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

Global Journal

of Science Frontier Research: D

Agriculture and Veterinary

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VOLUME 14 ISSUE 3 VERSION 1.0

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

Global Journal of Science Frontier Research: D
Agriculture & Veterinary
Volume 14 Issue 3 (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

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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
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Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Small Holder Fish Farmer's Information and Training Needs in Ogun State of Nigeria

By O. J. Olaoye, S. S. Ashley-Dejo & Adekoya, E. O
Federal University of Agriculture, Nigeria

Abstract- The study was carried out to examine the small holder fish farmer's information and training needs in Ogun State of Nigeria. Simple random sampling was used to select forty (40) fish farmers from each of the selected four agricultural extension zones. These data were collected from field through the use of structured interview; data obtained was subjected to descriptive statistics and inferential statistics. The study revealed that majority of the respondents fell between the age bracket of 41 and 50 years, over 60.0% were males and were married, with an household size ranges between 4 - 6 persons on average of 5 persons per house hold. The result indicated that majority of fish farmers sold fishes above N300:00 in all the four extension zones. The study show that majority of the respondents in the four agricultural extension zones performed fish farming management practices (cleaning, weeding, water quality) maintenance more frequently. Also fish production constraints faced includes high cost of feed, farm microcredit procurement and inadequate capital. The result of the hypotheses (ANOVA) revealed that there is a significant difference between the socioeconomic characteristics othe fish farmers and thier information and training needs at $p<0.05$ except for sex which showed a significant difference.Based on the research, more extension workers should be employed to give the technical knowledge to fish farmers on how to use some equipment and dissemination of new innovations on how to improve their fish farming system and productivity.

Keywords: *fish farming, information, training.*

GJSFR-D Classification : *FOR Code: 070499, 070107*

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Small Holder Fish Farmer's Information and Training Needs in Ogun State of Nigeria

O. J. Olaoye [α], S. S. Ashley-Dejo [σ] & Adekoya, E. O [ρ]

Abstract- The study was carried out to examine the small holder fish farmer's information and training needs in Ogun State of Nigeria. Simple random sampling was used to select forty (40) fish farmers from each of the selected four agricultural extension zones. These data were collected from field through the use of structured interview; data obtained was subjected to descriptive statistics and inferential statistics. The study revealed that majority of the respondents fell between the age bracket of 41 and 50 years, over 60.0% were males and were married, with an household size ranges between 4 - 6 persons on average of 5 persons per house hold. The result indicated that majority of fish farmers sold fishes above N300:00 in all the four extension zones. The study show that majority of the respondents in the four agricultural extension zones performed fish farming management practices (cleaning, weeding, water quality) maintenance more frequently. Also fish production constraints faced includes high cost of feed, farm microcredit procurement and inadequate capital. The result of the hypotheses (ANOVA) revealed that there is a significant difference between the socioeconomic characteristics othe fish farmers and thier information and training needs at $p<0.05$ except for sex which showed a significant difference.Based on the research, more extension workers should be employed to give the technical knowledge to fish farmers on how to use some equipment and dissemination of new innovations on how to improve their fish farming system and productivity.

Keywords: fish farming, information, training.

I. Introduction

Fish and fish products are known worldwide as a very important diet because of their high nutritive quality and significance in improving human health. Fish plays a vital role in feeding the world's population and contributing significantly to the dietary protein intake of hundreds of millions of the populace (Amao et al., 2006).

A decline in landing from capture fisheries as indicated that fish stocks have approached the point of maximum sustainable yield; therefore fish farming remains the only possible option for increasing fish production in order to meet the protein need of the people.

Fish farming activity in Nigeria started about 50 years ago, with the establishment of a small experimental station at Onikan Lagos and an industrial farm about 20ha at Panyam in Plateau State by Federal Government (Ekwegh, 2005). The primary aim of fish culture is to provide enough fish seeds for restocking open waters like natural and artificial lakes, reservoirs and running streams in order to prevent the extinction of commercially important species of fish especially when and where there is over-exploitation (Omitoyin, 2007) .

As population increases, the demand for fish and fish products increases, especially with its nutritional advantage over meat also there are numerous challenges confronting fish farming practices, among which are poor management, inadequate supply of good quality seed, lack of capital, high cost of feed, availability of extension services and marketing of products. This calls for improved fish farming technologies and other information needed for improved production level. However, in spite of research and extension services efforts there are improved packages on fish production; they are not being adequately used by farmers. This is either because there no information on these improved production packages or there is no adequate training on them (Adereti et al., 2006). Moreover, extension provides a channel through which fish farmers' problems could be identified for research and formulation of appropriate policies to the benefit of farmers.

a) Objective of the study

This study is conducted in order to determine small holder fish farmer's information and training needs in Ogun State of Nigeria. Also, the socio-economic characteristics of small holder fish farmers are to be determined and the paper additionally aims at determine the management practices in which small holder fish farmers need information and training needed for effective fish production.

b) Test of Hypotheses

The test of the hypotheses includes the following:

- There is no significant difference between the socioeconomic characteristics of small holder fish farmers and their information needs.
- There is no significant difference between the socioeconomic characteristics of small holder fish farmers and their training needs.

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II. Material and Methodology

a) The study area

The study was conducted in Ogun State, the state is bounded in the West by the Benin Republic, in the South by Lagos State and the Atlantic Ocean, in the East by Ondo State and in the North by Oyo and Osun State.

The study covered the whole four agricultural extension zones as classified by the Ogun State Agricultural Development Programme (OGADEP) based on ecological views for effective, adequate and complete improved technologies dissemination. The four zones are Ikenne, Ilaro, Ijebu-ode and Abeokuta zone located in southwestern Nigeria.

b) Sampling procedure and sample size

Simple random sampling was used to select forty (40) fish farmers from each of the selected four agricultural extension zones making a sample size of one hundred and sixty (160) fish farmers. These data were collected from field through the use of structured interview guides which were designed to achieve the objectives of the study. The reliability of the study is based on the information provided by the farm manager/owner of those farm sampled. Data obtained from the field was subjected to descriptive statistics and inferential statistics

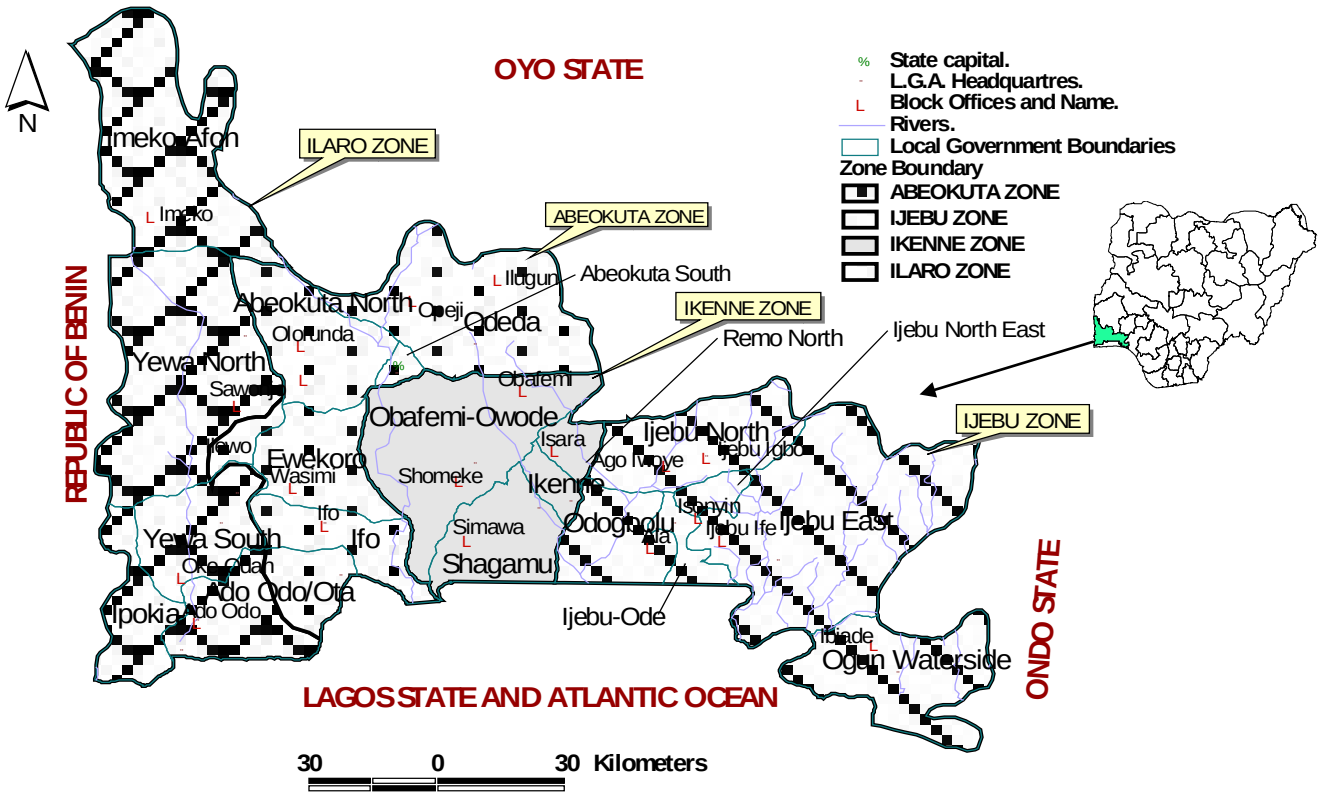

Figure 2 : Ogun State Map showing study location

Source: Olaoye, 2010

III. Results

The study examines the information and training needs of small holder fish farmers which are spread across the four agricultural zones (Abeokuta, Ijebu-ode, Ikenne, and Ilaro) in Ogun state of Nigeria.

a) Socio-economic characteristics of fish farmers

Table 1 shows that out of 160 respondents that are interviewed, 57.5%, 50%, 40%, and 40% of the respondents in Abeokuta, Ilaro, Ikenne and Ijebu-ode zones respectively were within the active age bracket of 41-50 years. It was also observed that 65.0%. 62.5%, 57.5% and 65.0% of the respondents are males while 35.0%, 37.5%, 42.5% and 35.0% of the respondents are females in the four zones further more 87.5%, 80.0%, 82.5% and 87.5% of the respondents in Abeokuta, Ijebu-Ode, Ikenne and Ilaro zones respectively are married while a few percentage of the fish farmers in the four zones have secondary widowed, divorced and single.

Date on educational status as shown in table 1 reveal that 55%, 47.5%, 47.5% and 55% of the respondents in Abeokuta, Ijebu-Ode, Ikenne and Ilaro zones had tertiary education while a few percentage of the fish farmers in the four zones have secondary

education, primary education, adult education and no formal education, majority of the respondents in Abeokuta (47.5% and 50.0%), Ijebu-Ode (52.5% and 42.5%), Ikenne (42.5% and 55.0%) and Ilaro (45.0% and 52.5%) zones are Christians and Muslims respectively, while a minute percentage of the fish farmers of the four zones have traditional religion. It also show membership of fish farmers association in the state 85.0%, 77.5%, 75.0% and 75.0% of the respondents in Abeokuta, Ijebu-Ode, Ikenne and Ilaro zones are members of fish farmers association while 15%, 22.5%, 25% and 25% of the four zones are not a member of any fish farmers association. Majority of the respondents have fish farming experience of between 1 – 5 years, about half of the fish farmers in the four zones purchased their land for fish farming. Majority of the respondents in Abeokuta, Ijebu-ode, Ikenne and Ilaro zones have their household size ranging between 4-6 persons with an average of 5 persons.

Table 1 : Socio-economic characteristics of fish farmers

Socioeconomic characteristics	Abeokuta zone		Ijebu-Ode zone		Ikene zone		Ilaro zone	
	Freq	%	Freq	%	Freq	%	Freq	%
Age								
21 – 30	3	7.5	2	5.0	2	5.0	2	5.0
31 – 40	5	12.5	7	17.5	7	17.5	8	20.0
41 – 50	23	57.5	20	50.0	16	40.0	16	40.0
Above 50	9	22.5	11	27.5	15	37.5	14	35.0
Sex								
Male	26	65.0	25	62.5	23	57.5	26	65.0
Female	14	35.0	15	37.5	17	42.5	14	35.0
Educational Status								
Adult education	1	2.5	1	2.5	1	2.5	1	2.5
Primary education	2	5.0	2	5.0	1	2.5	2	5.0
Secondary education	15	37.0	18	45.0	19	47.5	15	37.5
Tertiary education	22	55.0	19	47.5	19	47.5	22	55.0
Religion								
Christians	19	47.5	21	52.5	17	42.5	18	45.0
Muslims	20	50.0	17	42.5	22	55.0	21	52.5
Traditional	1	2.5	2	5.0	1	2.5	1	2.5
Membership of fish farmers association								
Yes	34	85.0	31	77.5	30	75.0	30	75.0
No	6	15.0	9	22.5	10	25.0	10	25.0
Fish farming experience (Years)								
Less the 6	20	50.0	18	45.0	20	50.0	18	45.0
6 - 10	9	22.5	8	20.0	10	25.0	9	22.5
11 - 15	6	15.0	6	15.0	6	15.0	6	15.0
16 – 20	4	10.0	7	17.5	3	7.5	6	15.0
Above 20	1	2.5	1	2.5	1	2.5	1	2.5
Mode of land acquisition								
Inheritance	9	22.5	10	25.0	7	17.5	9	22.5
Gift	3	7.5	3	7.5	3	7.5	3	7.5
Lease/Rent	9	22.5	9	22.5	9	22.5	9	22.5
Purchase	18	45.0	18	45.0	21	52.5	19	47.5
Type of labour								
Hired	32	80.0	31	77.5	29	72.5	32	80.0
Self	8	20.0	9	22.5	11	27.5	8	20.0
Household size								
Less than 4	10	25.0	10	25.0	9	22.5	10	25.0
4 – 6	19	47.5	20	50.0	20	50.0	19	47.5
7 – 9	9	22.5	8	20.0	9	22.5	9	22.5
10 and above	2	5.0	2	5.0	2	5.0	2	5.0

Source: Field survey, 2010

b) Fish production system

Table 2 show the fish production system of small holder fish farmers in all the four extension zones of Ogun State. It was observed that majority of the respondent's uses monoculture fish production system while a few make use of integrated and polyculture system of fish production.

It was also gathered that 56%, 57.5%, 57.55 and 60% of the respondents in the four zones sold their fish above N 300:00/kg. Majority (70%, 67.5%, 67.5%

and 67.5%) of the respondents in the four zones make use of earthen ponds for rearing of fish. It was to the fact that they are small holder fish farmers and they can't bear the cost of constructing concrete ponds.

Table 2 : Fish production system

Zones	Abeokuta zone		Ijebu-Ode zone		Ikene zone		Ilaro zone	
	Freq	%	Freq	%	Freq	%	Freq	%
Fish production system								
Integrated	6	15.0	3	7.5	3	7.5	6	15.0
Monoculture	28	70.0	22	55.0	22	55.0	19	47.6
Polyculture	6	15.0	15	37.5	15	37.5	15	37.5
Price of fish sold cat fish (₦)								
Less than 300:00	18	45.0	17	42.5	19	47.5	16	40.0
Above 300:00	22	56.0	23	57.5	21	57.5	24	60.0
Type of fish enclosure								
Earthen ponds	28	70.0	27	67.5	27	67.5	27	67.5
Concrete tanks	11	27.5	12	30.0	12	30.0	10	25.0
Plastic tanks	1	2.5	1	2.5	1	2.5	3	7.5

Source: Field survey, 2010

c) Frequency of performance of fish production management practice

Table 3 reveals the frequency of performance of fish production management practice indicating that cleaning, weeding and water quality maintenance was done more frequently in all the four zones of the State.

Table 3 : Frequency of performance of fish production management practice

Management	Seldomly (1)		Biweekly (2)		Weekly (3)		Daily (4)	
	Freq	%	Freq	%	Freq	%	Freq	%
Cleaning	4	10.0	10	25	7	17.5	19	47.5
Fertilization	22	55.0	4	10.0	6	15.0	8	20.0
Water quality maintenance	7	17.5	7	17.5	14	35.0	12	30.0
Weeding	7	17.5	9	22.5	11	27.5	13	32.5
Disease control	22	55.0	8	20.0	3	7.5	7	17.5
Liming	28	70.0	3	7.5	3	7.5	6	15.0
Harvesting	17	42.5	12	15.0	6	15.0	5	12.5
Marketing	14	35.0	16	40.0	5	12.5	5	12.5
Preservation	22	55.0	7	17.5	6	15.0	5	12.5
Processing	22	55.0	9	22.5	5	12.5	4	10.0
Security	22	55.0	9	22.5	5	12.5	4	10.0
Ijebu-Ode zone								
Cleaning	4	10.0	10	25.0	8	20.0	18	45.0
Fertilization	22	55.0	5	12.5	6	15.0	7	17.5
Water quality maintenance	8	20.0	7	17.5	14	35.0	11	27.5
Weeding	8	20.0	9	22.5	11	27.0	12	30.0
Disease control	23	57.5	8	20..0	3	7.5	6	15.0
Liming	29	72.5	3	7.5	3	7.5	5	12.5
Harvesting	18	45.0	12	30.0	6	15.0	4	10.0
Marketing	15	37.5	16	40.0	5	12.5	4	10.0
Preservation	23	57.5	7	17.5	6	15.0	4	10.0
Processing	23	57.5	8	20.0	5	12.5	4	10.0
Security	4	10.0	1	2.5	5	12.5	5	12.5
Ikenne zone								
Cleaning	4	10.0	10	25.0	9	22.5	17	42.5
Fertilization	22	55.0	4	10.0	5	12.5	9	22.5
Water quality maintenance	7	17.5	6	15.0	13	32.5	14	35.0

Weeding	7	17.5	9	22.5	12	30.0	12	30.0
Disease control	21	52.5	9	22.5	3	7.5	7	17.5
Liming	27	67.5	4	10.0	3	7.5	6	15.0
Harvesting	17	42.5	13	32.5	5	12.5	5	12.5
Marketing	14	35.0	16	40.0	5	12.5	5	12.5
Preservation	23	57.7	7	17.5	6	15.0	4	10.0
Processing	23	57.7	9	22.5	4	10.0	4	10.0
Security	4	10.0	1	2.5	5	12.5	30	75.0
Ilaro zone								
Cleaning	4	10.0	20	25.0	7	17.5	19	47.5
Fertilization	22	55.0	4	10.0	6	15.0	8	20.0
Water quality maintenance	7	17.5	7	17.5	14	35.0	12	30.0
Weeding	7	17.5	9	22.5	11	27.5	13	32.5
Disease control	22	55.0	8	20.0	3	7.5	7	17.5
Liming	28	70.0	3	7.5	3	7.5	6	15.0
Harvesting	17	42.5	12	30.0	6	15.0	5	12.5
Marketing	14	35.0	16	40.0	5	12.5	5	12.5
Preservation	22	55.0	7	17.5	6	15.0	5	12.5
Processing	22	55.0	9	22.5	5	12.5	4	10.0
Security	4	10.0	1	2.5	5	12.5	30	75.0

Source: Field survey, 2010

d) Fish production constraints facing farmers

Table 4 reveals of fish production constraints facing farmers indicating that majority of the fish farmers were faced, High cost of Feed, Fingerling procurement, Incidence of diseases/pests as their major constraints.

Table 4 : Fish production constraints facing farmers

Constrains	Not a constraint		Mild constraint		Severe constraint	
	Freq	%	Freq	%	Freq	%
Abeokuta zone						
High cost of Feed	3	7.5	10	25.0	27	67.5
Poaching	11	27.5	25	62.5	4	10.0
Fingerling procurement	11	27.5	22	55.0	7	17.5
Government policy	28	70.0	9	22.5	3	7.5
Incidence of diseases/pests	16	40.0	19	47.5	5	12.5
Poor water quality in farm Area	28	70.0	8	20.0	4	10.0
Water scarcity	34	85.0	4	10.0	2	5.0
Farm microcredit procurement	17	42.5	11	27.5	12	30.0
Inability to expand pond size	29	72.5	6	15.0	5	12.5
Inadequate capital	11	27.5	13	32.5	16	40.0
Lack of technical skills	34	85.0	4	10.0	2	50
Ijebu-ode zone						
High cost of Feed	3	7.5	10	25.0	27	67.5
Poaching	11	27.5	25	62.5	4	10.0
Fingerling procurement	11	27.5	22	55.0	7	17.5
Government policy	28	70.0	9	22.5	3	7.5
Incidence of diseases/pests	16	40.0	19	47.5	5	12.5
Poor water quality in farm Area	28	70.0	8	20.0	4	10,0
Water scarcity	34	85.0	4	10.0	2	5.0
Farm microcredit procurement	16	40.0	11	27.5	13	32.5
Inability to expand pond size	29	72.5	72.5	15.0	5	12.5
Inadequate capital	10	25.0	14	35.0	16	40.0
Lack of technical skills	34	85.0	4	10.0	2	5.0
Ikenne zone						
High cost of Feed	4	10.0	10	25.0	26	65.0
Poaching	13	32.5	23	57.5	4	10.0
Fingerling procurement	10	25.0	23	57.5	7	17.5
Government policy	28	70.0	9	22.5	3	7.5
Incidence of diseases/pests	16	40.0	18	45.0	6	15.0
Poor water quality in farm Area	27	67.5	9	22.5	4	10.0

Water scarcity	34	85.0	4	10.0	2	5.0
Farm microcredit procurement	18	45.0	10	25.0	12	30.0
Inability to expand pond size	28	70.0	7	17.5	5	12.5
Inadequate capital	11	27.5	14	35.0	15	37.5
Lack of technical skills	8	20.0	20	50.0	12	29.5
Ilaro zone						
High cost of Feed	3	7.5	10	25.0	27	67.5
Poaching	11	27.5	25	62.5	4	10.0
Fingerling procurement	11	27.5	22	55.0	7	17.5
Government policy	28	70.0	9	22.5	3	7.5
Incidence of diseases/pests	16	40.0	18	45.0	6	15.0
Poor water quality in farm Area	16	40.0	19	47.5	5	12.5
Water scarcity	28	70.0	8	20.0	4	10.0
Farm microcredit procurement	34	85.0	4	10.0	2	5.0
Inability to expand pond size	17	42.5	11	27.5	12	30.0
Inadequate capital	29	72.7	6	15.0	5	12.5
Lack of technical skills	11	27.5	13	32.5	16	40.0

Source: Field survey, 2010

e) Sources of information for fish farming

Table 5 reveals of sources of information for fish farming indicating that majority of the fish farmers used extension agent, Friends, and relations and Telephone (GSM) more frequently.

Table 5 : Sources of information for fish farming

Constrains	Always used		Occasionally used		Not used	
	Freq	%	Freq	%	Freq	%
Abeokuta zone						
Extension agent	27	67.5	7	17.5	6	15.0
Radio broadcast	5	12.5	13	32.5	22	55.0
Television broadcast	4	10.0	18	45.0	18	45.0
News papers	4	10.0	7	17.5	29	72.5
Friends and relations	26	65.0	11	27.5	3	7.5
Extension guide/bulletin	27.5	11	14	35.0	15	37.5
Telephone (GSM)	11	27.5	2	5.0	27	67.5
Village criers	2	5.0	3	7.5	35	87.5
Posters	6	15.0	3	7.5	31	77.5
Ijebu zone						
Extension agent	27	67.5	7	17.5	6	15.0
Radio broadcast	5	12.5	14	35.0	21	52.5
Television broadcast	4	10.0	19	47.5	17	42.5
News papers	3	7.5	7	17.5	30	75.0
Friends and relations	27	67.5	11	27.5	2	5.0
Extension guide/bulletin	12	30.0	14	35.0	14	35.0
Telephone (GSM)	12	30.0	2	5.0	26	65.0
Village criers	2	5.0	3	7.5	35	87.5
Posters	6	15.0	3	7.5	31	77.5
Ikenne zone						
Extension agent	27	67.5	6	15.0	7	17.5
Radio broadcast	5	12.5	13	32.5	22	55.0
Television broadcast	4	10.0	19	47.5	17	42.5
News papers	4	10.0	8	20.0	28	70.0
Friends and relations	26	65.0	10	25.0	4	10.0
Extension guide/bulletin	10	25.0	15	37.5	15	37.5
Telephone (GSM)	11	27.5	2	5.0	27	67.5
Village criers	2	5.0	4	10.0	34	85.0
Posters	6	15.0	4	10.0	30	75.0
Ilaro Zone						
Extension agent	27	67.5	7	17.5	6	15.0
Radio broadcast	5	12.5	13	32.5	22	55.0
Television broadcast	4	10.0	18	45.0	18	45.0
News papers	4	10.0	7	17.5	29	72.5

Friends and relations	26	65.0	11	27.5	3	7.5
Extension guide/bulletin	11	27.5	14	35.0	15	37.5
Telephone (GSM)	11	27.5	2	5.0	27	67.5
Village criers	2	5.0	3	7.5	3.5	87.5
Posters	5	15.0	3	7.5	31	77.5

Source: Field survey, 2010

f) Training needs of fish farmers

Table 6 reveals the training needs for fish farming indicating farmers needed training on feed formulation, fish breeding and hatchery management practices severely.

Table 6 : Training needs of fish farmers

Constrains	Highly needed		Moderately need		Not need	
	Freq	%	Freq	%	Freq	%
Abeokuta Zone						
Pond construction	14	35.0	14	35.0	12	30.0
Feed formulation	30	75.0	10	25.0	0	0.0
Fish breeding	28	70.0	9	22.5	3	7.5
Site selection	13	32.5	19	47.5	8	20.0
Hatchery management Practices	22	55.0	12	30.0	6	15.0
Diseases treatment and Prevention	19	47.5	17	42.5	4	10.0
Water quality management	9	22.5	27	67.5	4	10.0
Record keeping	13	32.5	15	37.5	12	30.0
Ijebu Zone						
Pond construction	13	32.5	15	37.5	12	30.0
Feed formulation	80	75.0	10	25.0	0	0.0
Fish breeding	28	70.0	9	22.5	3	7.5
Site selection	12	30.0	20	50.0	8	20.0
Hatchery management Practices	22	55.0	11	27.5	7	17.5
Diseases treatment and Prevention	19	47.5	16	40.0	5	12.5
Water quality management	9	22.5	26	65.0	5	12.5
Record keeping	9	22.5	16	40.0	15	37.5
Ikene Zone						
Pond construction	14	35.0	14	35.0	12	30.0
Feed formulation	29	72.5	11	27.5	3	7.4
Fish breeding	28	70.0	9	22.5	8	20.0
Site selection	14	35.0	18	45.0	5	12.5
Hatchery management Practices	28\4	60.0	11	27.5	4	10.0
Diseases treatment and Prevention	20	50.0	16	40.0	5	12.5
Water quality management	8	20.0	27	67.5	14	35.0
Record keeping	9	22.5	17	42.5	12	30.0
Ilaro Zone						
Pond construction	14	35.0	14	35.0	12	30.0
Feed formulation	30	75.0	10	25.0	0	0.0
Fish breeding	28	70.0	9	22.5	3	7.5
Site selection	13	32.5	19	47.5	8	20.0
Hatchery management Practices	22	55.0	12	30.0	6	15.0
Diseases treatment and Prevention	19	47.5	17	42.5	4	10.0
Water quality management	9	22.5	27	67.5	4	10.0
Record keeping	9	22.5	17	42.5	14	35.0

Source: Field survey, 2010

g) Results of inferential statistics

The result of the hypotheses (ANOVA) in table 7 and 8 revealed that the variables tested (sex, age, marital status, education status and religion) showed there is no significant difference between the socioeconomic characteristics othe fish farmers and thier information and training needs at $p<0.05$ except for sex which show a significant difference between the sociorconomic characteristics and training needs.

