volatilization from manure and litter by acting as acidifying agents, odour and moisture absorbents, and microbial and enzyme inhibitors. Most acidifying agents function similarly to reduce NH3 volatilization by lowering the pH of manure or litter and thereby reducing microbial activity. Use of these agents has been shown to improve bird performance and lower the energy usage needed to ventilate poultry houses. While the use of acidifying agents has been shown to be effective in controlling NH_3, their overall use has met with varying levels of success (Blair et al. 1999).

Acidified Chars are produced by pyrolyzing peanut hulls, pine chips and coconut husks. The reduction was achieved due to a combination of litter pH reduction and NH_3 immobilization by H_2SO_4 on the acidified char. The application of char did not affect the bird performance adversely. Other acidifiers include alum, Sodium bisulphate and phosphoric acid. Acidifiers could effectively reduce poultry house ammonia (NH_4) levels and improve the surrounding air quality (Ritz et al. 2011).

f) Alkaline materials

Alkaline materials such as $CaCO_3$, hydrated or slaked lime $Ca(OH)_2$ or burnt lime (CaO)may increase litter pH>7 and convert more ammonium into ammonia gas. Combining ventilation and heat, ammonia gas is vented out of the poultry house (Ritz et al. 2011).

g) Adsorbers

Adsorbers like Clinoptilolite and peat are known to adsorb ammonia. (Nakaue et al. 1981).

h) Inhibitors

Inhibitors such as Phenyl phosphorodiamidate may be used to reduce the urease activity, thereby reducing conversion of uric acid and urea to ammonia. Inhibiting enzymes and microorganisms can also be used to reduce ammonia emissions (McCrory and Hobbs, 2001).

i) Moisture reduction

By lowering the moisture content of poultry manure and litter, adsorbents inhibit the microbial activity associated with the formation and volatilization of NH_3. Microbial and urease enzyme inhibitors can reduce the formation and volatilization of NH_3 by inhibiting or preventing the growth of microorganisms and the action of enzymes that convert uric acid into NH_3 (Ferguson et al, 1998ab).

III. Methane Production from Poultry Waste

Poultry offal jointly consists of poultry viscera, feather meal, and blood and carcass waste. The biological methane production rate and yield of different poultry slaughtering residues differs. Poultry offal, blood, and bone meal which were rich in proteins and lipids, showed high methane yields at different concentrations of volatile solids. Blood and bone meal produced methane rapidly, whereas the methane production of offal was more delayed probably due to long-chain fatty acid inhibition. Sewage sludge at 35°C, have the shortest delay of a few days, while granular sludge did not produce methane within 64 days of incubation. Feather showed a somewhat lower methane yield of 0.21 m3 $kg^{-1}$when volatile solids added (50 m^3 ton^{-1} wet weights).

Combined thermal (120°C, 5 min) and enzymatic (commercial alkaline endopeptidase, 2-10 g 1^{-1}) pre-treatments increased methane yield by 37 to 51%. Thermal (70-120°C, 5-60 min), chemical (NaOH, 2-10 g 1^{-1}, 2-24 h), and enzymatic pre-treatments are less effective, with methane yield increasing by 5 to 32%. Anaerobic digestion of the poultry slaughter residues appears a promising possibility because of the high methane yield and nitrogen content of these residues (8 to 14% N of total solids). Pre-treatments improve the methane production of feather. The methane gas thus produced from the offal treatment can be used as biogas (Thyagarajan, 2013).

a) Utilization of methane

i. *Biodemethanation*

At 37°C methane and methanol are oxidized by organisms. Pseudomonas methanica produces formic acid from methanol oxidation. Vigorous oxidation of methane is noticed by Methlyococcus capsulatus at 50°C. This shows the potential of the organism to utilize methane. Pseudomonas methanica is an organism that uses methane and methanol by a pathway which is absent in facultative methanol organism. Pathway used by bacteria to utilize methane is allulose pathway (Thyagarajan, 2013).