Table 7 : There is no significant difference of between the socioeconomic characteristics the fish farmers and thier information needs.

	Sum of square	d.f	Mean square	F	sig	decision
Age	108.00	159	3.991	7.148	0.000	Accept H^1
Sex	36.400	159	0.876	3.396	0.001	Accept H^1
Marital status	31.600	159	0.587	2.172	0.022	Accept H^1
Educational level	77.775	159	1.511	2.631	0.004	Accept H^1
Religion	47.9	159	1.117	2.734	0.004	Accept H^1

Source: Field survey, 2010

- Decision criterion is reject null hypothesis when $p < 0.05$
- D.F= Degree of freedom

Table 8 : There is no significant difference of between the socioeconomic characteristics the fish farmers and thier training needs.

	Sum of square	d.f	Mean square	F	sig	decision
Age	108.000	159	2.786	3.668	0.001	Accept H^1
Sex	36.400	159	0.765	2.609	0.110	Reject H^1
Marital status	31.600	159	0.819	3.679	0.001	Accept H^1
Educational level	77.775	159	4.154	12.279	0.000	Accept H^1
Religion	47.900	159	1.413	5.830	0.000	Accept H^1

Source: Field survey, 2010

- Decision criterion is reject null hypothesis when $p < 0.05$
- D.F= Degree of freedom

IV. Discussion

Age is related to information and training need of fish farmers because the stage of life of farmers affects his attitude towards information usage and his attitude towards training. The older fish farmer becomes, the more he is willing to put fish farming related information into use and accept adequate training. According to the study, it was be shown that (47.5%, 50%, 40%, and 40%) in Abeokuta, Ilaro, Ikenne and Ijebu-ode zones respectively fell between the age bracket of 41 and 50 years. These are ages in which are considered highly productive and active to undergo strenuous task associated with farm work, indicating that the majority of the respondents were within economically active age distribution. This is in line with the assertion of Olowosegun et al., (2004) that age has positive correlation with acceptance of training in fish farming. However, this indicates that people between age the bracket of between 41 to 50 years of age are involved in fish farming. This is because fish farming requires adequate attention and a lot of sense of responsibility.

The sex of the respondents was an essential variable in this study as it focused on decision making in fish farming. Out of the 160 respondents that were interviewed (65.0%. 62.5%, 57.5% and 65.0%) in Abeokuta, Ilaro, Ikenne and Ijebu-ode zones respectively were males. This was in line with the work of Ajetumobi et al., (2001) who reported that females in this part of the country are usually involved as helpers or as suppliers of labour "light" farm operations such as planting, weeding, harvesting, processing and marketing. The survey also revealed that a large percentage (87.5%.80.0%. 82.5% and 87.5%) in Abeokuta, Ilaro, Ikenne and Ijebu-ode zones respectively are married, meaning that fish farming serves as a means of livelihood The male dominance in fish farming implies the laborious nature of fish farming operations right from pond construction to management which their female counterparts cannot easily undertake.

Education is an important factor which can influence farm productivity and determines the level of productivity and understanding of improved management techniques. The level of education according to the study, majority of the respondents in Abeokuta, Ijebu-ode, Ikenne, Ilaro zones had tertiary education. This is contrary to the general opinion that most farmers are illiterates or semi-illiterates; most of whom have dropped out of formal school system.

From the result, one can infer that Christianity and Islam are mostly practiced than any other religion as majority of fish farmers in Abeokuta, Ijebu-ode, Ikenne, Ilaro zones respectively are Christians (47.5%, 52.5, 42.5, 45.0%) and Muslims (50.0%, 42.5%, 55.0%, 52.5%) while a small proportion were traditional

worshippers, this may be attributed to the fact that both religions have no tenets towards the consumption of fish. The study indicated that majority of the respondents in Abeokuta, Ijebu-Ode, Ikenne and Ilaro the four zones are members of fish farmers association which is in line Kumar (1992) who stated that been a member of any association contributes increased awareness on new methods of production towards an increase in productivity.

Household size also contributed to productivity of smallholder fish farmers. Majority of the respondents in Abeokuta, Ijebu-ode, Ikenne and Ilaro zones have their household size ranging between 4-6 persons with an average of 5 persons. The implication is that the relatively small household may increase the number of labour needed against Idowu (2001) that stated that the larger the household size, the more the likelihood of labour efficiency on farmer's farm given the constant labour. The relatively average sizes of household may be attributed to their belief, for instance, religious tenets such as in Christianity, teaches monogamist type of family. From the result, a large percentage of the fish farmers adopted monoculture fish farming in the four zones while only few operated pure poly culture and integrated fish farming system in Abeokuta, Ijebu-ode, Ikenne and Ilaro zones. This suggested that a large number of the respondents basically engage in integrated fish farming for profitability and not for personal consumption.

The result indicated that majority of fish farmers sold fishes above N300:00 in all the four extension zones. This is associated with high inflation rate in the economy and high cost of most fish feed ingredients, particularly fish meal and its competitive use by livestock farmers and also most of the fish farmers depend on imported quality fish feeds which were expensive and not affordable (Omitoyin, 2007). In the four zones majority of the respondents make use of earthen ponds for rearing of fish. In terms of the type of fish cultured, the study showed that 62.5% of the fish farmers cultured Clarias spp more than any other fish species. The reasons being that the species has a high market value and it can attain market size under few months of culture.

The study revealed that majority of the respondents in the four agricultural development zones performed fish farming management practices (cleaning, weeding, water quality) maintenance more frequently while other fish farming management practices (fertilization, diseases control, liming, harvesting, marketing, preservation, processing and security) were performed less frequently. Also the study, the respondents in the four agricultural development zones were faced with fish production constraints (high cost of feed, farm microcredit procurement and inadequate capital) severely while other constraints (poaching, government policy, incidence of diseases, poor water quality in farm area, water scarcity, inability to expand ponds size, lack of technical skills) are mild constraints faced by the fish farmers.

Awareness creation is often the first step in disseminating a technology package, and to a large extent, the level of awareness could determine the level of productivity. Access to information was one of the most valuable resources in agricultural development (William and Naven, 1995). From the findings, majority of the respondents always used information on fish farming through extension agents, telephones (GSM), through friends and relations while few accessed information through newspapers, radio broadcast, television broadcast, village criers, posters, extension guide/bulletin. This implies that research institutes and universities have not put in enough efforts to carry out their function of information generation and delivery to farmers. However, giving farmers access to a variety of information, which are accessible, affordable, relevant and reliable, is the ultimate aim of providing agricultural information services. The result also showed that of the respondents in the four agricultural development zones strongly required information on market price, treatment and prevention of diseases, sources of fingerlings and feed formulation. In terms of fish farm training, majority were grounded in one or more training. The result showed that of the respondents in the four agricultural development zones strongly required training on feed formulation, diseases treatment and prevention, fish breeding.

V. Conclusion and Recommendation

1. More extension workers should be employed to give the technical knowledge to fish farmers on how to use some equipment and dissemination of new innovations on how to improve their fish farming system and productivity.
2. Government should encourage fish farmers to establish registered cooperative societies in other to enjoy government provision of credit facilities.
3. Government should form policies to standardize the interest rate of financial institutions on micro-credits granted to fish farmers.
4. Government should provide good and on time information and training through extension agents on new innovations based on research outcomes to fish farmers.
5. Gender bias should not be allowed in the dissemination of information and training of fish farmers.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Comparison of two Sampling Methods for Salmonella Isolation from Imported Veal Meat Samples of Unknown Infection Status

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Abstract- The current study was conducted on a deboned veal meat imported to the Kingdom of Saudi Arabia (KSA), and analyzed at Jeddah Food Control Laboratory (JFCL). The samples were collected routinely during 2013. The aim of this trial is to compare between effects of two sampling techniques; sponge swabbing and excision, on the capability of Salmonella recovery. A total of 900 samples of unknown infection status (150 individual samples × 3 analysts × 2 sampling methods) were examined for salmonella. Simultaneously, an artificial inoculation experiments of veal meat (n=120) were conducted. The international standard procedure for the detection of Salmonella (ISO 6579:2002) was the reference. Results show that the swab sampling technique was more representative, it resulted in higher isolation mean percentage of salmonella (97.8%) and (100%) of spiked samples, compared to excision percentage (86.7%) and (95%) of spiked samples. Percentages of swab and excision techniques of natural contaminated samples were positive for salmonella from the different analysts and ranged from 93.3% to 100% and from 70% to 100%, respectively. The average time for sampling by excision was significantly higher (5:10 minutes) than the corresponding time by swabbing technique (1:10 minute). Taking on consideration the daily workload pressure and the time required for sampling, the results illustrate that swabbing is superior to excision. This study suggests that swab sampling could be an alternative method for the detection of salmonella in meat on the basis of better recovery rate, accuracy, sensitivity and repeatability.

Keywords: *veal meat; salmonella; microbiological sampling; excision; swabbing.*

GJSFR-D Classification : FOR Code: 860109

Strictly as per the compliance and regulations of :

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Abstract- The current study was conducted on a deboned veal meat imported to the Kingdom of Saudi Arabia (KSA), and analyzed at Jeddah Food Control Laboratory (JFCL). The samples were collected routinely during 2013. The aim of this trial is to compare between effects of two sampling techniques; sponge swabbing and excision, on the capability of Salmonella recovery. A total of 900 samples of unknown infection status (150 individual samples × 3 analysts × 2 sampling methods) were examined for salmonella. Simultaneously, an artificial inoculation experiments of veal meat (n=120) were conducted. The international standard procedure for the detection of Salmonella (ISO 6579:2002) was the reference. Results show that the swab sampling technique was more representative, it resulted in higher isolation mean percentage of salmonella (97.8%) and (100%) of spiked samples, compared to excision percentage (86.7%) and (95%) of spiked samples. Percentages of swab and excision techniques of natural contaminated samples were positive for salmonella from the different analysts and ranged from 93.3% to 100% and from 70% to 100%, respectively. The average time for sampling by excision was significantly higher (5:10 minutes) than the corresponding time by swabbing technique (1:10 minute). Taking on consideration the daily workload pressure and the time required for sampling, the results illustrate that swabbing is superior to excision. This study suggests that swab sampling could be an alternative method for the detection of salmonella in meat on the basis of better recovery rate, accuracy, sensitivity and repeatability.

Keywords: veal meat; salmonella; microbiological sampling; excision; swabbing.

I. Introduction

The contamination of food products by food borne pathogenic organisms such as Salmonella spp. is an on-going problem worldwide which required governments to improve their food safety systems (Anonymous, 2002; Codex Alimentarius Commission, 2003; Orriss and Whitehead, 2000; Schlundt, 2002). The significance of Salmonella comes from the association with several food categories. Greig and Ravel (2009) reported that salmonellosis outbreaks over the four regions (Australia and New Zealand, Canada, EU, and USA) were the most numerous. The majority of human salmonellosis incidences are due to the consumption of contaminated foods of animal origin. Despite the enormous efforts to eliminate/reduce such risk, Salmonella will still be a risk to human health in the future (Anonymous, 2006). Consequently, the detection of pathogenic microorganisms in foodstuffs is one of the steps to control food safety. In this context, the KSA government has been working to develop the food control laboratories. In view of the fact that around 80% of the food are imported from over than150 countries (USDA, 2013), the strengthening of food control laboratories will eventually lead to the improvement of food safety system.

The first step of food microbiological analysis is obtaining representative sample. False negative or false positive results can occur when sampling executed incorrectly. To some extent, for liquid food products, it is quite easy to get a representative sample. On the other hand, the sampling process would be more difficult in cases of solid food. In view of obtaining representative samples, the sampling methods are very essential. The relative efficacy of excision and swab sampling methods for red meat carcasses have been compared in several studies (Van der Merwe et al., 2013; Pearce and Bolton, 2005; Gill and Jones, 2000; Gill and Jones, 2000; Gill et al., 2001; Dorsa et al., 1997). Nevertheless, the microbiological criteria in the reference standard for salmonella detection are applied to samples taken by excision of 25g (ISO 6579:2002). Yet, the excision method is very time consuming and usually covering limited area. On the other hand, swabbing technique seems to overtake the disadvantages of excision (Bolton, 2003). Additionally, Bolton (2003) reported the reliability of swabbing technique for monitoring salmonella.

The aim of this study is to evaluate the effectiveness of sponge swab sampling method in comparison with excision method for the recovery of Salmonella from deboned veal meat samples.

II. Materials and Methods

a) Sampling plan

A total of 150 duplicate frozen packed Veal meat compensated in 2 Kg bag were sampled (over a year) at JFCL from imported commodities. Each of six identical individual 2 Kg bags from same lot were taken as one sample, and divided to three groups (A,J,Z) each group has two bags (duplicate sample). The study was

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conducted in a controlled sterile environment of a laboratory in KSA, Jeddah, which has the approval of the International Accreditation Service (IAS).

b) Artificial inoculation

Artificial spiking experiments were conducted using 1–10 colony-forming units (n=60) and 20–50 CFU (n=60) concentrations of S. Typhimurium ATCC®14028, KWIK STIK, in 250 g initial weight of veal meat samples. Prior to an inoculation, all samples were initially confirmed as Salmonella-negative by real-time PCR.

c) Excision sampling

Excision samples were taken by every one of the analysts from each of the 150 samples (one set of the duplicate) by cutting 25g thin tissue from the surface of the sample using a sterile single use scalpels. Once excised, sample was placed into a separate sterile stomacher bag, and 225g of Buffer Peptone Water (BPW) poured into the bag. Without delay, the analysis was performed based on the horizontal method for the detection of Salmonella (ISO6579:2002).

d) Sponge swab sampling

The remaining set of the duplicate samples were also sampled using sponge (SPECI-SPONG" BAGS, Nasco Whirl-Pak, the USA) swabbing of the whole sample surface. Sponges were prepared in sterile stomacher bags pre-moistened with 10 ml of maximum recovery diluents (BPW; OXOID). Immediately prior to use, each sponge was grasped through the sterile plastic bag, which was inverted to present the sample sponge. After swabbing, the sponge was withdrawn into the stomacher bag. For pooled samples one sponge was used to sample all four sites, one side of the sponge was used to swab two sites, while the other side was used to swab the remaining two sites. After swabbing, 1:10 of the BPW was added to the bag and the reference analysis protocol was followed.

e) Microbiological analyses

All samples were stomached with 1:10 of BPW for 2 minutes in a Stomacher (Model 400 circulator Seward, England, UK). Then, the bag incubated at 37±1 °C for 18 ±2 h (pre-enrichment). After that comes enrichment in selective liquid media, 0.1 ml of the BPW was transferred into 10 ml of Muller-Kauffmann tetrathionate/novobiocin broth (MKTTn) and incubated at 37±1 °C for 24 ±3 h, and 1ml of the BPW was transferred into 10 ml of Rappaport-Vassiliadis medium with soya broth (RVS) and incubated at 41,5±1 °C for 24 ±3 h. The next step was plating on two selective solid media; xylose lysine deoxycholate agar (XLD) and Brilliant green agar (BGA), and then incubating at 37±1 °C for 24 ±3 h. Afterward, the typical salmonella colony streaked onto the surface of nutrient agar plate, and was incubated at 37±1 °C for 24 ±3 h. All medium used in this study were obtained from OXOID, UK. The last step was the confirmation of the isolation using a biochemical test (biochemical rapid test "api®20E", bioMérieux, France). A detailed description of the detection methods is given in the ISO 6579:2002, Figer.1 briefing the procedure.

III. Results

Percentages of salmonella obtained by each analyst recovered by excision and sponge swabbing are presented in Table 1. In spite of the consistent results by analyst (J), there were significant differences in the number of salmonella recovered according to the sampling technique.

A total of 300 individual naturally contaminated samples for each analyst (150 was sampled by excision, and 150 was sampled by sponge swabbing) were examined for Salmonella. Using the excision method, 30 of 150 samples were the highest positive recovery, whereas 21 of 150 was the lowest positive isolation. On the other hand, the number of the lowest positive recovery samples using sponge swabbing was 28 of 150 samples. The use of the excision method for sampling required more time to be performed by the analyst (Table 2). The average sampling time for one sample by sponge swabbing and excision were 1:10 minute, and 5:10 minutes, respectively. Additionally, there was a great difference in the time (about 10 hours) that was needed to accomplish the 150 samples task; the average needed swabbing time was (2.75 h), and average time of excision was (12.75 h) (Table3). In general, Salmonella were more recovered when sampled by sponge swabbing than excision.

In this study the artificial inoculation of veal meat samples revealed identical results for inoculation level of 20-50 CFU. It was observed that excision and swab sampling methods seemed to be suitable for the recovery of salmonella from veal meat samples with high levels of contamination (Table1). Nevertheless, the swabbing technique yielded a higher salmonella recovery rate (100%), compared to the excision (90%), with spiked level of (1-10 CFU).

Table1: Percentage of salmonella recoveries (%) from natural and artificial spiked veal meat samples

Analyst	Sampling method	Source of samples		
		Natural	Spiked (1-10 CFU)	Spiked (20-50 CFU)
A	Swab	100	100	100
	Excision	90	90	100
J	Swab	100	100	100
	Excision	100	100	100
Z	Swab	93.3	100	100
	Excision	70	80	100

Table 2 : Means of sampling time by swab and excision methods (minute).

Method	A	J	Z
Swab	1.10	1.20	1
Excision	5	7	3.30

Table 3 : Average time required for sampling 150 samples (hour).

Method	A	J	Z
Swab	2.75	3	2.5
Excision	12.5	17.5	8.25

IV. Discussion

This study compared two approved sampling techniques; the swabbing method, which is reported for sampling carcass surface (ISO, 2003a), and the excision method, the most common technique for bacterial recovery (ISO, 2003b). In the present study salmonella were recovered from a greater number of samples using sponge swab than excision. There are many factors that may account for the relatively higher salmonella recoveries by swabbing than excision. The main factor is that a larger area was sampled by swabbing compared to that sampled by excision, and hence, resulting in a lower variation of bacterial numbers (Taking in consideration that the distribution of microorganisms in food was assumed to be unevenly). In addition, sponge moist could cause loose bacterial attachment on meat tissue that leaded to a higher salmonella recovery by swabbing. Also, sponge is an abrasive material with a capability of recovering bacteria numbers higher to those obtained by excision. Nevertheless, analysts' behavior on excision technique has a great contribution on the sensitivity of salmonella isolation. This suggests that the recovery of salmonella may vary substantially as the analysts' performance differs.

Calculating average sampling time resulted in somewhat different estimates of the efficacy of the sampling methods compared to mean salmonella numbers. Since excision sampling resulted in higher variation compared to swab sampling, the increase of sampling time would raise the recovery rate. As a result, the relative differences between the two sampling methods in estimating the numbers of salmonella decreased for the different analysts, analyst J as an example, where a stabile average number was estimated by both excision and swabbing.

In this study, an artificial inoculation of veal meat samples (n=120) revealed essentially identical results, especially for spiked level 20-50 CFU. This observation suggests that the recovery of salmonella from meat sample will be more difficult when occur in low numbers. Nevertheless, in these spiking experiments, sponge swab seemed to be the most suitable sampling method for the detection of salmonella in meat samples with high and low levels of contamination.

The findings of this study suggests that swabbing using the polyurethane sponge should be considered as a suitable alternative method for the salmonella sampling of veal meat, which requires less time and yields higher recovery. Yet, there is a need to expand the current study on the basis of ISO 16140:2003, the protocol for the validation of alternative methods (ISO, 2003c).

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

The Challenges of Fishery Resource Management Practices in Mayo Ranewo Community in Ardo Kola Local Government Area (LGA), Taraba State Nigeria

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Abstract- Taraba State is well endowed with abundant surface water which includes ponds and rivers. This include rivers Benue (second largest river in Nigeria which traverse the state for over 390km), Taraba and Donga and their tributaries. The state has about 500,000 hectares of water body and 142 natural ponds. Fishery is therefore an important local resource bases of the rural communities in the State especially those along the river Benue. Conflict over access and ownership of this local resource base as a result of increasing population and demand for fish has been a source of concern to many people in recent times. This study examines the challenges of the fishery management practices in the local community in the face of declining fishery resources, increase degradation and climate change among others. The study focuses on artisanal inland fishery on the River Benue and its tributaries using the case study of Mayo Ranewo. It considers the challenges of operating fisheries in a sustainable way, the principles and management practices adopted in the rural community. The survey design method was used to collect data. The instrument involves the use of questionnaire which was randomly administered on 65 respondents in Mayo Ranewo community. Focus group discussion method was also used to generate additional information to compliment the questionnaire data. Descriptive statistics was used to analyse the data collected. The study is important because it provide information that will guide small scale fisheries management in the face of social, economic and environmental changes and allow for more adaptive response to new circumstances and opportunities.

Keywords: *community, challenge, fishery, management, resource and rural.*

GJSFR-D Classification : *FOR Code: 070499*

Strictly as per the compliance and regulations of :

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I. Introduction

Fisheries involve many activities and processes such as catching (or harvesting), processing, preservation, distribution and marketing of the landings (Moses, 2002 and Omorinkoba et al, 2011). It involves all the processes of taking the fish from the water and to the final consumer. Small scale fisheries have been observed to be important part of the rural economy in many parts of Nigeria, and have supported the livelihoods of thousands of rural people for whom national and state government are remote and ineffective in meeting their needs (Neiland et al, 2005).

According to Eyo (1992) and Akeredolu (1990), the sector serves as an income source, facilitates the development of cottage industries and provides employment opportunities for the myriad of people engaged in fishery production, processing and marketing. It equally serves as an important protein supplement to meat protein, more so because of the persistent rise in cost of meat (Oladedji and Oyesola, 2002). The artisanal fisheries sector supplies about 90% of domestic fish need in Nigeria, with the balance coming from the industrial sector, largely regarded as fish imports (FDF, 2007). Omorinkoba et al, (2011) reported that the inland water bodies in Nigeria are estimated at over 14million hectares that are being fished predominantly by artisanal fishermen. Daw et al., (2009) observed that fish are major sources of livelihood, providing direct and indirect employment to over 200 million people of the world, majority of who live in developing world.

The fishery sector has been very important as it contributed about 50% of the animal protein intake of the country's population especially the resource poor in Nigeria (Ahmed and Yusuf, 2014). The national demand for fish resource is put at over 2.6million metric tonnes with whole sale value of more than $1.5billion while the local production has been estimated at about 700,000 metric tonnes (Ahmed and Yusuf, 2014). This made the country to depend heavily on fish importation to meet the needs of the local populace. It is observed that Nigeria is the largest fish consumer in Africa with total consumption of 1.2million metric tonnes (Ahmed and Yusuf, 2014).

Taraba State is well endowed with abundant surface water which includes ponds and rivers. These include rivers Benue, Taraba and Donga and their tributaries. The state has about 500,000 hectares of water body and 142 natural ponds (TSEED, 2004). River Benue traverses the state for a distance of over 390km passing through Ibi, Wukari, Gassol, Karim Lamido, Ardo Kola and Lau LGAs (SEMA, 2012). River Taraba passes through Gashaka, Bali and Gassol LGAs before

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emptying into the Benue system. River Donga on the other hand passes through Sardauna LGA where it took its source, to Kurmi, Ussa, Donga and Wukari LGAs. The Katsina Ala River passes through Kashimbila in Takum LGA. There are so many other smaller rivers such as rivers Kam, Suntai, Gazabu, Pai, Bantaji etc and creeks in Ibi LGA. Out of the 16 LGAs in Taraba State, only 3 LGAs (Jalingo, Zing and Yorro LGAs) are not traverse by the 3 large rivers of Benue, Taraba and Donga. This hugh surface water resource makes fishing the second most important human economic activity after crop farming in Taraba State. The types of fish caught in these rivers include: Tilapia (oreochromis niloticus), Mudfish (clarias anguillaris), Nile petch (late niloticus). Silver side (Alestes macroleptilotus), Silver catfish (Bagrus bayad), Butter fish (Schilbemystus), Tiger fish (Hydrocymus forscalii), Catfish (Synodontis nigrita), Osteoglosid (Heterotis niloticus), Sailfins (Polypterus senegulus), Electric catfish (Malapterusus, electricus), African lungfish (Protepterus annectens), Trunkfish (Moruyrus rume) etc.

The importance of fishing activity in the state is clearly expressed in Ibi LGA that has an annual fishing festival, the Nwonyo. The 2009 episode of this event saw the catching of the largest size of fish that weighed 230kg. Towns such as Bantaji, Tella, Gindin Dorowa, Ibi, Donga and Lau are well known fishmarket towns in the state attracting people from far and near who came to buy fresh, dried and smoked fish (Oruonye and Abbas, 2011). The average production of fish in the state is about 1,987 metric tonnes per annum (TSEED, 2004). Daily fish catch in some LGAs like Ibi, Lau and Donga is about 3000kg. The state has over 30,000 fishing families fully engaged in daily fishing (TSEED, 2004). In recent times, fish farming is gradually gaining popularity and attracting many people into the business. The fishery sub sector contributes greatly to the state economy in the provision of employment opportunity, income generation and food supply. Fish represent about 40% of the total animal protein consumed in the state (TSEED, 2004).

Although extensive works have been done on traditional management of artisanal fisheries in north eastern Nigeria (Neiland 1997, Neiland et al, 1997, Neiland et al, 2000a,b, Neiland and Bene, 2004, Ladu and Neiland, 1997 and Sarch et al, 1997) this study scales down to examine the fishery resource management practices and challenges in Mayo Ranewo fishing community of Ardo Kola LGA, Taraba State Nigeria. The study attempt to address the following research questions;

1. Who owns the fishery resources in the area?
2. Are there fishing regulations in the area?
3. Who enforces the fishing regulations if they exist?
4. What are the difficulties of improving fishing in the study area?
5. What can be done to improve fishing in the study area?

II. Material and Methods

Data for the study were collected using a combination of secondary desk review and structured questionnaires. Interviews were conducted with villagers, including fishermen, traders, community leaders, and the village chief to obtain information about fisheries policies, regulations and challenges in the local community. Direct observation was also conducted in order to understand the livelihood aspects and the relationship between the communities and fishery resources. Issues that were examined included species diversity, fishing ground, ownership and accessibility, time used for fishing (season), fishing gear, fish capture and production and total fishery households involved in fisheries management. This study employed the purposive sampling technique for data collection on 65 respondents who live in the community. Descriptive statistics were used to analyze the data collected.

a) Description of Study area

Ardo Kola LGA is one of the four LGAs created in 1996 in Taraba state. The LGA was carved out of Jalingo LGA. It has a population of 86,921 people (44,020 male, 42,901 female) according to the 2006 national population census. It has a landmass area of 2,312km2. Ardo Kola LGA is roughly located between latitude 8o35'N to 9o08'N and longitude 10o52'E to 11o35'E. It is bordered by Lau LGA to the north, Jalingo LGA to the northeast, River Benue to the west, Gassol and Bali LGAs to the south and Yorro LGA to the south east (Fig 1).

Mayo Ranewo is one of the largest districts and political wards of Ardo Kola LGA. It is located in the south western part, at the confluence of River Fan Mangel with the Benue river (Fig. 1). The town of Mayo Ranewo is located on the bank and floodplain of the Benue River and was founded by Mohammed Borgu (Yahya Kachalla) in the 19th century around 1840. The people traced their origin to Bauchi emirate and had to migrate to Muri emirate following some political upheaval. The name 'Mayo Ranewo' was derived from the ponds in the community surrounded by locust bean trees named Mayo Nareje meaning locust Bean River. The town is roughly located between latitude 8o 47' to 8o 53'N and longitude 10o50' to 10o55'E. It was an important station of the French and British colonial masters along the River Benue during the colonial period. Mayo Ranewo town has a population of about 11,000 people according to the 2006 National Population Census. The dominant ethnic groups are the Fulani, Hausa and Jukun Kona. The people of Mayo Ranewo are fishermen and farmers.

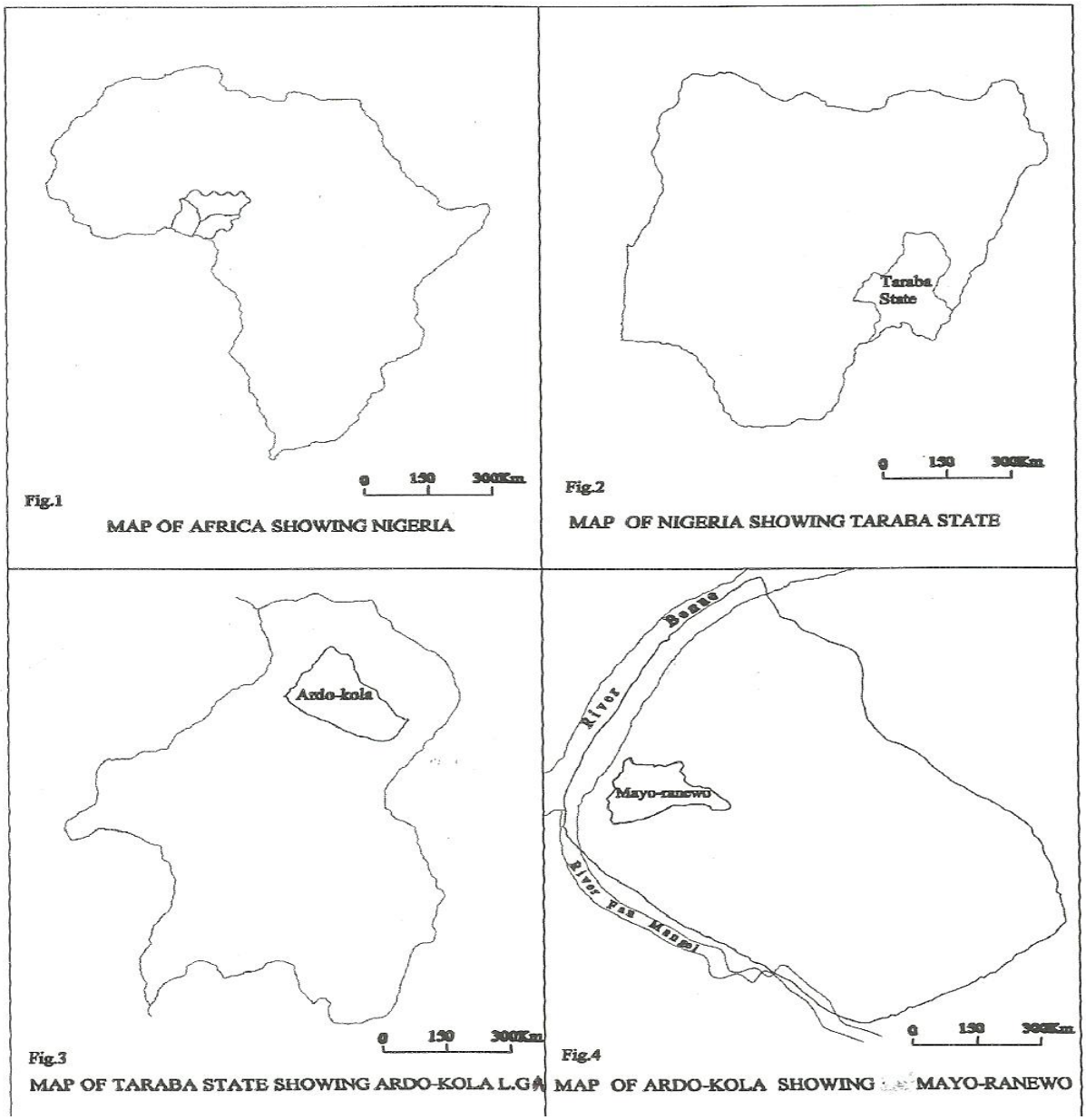

Fig. 1 : Map of the study area.

Fishing activities is at its peak during the dry season when the water level in the river is low and the farmers are observing their off-farm period. Harvesting of fish is usually around the month of March when the water level in the river and ponds have reduced drastically. This is because when the volume of water is high in the river valley and ponds, fishing are difficult and the people have to wait. The fish are caught using fishing net, hand paddled canoe and motorized boat. People come from different parts of the country to buy fresh, dried and smoked fish. The women are actively engaged in smoking and trading of the fish. There are about 25 fishing ponds in the community. The largest is the Mariwo. Others include Abarku, Anji, Kinkau, Na-huta, Ruwan barau, Yoride, Nubi, Ji and so on. The road to most of the fishing communities including Mayo Ranewo is seasonal and many places are inaccessible especially during the rainy season.

Mayo Ranewo is located on a sedimentary formation with extensive flood plains on both side of the River Benue. The soil consists of sandy loam soil and clay loam. The vegetation is the wooded savanna, comprising of few trees scattered in the area and a riparian forest along the banks of the river. Most residents of the community are crop farmers and fishermen. The cattle Fulanis are also found grazing along the banks of River Benue. Important crops in the community include yam, tomatoe, cassava, rice, maize and beans etc.

b) Results of the Findings

The demographic data shows that 74% of the respondents are male and 26% are female as shown in Table 1 below. The dominance of male in artisanal fishery sub-sector has been reported by Akpoko (2003) and Onemolease and Oriakhi (2011). The risk associated with inland water fishing activities may be responsible for the low female participation in the activity. In the study area, female participation in fishery is restricted to processing of catch (mainly smoking) and trading in fish. The demographic data also shows that 46.2% are within the ages of 20-30 years, 38.5% are between 31-40years, 10.8% between 41 -50 years and 4.6% are above 51years. The result also shows that 43.1% of the respondents are married, 38.5% are single, 10.7% are divorcee and 7.6% widow. It is also evident from Table 1 that 29.2% of the respondents had primary education, while 23.1% had secondary education. The remaining (47.7%) had no formal education. This implies that artisanal fisher folks have a low educational background. The low educational status of the respondents may influence their acceptance of improved fishery practices (Onemolease and Oriakhi, 2011). The positive influence of education on farmers' acceptance of improved farm practices has been established by several studies (Onemolease et al, 2000; Tshiunza, Lemchi and Uloma, 2001). This by extension could also affect the behavioural attitude of fishermen in responding to innovative practices in fishery resources management.

Table 1 : Demographic characteristics of respondents

GENDER		
Gender	Frequency	Percentage (%)
Male	48	74
Female	17	26
Total	65	100
AGE		
20 - 30yrs	30	46.2
31 – 40yrs	25	38.4
41 – 50yrs	07	10.8
51yrs and above	03	4.6
Total	65	100
MARITAL STATUS		
Married	28	43.1
Single	25	38.5
Divorcee	07	10.7
Widow	05	7.6
Total	65	100
EDUCATION		
No formal education	15	23.1
Primary education	19	29.2
Secondary education	31	47.7
Total	65	100
Occupation		
Farming	19	29.2
Fishing	18	27.7
Artisan	07	10.7
Retiree	05	7.7
Civil servant	10	15.4
Traders	06	9.3
Total	65	100

Source: Fieldwork, 2014.

The findings of this study reveal the prevalence of co-management system of fishery in the study area as shown in Table 2. This includes the individual (private) and state (open access) ownership system. The open access property comes under the jurisdiction of the local authorities such as village heads, heads of fishermen, district heads, state and federal government who enforce regulations to control fishing activity in the open water. The government control and regulate fishing activities in the open water at various tiers through its fisheries officers in the Ministry of Agriculture. Government officials from the Fishery department work together with the local communities and their leaders in enforcing the fishery regulation in the study area.

The confined waters (fishing ponds) (plates 1) are dominated by individual ownership. It is a private property. Findings from the study show that the system of rights in the confining waters (ponds) is similar to that of farmlands. The fishing ponds are appropriated like that of land and a system of ownership and management similar to that of land tenure are developed (Olomola, 1998). The respective individuals and families in the study area claimed descent right over the use and management of the fishery resources in the confined waters (ponds). During the dry season, individuals in the community identify suitable areas (which can retain substantial volume of water) within the flood plains of the river valley and convert them into fishing ponds. This conversion is usually carried out with the help of family labour and in some cases hired labour. Thus, the individuals that owns the fishing ponds makes decisions about the time and method of fish harvesting and takes steps to prevent other members of the community from fishing in the pond. This they do by employing private security guards to guard the ponds. The security guards usually built a temporary tent beside the pond (Plates 2) and watch over it day and night. This individual ownership of fishery resources is inheritable and usually passed from the father to sons who are interested in fishing.

Table 2 : Prevailing Water Management System

S/No	Management System	Frequency	Percentage
1	Open access	23	35.4
2	Private property	37	56.9
3	Co-management	05	7.7
4	Others	0	0
5	Total	65	100

Source: Fieldwork, 2014.

The ponds are usually dried up during the dry season and during the rainy season they are flooded. This individuals who owns the fishing ponds usually rent them out to prospective fishermen who also rent it out to others or at least collect fees from smaller artisanal fishermen. The fishing ponds are of different sizes and the fish contents also varies. The owners of the fishing ponds rent them out for a period of up to 3 years at an amount ranging from two hundred to three hundred thousand naira (N200,000 – N300,000 – $1,200 – $1,800) depending on the size of the fishing ponds and fish potentials. The individuals that rent the fishing ponds in turn collect fees of about ten thousand naira (N10,000 - $62) from smaller fishermen to allow them catch fish in the pond.

The bidding of rent of the fishing ponds are often very competitive and in some cases result into conflict among the fishermen. It also involves a lot of risk taking because once the rent is paid, it cannot be revoked whether there were enough fish in the pond to cover the cost or not. Thus, some form of agreement is usually entered between the owner of the pond and the individual renting it or paying to fish in the pond. The village head (Mai Ungwua) and the Head of fishermen (Sarkin Ruwa) are most often times witnesses to this agreement. Thus, the individual fishermen renting the fishing ponds have very good knowledge of the fish potentials of the ponds. The ponds are usually very rich in fish resources. This made the owners and individuals that rent the fishing ponds to employ security guards to protect the fishing ponds from poachers and illegal fishermen from exploiting the resources. An interview with a cross section of the fishermen revealed that thieves (poachers) do come in the night to use chemicals such as gamalin 20 to catch the fish. The use of chemicals enables them to catch as much fish as they can within the shortest time. This situation results into serious loses to the owners of the fishing ponds and those that rented them. This made the issue of security an important challenge to artisanal fishery in the locality.

III. Discussion

The fishery resources ownership rights are derived from the prevailing water tenure system in the study area which includes communal ownership, family (kin group) ownership and individual ownership. This also depends on the types of fishing grounds (open river, fishing ponds etc). Findings from the study show that the system of rights in the confining waters of rivers and ponds is similar to that of farmlands. The fishing ponds are appropriated like that of land and a system of ownership and management similar to that of land tenure are developed (Olomola, 1998). The open waters in the river Benue is an open access resource free for

any member of the community and non members of the community to exploit. As common property, the fishery resources are subject to rights of common use by all. Over the years, fishing regulations and prohibition relating to fishing season, fishing gears and location are adopted and enforced.

The findings of this study shows that there are so many local fisher folk operating from several fishing villages and settlements dotting the banks of River Benue engaged in part-time and full-time fishing all the year round. Fishing in the study area is artisanal in nature as it involves small scale fisheries whose gear is generally simple and hand-operated (hooks, gillnets, traps and baskets) and its craft is simple and traditional (constructed with timber planks and plywoods). As outlined by Moses (2002) and Onuoha, (2009), the artisanal fisheries' in the area are characterize by very low capital investment, poor infrastructure facilities such as lack of cold storage and processing plants, labour intensive.

Fishing units are numerous and generally highly scattered in remote hardly inaccessible settlements which makes evacuation, distribution and marketing of the fish products rather difficult. This leads to high rate of post harvest losses. It is also observed that the fisheries lacked access to credit from commercial banks and other financial institutions.

The result of the findings shows that there are Fishery officer from the state government in the rural community who undertake tour of the area. The Fishery officials and the Nigerian Police have their patrol boat and canoes which they use to patrol the Benue River to apprehend offenders and ensure strict compliance to the regulations. Anybody from anywhere can go and fish in the open water at anytime as long as he adheres to the fishing regulations. The fishing regulations forbid the use of chemicals in fishing and the use of small gears to catch fingerlings. The work of the fishery officials and security operatives are mainly to enforce government regulations on fishery such as apprehending and prosecuting those that use chemicals in fishing and prevent the use of small size nets in fishing or harvesting of fingerlings'.

Traditional authority in the communities also play important role in ensuring compliance with fishery resource management practices such as assignment of use rights, arbitration in tenancy regulation, non use of chemicals in fishing and adherence to approved fishing gears. For example, no tenant fisher is allowed to engage in any unproductive activity in the area other than fishing. The fishers are also not allowed to use fishing techniques/gears other than the ones for which the prescribed rents have been paid for.

a) Challenges to fishery resources management

Akankali and Jamabo (2011) observed that several empirical evidences existing in literature shows that the fisheries yield from artisanal sources is on the decline in Nigeria. The greatest challenge to fishery in the area is that it is operated by artisans who have learnt the art of fishing informally from their parents. Most of the fishermen are not educated and can hardly read or write. They lacked modern fishing equipment and can hardly maximize their catch in the face of declining fishery resources, climate change and economic recession. This made the local fishermen to resort to the use of chemicals and small fishing gears. This development has necessitated the deployment of government fishery officials and police to patrol the length of River Benue and entrench sustainable fishery practices in the area.

Some fish species are fast disappearing and the number of stocks caught are decreasing in average size due to over fishing and other harmful fishing practices. Fishermen use small eyed-nets which catch small and immature fish. The prices of fishing gears are continuously increasing in the market and out of the reach of the local fishermen. The increasing cost of fishing gears in recent times is making it difficult for most fishermen to afford. This increases the cost of fishing in the area.

Etim (2010) attributed the problem of overexploitation to invention and increased sophistication of fishing gear in recent times. The number of fishermen have been increasing while the average catch per week continue to declined, the sizes of individual fish in the catch are also becoming smaller and large sized fishes becoming rare to encounter. The occasional and intermittent release of water from the Lagdo dam, in Cameroon Republic upstream of River Benue affects fishing activities in the area. This problem is worsened when the water is released in the dry season, the peak period of fishing in the area. The people have to wait for the water level to reduce before they can continue with fishing activity again. This may last for several weeks or months.

The open access nature of the open waters of River Benue in which there is no restriction of entry into the property because there is no property right (Johnson, 1992) is the main problem of artisanal fisheries in the area as in other parts of Nigeria (Imaobong and Mandu, 2013). According to Etim (2010) open access is a situation in which there is no restriction of entry into a common property irrespective of whether the property is owned by an individual, community or state. Artisanal fisheries in the open waters of the Benue river is open access property. Unrestricted entry into the fisheries has resulted in heavy fishing pressure on stocks and attempt at using chemicals. This has resulted in serious challenges of enforcement of extant regulations in artisanal fisheries in the area.

Omorinkoba et al, (2011) highlighted the problems associated with fish handling practices in artisanal fisheries in the Kainji Lake area of Nigerian to include lack of credit facilities for artisanal fisheries and

revolving loan scheme to fishers. Since artisanal fisheries provide crucial roles in the socio-economic and political well-being of the state and Nigeria at large, there is a great need to ensure complete protection, development, management and sustenance of both its aquatic environments and its vast resources to avoid stock depletion and species extinction (Imaobong and Mandu, 2013).

Most peasant fishers including children and the aged as well as poachers sometimes use Gammalin 20 and root, leaf, fruit and flower extracts of certain poisonous plants in fishing. This is a wrong method of fish exploitation since other useful macro- and micro-organisms essential for the stabilization of the ecosystem is exterminated. These plant extracts pollute the aquatic ecosystem and reduce the fish stocks through uncontrollable mortality. Enyenihi (1990) noted the wrong use of gear such as nets of very small mesh sizes to catch fish as being a method of destabilizing the ecosystem. This leads to over-exploitation whereby the juveniles which would have been recruited into the fishery are caught along with the adults. Most of the fishing is mainly done using the traditional method of using hand pull boats, a few use engine boats; materials used in fishing e. g. nets, hook, trap, etc. are very costly and many people cannot afford them; the main sources of the above mentioned are also far and costly in terms of transport from the major town of purchase to the local community.

Generally, artisanal fisheries is characterized by lack of or hired processing and storage facilities. This condition leads to high rate of post-harvest fish losses. Bolorunduro (1996) had observed that despite the subsistence nature of capture of fisheries in Nigeria, as much as 50% of post-harvest loses has been recorded. Fish is a highly perishable commodity and as such it is usually frozen or canned in order to prevent post harvest losses (Nkeme et al, 2013). Once they are taken out of their natural habitats, decomposition processes set in. Thus, they must be handled, processed, preserved and stored in good hygienic conditions and facilities.

According to Ipinmoroti (2012) fishery is influenced by climatic factors. Ekpo and Nzegbule (2012) reported that a change in the key water variable such as temperature, salinity, wind speed and direction affect the abundance and distribution of fish population and fisheries activities. The impact of climate change on aquatic ecosystem include increased in mean annual temperature, latitudinal and depth shift in range, lower dissolved oxygen concentration, coral bleaching, threat of mangrove swamps, phenology of marine organisms and ocean acidification (Daw et al, 2009).

It has been observed that artisanal fishers are very likely to be the worst affected because many of them (if not all) depend on this as their source of livelihoods (Enin, 2012). The anthropogenic stressors such as fishing, pollution and habitat alteration, accentuate climate impacts on aquatic ecosystems and the exploited fish populations, by reducing their resilience and increasing their sensitivity to climate change (Enin, 2012). According to Akankali and Jamabo (2011) apart from climatic and environmental changes, certain institutional inadequacies are largely responsible for poor fish production in Nigeria, viz:

1. Changes in government policy thus affecting fish production.
2. Poor funding of research and extension services in institution and Universities.
3. Lack of effective institutional support and linkages
4. Monitoring, control and surveillance mechanisms are not fully developed
5. Illegal exploitation of the marine fisheries resources particularly by foreign vessels
6. Poor management and non effective utilization of most of the nations numerous water bodies
7. Shortage of competent and experienced manpower
8. Lack of training and demonstration facilities for transferring technologies

Fisheries in the country are largely the responsibility of the Nigerian institutions. Unfortunately, these same institutions often times are grossly underfunded and therefore ill equipped in terms of manpower, equipment and infrastructure to carry out credible and far reaching researches that would enhance sustainable development of the Nigerian Artisanal fisheries (Akankali and Jamabo, 2011). More so, where fishery policy exists, there is lack of implementation capacity, such as adequately trained manpower and equipment. Neiland et al, (2005) observes that many state fisheries departments in Nigeria have been constrained for various reasons, including financial under-resourcing in their ability to assume the responsibilities of overseeing and regulating fisheries in their areas. There is paucity of data on fish stocks inevitably warrant the over dependency on precautional approach as the only management option in the country.

Several efforts to make Nigeria self sufficient in fish production and supply still remain a mirage (Azionu et al, 2005). With about 14 million liters of inland water bodies, Nigeria could be self sufficient in fish production and a major exporter of fish. The repeated events of declining yields and economic returns, stock collapse and crises of social dislocation and loss of biodiversity could be arrested if the contemporary fisheries management precepts and practice are adopted and vigorously sustained (Akankali and Jamabo, 2011).

IV. Conclusion

This study has examined the challenges of fishery resource management practices in Mayo Ranewo community in Ardo Kola LGA, Taraba State, Nigeria. The findings of the study shows the existence of

private and open access management practices over the surface water bodies in the area. The study shows that fishing regulation in the study area include prohibition on use of chemicals/toxic substance in fishing, adherence to the use of approved fishing gears and prohibition on the catching of fingerlings. The findings from the study shows that the challenges to fishery management in the area include the artisanal nature of the fishery, high level of illiteracy among the fishing folk, security, open access nature of the water resulting in overexploitation, lack of credit facilities, activities of poachers, use of chemicals in fishing and difficulties in effective enforcement of fishery regulation in the area.

V. Recommendations

Based on the findings of this study, the following recommendations are made.

i. Although the people claimed that there is association of fishermen in the study area, there is need to mobilize the fishermen into organizing themselves into cooperative societies which will serve as a platform for empowerment creation of awareness on the dangers of using chemicals and toxic substance in fishing activities.
ii. Fishing community should be encouraged to mobilize or pool their financial resource in order to ameliorate the constraints imposed by lack of or inadequate capital. Alternative economic ventures such as downstream activities and other allied activities during closed area/ seasons for conservation purposes, should be encouraged and supported by the relevant agencies, as a means of inducing the fishers to cooperate with defined conservation and management programmes uncompelled.
iii. This study also recommends support to the fishermen in terms of fishing and processing equipments such as motorized boat, cold storage facilities at subsidized rate.
iv. To prevent the declining trend of fishery resources in the study area, there is need to develop alternative sources of income to substitute practices that are negatively impacting present source of income and livelihood.
v. There is need to employ and deploy more Fishery Officers in the study area to help improve sustainable fishery practices in the study area. The officers could help in public awareness campaign and training of local communities on issues of illicit use of chemicals and toxic substance in fishing.
vi. There should be an enhanced re-equipping of all existing Agencies such as the Licensing, monitoring and Enforcement unit of Federal and states department of fisheries to ensure that they possess the requisite manpower and equipment that would enable them effectively implement and enforce conservation policies and regulations for the sector at all times.
vii. Establishment and enforcement of fishing laws, edicts, rules and regulations should be done through partnership and linkage with the local communities in such a way that it will promote income generation and desirable livelihood activities in the area.
viii. Conservation policies and regulations should be developed to conform to scientific research findings that are focused on artisanal fisheries conservation and management for the various fisheries of the region.

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Plate 1 : Fishing pond

Plate 2. : Temporary tent of a hired security man guarding the Fishing pond

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

The Feasibility of using Natural Rocks as Sources of Calcium, Magnesium and Phosphorus in Livestock Feeding in Ethiopia

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Abstract- In Ethiopia, feed industries are widely using limestone as a cheap source of Ca without adequate information on the bioavailability of its Ca content and the presence of other toxic minerals. This being the case, the present study was conducted to determine the Calcium, Phosphorus and Magnesium content of samples of limestone and marble powder collected from different parts of Ethiopia. Adequate quantities of lime stone, marble powder and gypsum were procured from different parts of Ethiopia and subjected to laboratory chemical analysis in triplicate. The results of this study clearly showed that the total ash content of all the materials analyzed in this study ranged between 81 and 99%, indicating the potential use of these materials (limestone, marble powder and gypsum) collected from different part of Ethiopia) as supplementary mineral feed source in a very small amounts. The Ca content of the samples collected varied from 16.62 to 89.19%, with mean value of 74.4% the value of which was significantly higher than the Ca content of Calcium-carbonate and Calcite powder (39.17 ± 0.3%). On the contrary, the mean P and Mg content of all the test materials was 0.12 and 0.32-0.69% the values of which are comparable to the P and Mg content of common animal feed in Ethiopia. In summary the results of this study showed that lime stone and marble powder widely available in different parts of Ethiopia seems to have potential value as a Ca supplement for livestock feeding. Testing the bioavailability of these materials with animal seems to be the future direction of research.

Keywords: *calcite powder; lime stone; livestock; marble powder; minerals.*

GJSFR-D Classification : *FOR Code: 070799*

Strictly as per the compliance and regulations of :

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I. Introduction

Successful animal production depends on genetic and environmental factors including nutrition and management practices. of which nutrition plays an important role. It is believed that more than 50% of the farm expenditure or cost of animal production goes towards feeding of animals. Dietary nutrients promote programming and expression of the metabolic pathways that enables the animal to achieve its genetic production potential. All the nutrients (carbohydrate, proteins, fat, vitamins, and minerals) are equally important as deficiencies of one or more of these nutrients hamper the health status and productivity level of animals.

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There is variation in the mineral content of different animal tissues. The concentrations of essential elements must usually be maintained within the narrow limits, if the functional and structural integrity of the tissues is to be safeguarded and the optimum growth, health and productivity status of the animal are to be maintained. Continuous ingestion of diets that are deficient, imbalanced or excessively high in a mineral, induce change of the normal mineral concentration of body tissues. In such circumstances the biochemical and physiological functions of the animals are affected which in turn may result in structural disorders. The developed structural disorders are variable with the mineral element concerned and its toxicity, the degree and duration of dietary deficiency, and the age, sex and species of animal involved (Chesters and Arthur,(1988) Such a change could be prevented through the provision of balanced, palatable and adequate diet in desirable forms. According to McDowell et al (1993) mineral supplements differ in their bio-availability, one of the most important factors in mineral nutrition, which must be taken into consideration. Thus it is necessary to comparatively scan the available mineral supplements aimed at ensuring its adequacy and levels of toxicity incriminating minerals. This being the cases, the major objective of this research project was to study the feasibility of using natural rock as potential source Calcium and other mineral in livestock feeding in Ethiopia.

II. Materials and Methods

a) Sample Collection and Processing

Adequate quantities of Calcium carbonates, marble powder (both wet and dry), and gypsum and silica powder were collected from different locations as shown in Table1. Efforts were made to collect as many batch samples as possible during the field survey conducted. All the samples collected were transported to Jimma University college of Agriculture and Veterinary Medicine (JUCAVM). All the samples were dried at 100 0C and milled to pass through 1mm screen. The dried materials were stored in air tight contained until required for chemical analysis.

b) Chemical Analysis

All the laboratory chemical analysis was done in Canada at the Faculty of Agriculture of Dalhousie University. One gm of dried sample materials were taken into silica basin, charred to remove the smoke and ashed at 550oC in a muffle furnace for two hrs. The ashed materials were transferred to clean and oven dried glass beakers, boiled with 20 ml of HCL acid for 5 minutes and filtered through what man filter paper No. 42 into 250 ml volumetric flask. The residue was washed with hot distilled water until free of acid and the volume was made to the mark with distilled water. This extract was used for analysis of different minerals using standard methods.