ii. *Importance*

Methane dependent organism will be helpful to break down the methane produced from poultry offal and manure and reduce the negative impact on atmosphere by methane. When methane is not utilized or converted to other purposes (Thyagarajan, 2013).

b) Production of biogas by Anaerobic Digestion

Anaerobic digestion is used worldwide as a unit treatment for industrial, agricultural and municipal wastes. It involves the degradation and stabilisation of an organic material under anaerobic conditions by microbial organisms and leads to the formation of methane and inorganic products including carbon dioxide:

$$\text{Organic matter} + H_2O \xrightarrow{\text{anaerobes}} CH_4 + CO_2 + \text{New biomass} + NH_3 + H_2S + \text{Heat}$$

The organic components of poultry litter can be classified into broad biological groups: proteins, carbohydrates and lipids or fats. The anaerobic treatment of poultry litter involves two distinct stages (Williams, 1999). In the first stage, complex components, including fats, proteins and polysaccharides, are hydrolysed and broken down to their component subunits. This is facilitated by facultative and anaerobic bacteria, which then subject the products of hydrolyses to fermentation and other metabolic processes leading to the production of simple organic compounds. This first stage is commonly referred to as acid fermentation and in this stage organic 1material is simply converted to organic acids, alcohols and new bacterial cells. The second stage involves the conversion of the hydrolysis products to gases (mainly methane and CO_2) by several different species of strictly anaerobic bacteria and is referred to as methane fermentation.

Anaerobic digestion is a relatively efficient conversion process for poultry litter producing a collectable biogas mixture with an average methane content of 60%. Systems are usually site specific but must have a certain minimum amount of poultry litter to supply a given system. The methane produced by this process can be used as a fuel for boilers, as a replacement for natural gas or fuel oil and can also be fired in engine-generators to produce electricity for on-farm use or sale to electricity companies. The residual sludge is stable and can be used as a soil fertiliser. For

larger operations the gases would need to be scrubbed to remove impurities but may then be compressed and sold commercially to fuel companies. The poultry litter contains a higher fraction of biodegradable organic matter than other livestock wastes and this includes high levels of organic nitrogen due to the high content of protein and amino acids. The concentration of endogenous ammonia-nitrogen rises considerably during anaerobic digestion of poultry litter. While a certain amount of ammonium ions can be utilised by some anaerobic bacteria, an excess of ammonium can inhibit the destruction of organic compounds, the production of volatile fatty acids and methanogenesis (Thyagarajan, 2013).

IV. Phosphorous Emission from Poultry Waste

Phosphorous is released as a pollutant in poultry manure. Poultry manure contains around 4 % total nitrogen and 2 % total phosphorous. It was estimated that 41% of phosphorous was consumed by broiler breeders and 45% of phosphorous was consumed by broilers. Phytic acid attributes to high phosphorous excretion by monogastric animals resulting in environmental pollution (Xin et al. 2011).

a) Mode of action of phosphorous

Phytate bound phosphorous cannot be used efficiently by simple- stomached animals due to insufficient phytase activity. Hence phytase (myo-inositol hexaphosphate phosphohydrolase) supplementation improves the availability phytate phosphorous by hydrolysing phytate for utilization. It dephosphorylates phytate to a series of lower inositol phosphate esters and finally to inositol and inorganic phosphorous (Bingol et al. 2009).

Addition of phytase has also been reported to improve utilization of amino acids in broilers fed with soybean meal basal diets. Additions of increased concentrations of phytase linearly increased body-weight gain, feed intake, total ash percentage and retention of calcium and phosphorous and linearly decreased ($p<0.01$) phosphorous excretion (Bingol et al. 2009, Juanpere et al.2004).