All the required standard solutions were prepared as shown in Table 2,and all the samples were analyzed in triplicate and Ca and Mg were estimated, according to (AOAC,2002), with the use of atomic absorption spectrophotometer (AAS) employing acetylene, air and specific hallow cathode lamps for the determination of individual mineral as the case may be. Strontium chloride was added during the estimation. Total phosphorus in the mineral supplement samples was estimated by spectrophotometric method (Tran and Simard, 1993).

Table 1 : Sources of calcium carbonate

Sr. No.	Date Of Collection	Name of Sample	Place of Collection
1	17/07/2013	Marble powder(wet)	Addis marble factory
2	17/07/2013	Marble powder (dry)	Addis marble factory
3	17/07/2013	calcium carbonate (Lime stone)	Amhara (Gojam) filiklik Abyssinia cement factory
4	17/07/2013	calcium carbonate (Lime stone)	Amhara (North showa) Jamma Abyssinia cement factory
5	17/07/2013	gypsum	Amhara(Go jam) filiklik
6	17/07/2013	calcium carbonate (Lime stone)	oromia (Durba) Mugger cement factory
7	17/07/2013	silica powder	oromia (Durba) Mugger cement factory
8	17/07/2013	calcium carbonate (Lime stone)	oromia (Durba) Durban cement factory
9	18/07/2013	calcium carbonate (Lime stone)	Hungshan cement factory Mojo Hirnna (Harar)

Table 2 : Preparation of standard solutions for various elements

Element	Salt	Quantity in mg will be made to 100 ml with distilled H_2O	Yield	Standard range
Calcium	$CaCl_2.2H_2O$	40.76	100 ppm	1-20 ppm
Magnesium	$MgSO_4.7H_2O$	102.43	100 ppm	0.06-0.6 ppm
Copper	$CuSO_4 .5H_2O$	39.89	100 ppm	0.8-8 ppm
Zinc	$ZnSO_4.7H_2O$	44.235	100 ppm	0.4-2 ppm
Iron	$FeSO_4.7H_2O$	50.80	100 ppm	0.8-8 ppm
Manganese	$MnSO_4.H_2O$	31.39	100 ppm	0.5-5 ppm
Cobalt	$CoSO_4.7H_2O$	49.17	100 ppm	1.6-16 ppm
Lead	$(CH_3COO)_2Pb.3H_2O$	18.49	100 ppm	2.0-20 ppm
Cadmium	$CdCl_2$	16.81	100 ppm	0.6-6.4 ppm

III. Results and Discussion

a) Total Ash and Acid Insoluble Ash

The total ash, AIA, Ca, P and Mg contents of the limestone, marble powder, gypsum and silica collected from different part of Ethiopia are given in Table 3. According to Kabaija and Little (1993), the total ash content of most of the Ethiopian common animal feed is equal or lower than 12%. Total ash content of 10-12% and 4.6-8.7% was reported from range grasses and highland hays of Ethiopia respectively. The highest total ash content of 12% was reported from Chrysopogon aucheri grown in the highland of Ethiopia. According Table 3, total ash content of 99% was recorded from Addis Marble powder, Jamma Limestone (Abissinia Cement), Durban Silica Muger Cement, Durban limestone cement and from Hirna limestone hungshane cement, the value of which is very high compared to the others. The lowest total ash content of 81% was recorded from Durban Gypsum cement. The results of this study clearly showed that the total ash content of all the materials analyzed in this study ranged between 81 and 99% (on dry matter basis), indicating the potential use of these materials (limestone, marble powder, gypsum and silica collected from different part of Ethiopia) as supplementary mineral feed source in a very small amounts.

Acid Insoluble Ash content of animal feed seems to receive adequate attentions. The BIS (2002) restricted Acids Insoluble Ash content to 2.5 to 3.0%in the final mineral mixtures as high levels of AIA lowers the utilization of nutrient and palatability. Ammerman et al (1984) reported that high levels of AIA in the ration of livestock depressed the utilization of P and certain other micronutrients. Kabaija and Little (1993), reported ADF ash content of 3-5% from common Ethiopian animal feeds. ADF ash content of range grasses ranged between 4.06 and 7.61%. It is reported that high levels of ADF ash in animal feed negatively affect digestibility. It is also reported that the high levels of ADF ash in animal feed could be attributed to the presence of large amounts of silica which in turn may seriously reduce digestibility (van Soest, 1982). The result of this study showed that Durban Silica Mugar Cement contain 96 % Acid Insoluble Ash which makes it unfit as animal feed because of its insolubility. Jamma limestone, Durban gypsum Muger and Kiliklik limestone Gojam contain 4.2-8.3% Acid Insoluble Ash, the values of which are high for the use as animal feed compared to the others. On the other side (Table 3.1) the Acid Insoluble Ash content of the others (Limestone Abyssinia cement factory (Jamma), Limestone Durban cemnt factory (Durba), Limestone Hungshan cement factory (Hirna)) ranged between 0.29 and 3.29%, the values of which are lower than that reported from the Ethiopian highland range grasses and straw based dry period roughage feeds. Therefore, the results of this study clearly showed that Limestone from durba, Limestone (JN amma) and Limestone (Hirna) could be used as mineral supplant in livestock feeding based on their percent composition of Acid Insoluble Ash.

b) Calcium

Calcium content of 0.16-0.79% was reported from some hays from Ethiopian highlands and range grasses from Ethiopian Sidamo southern rangelands (Kabaija and Little (1993),. According to the result of this study (Table 3), the calcium content of all the materials studied (with the exception of Durban Silica Muger Cement and Jimma limestone cement) ranged between 77 and 89% indicating the potential use of these materials as Calcium supplement in livestock feeding. Addis Marble and Gojam limestone contain 88% of Calcium on dry matter basis. Moreover the mean Acid Insoluble Ash content of Marble powder was found to be 1.21%. The result obtained tends to indicate that one kg of marble powder or Filikliki limestone contains about 880 g of Calcium. It is reported that dietary Ca concentrations of 2-6 g/kg, with higher requirements for lactation have been variously recommended for cattle and sheep (NRC, 1978, 1984, 1985: ARC, 1980), the findings of Sykes and Field (1972) suggest that levels of 2.53. g/kg (0.25%) are adequate in most circumstances (Kabaija and Little (1993).. Thus one kg of Marble powder and/or Filikliki limestone could be adequate to feed 350 dairy cow placed on Calcium free basal diet/day.

The Calcium content in lime stone varied from 16.62 to 88.12 with an average of 68.6 which was quiet high compared to the Calcium content of Caco3 (Table 4.1). As compared to the results of the current study, Lall (1987) reported that carbonate of Ca were rich in Calcium content, contrary to sulphate forms of Calcium.. The sulphate forms of Ca such as gypsum and phosphor-gypsum were found to contain 12-35.6% Calcium. The Acid Insoluble Ash content of the limestone studied in the current study ranged between 0.29 and 8.29% with mean value of 3.88%. Thus, the high content of calcium and the low Acid Insoluble Ash content of limestone make it a suitable source of Ca supplement for livestock feeding under the current Ethiopian conditions.

c) Phosphorus

Kabaija and Little (1993),reported Phosphorus content of 0.12 -0.22% from some hays from Ethiopian highlands and range grasses from Ethiopian Sidamo southern rangelands. Maynard and Loosli (1969) reported that Ca and P content in rock phosphate varied from 20 to 36% and 12 to 18% respectively and that Ca and P content of rock phosphate are observable. According to the result of this study, the men Phosphorus content of all the test materials was 0.12%, the value of which is comparable to the phosphorus

content of common animal feed. As shown in Table 3, the materials tested contain large excess of Ca over P. resulting in Ca:P ratios approximating 500. It is reported that Ca:P ratio of 10 or more is deleterious to ruminants, Although much conflicting evidence occurs in the literature (reviewed by Little, 1970). In this context it is noteworthy that the ARC (1980) concluded that "...it is not possible to state the optimal ratio of calcium to phosphorus for animal performance or whether such a ratio actually exists." Where wide ratios occur, The general tendency is that the dietary concentration of P per se is almost certain to be inadequate in the common animal feed in Ethiopia.

Underwood (1981) considered a dietary P level of 1.7 g/kg to be marginal for grazing animals, in essential agreement with work of Little (1980, 1985) which indicated that 1.4 g/kg should be regarded as minimal for growing cattle. Most grasses and crop residues examined were marginal to deficient in P. and supplementation with P is likely to be beneficial. According to Table 3, the mean phosphorus content (1.2 g/kg) of all the test materials studied is below the minimum requirement for growing cattle (1.4g/kg) indicating that they are poor source of phosphorus for livestock feeding under the current Ethiopian conditions. From a survey of mineral status of soils, feeds and cattle in the Selale, Ethiopian highlands, Khalili et al (1991) , reported wide variation in the concentrations of minerals on different farms. Pasture grass and other feeds were found to be deficient in P and Mg in relation to dietary requirements. Analyses of blood plasma from crossbred and local cattle showed that a number of samples contained P below the critical level of 1.45 mmol/litre. Effects of year and season were significant for Ca, P and Mg. The effect of age was also found to be significant for P ($P < 0.001$).

d) Magnesium

It was evident from the (Table 3.1), that the Mg content in the lime stone powder obtained from filiklik (Gojam) was highest (1.59%) followed by samples procured from Durba cement factory(2.56%). The other test materials (except Silica factory) contain 0.32-1.06% of magnesium the values of which are comparable to the magnesium content of common Ethiopian animal feeds. This result is also comparable or better than that of -Kabaija and Little (1993), who reported Magnesium content of 0.1-0.2% from some hays from Ethiopian highlands and range grasses from Ethiopian Sidamo southern rangelands. The result of this study showed that the presence of Mg in lime stone powder was low so that additional supplement is required. This result agree that of Gohl (1981), who suggested that t lime stone that contained 36.4% Ca can safely be fed free choice mixed with salt to livestock, however due to high Mg CO3 content (about 5% in dolomite limestone) it should not be used in feeding of poultry. From a survey of mineral status of soils, feeds and cattle in the Selale, Ethiopian highlands,

IV. Conclusions

Samples of lime stone powder (CaCo3) powder were collected from different parts of Ethiopia were subjected to laboratory chemical analysis in triplicates. The results obtained showed that the total ash content of all the materials analyzed in this study ranged between 81 and 99% (on dry matter basis), indicating the potential use of these materials (limestone, marble powder, gypsum and silica collected from different part of Ethiopia) as supplementary mineral feed source in a very small amounts. The Acid Insoluble Ash content of limestone from abycinia,cement factory (Jamma), Limestone Durbacemnt factory.(Durban), Limestone Hungshan cement factory (Hirna)) ranged between 0.29 and 3.29%, the values of which are lower than that reported from the Ethiopian highland range grasses and straw based dry period roughage feeds. Therefore, the results of this study clearly showed that - Limestone from durba, Limestone(Jamma) and Limestone(Hirna) could be used as mineral supplant in livestock feeding based on their percent composition of Acid Insoluble Ash. According to the results of this study, the high content of calcium and the low Acid Insoluble Ash content of limestone make it a suitable source of Ca supplement for livestock feeding under the current Ethiopian conditions. Moreover, the results obtain showed that the P and Mg content of the test materials are comparable to that of the common Ethiopian animal feed stuffs. However, animal evaluation of the bioavailability of the test materials seems to be the future direction of research.

V. Acknowledgments

The author, is highly indebted to Anne Lelacheur and Prof. Alan fredeen of department of plant and Animal sciences of the faculty of Agriculture of Dalhousie University Truro, Canada, and prf Solomon Demeke of Jimma university for their unreserved help & advice in analyzing the samples. The author also extend his gratitude to prf. Tesema Astatke, Dr. Nancy Pitts, Nancy Thornton, Michelle Richards and other members of the university community who made us feel at home during the conduct of this study in Canada.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Assessment of Factors Affecting the Acceptance of Agricultural Innovations in Zurmi Local Government Area, Zamfara State Nigeria

By Dr. Lawal Mohammed Anka

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Abstract- The aim of this paper is to assess the factors affecting acceptance of agricultural innovations in Zurmi Local Government Area of Zamfara State of Nigeria. The researcher investigated why new innovations were rejected and the role of government in motivating farmers to accept new innovations. A total sample of 80 respondents was selected out of the selected six wards, to represent the entire local government. Data was analysed using various statistical tools like frequencies, percentages and direct response. The major conclusions drawn from this paper were data regarding responses to new innovations have shown that 28 (35%) of the respondents accepted new innovations while 52 (65%) rejected the idea. Survey results regarding why new innovations were rejected revealed that 27 (33.7%) of the respondents reported poor roads is responsible, while 13 (16.2%) were not interested in accepting new innovations at all. Similarly, 40 (50%) reported financial constraints is responsible for not accepting new innovations. Perception of respondents regarding what should government do to encourage farmers to accept new innovations revealed that majority of the farmers 48 (60%) agreed that government should give loans to them. Similarly, 22 (27.5%) agreed that more extension advice should be delivered. Only 10 (12.5%) would want government to sell inputs at subsidised rates. Finally, this paper recommends some strategies aim at motivating farmers to accept new agricultural innovations.

GJSFR-D Classification : FOR Code: 079999

Strictly as per the compliance and regulations of :

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I. Introduction

Some people adopt something new simply for the sake of change. The bag of innovations that an extension worker carries is generally presented as full of potential benefits to its recipients.

However, research institutes were established in different parts of the country to develop new innovations in agriculture. The primary responsibility of Extension Workers therefore is to carry these innovations to the farmers. The process of acceptance and use of ideas or innovations follows a successful pattern such as (a) awareness of the innovation (b) interest of the farmers (c) trail of the innovations through demonstrations and (d) adoption of new innovations.

For these to be successfully done, there must be an effective communication between the Extension Workers and farmers and a good working relationship must be maintained in order to make the farmers understand the innovations. However, the following factors affects the acceptance of innovations such as cultural influence, educational level, attitudes of the extension staff, bulkiness of the innovations, low income levels by the farmers etc.

Adoption of agricultural innovations if forced under authoritative or social pressure may not yield the expected results. Secondly, the objective for which an innovation has been diffused may very well be achieved but its side effects may be ignored. Professional agricultural extension cannot in isolation solve all agricultural development problems among other things, the whole range of agricultural support services from provision of improved seeds, fertiliser, credit and other inputs and to transport, communications and marketing must be improved to achieve a real sustainable impact on agricultural production, when the is the most appropriate time to introduce adoption and diffusion of agricultural innovation. The answer is it is never too early for the introduction of the above techniques organised along professional lines.

Zurmi Local Government Area of Zamfara State of Nigeria is located in the southern part of the State. Majority of the population are predominantly farmers. Guinea-corn, millet, maize, groundnut and cotton are the major food and cash crops they cultivate.

a) Problem Statement

There have been a number of criticisms regarding acceptance of agricultural innovation generally in developing countries. These includes (a) a pro-innovation and the sources of failure of unsuccessful innovation (b) a tendency to blame the farmers or the peasant for failure to adopt rather than question the appropriateness or profitability of innovation (c) inadequate attention to the interrelated process involved in innovation generation and utilisation (d) failure to develop the appropriate technology for adoption by farmers. Most of the people in |Zurmi Local Government Area are peasant farmers only few of them are large scale farmers, because of the land tenure system being practiced in the area; it is very difficult to adopt any agricultural innovation brought to the farmers.

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b) Objectives of the Study

i. *Overall Objectives*

The overall objectives are to assess the factors affecting the acceptance of agricultural innovation in Zurmi Local Government Area.

ii. *Specific Objectives*

1. To investigate how farmers manage both crops and livestock.
2. Examine why farmers still go by traditional method.
3. Assess if farmers have access to agricultural extension services provided by Agricultural Development and if they receive any new technology.
4. To investigate why new innovations were rejected by the farmers in the area.
5. To highlight the role of government to motivate farmers to accept new innovations and the problems being faced by farming community.

iii. *Research Questions*

1. Is there any benefit that farmer's derive acceptance of agricultural innovation?
2. What is the attitude of farmers to the acceptance of agricultural innovation to improve their farming operations?
3. Is there any relationship between acceptance of agricultural innovations and development in Zurmi Local Government Area?
4. Are farmers making effective use of agricultural innovation?

II. Review of Literature

The review of literature relevant to the above study is presented as follows.

Despite the fact that government is trying its best to introduce new innovations, there are forces which resist change. Certain force like education, industrialisation, with its innovation tends to encourage change while socialisation and social control which try to maintain status quo tend to resist change (Money, 1976).

According to Bankang 1981 no matter how smoothly we may feel an innovation can be adopted, there will be underlined forces which can slow down or completely block the intended change.

Jabe, 1992 stated that cultural resistance occur when an idea which proposes change comes in conflict with existing cultural element such as norms values and believes.

Eze, 1972 stated his reason as economic resistance. This relates to technological innovation, without the necessary economic ability to purchase technology, there will be resistance to change. Poverty or lacks of capital are the main sources of economic resistance to change.

Bila, 1977 identified his reason as economic resistance. This relates mostly to technological innovation, one may be confident but without the necessary economic ability to purchase technology there will be resistance to change.

Abbot, 1981 stated that vested interest in social system where stratification is fairly strong and entrenched, there will be resistance to change. Any time there is a change some people benefit while others don't benefit. If some one perceives what he will lose in change process, he will do his best to sabotage such a programme.

Ovjobi, 1973 stated that one of the effective ways of communicating, new innovation to rural areas is by inviting innovations and early adopters to agricultural firms so as to enlighten them of a new package with the advice of extension officers, the innovation will be implemented to improve farming skills.

Omokere, 1989 concluded that if an innovation is found it needs to be treated, analysed and blends carefully to suit our new innovation in rural areas. Agricultural loan can help in raising the financial position of these early adopters and innovators. The role of extension officer is to guide the innovators in implementing the new package.

Anka and Khooharo, 2010 stated that the level of extension visit to farming families was not encouraging in Zamfara State of Nigeria. The numbers of visit recorded were low particularly during the year 1998 and 1999. But some improvement could be attributed to 32 additional Village Extension Agents (VEA) recruited by the Management of ZADP. In addition, small plot trials, management training was restricted to crops while demonstration was used for technology transfer.

Anka, 2000 identified some important competency areas that will help Extension Workers improve their performance in maintenance of professionalism and understanding human behaviour in transfer of new agricultural innovations to farmers.

Roseboon etal, 2004 recommends that ASARIECA and its members promote the adoption of an agricultural innovation perspective in their policy analysis. This will help them identify weak or missing components and linkages within their agricultural innovation system and take measures accordingly.

Anderson and Feder, 2004 stated that critical to adoption of new innovations are the availability of improved technology, access to modern inputs and resources and profitability at an acceptable level of risk. Farmers get information from many sources. Public extension is one source but not necessarily the most efficient. Much need to be done to bring appropriate extension services to poor farmers around the world because most of the extension services will remain largely publicly funded.

Rajalahti, 2009 concluded that the ability to innovate is often related to collective action and having in place conditions that enabled adoption of innovation. Thus promoting innovation in agriculture requires coordinating support to agricultural research, extension and education fostering innovations partnerships and linkages along and beyond agricultural value chain.

CGIAR, 1998 identified factors limiting adoption is that seed availability is not dependable. Adoption has been more extensive among large scale farmers in the wet zones because they have capital to invest in seeds. The rate of adoption of sorghum varieties has been reduced because during time of their development subsidy was removed. Farmers were dissatisfied with the yield of the new cultivars in the absence of fertiliser.

III. Methodology

a) Location and Population of the Study

The study area is located in Zurmi Local Government Area in Zamfara State of Nigeria. The study covers six (6) wards that constitute the Local Government. The target population of the study were farmers, peasants and some civil servants working for the Local Government Area of Zurmi.

b) Sampling Techniques and Sample Size

A sample of six wards out of 10wards was selected. Eight respondents were selected out of the selected six wards to represent the entire Local Government. The questionnaire was formulated by the researcher based on the research questions.

c) Techniques of Data Analysis

The data collected from the field via questionnaire were analysed using the quantitative method. The variables in the questionnaire were coded on a code sheet and a code book respectively. Information was analysed using various statistical tools like frequencies, percentages and direct response. This was used to show variations between a variable.

IV. Results and Discussions

a) Section A: - Field Staff Questionnaire

This section describes how the data was analysed using various statistical techniques. The results were interpreted as follows: -

Table 4.1 : Age of the Respondents

Responses	Frequency	Percentage (%)
10 – 20Years	25	31.2
25 – 30Years	38	47.5
40 – 50Years	17	21.2
60 – 70Years	-	-
Total	80	100%

Source: Survey Results, 2011

Data presented in Table 4.1 shows that 25 (31.2%) of the respondents are in the age range of 10 – 20years, while 38 (47.5%) are in the age range of 25 – 30years. Similarly,17 (21.2%) of the respondents are in the age range of 40 – 50years. Those who are between 60 – 70years are too old to remain in farming business, they have zero percentage.

Table 4.2 : Types of Farming Being Practiced

Responses	Frequency	Percentage (%)
Livestock Production	32	40
Crop Production	17	21.2
Fish Production	25	31.2
All of the above	6	7.5
Total	80	100%

Source: Survey Results, 2011

Survey results presented in Table 4.2 shows the major business of farmers in the study area. Majority of the respondents 32(40%) are livestock farmers, while 17(21.2%) are crop farmers. Similarly about 25(31.2%) are engaged in fish farming to sustain themselves.

Table 4.3 : Crop/Livestock Cultivated in the Area

Responses	Frequency	Percentage (%)
Guinean-corn	14	17.5
Millet	12	15
Maize	23	29
Cattle	10	12.5
Sheep	6	7.5
Beans	15	18.5
Total	80	100

Source: Survey Results, 2011

Perception of respondents regarding types of crop/livestock cultivated in the area revealed that 14(17.5%) of the respondents area cultivating guinea-corn, while 12 (15%) and 23 (29%) are cultivating millet and maize. The results further shown that 10 (12.5%) and 6(7.5%) are livestock farmers rearing cattle and sheep respectively. Lastly, 15(18.5%) are those cultivating beans in the study area.

Table 4.4 : Management of Crops and Livestock

Description	Frequency	Percentage (%)
By Traditional Method	55	68.7
By Improved Method	25	31.2
Total	80	100%

Source: Survey Results, 2011

Opinion regarding management of crops and livestock is presented in Table 4.4. The results revealed 55(68.7%) of the respondents adopt the traditional method of farming and livestock rearing. While 25(31.2%) prepare to adopt the improved method which if done properly better results will be achieved.

Table 4.5 : What Discourage You to Accept New Innovation

Responses	Frequency	Percentage (%)
Financial Constraint	50	62.5
Lack of Understanding	10	12.5
Lack of Access to Agric. Dev Project	25	25
Total	80	100%

Source: Survey Results, 2011

Data presented in Table 4.5 indicates that 50(62.5%) of the respondents reported lack of finance is responsible for acceptance of new innovation. Similarly 10(12.5%) and 25(25%) of the respondents reported lack of understanding of what innovation is and lack of access to services offered by Agricultural Development Project in the area respectively discourage them to accept new agricultural innovations.

Table 4.6 : Do you receive new Technology from Extension Workers?

Responses	Frequency	Percentage (%)
Yes	64	80
No	16	20
Total	80	100%

Source: Survey Results, 2011

Table 4.6 indicates that 64(80%) agreed that Extension Officers implemented new packages of innovation to them, while 16(20%) did not receive any package. It was discovered during the interview that majority of them are not aware of the new packages. The results show that farmers receive new technology from Extension Workers.

Table 4.7 : If Yes, In what form?

Responses	Frequency	Percentage (%)
By giving improved seed	19	23.5
By giving technical advice	40	50
By giving fertilizer	14	17.5
By giving chemicals	7	9
Total	80	100%

Source: Survey Results, 2011

Data presented in Table 4.7 summarises opinion regarding the type of extension technology delivered to the farmers. About 19(23.5%) of the respondents reported that improved seed was giving to them, while 40(50%) benefited from technical advice. Furthermore, 14(17.5%) and 7(9%) received fertilisers and chemicals respectively. The results conclude that majority of the farmers received technical advice from Extension Workers. This helped them increase yield in this cropping season.

Table 4.8 : Response to New Innovations

Responses	Frequency	Percentage (%)
Accepted	28	35
Not Accepted	52	65
Total	80	100%

Source: Survey Results, 2011

Perception of respondents regarding acceptance of new innovations is presented in Table 4.8. The results have shown that 28(35%) accepted new agricultural innovation, while majority 52(65%) rejected new innovations delivered to them by Extension Workers. This shows that there is a need for awareness campaign from Agricultural Development Project in the study area.

Table 4.9 : Why New Innovations Was Rejected?

Responses	Frequency	Percentage (%)
Poor Rodas	27	33.7
Not Interested	13	16.2
Financial Constraints	40	50
Total	80	100%

Source: Survey Results, 2011

Data presented in Table 4.9 shows that 27(33.7%) of the respondents revealed that poor roads discourage to accept new innovation, and about 13(16.2%) were not interested. Majority 40(50%) of the respondents reported financial constraints is responsible for not accepting new innovations.

Table 4.10 : What should Government do to encourage farmers to Accept new innovations

Responses	Frequency	Percentage (%)
By giving loan	48	60
More extension advice	22	27.5
Selling inputs at subsidised rates	10	12.5
Total	80	100%

Source: Survey Results, 2011

Survey results in Table 4.10 have shown that sending more Extension Workers to deliver new innovations to farmers will not solve the problems of accepting new innovations rather majority of the farmers 49(60%) suggested that by disbursing loans to overcome their financial problems will motivate them to accept new innovations. About 22(27.5%) and 10(12.5%) believe that more extension advice and selling inputs at subsidised rates will motivate them to accept new innovations.

Table 4.11 : Which of this factors will help you in adoption of New Innovations

Responses	Frequency	Percentage (%)
Its relative advantage	12	15
Its compatibility	22	27.5
Its level of friability	13	16.2
Its level of observability	17	21.2
All of the above	16	20
Total	80	100%

Source: Survey Results, 2011

Opinion regarding factors that helps farmers in adopting new innovations is presented in Table 4.11. The results shows that 12(15%) of the respondents believe that its relative advantage will help them adopt new innovations. Similarly, majority of the farmers 22(27.5%) reported its compatibility, while 13(16.2%) and 17(21.2%) reported its level triability and observability. Lastly 16(20%) of the farmers believe that all of the above mentioned will help in better adoption of new agricultural innovations.

Table 4.12 : Problems farmers encountered while accepting New Innovations

Responses	Frequency	Percentage (%)
Farmers neglect accepting advice from Extension Workers	38	47.8
Most of the farmers are too conservative	42	52.5
Total	80	100%

Source: Survey Results, 2011

Table 4.12 above have shown that 38(47.8%) of the respondents neglect accepting advice from Extension workers, while majority 42(52.5%) of the respondents are too conservative. This attitude affects acceptance of new innovations in the study area. More awareness campaign is needed to change this attitude and traditional institutions should be involved in this campaign.

V. Summary, Conclussions and Recommendations

a) Summary

The purpose of this paper is to assess the factors affecting acceptance of agricultural innovation in Zurmi Local Government in Zamfara State of Nigeria. The study examines how farmers manage their crops and livestock and why traditional method is accepted by farmers. Furthermore, the researcher investigated why new innovations were rejected and the role of government in motivating farmers to accept new innovations. A total sample of 80 respondents were selected out of the selected six wards to represent the entire Local Government. Data was analysed using various statistical tools. The results of the study is presented as follows.

b) Conclusions

The major conclusions drawn from this paper were: -

- Results of the study regarding what discourage farmers to accept new innovations have shown that majority 50(62.5%) of the respondents reported lack of finance, while 10(12.5%) and 25(25%) reported lack of understanding of the concept of innovations and lack of access to services offered by agricultural Development Project in the area is responsible.
- Perception of respondents regarding new technology delivered by Extension workers revealed that majority 64(80%) of the respondents agreed new packages were delivered to them, while only 16 (20%) agreed new packages were not delivered to them.
- Data regarding responses to new innovations have shown that 28(35%) of the respondents accepted new innovations, while 52(65%) rejected the idea.
- Survey results regarding why new innovations were rejected revealed that 27(33.75) of the respondents reported poor roads is responsible, while 13(16.2%) were not interested in accepting new innovations at all. Similarly, 40(50%) reported financial constraints is responsible for not accepting new innovations.
- Opinion regarding problems farmers encountered while accepting new innovations have shown 38(47.5%) of the respondents neglected advice offered by Extension Workers, while majority 42(52.5%) of the respondents are too conservative.
- Perception of respondents regarding what should government do to encourage farmers to accept new innovations revealed that majority of the farmers 48(60%) agreed that government should give loans to them. Similarly, 22(27.5%) agreed that more extension advice should be delivered. Only 10(12.5%) would want government to sell inputs at subsidised rates.

c) Recommendations

On the basis of the above conclusions, the following recommendations are made: -

- Agricultural Development Project and Local NGOs should encourage mass literacy campaign to educate farmers on new agricultural innovations.
- Government should provide adequate infrastructural facilities like good roads, water, transport and accommodation for Extension Workers who are posted to work in rural areas.
- Agricultural inputs should be provided to the farmers by government agencies and NGOs at subsidised rate to enhance effective participation by farmers in the study area.
- Storage facilities should be provided to the farmers to enable them store their harvested crops for future use.

- Extension Agents should continue to visit farmers regularly so as to teach the farmers new innovations coming from Agricultural Research Institute.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Effect of Planting Time and Cultivar on Soybean Performance in Semi-Arid Punjab, Pakistan

By Muzammal Rehman, Tasneem Khaliq, Ashfaq Ahmad, Syed Aftab Wajid, Fahd Rasul, Jamshad Hussain & Saddam Hussain

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Abstract- A field study was undertaken to optimize the planting time for different soybean cultivars in agro-ecological conditions of Faisalabad, Punjab. The experiment was comprised of planting times (21st January, 28th January, 4th February, 11th February and 18th February) and two cultivars (SA 72-60 and Faisal soybean). Replicated three times, the experiment was laid out in randomized complete block design with split plot arrangement having planting time in main-plot and cultivar in subplot. Data were collected on number of pods per plant, number seeds per plant, plant height, 1000- seed weight, seed yield, biological yield, protein percent and oil percent. Statistical analysis of data revealed significant differences among means of traits at different planting date treatments. Cultivars with early planting produced higher yield and quality as compared to the late planting dates. The results revealed that higher numbers of pods per plant and number of seeds per plant were produced by 28th January and Faisal soybean. Similarly maximum seed yield (1647.10 kg ha-1 and 1440.23 kg ha-1) were also produced by 28th January, Faisal soybean and 21st January, Faisal soybean, respectively. Thus 28th January planting was the best for high yield of spring soybean. While, among two cultivars Faisal soybean performed the best in Faisalabad.

Keywords: *planting date, quality, soybean cultivar, seed yield.*

GJSFR-D Classification : *FOR Code: 820405, 070103*

Strictly as per the compliance and regulations of :

Effect of Planting Time and Cultivar on Soybean Performance in Semi-Arid Punjab, Pakistan

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Abstract- A field study was undertaken to optimize the planting time for different soybean cultivars in agro-ecological conditions of Faisalabad, Punjab. The experiment was comprised of planting times (21st January, 28th January, 4th February, 11th February and 18th February) and two cultivars (SA 72-60 and Faisal soybean). Replicated three times, the experiment was laid out in randomized complete block design with split plot arrangement having planting time in main-plot and cultivar in subplot. Data were collected on number of pods per plant, number seeds per plant, plant height, 1000-seed weight, seed yield, biological yield, protein percent and oil percent. Statistical analysis of data revealed significant differences among means of traits at different planting date treatments. Cultivars with early planting produced higher yield and quality as compared to the late planting dates. The results revealed that higher numbers of pods per plant and number of seeds per plant were produced by 28th January and Faisal soybean. Similarly maximum seed yield (1647.10 kg ha^{-1} and 1440.23 kg ha^{-1}) were also produced by 28th January, Faisal soybean and 21st January, Faisal soybean, respectively. Thus 28th January planting was the best for high yield of spring soybean. While, among two cultivars Faisal soybean performed the best in Faisalabad.

Keywords: planting date, quality, soybean cultivar, seed yield.

I. Introduction

Soybean is classified more as an oil seed crop than as a pulse. It contains 40-42% of proteins and 18-20% of oil (Devi et al., 2012). Due to its high nutritional value there is an increasing demand of soy food e.g. soymilk, soybean sprouts, soy nuts, several types of tofu, cottage cheese and curd (Rao et al., 2002). In Pakistan, seed yield of soybean is very low as compared with its yield potential and the average of world. Despite numerous uses, its low yield at field level has lessened its popularity among Pakistani farmers because there is a lack of interest for growing the edible oilseed crops among the growers. There are many factors limiting soybean production at farmers farm. Among these factors improper planting time, climatic variability, low germination percantage poor quality seed irrigation shortage. Exploring the soybean varietal and agronomic flaws can help us to bridge this gap. Quick germination and even crop stands are essential for obtaining higher yield levels (Yari et al., 2010). Another possible reason of low production is the non-adoption of new developed cultivars with higher nutrition requirements. The sowing of soybean cultivars of high yield potential at optimum planting time is considered as a hopeful approach to increase soybean production. Choices of cultivar play a great role in increasing soybean production. Generally, the planting time varies depending on the climatic condition of the region and the cultivar to be grown. Different cultivars of soybean are sensitive to change in environmental conditions where the crop is being planted. Therefore, it is also necessary to study the genotype × environment interaction to identify the varieties which are stable in different environments (Calvino et al., 2003a). The previous studies showed that the early or late planting significantly decreased the crop yield (Rehan, 2002). Sowing date is the variable with the largest effect on crop yield (Calvino et al., 2003a, b). Proper management of soybean by planting date is an excellent approach to increase both crop yield and economic benefit. Effects of planting time on soybean yield and other traits varied at locations (Naeve et al., 2004). Environmental conditions associated with late planting affect crop features related to the capture of radiation and portioning of crop resources. These include less vegetative growth (Board et al., 1992), shorter stems (Boquet, 1990); lower reproductive nodes (Board et al., 1999), and shortening of the reproductive phases (Kantolic & Slafer, 2001). In spring-sown single crops of soybean, yield is most susceptible to nutritional and water deficits during late flowering and grain filling, and grain number is the main yield component involved in this response (Andriani et al., 1991). Delayed planting generally shifts reproductive growth into less favorable conditions with shorter days and lower radiation and temperature (Egli & Bruening, 2000). In a simulation study, Egli and Bruening (1992) found that reduced radiation and temperature accounted for most of the reduction in yield associated with late planting in well watered soybean crops reaching maturity in late season. CROPGRO-soybean model can be used to simulate the growth and development of soybean. So for determining the best planting time of spring soybean, CROPGRO-soybean model from the DSSAT (Decision Support

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System for Agro-technology Transfer) of United States could be calibrated. The objective of present study was to evaluate the effect of planting times and cultivars on yield and quality attributes of soybean in agro-ecological conditions of Faisalabad, Pakistan.

II. Materials and Methods

In order to evaluate the effects of planting date and cultivar on various yield and quality attributes of soybean, a split plot experiment based on randomize complete block design with three replications was conducted at Agronomy Research Farm, University of Agriculture, Faisalabad, Pakistan (31.25° N, 73.09° E, and 184 m above sea level) during the spring 2012. Due to high evapotranspiration, Faisalabad features a semi-arid climate with mean annual rainfall of about 200 mm. The soil of the experimental site was a sandy clay loam with proportion of sand, silt and clay as 51.15, 22.50 and 26.35%. Soil pH and EC was 7.7 and 0.94 dSm^{-1}, respectively. The organic matter, total nitrogen, available phosphorus and potassium were 0.68%, 0.062%, 14 mg kg^{-1} and 188 mg kg^{-1}, respectively. The Bulk density and cation exchange capacity was 1.44 g CC^{-1} and 4.3 $cmol_c$ kg^{-1}.

Five planting dates including 21st January, 28th January, 4th February, 11th February and 18th February (T_1, T_2, T_3, T_4 and T_5, respectively) were considered as main plots and the cultivars including SA 72-60 and Faisal soybean (V_1, and V_2, respectively) were also considered as sub- plots. Each sub plot was consisted of six rows 6 m long and 30 cm apart. While, the distance between plants on each row was 5 cm. Crop management factors like land preparation, fertilizer, and weed control were followed as recommended for local area. All the plant protection measures were adopted to make the crop free from insects. The data were recorded on ten randomly selected plants of each entry of each replication for number of pods per plant, number of seeds per plant, plant height, 1000- seed weight, seed yield and biological yield was recorded. The protein and oil contents of soybean seeds were obtained by using Kjeldhal's method and Rooskhvisky's method, respectively. The analyzed statistically by using Fisher's Analysis of Variance Technique and least significant difference (LSD) test at 5% probability level (Steel et al., 1997).

III. Results and Discussion

Analysis of data revealed that all the yield and quality related attributes were significantly ($p \leq 0.05$) affected by various planting times. However, response of different cultivars varied only for number of pods per plant, number of seeds per plant, plant height and seed yield. The interaction between these two factors was also non-significant for all parameters recorded.

a) Number of Pods Per Plant

Data (Table 1) regarding number of pods per plant revealed a decrease with delay in planting time. Maximum number of pods per plant (29.53) was produced by 28th January planting. Regarding different cultivars, Faisal soybean produced significantly more number of pods per plant (21.79) as compared to SA 72-60 (20.19).These results are matched with the findings of Ahmed et al. (2010) on soybean pods. In another experiment Ahmed et al. (2008) also recorded the similar results. Number of pods per plant was affected significantly by genotype (Hwang, 1998).

b) Number of seeds Per Plant

Analysis of data revealed that maximum number of seeds per plant (81.23) was recorded for those plots grown on 28th January. These results are quite similar to the findings of Calvino et al. (2003b) who reported higher number of seeds per plant in early planting as compared to late planting. In cultivar, maximum number of seeds per plant 58.72 was recorded in Faisal soybean. There was also lot of difference between the size and weight of seeds during early and delayed planting. These results are quite in line with the findings of Lee and Hwang (1998) who reported that number of seeds per plant was significantly affected by genotype.

c) Plant Height (cm)

Plant height represents the phenology and growth of crop. The plant height was affected significantly by different planting times (Table-1). 28th January planting produced significantly taller plants 96.23 cm than all other treatments. Likewise, among the two varieties Faisal soybean produced statistically taller plants 80.83 cm against significantly the lowest plant height of 76.16 cm for SA 72-60. The greater plant height recorded in 28th January was probably due to comparatively longer growing period along with the optimum environmental conditions. These results are in line with those of reported by Wade and Johnston (1975) who stated that photoperiod sensitivity had marked reduction in growth period due to delayed seeding might account for decrease in plant height.

d) 1000-Seed Weight (g)

Planting time treatments showed that maximum 1000-seed weight of (74.79 g) soybean was recorded in T_2 (28th January), which was statistically at par with T_1 (71.85), when planting was done on 21st January. These two treatments were statistically at par with each other against the minimum 1000-seed weight (65.97 g) was observed in T5 (18th February). This might be due to the short vegetative growth period and long reproductive and grain filling period, that significantly raised the 1000-seed weight. These results are similar with Pedersen and Lauer (2004), in case of soybean, who stated that average seed weight from early sowing was higher than that from late sowing. Early planted varieties got more

time and growth period to accumulate more photo-assimilates. Furthermore, high temperature caused shrinking of seeds during late planting. There was statistically similar behavior of two varieties Faisal soybean and SA 72-60 with 1000-seed weight of (70.96 g) and (70.63 g), respectively. The delaying of planting time than 28th January caused decrease in seed weight. Seed yield is affected by the seed weight. These results are matched with the findings of Adeniyan and Ayoola (2007). However, the interactive effect of varieties and planting time was non-significant.

e) Seed Yield kg ha $^{-1}$

Data (Table 1) depicted that seed yield of soybean was significantly ($p \leq 0.05$) affected by different sowing dates and cultivars. Maximum seed yield 1530.2 kg ha^{-1} was recorded in 28th January planting which was statistically at par with the yield of 21st January, but significantly higher than rest of planting dates. Higher seed yield in T_2 might be due to greater leaf area closely related to Kumudini et al., (2001) reported that Greater leaf area enhanced the grain yield due to increased interception of solar radiation and healthier carbon exchange rate. Among cultivars Faisal soybean produced significantly higher seed yield of 1228 kg ha^{-1} as compared to 1121.9 kg ha^{-1} produced by SA 72-60. These results are in line with the results of Evans (1996), who concluded that genotypes had a significant effect on the seed yield. Results revealed that with the delayed planting of spring soybean after January its yield lost drastically over time because it results decrease in vegetative and reproductive growth. Late planting due to the loss of suitable time for the growth, the plant was not achieved its potential ability because light interception and crop simulates partitioning were severely affected and consequently lead to yield decline. In case of early planting there was more time for plant growth in optimum temperature and moisture, so seed yield increasing is rational. With late planting the growth period becomes short. High temperature during flowering decreases the seed yield and yield components of soybeans. In another studies, the delayed planting decrease the yield (Kane et al., 1997; Board et al., 1999; Egli & Bruening, 2000; Kantolic and Slafer, 2001). Similar results were recorded with late planting by Ahmed et al. (2010), Calvino et al. (2003) and Ngalamu et al. (2012).

f) Biological Yield kg ha $^{-1}$

Analysis of data revealed that biological yield of soybean was significantly influenced by different planting dates. Late planting of spring soybean after January resulted in drastic biomass reduction over time. Among five planting dates, spring soybean produced significantly higher biological yield of 4431 kg ha^{-1} and 4308 kg ha^{-1} with T_2, and T_1 respectively, against the lowest T5 (3949.3 kg ha^{-1}). However, No meaningful difference between cultivar SA 72-60 and Faisal soybean with respect to biological yield was recorded (Table 1). Same results were recorded with the late planting by Ngalamu et al. (2012), Ahmed et al. (2010) and Calvino et al. (2003) in their experiments.

g) Protein Contents (%)

Analysis of data (Table 1) revealed that protein concentration of soybean seeds was significantly affected by planting times. Early planted soybean (T_1: 21st January) produced seeds with lower protein percentage of 31.65 %. However, the protein percentage was increased with delayed planting as late planted (T_4) crop gave maximum protein percentage of 33.53 % which was comparable with T_5 (33.32 %). This maximum protein percentage might be due the optimum temperature during the seed development and maturity. While, the lower percentage with early planted crop was due to the effect of environmental factors, such as high temperature and photoperiod at maturation. No significant difference was recorded between cultivars regarding protein percent. These results are in line with those of reported by Khan et al., (2001) who stated that protein contents in late planted crop were higher than the early planted crop. The results are also matched with the findings of Moosavi et al., (2011).

h) Oil contents (%)

Results regarding percentage of oil in soybean seeds showed that there was meaningful difference between effects of different planting times on this trait. While, no significant variation was recorded in different cultivars. Interactive influence of these two factors was also non-significant (Table 1). Highest oil percentage was recorded in T_1 (20.90 %) followed by T_2, T_3 and T_4 which were statistically at par with each other. Delay in sowing decreased concentration of oil and seeds harvested from T_5 gave minimum oil percentage of 18.92 % statistically similar with T_4. The seeds harvested from early sowing developed and matured at high temperature which resulted in maximum oil percentage as compared to late planted crop. Suryavashi et al. (1993) and Wolf et al. (1982) reported more oil contents from seeds matured at high temperature than the seeds matured at low temperature. Nishioka and Okumura (2008) also concluded similar results and suggested that the increased oil contents with early planting. Hu and Waitrak (2012) reported that high temperature associated with delayed planting can have a negative effect on yield and quality of soybean seeds by changing the protein and oil contents. Planting methods affected the oil percentage and highest oil percent was found in early planting Calvino et al. (2003a).

In crux, it is concluded that early planting of soybean (21 January) is more appropriate in terms of higher yield than late-sown crop in agro-ecological conditions of Faisalabad. Under these conditions cultivar Faisal soybean seems more suitable than SA 72-60, as it outperformed regarding productivity.

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Fig. 1 : Mean Weekly Weather Data for Soybean Growing Season January - June in 2012.

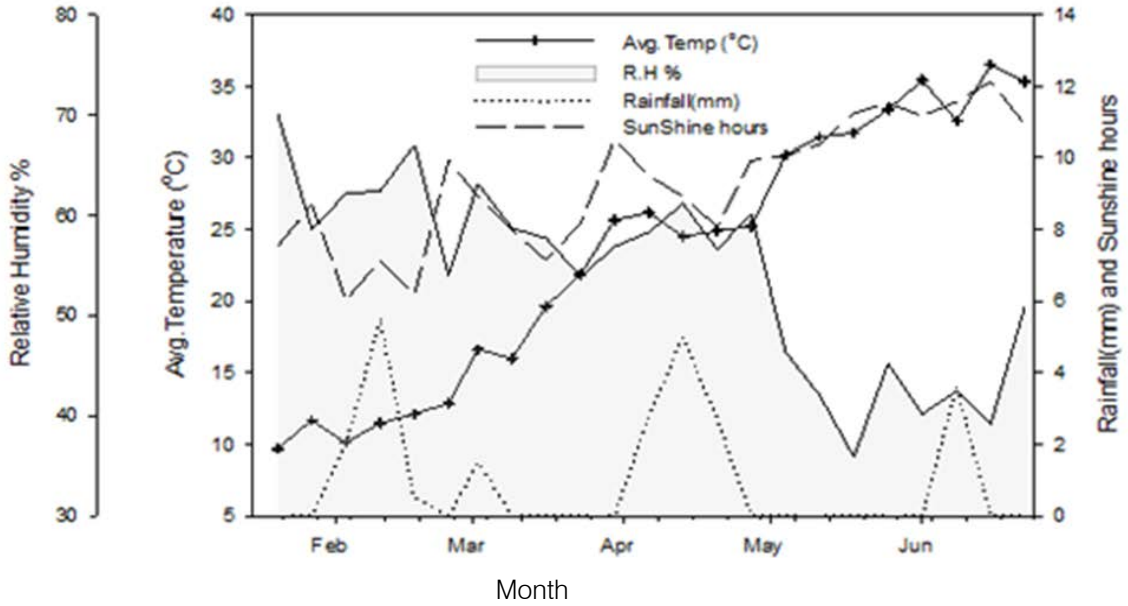

Table 1 : Effect of Various Plant Times on Yield and Quality Attributes of Different Soybean Cultivars.

Treatment	Number of pods per plant	Number of seeds per plant	Plant height (cm)	1000-seed weight (g)	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Protein percent	Oil percent
Variety								
SA 72-60	20.19 b	53.58 b	76.16 b	70.63	1121.9 b	4165.7	32.61	19.84
Faisal soybean	21.79 a	58.72 a	80.83 a	70.96	1228.0 a	4221.3	32.98	20.10
LSD	1.03	2.28	3.75	NS	103.22	NS	NS	NS
Planting time								
T_1 = 21st Jan	21.97 b	57.81 b	91.13 a	71.85 ab	1413.3 a	4308.0 ab	31.65 c	20.90 a
T_2 = 28th Jan	29.53 a	81.23 a	96.23 a	74.79 a	1530.2 a	4430.5 a	32.57 b	20.60 ab
T_3 = 4th Feb	21.43 b	57.95 b	78.77 b	71.48 b	1193.8 b	4187.0 bc	32.92 ab	20.05 bc
T_4 =11th Feb	19.10 b	50.04 c	65.83 c	69.88 b	929.8 c	4092.8 cd	33.53 a	19.37 cd
T_5 = 18th Feb	12.90 c	33.73 d	60.50 c	65.97 c	807.7 c	3949.3 d	33.32 a	18.92 d
LSD	3.44	3.97	6.44	3.14	175.69	204.90	0.64	0.77
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Study of the Quality of under Ground Water of District D. G. Khan, Southern Punjab (Pakistan)

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Abstract- To analyzing the EC (µS/cm), RSC (meq/L) and SAR for assessing the quality of ground water of District Dera Ghazi Khan Southern Punjab (Pakistan). About 16555 water samples from D. G. Khan Tehsil and 5500 water samples from Tehsil Taunsa Sharif were collected. On the basis of RSC water samples show highly fitness. In Tehsil D. G. Khan it was 99% fit, correspondingly same result were drown from Taunsa Sharif. However on SAR basis ground water quality were noted that 98% from D.G. Khan and 97% from Taunsa Sharif were fit. Finally classifying the water samples on the three quality parameters EC (µS/cm), RSC (meq/L) and SAR in Tehsil D. G Khan and Taunsa Sharif following result were set up in (Table 6) that point out 60.60% water samples were consider fit, 5.65% marginally fit and 33.75% unfit, respectively. In Tehsil Taunsa Sharif, 29.07% samples were fit, 4.02% were marginally fit and 66.91% were unfit.

Keywords: ground water, electrical conductivity, SAR, RSC, fit, marginally fit, unfit.

GJSFR-D Classification : FOR Code: 060204, 960807

Strictly as per the compliance and regulations of :

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I. Introduction

The existence of life depends on water. Life without water cannot be expected and is thought to be impossible. It is the main necessity of the whole world. Water exists naturally in two forms, surface water and groundwater. Groundwater plays an important role for irrigation and live stock purpose. Groundwater is the mixture of various contents because it passes through the underground rocks and during its passage it combines with different substances, which makes it favor for various serving purposes (Ramkumar et al., 2009). The assessment of irrigated water depend on the composition of salt and salt inducing body, presence the plenty of micro and macro nutrients, trace elements, alkalinity, acidity, stability and the amount of suspended solids (U.S. Salinity Laboratory Staff, 1954; Ajayi et al. 1990). However Irrigated water brings some dissolved salts from sources (Michael, 1985). The quality and quantity of these dissolved salts depend on the source. Usually most water dissolved substance include sodium (Na^{+}), magnesium (Mg^{+2}), calcium (Ca^{+2}), sulphate ($SO4^{+2}$), nitrate ($NO3^{-1}$), chloride (Cl^{-}), boron (Br), carbonate ($CO3^{-2}$) and bicarbonates ($HCO3^{-2}$). The amount and concentration of these dissolved ions determine the fitness of water for irrigation (Ajayi et al., 1990).The common quality parameters are Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC). Chemically irrigated water affect the growth of plant directly (toxicity or deficiency) or indirectly by altering the composition of plant nutrients. (Ayers and Westcot, 1985; Rowe et al., 1995).Climatic change also influence the good quality of irrigated water from humid to arid conditions. Salts are originated from weathering of rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. These substances are transferred from water resource to wherever it is used (UCCC, 1974; Tanji, 1990). Sufficient supplies of useable quality water would increase the requirement of irrigated agriculture. Lower quality of irrigated water adversely affects the production rate of crops (Bello, 2001). But unfortunately quality of irrigated water should be deserted (Shamsad and Islam, 2005; Islam et al., 1999). Due to various factors the surface water resources of Pakistan has been reduced down about 70% (Kahlown et al., 2003). Unfortunately, canal water is inadequate to meet the requirement of crops under severe harvesting system in Punjab (Ahmad and Chaudhary, 1988; Ahmad et al., 2007). For this requirement, there were about 250,000 public and 350,000 private tube wells working in various irrigated parts of country in the year 2000 (Alam, 2002). In which more than 70% are of poor quality (Qureshi and Barrelt-Lennard, 1998).

Keeping in view the importance of irrigation water quality, the present study was contemplated with the following objectives. i) to ensure the quality of tubewells water for irrigation and ii) suggest the different option to improve the adverse effects of poor quality of irrigation water on soil and crop yields on the command area of district Dera Ghazi Khan.

II. Materials and Methods

a) Description of study area

Dera Ghazi Khan District is situated between river Indus and Suleiman range and lies between 20.40 North and 70.75 East. The total geographical area of the district is 4.07 million hectares out of which 2.36 million hectare area is cultivated while 68.03 hectare under forest and the rest are either not available for cultivation or cultural waste. Out of the cultivated area of 7, 15,846 hectares are canal irrigated and rest is barren. The

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climate of district is dry with very little rain fall. The winter is cold and summer is very hot. The annual rainfall in the district is insufficient.

b) Water sampling

To achieve the goal of this research, the study was revealed in the Soil and Water Testing Laboratory for Research Dera Ghazi Khan having two Tehsils (Tehsil D.G. Khan and Tehsil Taunsa Sharif). The water samples were collected from different tubewells using GPS. The samples were collected in plastic bottles after the 30 minutes operation of tubewells. The water samples were collected at the depth of 80-250 feet.

c) Water analysis

The water samples were analyzed at Soil and Water Testing Laboratory for Research, Dera Ghazi Khan for electrical conductivity, cations (Ca+2+ Mg+2, Na+) and anions (CO3-2, HCO3-1 and Cl-1) by the methods described by Page et al.,(1982). Residual sodium carbonates (RSC) and Sodium Adsorption Ratio (SAR) were calculated according to the procedure described by Washington DC Method (1954). The collected water samples were analyzed on the basis of following criteria regarding their suitability for irrigation purpose.

d) Water quality criteria

Table 1 : Criteria of parameters used for water analysis

Parameters	Fit	Marginally fit	Unfit
EC (µS/cm)	0-1000	1000-1250	>1250
SAR	0-6	6-10	>10
RSC (meq/L)	0-1.25	1.25-2.50	>2.50

e) Results

Table 2 : Range, mean and standard deviation (SD) of cations, anions and irrigated water quality parameters of district D.G Khan (Tehsil D.G Khan & Tansua sharif)

Tehsil		EC (µS/cm)	Ca + Mg (meq/L)	Na (meq/L)	CO_3^{-2} (meq/L)	HCO_3^{-1} (meq/L)	Cl^{-1} (meq/L)	SAR	RSC meq/L
D.G. Khan	Range	70-999	0.19-9.92	0.0-9.90	0.02-11.3	0.04-9.90	0-9.69	0.02-9.57	0.01-10.3
	Mean	1130.448	7.602665	3.997104	1.344567	6.056278	3.310596	2.07355	1.379247
	SD	715.8134	14.36571	3.599562	1.237315	9.055964	4.366961	1.373505	1.116693
Taunsa Sharif	Range	201-9900	1.02-9.80	0.1-9.90	0.08-3.69	0.1-3.50	0.1-7.3	0.8-8.96	0.0-12.78
	Mean	1582.438	10.84279	5.267601	1.133859	8.278326	4.922256	2.360902	2.556875
	SD	1032.563	20.06196	4.92646	0.608702	4.914243	15.56307	5.526436	3.770826

Table 3 : Classification of water sample on the basis of EC (µS/m) in Tehsil D. G. Khan and Tehsil Taunsa Sharif

Sites	Total Samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G. Khan	16555	10034	60	934	6	5587	34
Taunsa Sharif	5497	1598	29	221	4	3678	67

On the basis of RSC water samples show highly fitness. In Tehsil D.G. Khan about 99% were fit, 0.59% were marginally fit and just 0.30% were found unfit. Similarly, same behavior was observed in Tehsil Taunsa Sharif, which indicated 99.9% fit, only 0.01% marginally fit and 0.09% were unfit. (Table 4)

Table 4 : Classification of water sample on the basis of RSC (meq/L) in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total Samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G. Khan	16555	16406	(99)	98	(0.59)	51	(0.30)
Taunsa Sharif	5497	5491	(99.9)	1	(0.01)	5	(0.09)

On SAR basis it was noted that in Tehsil D.G. Khan 98% samples were fit, 1.50% were marginally fit and 0.19% samples were observed unfit. Correspondingly same results were found in Tehsil Taunsa Sharif , it showed that 97% were fit, 1.80% were marginally fit and 0.56% were examine unfit.(Table 5)

Table 5 : Classification of water sample on the basis of SAR in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D. G. Khan	16555	16299	(98)	244	(1.50)	32	(0.19)
Taunsa Sharif	5497	5367	(97)	99	(1.80)	31	(0.56)

Finally classifying the water samples on the three quality parameters EC (μS/cm), RSC (meq/L) and SAR in tehsil D.G Khan and Tansua sharief following result were set up in table 6. It point out that 60.60% water samples were consider fit, 5.65% marginally fit and 33.75% unfit respectively. In tehsil tansua sharif 29.075 samples were fit, 4.02% were marginally fit and 66.91% checked unfit (table 6).