The inclusion of phytase enzyme in diets with low concentration of non-phytate phosphorous increases the coefficient of phosphorous retention and reduced the presence of this element in broiler excreta by up to 45% (Bingol et al. 2009, Juanpere et al.2004).

b) Mitigation of phosphorous pollutants

i. *Mitigation of phosphorous pollutants using aluminium sulfate*

The second approach to prevent phosphorous runoff from fields is the addition of Aluminium sulfate. Aluminium sulfate precipitates phosphorous, making it less soluble in water. Thus phosphorous is retained in soil which can be utilized by plants. Alum applied to litter at a rate of 1816 kg/house corresponding to 0.091 kg/bird reduced the litter pH, which resulted in less NH3 volatilization. Broilers grown on alum-treated litter were significantly heavier than controls. Hence alum-treatment of poultry litter was a best management practice to reduce phosphorous and ammonia nonpoint source pollutions (Moore et al. 2000).

ii. *Dietary manipulation to improve feed utilization*

Reduced levels of dietary nonphytate phosphorous (NPP) and inclusion of phytase had positive effects on broiler breeder performance and negative effects on phosphorous runoff. Reduction in NPP diets by 0.1% reduced the phosphorous output of broilers by 18 %. But reduction of NPP diets below 0.37% increased egg production and reduced fertility. Hence an alternative source of phosphorous dicalcium phosphate can be used, which was found to reduce total phosphorous and water soluble phosphorous concentration by 42% without affecting the fertility factor (Plumstead et al. 2007).

iii. *Controlling phosphorous loss using vegetative filter strips*

Another innovative yet simple approach for mitigation of phosphorous pollution was the use of vegetative filter strips. Vegetative filter strips (VFS) had been identified to have high potential to prevent phosphorous runoff from agricultural source areas. Simulated rainfall was used to analyze the effects of VFS fescue (Festuca arundinacea Schreb) grown to various lengths on phosphorous runoff from poultry litter. VFS was found to reduce mass transport of ammonia nitrogen (NH_3- N), total kjeldahl nitrogen (TKN), ortho-phosphorous (PO_4-P), total phosphorous (TP), chemical oxygen demand (COD) and total suspended solids (Chaubey et al. 1995).

V. Odour

In poultry farms, day old chicks are grown on a bed of dry organic litter. As they grow rapidly in subsequent weeks, the amount of manure they excrete increases. Further breakdown of litter creates odorous compounds. The complex factors causing odour generation in poultry sheds are ammonia (NH_4), Hydrogen sulphide (H_2S), dimethyl sulphide, dimethyl disulphide, amines (primary, secondary and tertiary), methyl mercaptan, aldehydes, formaldehydes, olefinic hydrocarbons, acrylic esters, methacrylate, ammonia, phenol, toluene, methanol, ethanol, iso- propanol and mercaptens and some 75 compounds in meat chicken sheds. Anaerobic bacterial activity is generated by high litter moisture, low oxygen levels, small particles, high temperatures and low pH which in turn produce bad odour. If proper preventive measures are not taken, it could lead to serious health issues for poultry farmers

and performance issues for poultry. Odour can be reduced by providing with proper ventilation facilities, maintaining proper in-house temperature regularly removing dust build up from screens, ventilation shafts or wind breaks. Minimizing dust levels will also reduce odour transmission. (McGahan et al. 2002).

a) Methods for reduction of odour

i. *Shed temperature and moisture level*

Poultry house temperature should not be less than 22°C since it may increase the moisture content thereby increasing the odour production. Healthy birds will usually produce drier and odourless manure (Briggs, 2004).

b) Shed Ventilation

Proper ventilation design for effective exchange of air within the shed reduces shed temperatures and helps maintain optimal litter moisture levels reducing the need for fogging and increasing drying rates (McGahan et al. 2002, Briggs, 2004).

c) Poultry litter moisture content

It was reported that reducing the moisture levels within sheds and maintaining litter pH above 7.5 effectively reduces odour emission from meat chicken sheds by inhibiting anaerobic bacterial activity (Jiang & Sands 2000). The optimal litter moisture content should be between 15% and 30% (wet basis).