Table 6 : Classification of water sample on the basis of EC (μS/cm), RSC (meq/L) and SAR in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G Khan	16555	10032	(60.60)	935	(5.65)	5588	(33.75)
Taunsa Sharif	5497	1598	(29.07)	221	(4.02)	3678	(66.91)
	22052	11630	(52.73)	1156	(5.24)	9266	(42.01)

III. Discussions

The quality of ground water for agricultural use was the main concern of this study. On the basis of classification, the analytical data shows that 34 % and 67 % water samples were found to be unfit due to EC in Tehsil D. G. Khan and Tehsil Taunsa Sharif, respectively containing high content of soluble salts. But in case of SAR only few water samples (0.19% and 0.56%) of both Tehsils were found to be unfit (Table 5). Regarding RSC same trend was found in both Tehsils (Table 4). On over all basis it was noted that all the three parameters are considered to see the fitness of the quality status of underground water. In both of the Tehsils, it was observed that 42 % tube wells were delivering poor quality of water and ultimately causing gradual increase of deposition of salts and deteriorating the soil health as well as crop quality and yield (Table 6). Some investigations revealed that poor quality of water exerted hazardous effects on soil quality, soil fertility and ultimately on plant health. There are many factors that are responsible for salinity of ground water, including climate of that region, soil type and the amount of precipitation. Generally these problems occurred in tropical region where annual rainfall is infrequent. Due to low precipitation amount of salts increased in these regions.

IV. Recommendations

So keeping in view the gravity of the problems using poor quality water it is strongly recommended that either canal water should be mixed with such waters before use or such waters must be treated with certain suitable amendments such as gypsum or sulfuric acid in order to maintain soil health on sustainable basis for better crop yields.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Factors Affecting L-Band Alos Palsar Backscatter on Tropical Forest Biomass

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Abstract- Above ground biomass (AGB) is one of the key parameters for carbon accounting in a forest area. However, estimating this parameter by using remote sensing approach has been challenging as the interpretation of remotely sensed data are constrained by various factors, especially in a complex tropical forest ecosystem. Synthetic aperture radar (SAR) sensor system has its potential in obtaining acceptable AGB estimation but several issues such as complex forest structure and saturation at certain biomass levels remain unanswered and continuously being studied. This study was carried out to identify factors that contribute to the variation of backscattering properties on forest biomass. The sensitivity of L-band backscatter from Alos Palsar satellite with a wavelength of about 23 cm to the forest biomass was examined. Natural and logged forests of Dungun Timber Complex in Terengganu, Peninsular Malaysia were selected as the study area. AGB at a number of sample plots were measured on the ground in the study area. Both aspects of forestry and remote sensing comprised several variables namely tree allometry, vertical forest strata, tree diameter classes, radar polarimetry, and spatial variability were examined in four experiments. AGB was calculated based on these parameters and tested by using statistical backward elimination method to identify the most significant factor that infer the backscatter. The study revealed that the L-band Alos Palsar backscatter interacts only with canopies of forest at certain size of trees.

Keywords: *alos palsar, aboveground biomass, tropical factors, saturation.*

GJSFR-D Classification : *FOR Code: 960806, 300699*

Strictly as per the compliance and regulations of :

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Abstract- Above ground biomass (AGB) is one of the key parameters for carbon accounting in a forest area. However, estimating this parameter by using remote sensing approach has been challenging as the interpretation of remotely sensed data are constrained by various factors, especially in a complex tropical forest ecosystem. Synthetic aperture radar (SAR) sensor system has its potential in obtaining acceptable AGB estimation but several issues such as complex forest structure and saturation at certain biomass levels remain unanswered and continuously being studied. This study was carried out to identify factors that contribute to the variation of backscattering properties on forest biomass. The sensitivity of L-band backscatter from Alos Palsar satellite with a wavelength of about 23 cm to the forest biomass was examined. Natural and logged forests of Dungun Timber Complex in Terengganu, Peninsular Malaysia were selected as the study area. AGB at a number of sample plots were measured on the ground in the study area. Both aspects of forestry and remote sensing comprised several variables namely tree allometry, vertical forest strata, tree diameter classes, radar polarimetry, and spatial variability were examined in four experiments. AGB was calculated based on these parameters and tested by using statistical backward elimination method to identify the most significant factor that infer the backscatter. The study revealed that the L-band Alos Palsar backscatter interacts only with canopies of forest at certain size of trees.

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I. Introduction

Synthetic aperture radar (SAR) is well known because of its capability to penetrate cloud cover has been recognized as the most signif-ycant advantage compared to optical sensor system. The advantages of obtaining cloud-free, wall-to-wall images are greater for a tropical region, like Malaysia. Studies that concentrated on the uses of SAR data for biomass estimations indicated that the system is probably the best option available for a landscape as well as regional studies, at reasonable spatial resolution (Saatchi et al. 2011). However, because tropical forests contain large amount of biomass, special attention needs to be paid concerning the limitation of backscattering intensity in complex forest structures. Previous research indicated that long-wavelength radar data have the advantage in estimating aboveground biomass (AGB) on complex forest stand structures. Specifically, SAR L-band data have proven to be valuable for biomass estimation, particularly AGB (Quinones and Hoekman, 2004; Hamdan et al. 2011; Le Toan, 2011). While L-band SAR systems offer some advantages in estimating forest biomass, the saturation problem is common in radar data (Imhoff, 1995b). It means that the sensitivity of the backscattering intensity will cease at certain threshold of biomass. This has been identified as a critical challenge in the last decade (Lu, 2006). The saturation levels depend on the polarization and the structure of the forests. However, the sensitivity of the backscatter and the saturation level seem to be rather site dependent, since forest structure influences the relative contribution of the scattering mechanism (Imhoff, 1995a, Lucas et al. 2010).

When a SAR sensor transmits the radar pulse, the transmitted energy is called forward scattering and the returned signal after it interacts with a forest is known as backscatter. The forest stand structure will cause attenuation of the signal and the forest structure itself is referred to as scatterers or scattering mechanism. It is much influenced by the dielectric and structural properties of the forest structure, which consist of canopy, leaves, branches and trunk of trees. In this situation, the forest medium can be considered as a homogenous medium containing a large number of scatterers of a single category. The backscatter intensity depends mainly on the orientation, size and dielectric constant distribution of the backscattering and forward scattering functions (Chen et al. 2009).

Backscatter is normally low (approximately -25 to -18 dB) in non-vegetated areas such as clear-cuts or burnt areas (Santoro et al. 2009). In addition, the individual contribution to the total forest backscatter is also dependent on the environmental conditions (i.e. weather conditions, moisture conditions, and weather dynamics) because it can affect the dielectric properties of the vegetation and ground surface. However, a similar forest ecosystem in a specific area can yield different backscatters because SAR can propagate through varying wavelength, polarization and incidence angle. The interactions between the radiation and the plant's internal properties (e.g. moisture content influencing the dielectric constant of a material and cell structure) and external components (e.g. size, geometry and

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orientation of leaves, trunks, branches, and aerial or stilt roots) also result in specific backscatter values (Kuenzer et al. 2011).

Radar backscatter increases approximately linearly with biomass until it saturates at a level that depends on the radar frequency. However, L-band backscatter cannot measure biomass directly since the backscattered waves interact mostly with the canopy layer (leaves/needles and branches), which contains only a fraction of the total tree biomass (Imhoff, 1995a). Canopy biomass however is often a reliable indicator of total tree biomass, allowing for indirect relationships to be formed between radar and forest inventory data. Estimation of stem volume, biomass, basal area and other forest stand parameters are possible by developing regression models between stand parameters and radar backscatter.

Investigations (i.e. Pullianen et al. 1999; Watanabe et al. 2006; Watanabe and Shimada, 2006; Narvaes et al. 2007; Sandberg et al. 2011) reported an increase of L- band backscatter with increasing forest growing stock volume or aboveground biomass and with increasing canopy density and height. In this situation, the backscatter contribution from the forest floor declines and the volume scattering contribution from the canopy increases. However in many cases saturation will occur. Saturation has been reported to occur in biomass ranges of 80 to 150 Mg ha-1 for savanna (Lucas et al. 2010), 40 to 150 Mg ha-1 for boreal and temperate forests (Sandberg et al. 2011) and 40 to 150 Mg ha-1 in the tropics (Saatchi et al. 2011). Luckman et al. (1997) found that the longer-wavelength (L-band) SAR image was more suitable to discriminate different levels of forest biomass up to a certain threshold. L-band backscatter shows no sensitivity to increased biomass density after the threshold, such as 40 Mg ha-1, has been met, indicating that it may be suitable for estimating biomass of regenerating forests in tropical regions.

Saturation level varies with the type and structure of the forest. It was demonstrated that the sensitivity of polarimetric SAR is depending on the structure, density and the tree elements (i.e. trunk/stem, branches and leaves) of the forests (Imhoff, 1995a). The accuracy is mostly influenced by the tree density, tree sizes, soil surface roughness, soil moisture, and the layering effects of the SAR itself (Quinones and Hoekman, 2004). Factors such as orientation of the trees, polarimetry, incidence angle, and crown structure also play an important role in the biomass estimation (Watanabe et al. 2006; Guo et al. 2009). Tree height was the prominent factor that affected backscattering. Nevertheless variations in the floristic composition, forest structure and management practices can have an important effect on the results (Narvaes et al. 2007). Using backscatter values, Beaudoin et al. (1994) found that the horizontal-horizontal (HH) polarization return was related to both trunk and crown biomass, and the vertical-vertical (VV) and horizontal-vertical (HV) polarizations returns were linked to crown biomass. Kuplich et al. (2000) used JERS1 data for AGB estimation of regenerating forests and concluded that these data had the potential to estimate AGB for young, regenerating forests following block logging rather than selective logging.

However, these studies were conducted in forest types and ecosystems different from Malaysia. In Malaysia there are limited studies on the applications of SAR for estimating biomass. Out of many studies conducted worldwide, very few have been done in Malaysia (viz. Morel et al. 2011; Morel et al. 2012; Hamdan et al. 2011; Hamdan et al. 2013). This indicates that the potential, limitations and advances of L-band SAR in estimating tropical forest in Malaysia are not explored extensively. Methods to apply this SAR system are also scarcely exploited.

There are several issues that can be related to the biomass estimations using L-band SAR data in Malaysia's forests. These issues can be generalized into three major groups, which are (i) the natural conditions of the forest that is native to Malaysia, (ii) the forest management system being practiced, and (iii) the technical issues related to the remote sensing system being used. Therefore this study was conducted to address these issues that arise from the technical configurations of the polarimetric L-band SAR as well as the circumstances of forests in Malaysia. The study allowed all possible parameters that can be generated from both imagery and forestry aspects to be tested. The objectives of this study are to identify the most significant factors that contribute to the variation of the L-band Alos Palsar backscattering on the tropical forest biomass of Malaysia.

II. Materials & Methods

a) The study area

The study area is located within 4.95^{0}N, 102.90^{0}E (upper left) and 4.50^{0}N, 103.25^{0}E (lower right). It is part of the Dungun Timber Complex (DTC), which is located about 120 km to the southwest of the State capital Kuala Terengganu, in the administrative district of Dungun (Figure 1). The study area consists of six Permanent Reserved Forests (PRFs) namely Besul, Besul Tambahan, Jengai, Jerangau, Pasir Raja Barat, and Pasir Raja Selatan, which made up a total areal extent of 60,187 ha. It is currently being managed by Kumpulan Kayu Kayan Terengganu Sendirian Berhad (KPKKT), a forest concessioner appointed by the Terengganu State Government.

Lowland dipterocarp forest is dominant in the study area, with a small extent of hill dipterocarp forest. Most of the areas are dedicated for timber production where logging activities has been active since the early

1970s. More than 80% of the study area has been logged in the last 30 years. Being part of the Main Range of Peninsular Malaysia, the topography in the study area is heterogeneous, and comprises flat river plains and swamps, undulating hills and mountainous areas, especially in the western areas. Its western boundary is dominated by steep, rugged mountains; the foothills which occupy most of the remaining land are less rugged than the mountains, separated by flat to gently undulating riverine flood plains.

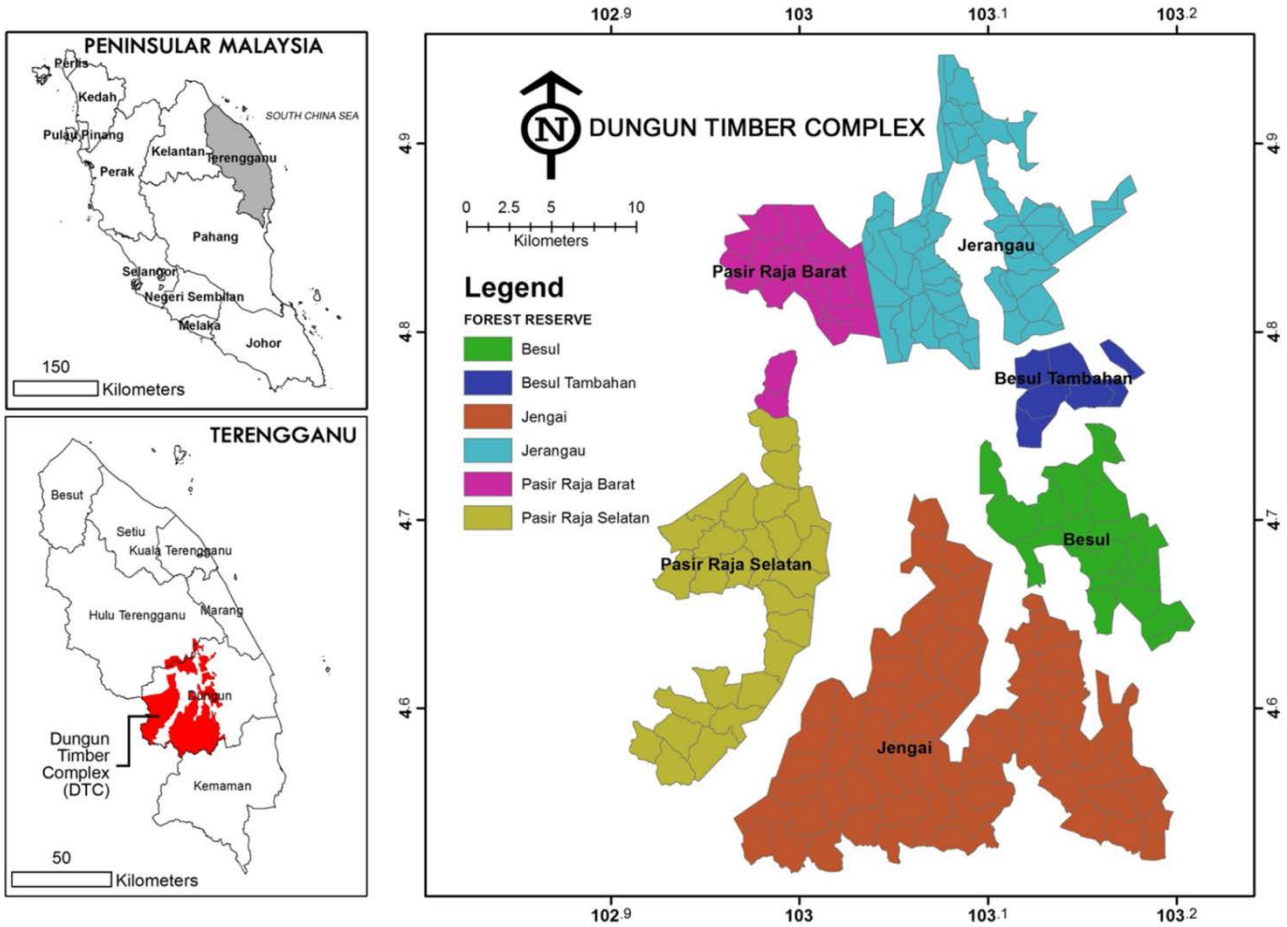

Fig.1 : Location of the study area

b) Field inventory data

A total of 41 sample plots, measuring 60 x 60 m were established in early 2012, in which 10 and 31 plots were located in natural and logged forests, respectively. The reason why the sample plots were divided into logged and natural conditions was to observe the effect of harvesting system on the SAR sensitivity. The fact that timber extraction reduces the density of harvested production forest decrease in the total AGB has driven the sampling design of this study. This reduction can alter the strength of L-band SAR backscatter compared to the natural forest.

In each plot, every tree with a diameter at breast height quarters with a dimension of 30 x 30 m each. It was designed in such a way to facilitate the mobility of inventory work at the field. Location (i.e. coordinates) of the plot centre was recorded by using Global Positioning System (GPS).

c) Satellite and supporting data

The satellite images used in this study were acquired by the Alos Palsar L-band (1270 MHz, 23.62 cm wavelength), in dual-polarized mode. The images were 1-degree mosaic product that came with two polarizations, HH and HV, and were obtained from the Japan Aerospace Exploration Agency (JAXA). The images were acquired on 1 October 2010 and were every stand was also recorded. A plot was divided into 4 geometrically and topographically corrected, with a spatial resolution of 25 m.

The Alos Palsar image that was used in this study was built on a 16-bit data type and all pixels have digital numbers (DN) ranging from 0–65535. These DNs however do not represent the radar signal of features or objects on the ground. Therefore, the DNs have to be converted to backscatter coefficients (radar signals) known as Normalized Radar Cross Section (NRCS) and represented in decibels (dB). The equation that was

used for the calculation of NRCS for Palsar are slightly different from other sensors in that the usual sine term has already been included in the DN values. Thus, for the data stored in Level 1.5 products, the equation for NRSC of any of the polarization component can be obtained by the following formula with single calibration factor (CF), which can be expressed as equation 1 for distributed scatterers (Shimada et al. 2009).

$$NRCS\ (dB) = 10 \times \log_{10}(DN^2) + CF \qquad (1)$$

where CF = -83.0

Supporting data comprised compartment boundaries in shapefile (.shp) format was acquired from the KPKKT. The data contains attributes that consist of the name of forest reserve, compartment number, areal extent, and record of logging year, which are important for the study.

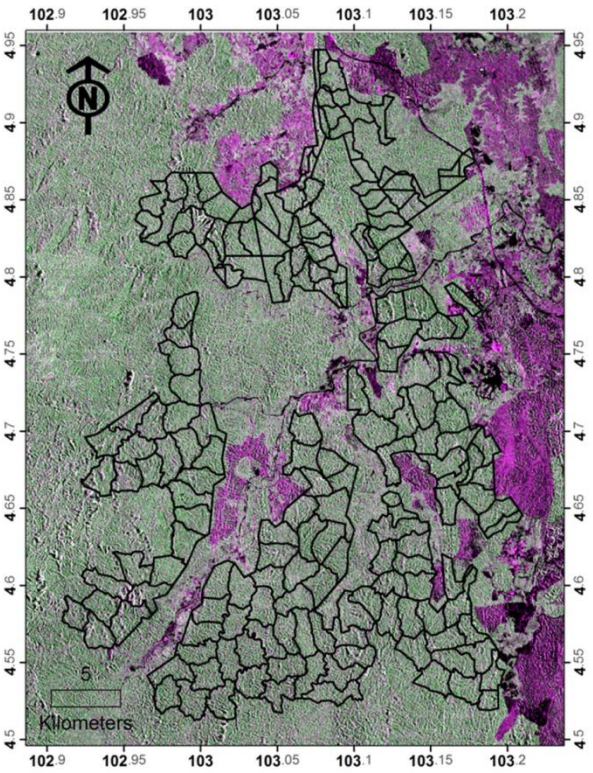

Fig. 2 : Palsar images over the study area. The image are displayed in RGB colour composite with combination of HH, HV & HH polarizations. The polygons indicate compartment boundaries of the study area

d) Methodology

This study was conducted in experimental approach to examine the sensitivity of L-band SAR signals to the forest biomass at different aspects. The experiment covered both aspects of forestry and remote sensing. Several parameters were tested to investigate the most influential factors that attribute to the accuracy of biomass estimation by using L-band SAR images. The tested variables and parameters are summarised in Table 1. All parameters were tested by stepwise backward elimination method. This method compares a series of selected parameters and identifies the significant interaction effect between each other, while parameters which are not significant to the response variable will be dropped. It started with all candidate variables, testing the deletion of each variable using a chosen model comparison criterion, deleting the variable (if any) that improves the model, and iterating this process until no further improvement is possible.

Dummy variables with treatment codes of 0 and 1 were assigned to respective variables prior to perform this comparison. Fitting the parameters of backward elimination was done with linear regression of RExcel (Heirberger and Neuwirth, 2009). In the first run, the resulted significance values of >0.05 was eliminated and the analysis proceeded to next iteration with the remaining variables until a significance values of ≤ 0.05 is achieved. The selected parameters which identified to have significant interaction were then checked with analysis of variance (ANOVA) to determine the main contribution of each parameter. Eventually, the best parameter that influences most to the variation of L-band SAR was selected by looking at the returned coefficient of determination (R^2), standard error of residuals, F-statistic, and p-value. A variable that has p-value of 0.05 or smaller determined the feasibility of the relationship to the L-band SAR backscatter.

Experiment 1: Effect of allometric functions

This experiment was conducted to investigate is there any relationship between SAR polarimetry and AGB. Instead of one allometric function, five different functions were used to calculate the AGB as listed in Table 2. In this experiment, AGB was calculated for all trees measuring dbh of ≥ 5 cm. Independent variables comprised AGB (in Mg ha-1) calculated from all five allometric functions while dependent variables were consisted of HH and HV polarizations. Therefore two analyses were conducted to study the effects of these polarizations on AGB.

Table 1 : Experimental variables used in the study

Aspects of study	Variables category	Experimental parameters
Forestry aspect (Stand variables)	Allometric functions	AGB from Kato et al. (1978)
		AGB from Katterings et al. (2001)
		AGB from Chave et al. (2005)
		AGB from Basuki et al. (2009)
		AGB from Kenzo et al. (2009)
	Diameter (dbh) classes	AGB in trees at dbh ≥ 10 cm
		AGB in trees at dbh ≥ 20 cm
		AGB in trees at dbh ≥30 cm
	Biomass components	Canopy biomass of trees at dbh ≥ 5 cm
		Canopy biomass of trees at dbh ≥ 20 cm
		Canopy biomass of trees at dbh ≥ 30 cm
Remote sensing aspect (Image variables)	SAR polarimetry	HH polarization
		HV polarization
	Pixel resampling	50 x 50 m
		100 x 100 m
	Pixel enhancement (GLCM)	3x3
		5x5
		7x7

Table 2 : Allometric functions that were developed from various study sites for estimating aboveground biomass

No.	Source	Allometric functions	Site
1.	Kato et al. (1978)	$1/H = 1/(2.0*D) + 1/61$ from the values of D and H, the dry mass of stem, branches, and leaves of the tree is estimated $M_s = 0.0313*(D^2H)^{0.9733}$ $M_b = 0.136*M_s^{1.070}$ $1/M_l = 1/(0.124M_s^{0.794}) + 1/125$	Primary forest, Peninsular Malaysia
2.	Katterings et al. (2001)	$\ln(W_t) = 2.59 \times \ln(D) - 2.75$	Secondary forest, Sumatra, Indonesia
3.	Chave et al. (2005)	$W_t = \rho*\exp(-1.499 + 2.148*\ln(D) + 0.207*(\ln(D))^2 - 0.0281*(\ln(D))^3)$	Pasoh 50 ha plots and other Center for Tropical Forest Sciences (CTFS) plots
4.	Basuki et al. (2009)	$\ln(W_t) = 2.196 \times \ln(D) - 1.201$ $\ln(M_s) = -1.472 + 2.180*\ln(D)$ $\ln(M_b) = -0.097 + 1.361*\ln(D)$ $\ln(M_l) = -1.392 + 1.250*\ln(D)$	Secondary forest, Kalimantan, Indonesia
5.	Kenzo et al. (2009)	$W_t = 0.0829 \times D^{2.43}$	Secondary forest, Sarawak, Malaysia

Note: H is the total tree height; D is the stem diameter at breast height (dbh); Ms, Mb, and Ml denote the dry mass of stem, branches and leaves respectively; Wt is the aboveground biomass of standing trees; and ρ is the wood density.

Experiment 2: Effects of sizes of trees

Variations in total living AGB in a given forest area is highly depending on the size of the trees. Many small trees can contribute to a certain level of biomass, which is probably low but a few large trees can yield higher biomass. Aboveground biomass in each sampling plot was calculated based on varying diameters to investigate the response of SAR backscatter to the AGB at varying levels. Trees within a plot were segregated into several diameter classes namely i) 10 cm and above, ii) 20 cm and above, and iii) 30 cm and above. Aboveground biomass for each plot was calculated based on these diameter classes. It means that a sample plot consisted of three different values of AGB as illustrated in Figure 3 and the variations were determined by the number of trees in a diameter class.

Analysis for this experiment was conducted similar to experiment 1 but used only one dependent variable, which was the backscatter from HV polarization.

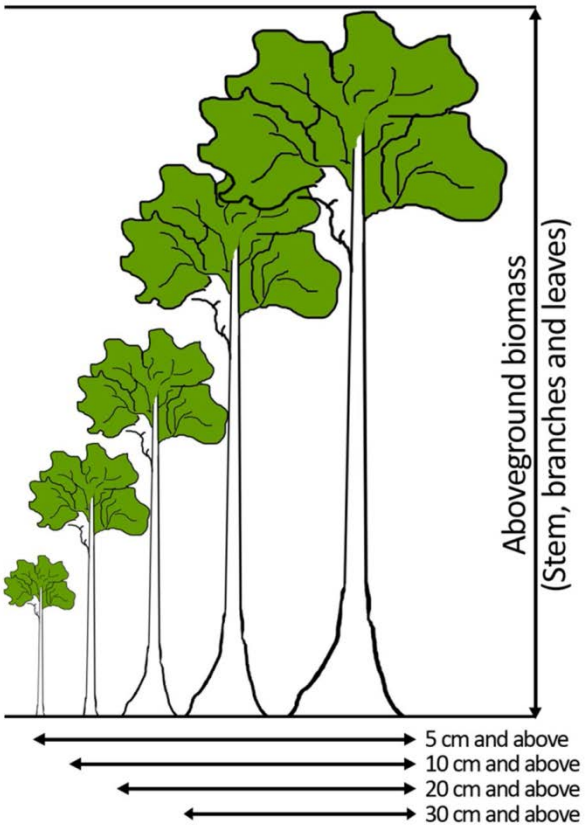

Fig. 3 : Aboveground biomass was calculated based on several dbh classes.

Experiment 3: Interaction of SAR signal with canopies

A natural tropical forest is generally divided into four vertical strata, which are emergent, canopy, understory and forest floor. These strata are related also to the sizes of trees and influence much to the sensitivity of SAR backscatter. The strata, which often referred as forest structure can influence the relative contribution of the scattering mechanism (Lucas et al. 2010). In this regard biomass of the forest canopy was treated separately to examine how it affects the SAR backscatter. Canopy biomass, illustrated in Figure 4, which comprises the top component of a tree (i.e. branches and leaves), was calculated for each sampling plot. The biomass was broken into three classes, which are canopy biomass that belong to trees measuring 5 cm and above, 20 cm and above, and 30 cm and above. Therefore, a plot will have three values of canopy biomass which were set as independent variables for this experiment. These biomass values were correlated against backscatter of HV polarization, also the same approach used for experiment 2.

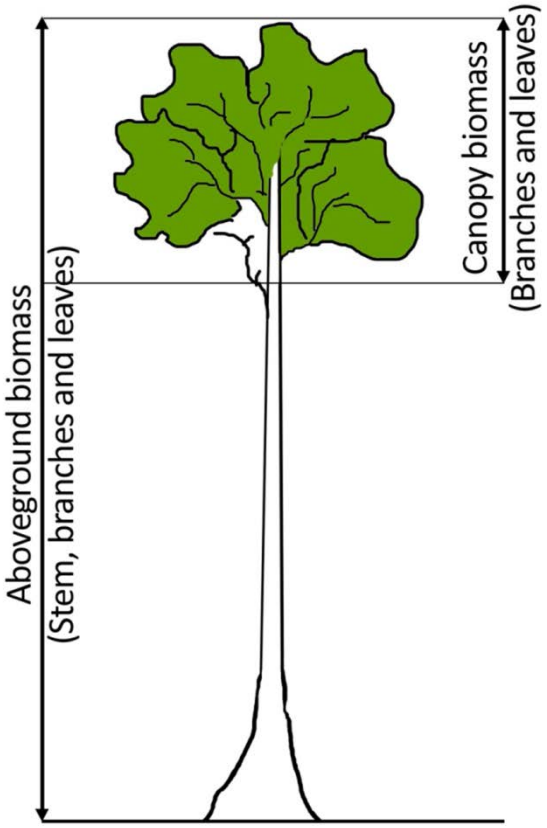

Fig. 4 : Biomass was divided into components of trees (stem & canopy).

Experiment 4: Effects of spatial variations

This experiment was slightly different from the above experiments, where dependent variables were derived from the satellite images and the independent variables were the most significant variables resulted from experiments 1-3. Studies (e.g. Saatchi et al. 2011; Cartus et al. 2012; Robinson et al. 2013) indicated that different pixel size affected the biomass estimations. Original pixel size of 25 x 25 m was degraded to 50 x 50 m and 100 x 100 m pixel dimensions, which averages of 4 x 4 and 16 x 16 pixels that produced pixels of areal extents of 0.25 and 1 ha, respectively. Three images (including original image) derived from this process were used as dependent variables. Pixel values for these images were remained as backscatter (σ^o, dB). Studies (e.g. Kuplich et al. 2003; Sarker et al. 2012) also demonstrated that the image with incorporation of texture measure improved the accuracy of forest biomass estimations. Texture measure or known as grey-level co-occurrence matrix (GLCM) uses a grey- tone spatial dependence matrix to calculate texture values. This matrix will calculate relative frequencies with which pixel values occur in two neighbouring processing windows separated by a specified distance and direction, with a central pixel at the centre of the windows. For this purpose texture has been defined as repeating pattern of local variations in

image intensity which is too fine to be distinguished as separate class at the observed resolution. Thus, a connected set of pixels satisfying a given gray-level properties which occur repeatedly in an image region constitute a textured region. It shows the number of occurrences of the relationship between a pixel of row (i) and column (j) and its specified neighbour. Mean-type GLCM, with a window sizes of 3 x 3, 5 x 5, and 7 x 7 pixels were then applied to the original image. The GLCM can be defined as

$$\mu_{i,j} = \sum_{i,j=0}^{N-1} i(P_{i,j}) \qquad (2)$$

The equation produced three images that contained unitless pixel values that were no longer in backscattering coefficient unit (σo, dB). Altogether five dependent variables (two with varying pixel sizes and three textures from different window sizes) were used for this experiment. These variables were paired with three independent variables that comprised most influential parameters resulted from experiments 1 to 3. This experiment determined the best image and biophysical variable that have the best interaction between each other.

III. Results & Discussion

a) *Summary of sampling plots*

Sampling plots were consisted of natural forest (where have not been logged before) and logged forest, which were logged within 30 years before, under the selective harvesting system. A total of 14,774 trees were measured in all sampling plots comprised 10,862 and 3,912 in logged and natural forests, respectively. It was estimated that an average of 1,001 and 1,358 trees standing in a hectare of logged and natural forests, respectively for trees measuring dbh ≥ 5cm. Table 3 summarises the measured trees in the sampling plots, divided into several dbh classes. Figure 5 shows average number of trees in a hectare, also divided into dbh classes. Referring to the Table 3 and Figure 5, it is obvious that the small trees (i.e. dbh 5 – 10 cm) dominated the forests, which accounted for around 54% of the total in term of numbers. However, in terms of biomass, these trees comprised only around 6% from the total AGB in a hectare both for logged and natural forests.

Under the current logging practices, only huge trees above cutting limits (i.e. dbh > 55 for non-dipterocarp and > 65 cm for dipterocarp species) can be removed from the forest. In one hectare of logging unit, about 12- 15 trees are felled and the remaining trees are left for the next harvesting cycle (i.e. 30 years). Figure 6 summarises the basal area calculated from all the sampling plots. Basal area (BA), which is measured in square meter per hectare (m2 ha-1) is often used to show the density of trees in a forest area. Figure 6 presents conditions of logged and natural forests; which in almost all cases, the basal area of logged forest was lower that the natural forest.

Table 3 : Number of trees measured in the sampling inventory, divided into diameter classes

Diameter class (cm)	No. of tree	
	Logged forest	Natural forest
5 - 9.9	5,825	2,094
10 - 19.9	2,997	1,017
20 - 29.9	1,067	390
30 - 39.9	506	171
40 - 49.9	229	106
≥ 50	238	134
Total	10,862	3,912

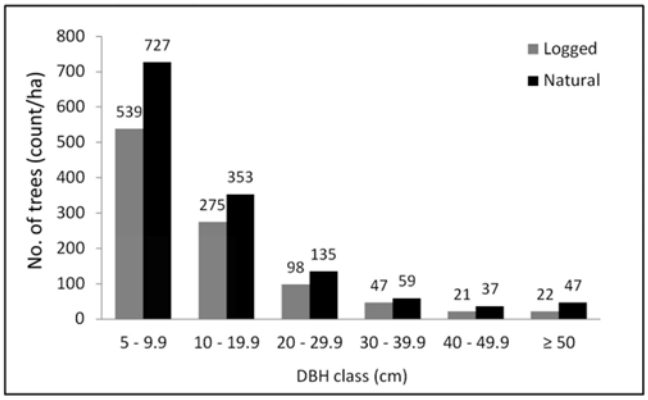

Fig. 5 : Average numbers of trees in a hectare of the sampling plots.

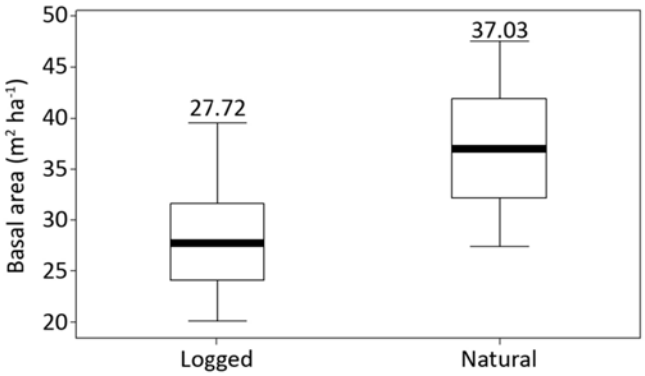

Fig.6 : Boxplots showing average basal area of all sampling plots. The figures indicate the average values as represented by the bolded line. The basal area is ranging from the minimum and maximum values, as indicated by lower and upper bars, respectively.

b) Results from experiment 1

Estimated AGB by using different allometric functions showed considerable differences among each other, especially for trees measuring more than 30 cm in diameter. However Kato and Chave produced almost similar AGB along with the increasing dbh (Figure 7). Figure 8 summarises the estimated AGB at all sampling plots, where logged forest showed lower AGB than the natural forest.

Statistical analysis found that the HH polarization has no significance between all the AGB calculated from the allometric functions. However, HV interacted well with the AGB calculated from all allometric functions, except from Chave's function as it was eliminated in the first iteration. The results of this experiment are summarised in Table 4. The significance values indicated that the Kato's function gave a significant effect to the backscatter on HV polarization but this result did not determined the most affective factor until ANOVA test was carried out.

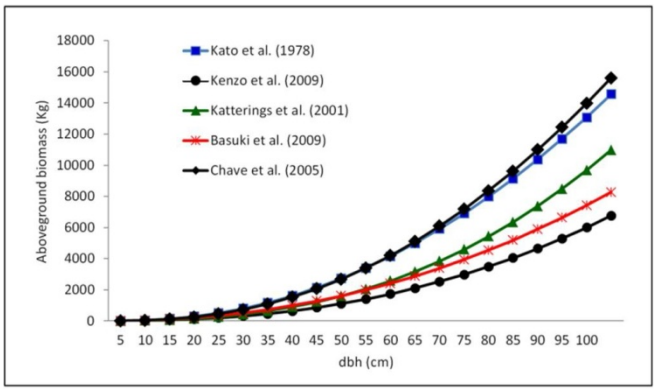

Fig.7 : Aboveground biomass calculated from different allometric functions.

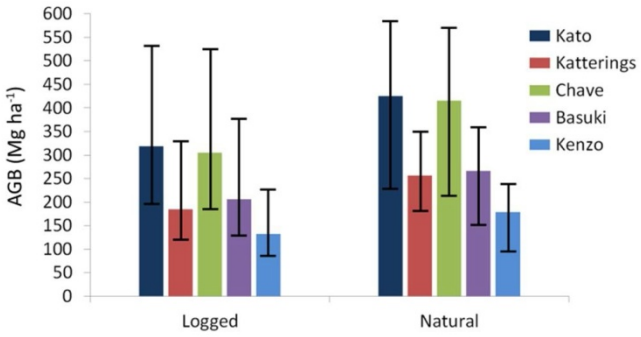

Fig.8 : Average AGB at all sampling plots. The line-bar indicate range of estimated AGB.

c) Results from experiment 2

About only 6% of the total AGB was in small trees with dbh 5 – 10 cm, and about 20% were in trees with dbh 10 – 20 cm (Figure 9). The class contributing most to the AGB was trees with dbh ≥ 30 cm for natural forest but 20 – 30 cm for logged forest. This indicated that logged forest consisted of many intermediate size trees as the larger trees were extracted during logging.

An experiment has been made to assess how the tree size influence the backscattering intensity and found that only trees with diameter at dbh larger than 15 cm that dominating higher canopies gave the best response to backscatter at HV polarization of L-band Palsar (Hamdan et al. 2013). This study also indicated about similar results where AGB in trees with dbh ≥ 10 cm and ≥ 30 cm characterised the HV backscatter. Therefore these two variables were considered as potential factors for this experiment. The experiment showed that AGB in trees with dbh ≥ 20 cm did not give any response to the backscatter, as it was eliminated in the first iteration. The results of this experiment is summarised in Table 5.

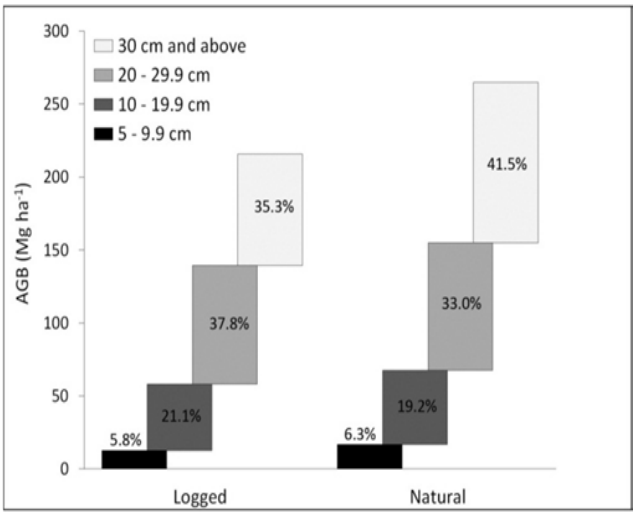

Fig. 9 : Average AGB for logged and natural forests at different dbh classes. Values indicate proportion of biomass at corresponding dbh classes.

d) Results from experiment 3

Biomass component in tree canopy comprised about 20% of the total AGB. It is indicated in Figure 10, which both natural and logged forests have about similar condition. However, different sizes of trees have different amount of biomass, both in stems and canopies. The experiment proved that biomass in canopies at different sizes of trees gave significant effect to the backscatter from L-band SAR. Table 6 summarises the results from the experiment, which is showing that canopy biomass at all sizes of trees gave response statistically to the HV backscatter at different significance levels.

e) Results from experiment 4

This experiment was designed to observe the effect of spatial variations on the AGB. The most significant independent variables resulted from experiments 1-3 were used as pairing variables in this experiment. In this case, the independent variables were obtained from ANOVA test results, as listed in Table 8, which were determined prior to this experiment. The

variables are (i) AGB calculated from Kenzo's allometric function, (ii) AGB in trees ≥ 10 cm, and (iii) canopy biomass in trees ≥ 30 cm. Results of this experiment show that certain image variables have significant effect on AGB but some are absent. Table 7 summarises the statistical values returned from the analysis. The p-value (i.e. Pr(>|t|)) of larger than 0.05 for the images variables of GLCM 3 × 3 and 7 × 7 indicated that these variables have no interaction with biomass in all conditions. Image with pixel size degraded to 50 x 50 m indicated good correlation with AGB as compared to the other image variables. This agreed well with results obtained from the studies that were conducted earlier (e.g. Saatchi et al. 2011; Robinson et al. 2013).

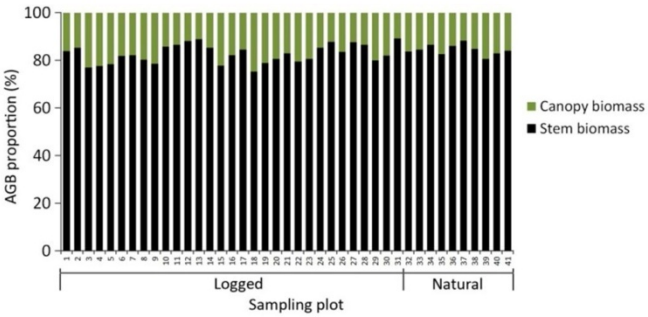

Fig. 10 : Proportion of AGB at all sampling plots in the study area.

Table 4 : Significance variables found from multiple linear regression in Experiment 1

Dependent variable	Independent variable	Coefficient	Std. error	t value	Pr(>|t|)
HV	AGB from Kato	0.009	0.002	5.779	2.9E-08
	AGB from Katterings	1.213	0.363	3.341	1.0E-03
	AGB from Basuki	1.043	0.347	3.007	3.0E-03
	AGB from Kenzo	1.731	0.421	4.109	5.8E-05

Table 5 : Significance variables found from multiple linear regression in Experiment 2

Dependent variable	Independent variable	Coefficient	Std. Error	t value	Pr(>|t|)
HV	AGB of trees at dbh ≥ 10 cm	-0.621	0.327	-1.899	6.0E-02
	AGB of trees at dbh ≥ 30 cm	0.012	0.003	4.469	1.8E-05

Table 6 : Significance variables found from multiple linear regression in Experiment 3

Dependent variable	Independent variable	Coefficient	Std. Error	t value	Pr(>|t|)
HV	Canopy biomass of trees at dbh ≥ 5 cm	0.105	0.018	5.69	9.3E-08
	Canopy biomass of trees at dbh ≥ 20 cm	1.526	0.424	3.595	4.7E-04
	Canopy biomass of trees at dbh ≥ 30 cm	2.465	0.544	4.532	1.4E-05

Table 7 : Significance variables found from multiple linear regression in Experiment 4

Dependent variable	Independent variable	Coefficient	Std. Error	t value	Pr(>|t|)
HV (50 x 50 m)	AGB from Kenzo	0.015	0.003	5.427	3.0E-07
	Canopy biomass of trees at dbh ≥ 30 cm	1.864	0.402	4.636	9.1E-06
HV (100 x 100 m)	AGB from Kenzo	0.009	0.002	3.995	1.1E-04
	Canopy biomass of trees at dbh ≥ 30 cm	1.061	0.311	3.413	8.8E-04
HV (GLCM 3x3)	AGB from Kenzo	0.013	0.011	1.159	2.5E-01
	AGB in trees ≥ 10 cm	-0.045	0.991	-0.045	9.6E-01
	Canopy biomass of trees at dbh ≥ 30 cm	1.611	1.707	0.944	3.5E-01
HV (GLCM 5x5)	AGB from Kenzo	0.007	0.002	2.828	5.5E-03
	Canopy biomass of trees at dbh ≥ 30 cm	0.841	0.348	2.415	1.7E-02
HV (GLCM 7x7)	AGB from Kenzo	0.003	0.002	1.662	9.9E-02
	AGB in trees ≥ 10 cm	-0.011	0.166	-0.065	9.5E-01
	Canopy biomass of trees at dbh ≥ 30 cm	0.387	0.286	1.354	1.8E-01

f) Summary of all experiments

One way ANOVA was used to determine factors (i.e. independent variables, which are biomass) that influenced most to the image variables. A factor in an experiment was selected by looking at an outstanding correlation, which has the smallest p-value and the largest F-value. Table 8 summarises the results of ANOVA test that was conducted for all experiments. Experiment 1 found that the AGB calculated by using Kenzo's allometric function affected the HV backscatter most compared to other allometric functions.

Experiment 2 decided that the AGB in trees at dbh ≥ 10 cm has influenced most to the HV backscatter compared to the trees of dbh ≥ 30 cm. The canopy biomass in trees with dbh ≥ 30 cm prevailed in all cases in experiments 3 and 4. From the summary, it was also observed that the image with pixel size of 50 x 50 m was outstanding among all image variables. This image was then correlated individually with canopy biomass of trees at dbh ≥ 30 cm by using simple linear regression and it was found that the returned R^2 was attained at 0.63. Textured images with GLCM 5x5 were also significant in the interaction but less powerful as compared to other image variables.

Table 8 : ANOVA of tested variables

Experiment	Dependent variable	Independent variable	Mean square	F - value	p-value	Level of Significance
1	HV	AGB from Kato	36.14	15.07	1.4E-04	AGB from Kenzo
		AGB from Katterings	1.90	0.79	3.7E-01	
		AGB from Basuki	1.57	0.65	4.2E-01	
		AGB from Kenzo	40.48	16.88	5.8E-05	
	HH	AGB from Kato	2.59	2.46	1.2E-01	No significance found
		AGB from Katterings	0.14	0.13	7.2E-01	
		AGB from Chave	0.41	0.39	5.3E-01	
		AGB from Basuki	0.03	0.02	8.8E-01	
		AGB from Kenzo	2.60	2.47	1.2E-01	
2	HV	AGB of trees at dbh ≥ 10 cm	39.27	16.37	9.3E-05	AGB of trees at dbh ≥ 10 cm
		AGB of trees at dbh ≥ 30 cm	8.65	3.61	6.0E-02	
3	HV	Canopy biomass of trees at dbh ≥ 5 cm	25.97	11.70	8.6E-04	Canopy biomass of trees at dbh ≥ 30 cm
		Canopy biomass of trees at dbh ≥ 20 cm	0.31	0.14	7.1E-01	
		Canopy biomass of trees at dbh ≥ 30 cm	45.56	20.53	1.4E-05	
4	HV (50 x 50 m)	AGB from Kenzo	9.51	7.96	5.6E-03	Canopy biomass of trees at dbh ≥ 30 cm
		Canopy biomass of trees at dbh ≥ 30 cm	25.67	21.49	9.1E-06	
	HV (100 x 100 m)	AGB from Kenzo	3.08	4.31	4.0E-02	Canopy biomass of trees at dbh ≥ 30 cm
		Canopy biomass of trees at dbh ≥ 30 cm	8.32	11.65	8.8E-04	
	HV (GLCM 3x3)	AGB from Kenzo	7.28	0.36	5.5E-01	No significance found
		AGB of trees at dbh ≥ 10 cm	1.79	0.09	7.7E-01	
		Canopy biomass of trees at dbh ≥ 30 cm	17.90	0.89	3.5E-01	
	HV (GLCM 5x5)	AGB from Kenzo	1.94	2.16	1.4E-01	Canopy biomass of trees at dbh ≥ 30 cm
		Canopy biomass of trees at dbh ≥ 30 cm	5.23	5.83	1.7E-02	
	HV (GLCM 7x7)	AGB from Kenzo	0.42	0.75	3.9E-01	No significance found
		AGB of trees at dbh ≥ 10 cm	0.10	0.18	6.7E-01	
		Canopy biomass of trees at dbh ≥ 30 cm	1.03	1.83	1.8E-01	

This has proven that of all image variables used, the response of biomass came only from the canopy of these trees, which characterised the backscattering intensity of L-band Alos Palsar. This statement is supported by R^2 and F-statistic as depicted in Figures 11 and 12 for experiments 1-3 and 4

respectively. It was observed that the biomass in canopies of trees larger than 30 cm has the most significant inference to the L- band data. The study demonstrated that the L-band, which has a wavelength of about 23 cm, has the ability to penetrate the forests at certain levels of vertical forest strata. In this case, the SAR waves at HV polarization penetrated well through the upper canopies but due to the leaves, twigs and branches scattering, the penetration ceased beyond this level. Saturation was then occurred and the backscatter that was returned to the sensor represented only the biomass of the canopies of the forest. The R^2 returned from all the experiments were considerably low because the analysis took into account multiple variables in a single model and represented by an R^2. This also implied the time difference between image acquisition and the establishment of sample plots on the ground, which was more than 1 year. The size of the sample plots also played roles in the estimation results. Even though only the canopy biomass of trees larger than 30 cm indicated the best correlation, this variable can be used as an indicator to estimate the total AGB by using L-band Alos Palsar data. By using information from large tress (i.e. dbh ≥ 30 cm), the AGB of smaller trees (i.e. dbh < 30 cm) can be estimated if the proportion is known (Imhoff, 1995b). Through this approach, the saturation level of biomass can be avoided to produce more reliable estimates on tropical forests.

In order to demonstrate the results, a sample plot in logged forest was selected and the distribution of trees within this plot was visualised by using stand visualization system (SVS) (McGaughey, 1997). Locations of trees (dbh ≥ 5 cm) were distributed randomly in a square plot measuring 60 x 60 m. Visual of this forest is seen in Figure 13, where structure of the stands and canopies can be seen clearly in the system. The system also allows trees to be removed and threshold at a given dbh. Despite of unreal forest structure, the system can be used to visualise the response of SAR interaction with forest biomass, especially when the small trees (dbh < 30 cm) were removed (Figure 14).

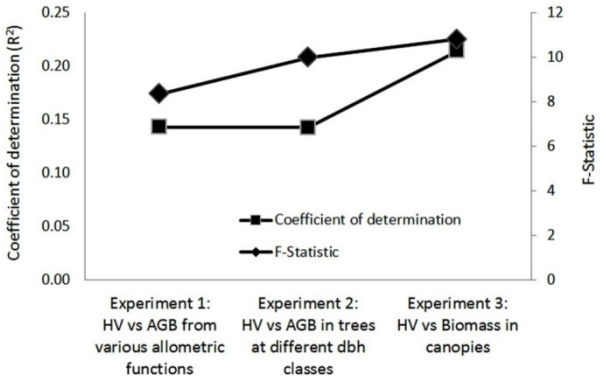

Fig. 11 : Summary of experiments 1-3

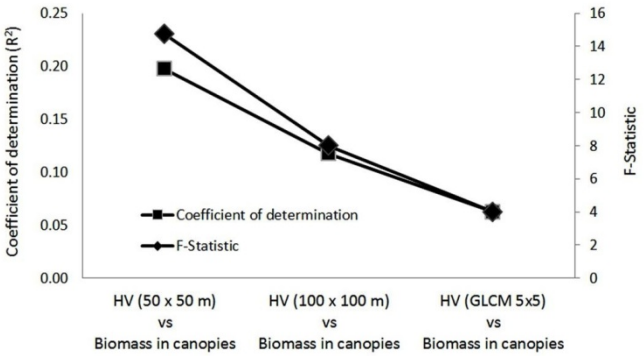

Fig. 12 : Summary of experiment 4

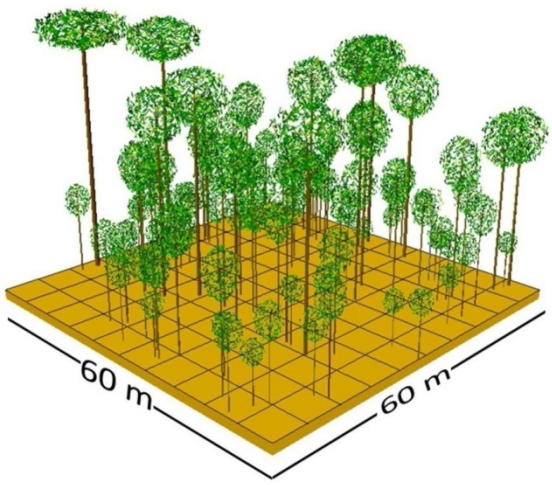

Fig. 13 : Structure of forest stands visualised by using SVS.