d) Dietary manipulation

Dietary manipulation strategies such as reducing the crude protein levels could help in reducing the litter moisture content, reducing the ammonia (approximately 90% lower) and total ammoniacal nitrogen (approximately 50% lower) in the litter. Production performance was also not compromised between 1.8 to 2 kg feed per kg body weight (Briggs, 2004).

e) Dead bird management

Inappropriate handling of dead birds can also cause odour problems. Hence dead birds should be disposed in proper ways as follows

- Composting methods that are designed to manage heaps of dead birds
- Off-site authorised landfill disposal or recycling
- Incineration (Briggs, 2004).

f) Neutralization by inhibiting agents

Odours can also be neutralised by using inhibiting agents as feed additives or in drinking water. Inhibiting agents like Clinoptilolite zeolite and De-odorase can also be added to litter to prevent anaerobic degradation or to react with odour causing agents thereby minimizing it (McGahan et al. 2002).

g) Vegetative screens

Tree plantations can help in redirecting the wind flows or aid in dispersion of dust. But their main use is to reduce the visibility of poultry farms. To maintain it effectively proper weed control and watering of plantations should be done for first two years (Briggs, 2004).

h) Windbreak walls

Windbreak walls of 3m high help in reducing the concentration of odours at nearby dwellings by directing the air expelled upwards. This encourages the odour-carrying dust particles to withdraw from the air flow. Materials used include concrete panels, sheet iron, hay bales, brushwood and tarpaulins (McGahan et al. 2002).

i) Short stacks

Odorous compounds are released from lower heights through Short stacks when attached to exhaust fans upwards; increasing chance for air to get dispersed (Briggs, 2004).

j) Air scrubbers

Air scrubbers cause exhaust gases to absorb into a liquid stream and are an effective means to remove airborne contaminants and odours from industrial exhausts. The removal of odorous air from fish processing and rendering plants by high pressure venturi scrubbers is known to be greater than 99%. A simple pressure scrubber system removed around 10% of dust particles and some ammonia but was ineffective at reducing odour from meat chicken sheds. Fixed- bed scrubbers minimise the use of water by directing odorous airflow through towers packed with plastic or ceramic materials over which thin film of water flows (McGahan et al.2002).

k) Oxidisation

Oxidisation is done using ozone in various industries to kill airborne bacteria, deodorise odours and remove particles. Ozone has strong oxidising properties which are claimed to neutralise a range of odorous compounds in poultry sheds. Low levels of ozone (0.1ppm) can be used to deodorise and reduce airborne bacteria (McGahan et al.2002). Active oxygen is a recent technology which passes oxygen over charged electrical sources to increase the capacity to oxidise odorous compounds.

l) Bio filters

Bio filters with a steady flow of exhaust air, when passed through a bed of moist organic material inhabited with bacteria, breaks down and oxidises odorous compounds (McGahan et al.2002).

VI. Utilization of Solid Waste

a) Poultry Feather

i. *Biodiesel production*

In biodiesel production, fat is extracted from feather meal in boiling water (70oC) and then trans esterified into biodiesel using potassium, nitrogen and methane; 7-11% biodiesel (on a dry basis) is produced

in this process. ASTM analysis showed that biodiesel from feather meal is of good quality and comparable to other biodiesel made from other common feed stocks. In addition it is possible to prepare higher priced goods like biodegradable plastic from feathers (Thyagarajan, 2013).

b) Feather meal

Feathers are also degraded to feather meal which is used as animal feed, organic fertilizers and feed supplements, because it is made up of >90% protein and rich in hydrophobic amino acids and important amino acids like cystine, arginine, threonine. Most popular method of feather meal production is by hydrothermal process where feathers are cooked under high pressure at high temperature. However, hydrothermal treatment results in destruction of essential amino acids like methionine, lysine, tyrosine, and tryptophan and has poor digestibility and low nutritional value (Ekta and Rani, 2012).

c) Chemical hydrolysis

Chicken feather keratin was treated with lime (calcium hydroxide) to obtain a liquid product rich in amino acids and polypeptides that can be used as an animal feed supplement. At high temperatures (150°C), 80% of feather keratin was solubilised within 25 min, whereas a relatively longer reaction time (300 min) is needed at moderate temperatures (100°C). After 3 h of hydrolysis at 150°C, 95% of feather keratin was digested. For the recommended conditions (100°C, 300 min, and 0.1 g $Ca(OH)^2$/g dry feather), after lime treatment, about 54% of calcium can be recovered by carbonating.

d) Feather bioconversion

Feather wastes are utilized on a limited basis as a dietary protein supplement for animal feedstuffs (feather meal). Prior to use, the feather wastes are cooked with steam or chemically treated to make it more digestible, but such treatments require significant energy. Meanwhile, the use of microorganisms represents an alternative method to improve the nutritional value of feather wastes. It has already been demonstrated that the feather-lysate obtained by Bacillus licheniformis PWD-1 has nutritional features for feed use similar to soybean protein. Although bacterial keratinolytic proteases show a potential to be utilized for feather bioconversion, enhancement of enzyme activities and increase in yields are required to make these suitable for industrial applications (Kim et al. 2001)

e) Biodegradable plastic

Poultry feathers can also be converted into biodegradable plastics by a process called polymerization.

VII. Poultry Offal

a) Rendering

Rendering refers to various heating processes to separate fat from meat (Swan, 1992). Rendering at 133°C for a minimum of 20 min at 3 bars or an alternative heat treatment is needed for high-risk materials intended for animal feed or as an intermediate product for the manufacture of organic fertiliser or other derived products (Thyagarajan, 2013).

b) Burial and controlled land filling

Burial of dead birds on the farm is strictly prohibited to avoid ground water contamination. Strict regulations have been laid down by Commission of European communities, 1999, which state that landfills must reduce their adverse effects on the local environment.

c) Composting

Composting is an aerobic biological process used to decompose poultry slaughterhouse wastes, including screenings, floatation tailings, grease trap residues, manure, litter and feather. It reduces pathogens and may be used as soil conditioner or fertilizer. Wastes with high moisture and low fibre content need considerable amounts of moisture sorbing and structural support to compost well (Thyagarajan, 2013).

VIII. Poultry Litter

a) Vermicomposting employing exotic and indigenous species of earthworms

The vermicomposting potential of P. ceylanensis over the organic substrate, turkey litter in combination with cow dung (1:1, w/w), could result in the production of nutrient-rich vermicompost. The soil nutrients and microbial population showed increase in the plots which received vermicompost, insisting that the growth of beneficial microorganisms in the soil are enhanced along with sustainable nutrient release (Jayakumar et al, 2011).

b) Electricity generation from Poultry litter

The poultry litter has a considerable energetic potential, both for its calorific power as by the large amount of waste generated. Several types of technologies are being implemented in order to enable the conversion of this type of biomass in electricity energy. Anaerobic digestion and Biomethanation of poultry litter results in methane (biogas) production which can be used to run turbine which generate power, thus producing electricity. The biogas generated from poultry litter can also be used as a source of thermal energy to heat the chicken at the beginning of the batch (Oliveira et al. 2012).

IX. Conclusion

Poultry waste could pose enormous threats to our environment if not handled properly. It is necessary that, different pollutants emitted from the poultry waste should be properly reduced or utilized in an effective way. Some of the harmful gaseous pollutants such as Ammonia, Nitrogen and Nitrous oxide could be reduced by different methods such as dietary manipulation, chemical neutralization by acidifiers, alkaline materials, adsorbers and inhibitors and moisture reduction to prevent ammonia volatilization. Another important pollutant is methane which is produced by anaerobic fermentation of bacteria from different sources of poultry waste and could be utilized as biogas. Next important pollutant is phosphorous released from poultry manure. Phosphorous runoff can be managed and reduced by using aluminium sulfate, vegetative filter strips and by dietary manipulation using phytase enzyme. Odour can cause a major problem in the performance of birds. some of the odorous compounds are ammonia, hydrogen sulphide, dimethyl sulphide, dimethyl disulphide, amines (primary, secondary and tertiary), methyl mercaptan, aldehydes, formaldehyde, olefinic hydrocarbons, acrylic esters, methacrylate, phenol, toluene, methanol, ethanol and iso-propanol. These odour producing compounds can be reduced by various methods like maintaining proper shed temperature and moisture, providing proper ventilation, dietary manipulation, proper disposal of dead birds, neutralisation by inhibiting agents, vegetative screens, windbreak walls, short stacks to remove circulating air, air scrubbers, oxidisation and bio filters. Positive utilization of solid waste includes Biodiesel production, feather meal, biodegradable plastic, vermicomposting of poultry litter to be used as fertiliser and electricity generation from poultry litter. Planned attempts either to reduce the pollutant effects or to utilize the poultry waste can enhance production performance of the birds positively.

References Références Referencias

1. Blair R., J.P. Jacob, S. Ibrahim and P. Wang, 1999. A Quantitative Assessment of Reduced Protein Diets and Supplements to improve Nitrogen Utilization, J. Appl. Poultry Res. 8: 25-47.
2. Chaubey I., D. R. Edwards, T. C. Daniel, and D. J. Nichols. 1993. Effectiveness of vegetative filter strips in controlling losses of surface- applied poultry litter constituents. ASAE 38(6): 1687-1692.
3. Commission of the European Communities, 1999. Council Directive 1999/31/EC. Official Journal, No. L 182,1–9.
4. Ekta Tiwary and Rani Gupta, 2012. Rapid conversion of chicken feather to feather meal using dimeric keratinase from Bacillus licheniformis ER-15, J Bioprocess Biotechniq 2:4.
5. Ferguson N.S., R.S. Gates, J.L. Taraba, A.H. Cantor, A.J. Pescatore, M.L. Straw, M.J. Ford and D.J. Burnham. 1998a. The effect of dietary protein and phosphorus on ammonia concentration and litter composition in broilers. Poultry Science. 77: 1085-1093.
6. Ferguson N.S., R.S. Gates, J.L. Taraba, A.H. Cantor, A.J. Pescatore, M.J. Ford and D.J. Burnham. 1998b. The effect of dietary crude protein on growth, ammonia concentration and litter composition in broilers. Poultry Science. 77:1481-1487.
7. Glenda Briggs, 2004. Odour management options for meat chicken farms, Agnote DAI-315.
8. Jayakumar M., T. Sivakami, D. Ambika and N. Karmegam, 2011. Effect of turkey litter (Meleagris gallopavo L.) vermicompost on growth and yield characteristics of paddy, Oryza sativa (ADT-37), African Journal of Biotechnology Vol. 10(68), 15295-15304.
9. Jiang J. & Sands J., 2000. Odour and ammonia emission from broiler farms, RIRDC Project UNS-11A, Rural Industries Research and Development Corporation, Canberra.
10. Juanpere J., A.M. Perez-Vendrell and J. Brufau, 2004. Effect of microbial phytase on broilers fed barley based diets in the presence or not of endogenous phytase. Anim. Feed Sci. Technol., 115: 265-279.
11. Kim, J.M., W.J. Lim and H.J. Suh, 2001. Feather-degrading Bacillus species from poultry waste, Process Biochemistry 37: 287-291.
12. McCrory D.F. and P.J. Hobbs, 2001. Additives to reduce ammonia and odour emissions from livestock wastes: A review. J. Environ. Qual. 30: 345-355.
13. McGahan E., C. Kolominskas, K. Bawden, & R. Ormerod, 2002. Strategies to reduce odour emissions from meat chicken farms, Proceedings of 2002 Poultry Information Exchange, 14 to 16 April, Gold Coast, Queensland Department of Primary Industries, pp. 27–39.
14. Mitran L., J.M. Harter- Dennis, and J.J. Meisinger, 2008. Determining the Nitrogen Budget and Total Ammoniacal Nitrogen Emissions from Commercial Broilers grown in Environmental Chambers, J. Appl. Poult. Res. 17: 34-46.
15. Moore P.A., T.C. Daniel and D.R. Edwards, 2000. Reducing Phosphorous runoff and Inhibiting Ammonia Loss from Poultry manure with Aluminium sulfate, J. Environ. Qual. 29:37-49.
16. Nakaue H.S., J.K. Koelliker and M.L. Pierson, 1981. Studies with clinoptilolite in poultry: II. Effect of feeding broilers and the direct application of clinoptilolite (zeolite) on clean and reused broiler litter on broiler performance and house environment. Poultry Science, 60:1221-1228.

17. Oliveira M. O., R. Somariva, O. H. Ando Junior, J. M. Neto, A. S. Bretas, O. E. Perrone, and J. H. Reversat, 2012. Biomass Electricity Generation Using Industry Poultry Waste, International Conference on Renewable Energies and Power Quality (ICREPQ'12) Santiago de Compostela (Spain), 28th to 30th March, 2012.
18. Plumstead P.W., H. Romero-Sanchez, R.O. Maguire, A.G. Gernat, and J. Brake, 2007. Effects of Phosphorus Level and Phytase in Broiler Breeder Rearing and Laying Diets on Live Performance and Phosphorus Excretion, Poultry Science, 86: 225-231.
19. Ritz C.W., B.D. Fairchild and M.P. Lacy, 2004. Implications of Ammonia production and Emissions from Commercial Poultry Facilities: A Review, J. Appl. Poult. Res. 13:684-692.
20. Scott D. Carter and Haejin Kim, 2013. Technologies to reduce environmental impact of animal wastes associated with feeding for maximum productivity, Animal Frontiers, Vol 3:3.
21. Swan, J.E., 1992. Animal by-product processing. In: Hui, Y.H. (Ed.), Encyclopedia Food Science Technology, vol. 4, pp. 42–49.
22. Thyagarajan, D., 2013. Biotechnological applications to mitigate environmental pollutants in poultry industry, Poultry production Biotechnology, Chapter 26, 223-236.
23. Tugba Bingol N., M. Akif Karsli, D. Bolat, I. Akca and T. Levendoglu, 2009. Effects of Microbial Phytase on Animal Performance, Amount of Phosphorus Excreted and Blood Parameters in Broiler Fed Low Non-Phytate Phosphorus Diets. Asian Journal of Animal and Veterinary Advances, 4: 160-166.
24. Williams, P.T., 1999. Waste Treatment and Disposal. Wiley, New York.
25. Xin H., R.S. Gates, A.R. Green, F.M. Mitloehner, P.A. Moore and C.M. Wathes, 2011. Environmental impacts and sustainability of egg production systems, Poultry science. 90(1):263-277.

Global Journals Inc. (US) Guidelines Handbook 2014

www.GlobalJournals.org

FELLOWS

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (FARSS)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSS" title to individuals. The 'FARSS' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The "FARSS" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSS or William Walldroff, M.S., FARSS.

FARSS accrediting is an honor. It authenticates your research activities. After recognition as FARSB, you can add 'FARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSS designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSB title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA). The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.
Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSS members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSS member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The "MARSS" is a dignified ornament which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not conveninet , and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

Preferred Author Guidelines

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.

2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Administration Rules Listed Before Submitting Your Research Paper to Global Journals Inc. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896