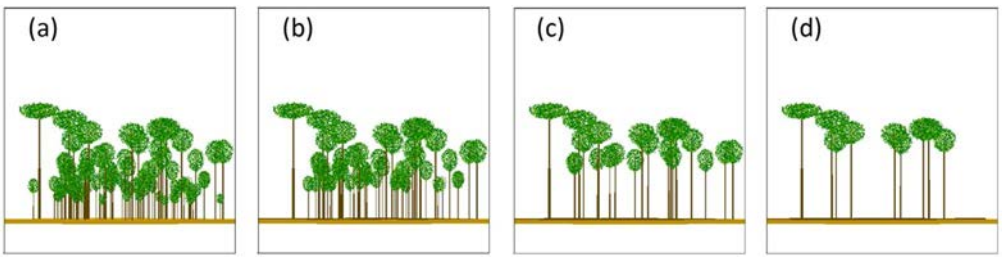

Fig. 14 : Structure of forest at different threshold of tree sizes. Trees are visualised at dbh classes of (a) ≥ 5 cm, (b) ≥ 10 cm, (c) ≥ 20 cm, and (d) ≥ 30 cm.

IV. Conclusion

The study has successfully identified the most significant factors that attributed the scattering mechanism in tropical forest. The study found that allometric functions did affect the AGB estimation. In this case, Kenzo's allometric function (Kenzo et al. 2009) played a significant role in estimating AGB by using L-band Alos Palsar. Size of trees and biomass in canopy component also gave significant effects to the L-band backscattering intensity. Aboveground biomass in trees with dbh ≥ 10 cm gave greater impact, which can improve biomass estimation by using L-band data. The fact that SAR penetrates through the forest canopy has proven that only the emergent canopies interact with the L-band backscatter. In this study biomass in canopies of trees with dbh ≥ 30 cm gave the greatest response. The study also noticed that there were no significant differences in terms of L-band interaction with AGB in logged and natural forests.

Pixel degradation from 25 m to 50 m was found most appropriate image enhancement technique for estimating biomass in Malaysia's forests by using Alos Palsar images. When the images were correlated to the biomass in canopies of trees with dbh ≥ 30 cm, the correlation was improved significantly. Therefore the study suggests that the L-band Alos Palsar image with spatial resolution of 50 m can used to estimate canopy biomass. The estimation can be expanded to obtained total AGB provided that the proportion between canopy and stem biomass is identified.

The study proved that L-band Alos Palsar was relevant for AGB estimation in a complex tropical forest such as Malaysia. The results allowed understanding the effects of the structural aspects at the L-band response, confirming that this is a very important study to characterize and monitor the tropical Malaysian landscape.

V. Acknowledgements

This work has been undertaken within the framework of the JAXA Kyoto & Carbon Initiative (Phase 3). Special thanks to JAXA for the provision of the Alos Palsar dataset through RESTEC EORC. Special gratitude also goes to KPKKT whose provide the supporting data and allowing the research team to conduct the study in its concession forest. Thanks also to anonymous reviewers who have spent time to review this manuscript and made it in final form.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 14 Issue 3 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

Damming Effect on Downstream Aquatic Ecosystems: A Case Study of Lake Mutirikwi, Masvingo, Zimbabwe

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Abstract- Dams are common in water scarce regions for alleviating water supply problems. However, studies have established that damming has led to the disruption of flow regime, which is the driver of river and floodplain wetland ecosystems. Historical information on the river and data on the fish species was obtained from fisherman and Kyle Recreational Park, Zimbabwe. We that observed reduced stream flow beyond the dam wall has also disrupted seasonal flow, reduced river channel and negatively impacted reproduction, growth and survival of fish and riverine vegetation. This study established the impact of flow regime on sustainable conservation and development.

Keywords: *climate change, fish, livestock, population, vegetation.*

GJSFR-D Classification : *FOR Code: 050102, 070301*

Strictly as per the compliance and regulations of :

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Rachel Gwazani [α], David Chikodzi [σ] & Tinoziva Hungwe [ρ]

Abstract- Dams are common in water scarce regions for alleviating water supply problems. However, studies have established that damming has led to the disruption of flow regime, which is the driver of river and floodplain wetland ecosystems. Historical information on the river and data on the fish species was obtained from fisherman and Kyle Recreational Park, Zimbabwe. We that observed reduced stream flow beyond the dam wall has also disrupted seasonal flow, reduced river channel and negatively impacted reproduction, growth and survival of fish and riverine vegetation. This study established the impact of flow regime on sustainable conservation and development.

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I. Introduction

Knowledge on the interdependence between land and water resources upstream and downstream is critical information for use in potential conflict resolution, resource preservation and development (Luijten et al., 2000). Damming of most streams, for purposes of alleviating water scarcity for agriculture, fishing, domestic use, hydro-electrification and manufacturing has in the process caused changes in the downstream hydrology and geomorphology (Cudennec et al., 2007). As a consequence of damming loss of sediment has been noted downstream, leading to reduced soil fertility thus negatively impacting on quality of aquatic habitats. Change in the flow regime downstream is a factor controlled by both flooding patterns and the possible impact of rainfall changes. Rainfall patterns in the southern African semi-arid region have been generally low, less than 500 mm annually, partly because of climate change factors. However, historical changes in land and water use appear difficult to assess because of limited availability of data.

Studies have shown that water modification and appropriation for human purposes can yield greater costs than benefits and create the risk of irreversible losses of species and ecosystem services (Postel, 2003). Natural river flow is essential for native macro fauna (fishes, shrimps and snails) (March et al., 2003).

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The adults of some fish live and breed in rivers and streams meanwhile their larvae drift downstream into salt water, where they metamorphosis before drifting back upstream into fresh water (Baxter, 1977; March et al., 2003). For example, the eel (Anguilla species) live in fresh water, but breed in salt water (March et al., 2003). Regulated rivers disrupt migration and spawning routes of fish (Doremus, 2001; March et al., 2003), hence affecting fish diversity and functional organisation of fish communities. The growth, reproduction and survival of native fishes can be influenced by flow since under natural circumstances downstream biota strives on excess nutrients from upstream.

Flow regime also determines the physical habitat of a stream which in turn influences biotic composition. Flow influences species distribution, abundance, composition and diversity (Bunn and Arthington, 2002). Flow can lead to recruitment failure and loss of biodiversity consequently threatening ecological sustainability. The abundance and distribution of some aquatic plants and animals increase with habitat complexity, depth, water velocity and cover. Habitat of low water velocity can be silted compared to high water velocity which is free from silt. Pools which are not found under normal flow can be formed leading into invasion and success of exotics in rivers (Bunn and Arthington, 2002), hence supporting the notion that aquatic histories evolve in response to natural flow.

Unfortunately, water needs of ecosystems themselves rarely appear on the balance sheets, it is always whatever is left over after agricultural, industrial and urban needs are met (Postel, 2003). Stream flows have been persistently low to levels insufficient to support aquatic life (Doremus, 2001). Disturbance of human communities who depend on the river for domestic use, hunting and fishing is inevitable, and the affected benefit very little from the modified river system (Baxter, 1977). The river downstream from Glen Canyon Dam is probably the most studied river reach in the world; downstream effects noted include erosion, loss of beaches, changes in the riparian distribution and alterations of habitat for endangered native fishes (Graf, 2005).

Ecologists still have difficulties in differentiating the direct effects of modified flow regime from effects

associated with land use change (Bunn and Arthington, 2002). This study assessed the possible impacts that damming had on Mutirikwi River, Masvingo, Zimbabwe. The water in Mutirikwi River was dammed for the purposes of irrigating the Chiredzi and the South Eastern lowveld sugarcane estates. The study established the type of vegetation, fish species and land use patterns along the river. Water flows down the river according to the schedule set by the farming industry some over 200 km downstream. The study intends to add to the existing information advocating that water is a finite resource, therefore, there is need to put a limit to the use and modification of natural freshwater systems.

II. Materials and Methods

a) Study Area

Mutirikwi and Shagashe rivers are the two major tributaries of Lake Mutirikwi in Masvingo, Zimbabwe. Downstream Mutirikwi river flows past Bangala dam, to the lowveld sugar estates. The dam wall which measures 63 m high was built from 1958-1960. The storage capacity of the dam is 1.4 x 109 m3, when full its surface area is 9105 ha and the shoreline is 238 km. Lake Mutirikwi (Figure 1), was constructed for the purposes of supplying water to Masvingo city and to the sugar estates in the southern eastern lowveld. The lake lies in agro-region IV which has an average annual rainfall of 650 mm. The area is prone to droughts and it experienced major droughts in 1983/84 and 1992/93.

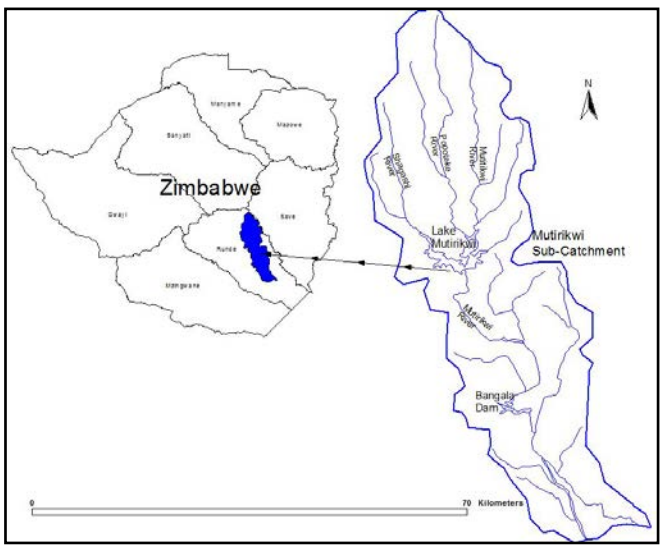

Figure 1 : Location of Lake Mutirikwi, Masvingo, Zimbabwe.

b) Vegetation Assessment

Vegetation was assessed at 5 randomly selected sites using the DNR-random tools in ArcView GIS downstream of Lake Mutirikwi. Two sites upstream site were also selected using the same method (Figure 2). The main objective of this assessment was to determine life forms along Mutirikwi River beyond the dam wall to as far as Bangala dam as a basis for estimating plant and animal population densities inhabiting this stretch of a river. This stretch is approximately over 100 km and stretches through a gorge between UTM coordinates 7759914, 36K 0294588 at Elevation 1032 m and 77552156, 36K 0292082 at Elevation 867 m then spans on a gentle floodplain from point 77552156, 36K 0292082 and beyond. The assessment entailed identifying the vegetation present after water impoundment in Lake Mutirikwi in 1960. The physiognomic vegetation type on the upper section of the river within approximately 10 km from the dam wall consists basically Miombo woodland type with Brachystegia glauscesens dominating whilst the Brachystegia spiciformis and Julbernadia globiflora are the co-dominant species. Aloe species were recorded at the immediate surrounds to the dam wall commonly on the steep rock outcrops.

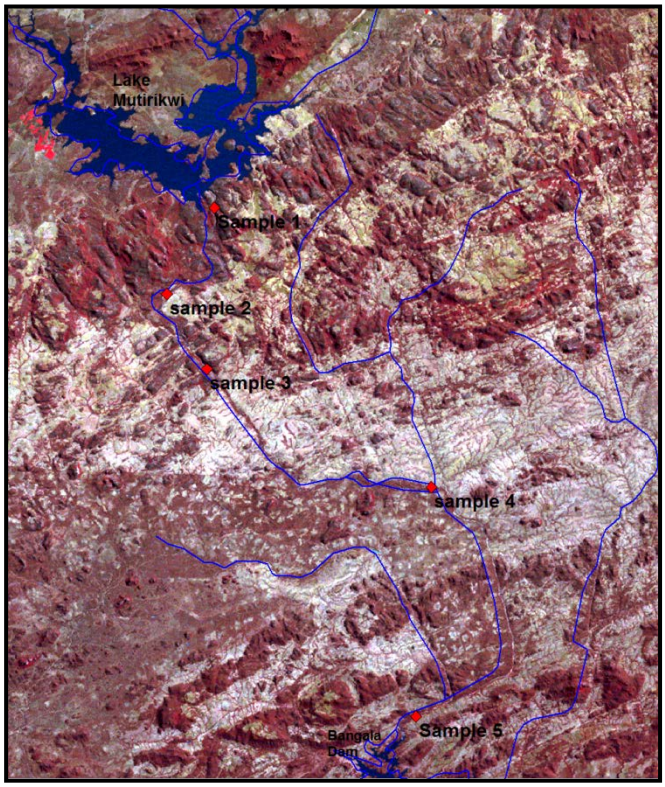

Figure 2 : Landsat Image Showing the Sampled Sites in the Pseudo Natural Colour Composite.

An inventory of tree species composition and density was carried out using the Point Center Quarter Method (PCQM) (Dahdouh-Guebas and Koedam 2006). The technique involves the observer moving in a predetermined direction recording data at predetermined intervals. A purposive random sampling technique was used to pick survey routes and two cross-sectional path lines to the river at selected river segments were mapped approximately 500 m apart and used as transect lines. Along each cross-sectional line a 50 m line transect on both side of the river was

established and each 10 m intervals along these transect lines was treated as a sampling point. At each sampling point the tree nearest to the observation point in each quadrant was recorded together with the distance of that nearest tree (Figure 3). Furthermore, the quadrat method was employed for inventorying grasses along the same path used during the tree inventorying exercise. A square metre quadrat (1 m x 1 m) was used estimating grass species composition and density. A total of forty quadrats were sampled. The observer would stop after every 5 m and place the quadrat along the transect line on alternate sides and record all the species which were within the quadrat.

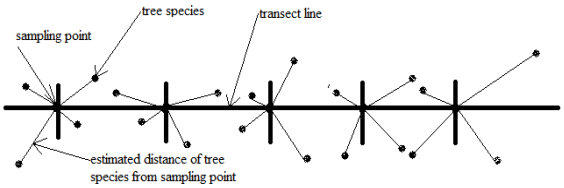

Figure 3 : Illustration of the Point Center Quarter Method.

c) Fish Assessments

Electrofishing was conducted and all depths were less than 50 cm. The average pool sizes were approximately 30 m^2. Fishing was done through walking along the pool for 10 minutes each with the eletrofisher. Two different sites were sampled for fish.

d) Hydrology and Geomorphology

Remote Sensing and Geographic Information System (GIS) were then used to obtain and classify the two satellite images of the study area. Multispectral image classification was done to enable comparison of the current status of the vegetation and the land use types to those decades ago in this case it was 1976. Classification was done manually by training pixels in a sample set. For both the 1976 and the 2010 images, the August month was selected because it has the best quality images for both time periods. This included limited cloud cover and the best time to differentiate between evergreen forest and deciduous forest that shed their leaves in the dry summer season. The classification of both the 1976 and 2010 images was done in ILWIS GIS using the maximum likelihood classification algorithm. Spot satellite imagery was then used to show the state of the sampled site in 2010. Spot imagery were chosen because of a convenient downloading policy and also their high spatial resolution of 2.5 m x 2.5 m. Informal interviews were also held with 10 community members from each site to gather information relating to the history of the river.

e) Data Analysis

The following formulae were used to estimate the vegetation density and at the same time relative density of different species.

i. $d = \frac{D}{Total\ number\ of\ quarters}$

Where d is the mean distance (m) and D is total of all distances.

ii. MA = d^2 where MA is the mean area per individual tree

iii. Density = $\frac{1}{MA}$ and relative density $\frac{d}{D}$ x density (trees /hectare)

Species diversity was calculated using the Shannon-Weiner diversity index: -∑pilnpi; where *pi* is the probability of encountering a given species and ln is the natural logarithm.

III. Results

a) Land Cover/Land Use Changes

Figure 4 shows a comparison of landcover/landuse maps of the the Mutirikwi sub-catchment in August 1976 and August 2010. It is evident from figure 4 that landcover/landuse has changed in the area. In between 1976 and 2010, it was mainly the evergreen and the deciduous forests that have been seriously reduced. Cropland and grasslands now dominate the landscape with an increase from 36% to over 60%. Deciduous forests have gone down from close to 35% to less than 27%. It is the evergreen forests however that have suffered the highest magnitude of decline from close to 20% in 1976 to less than 5% in 2010 (Figure 5).

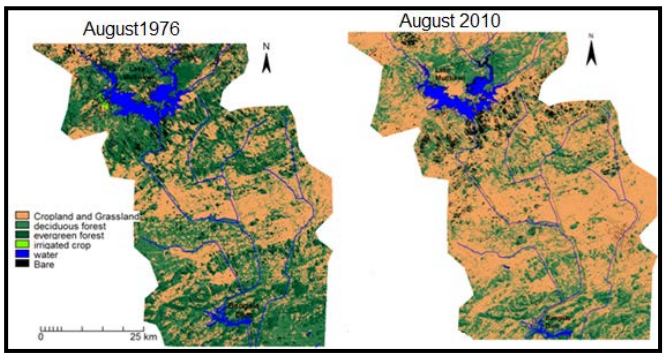

Figure 4 : Comparison between the land Cover/Land use Maps of 1976 and 2010 Derived from Landsat Images of the Mutirikwi Sub-Catchment from Lake Mutirikwi to Bangala dam.

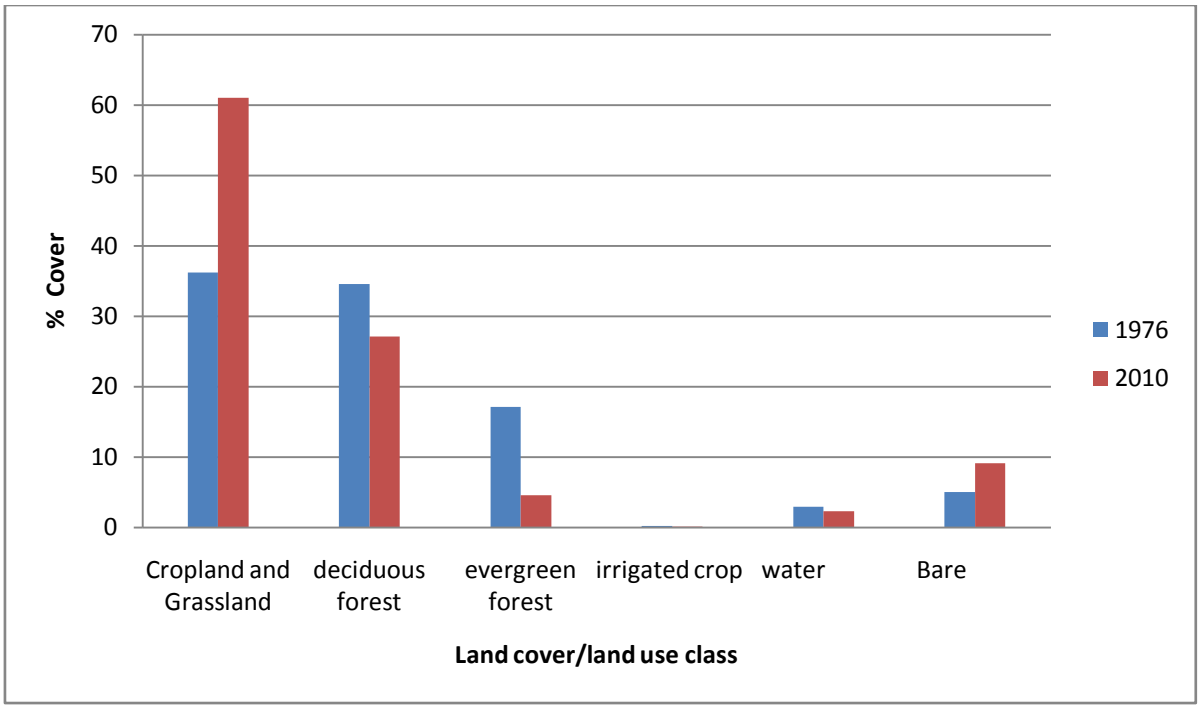

Figure 5 : Comparison of Land Cover/Land Use Classes in 1976 and 2010.

b) Woody Plant Diversity

A total of 11 species were identified (Table 1) with a diversity of 1.67 (Shannon-Weiner Index). The overall mean woody plant density for the sampled area was 383 woody plants per ha.

Table 1 : Relative Density of Tree Species.

Tree species	Relative density (woody plants/ha)
Brachystegia glausescens	0.44
Brachystegia boehmii	0.07
Brachystegia spiciformis	0.17
Faurea saligna	0.03
Securinega virosa	0.07
Pterocarpus rotundifolius	0.01
Bauhinia pertesiana	0.01
Rhus lancea	0.02
Julbernadia globiflora	0.12
Zizphus mucronata	0.01
Bolusanthus speciosus	0.03

c) Grass Composition

The overall grass Shannon-Wiener Index of diversity was 2.19. Hyperrhaenia filipendula was the dominant grass species on the upper section of the stretch around the dam wall site (Table 2) and was clustered around well-developed soil substrate. Other co-dominant species included Rhynchetrium repens and Eragrostis aspera which were found in distinctive stands on disturbed areas around the immediate area to the dam wall. The least abundant grass was Cymbopogon pardus which was only noted on the margins of the cross-section.

Table 2 : Grasses Species in the Surveyed Quarry Site and the Immediate Surrounding Area.

Name of species	Relative abundance (%)
Hyperrhaenia filipendula	0.23
Eragrostis aspera	0.14
Rhynchethrium repens	0.12
Heteropogon contortus	0.11
Hyparrhaenia rufa	0.09
Hyperrhaenia cymbaria	0.08
Cynodon dactylon	0.07
Loudetia simplex	0.06
Pogonathria squarrosa	0.05
Cymbopogon pardus	0.05

d) Fish Composition

Five fish species were found downstream on site 3 and 4, i.e., Barbus atromaculatus three spotted minnow, Tilapia rendalli red breasted bream, Clarius gariepinus catfish, Oreochromis niloticus and Micropterus salmoides bass (Figure 6). Barbus. trimaculatus and T. rendalli were the only fish species caught in greater numbers (more than 6 per 10 minute sampling). All fish sampled were less the 10 g in weight and the average standard length was less than 10cm except for the catfish and bass which had a standard length of between 10 and 13cm. Bass and O. niloticus are exotic species which are also found in the dam and downstream. Results from electrofishing conducted in

Lake Mutirikwi showed similar fish species except for two species (O. macrochir and S. robustus), species in the dam include T. rendalli, O. niloticus, O. macrochir, Seranochromis robustus, C. gariepinus and M. salmoides.

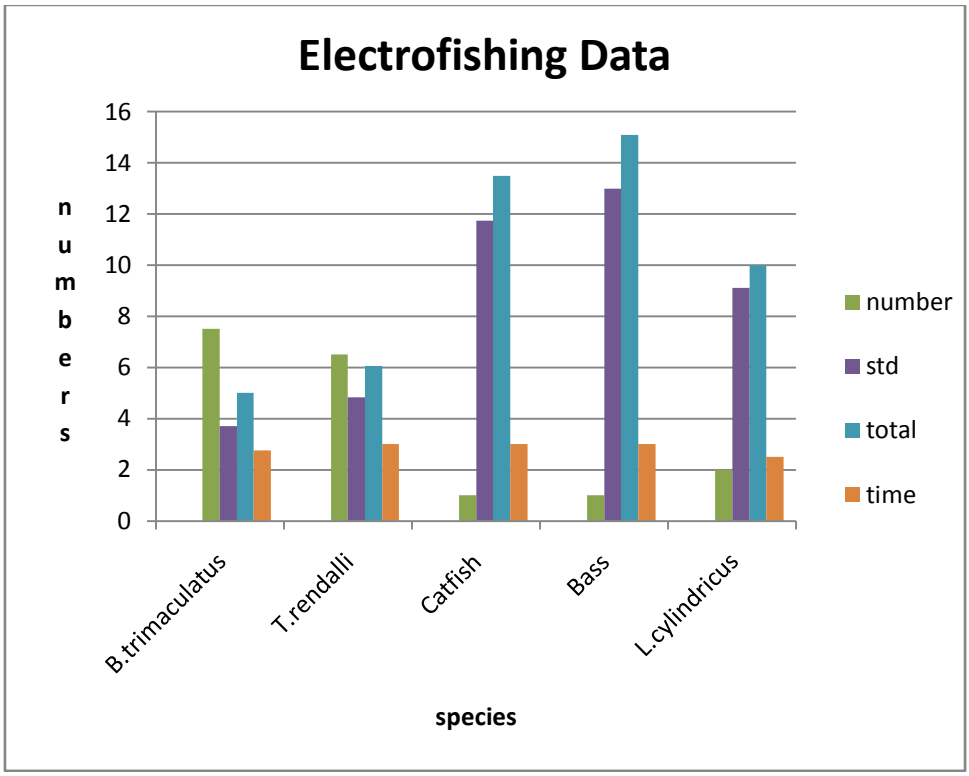

Figure 6 : Summary of Electrofishing Findings, Showing Standard Length, Total Length and Number of Fish Caught.

e) Hydrology and Geomorphology

i. *Site 1*

Situated downstream soon after the dam wall was characterized by continuous steep rock slopes with a single narrow river channel at the bottom of the slopes. There was no evidence of any soil substrate (Figure 7). In addition, there was a great reduction from a thick evergreen forest in 1976 to an almost bare surface with fragmented tree cover.

Figure 7 : Spot Image of Sample Site 1 on 30 October 2012.

ii. *Site 2*

Downstream the river had split into two channels and Sand Island of 819.45 m^2 separated the river (Figure 8). Maize fields were less than 50 cm from the stream bank. The water level was shallow and villagers were crossing on foot. The river bottom was sandy. The width of the two streams varied between 2 and 3m. Compared with the situation in 1976 the island had not yet formed. There was a reduction of vegetation cover from a relatively thick deciduous forest to just scattered trees and shrubs. Close by landuse is now dominated by crop cultivation and grazing fields as compared to what it was in 1976.

Figure 8 : Spot image of Sample Site 2 on 30 October 2012.

iii. *Site 3*

Downstream was characterized by crystalline basement rocks, large boulders with clear water pools scattered within the boulders greater than 40 cm in diameter. The river width was 80 m (Figure 9). There was no evidence of farming along the river bank. Vegetation cover has not changed much from its de-vegetated

state in 1976 and the current land use practices characterised by croplands, bare rocks and grasslands.

Figure 9 : Spot Image of Sample Site 3 on 30 October 2012.

iv. *Site 4*

Downstream the river had again reduced into a small stream with sandy patches with rock out crops (Figure 10). Gardens were also along the river bank.

Figure 10 : Spot Image of Sample Site 4 on 30 October 2012.

v. *Site 5*

Downstream the river was wide, about 120m. The substrate was all sand (Picture 1). The water in the river appeared in patches gently flowing both above and below the sand beds. The site was not very far from Bangala dam mouth (Figure 11). Vegetable gardens were along the river bank in positions which indicated the past high water mark. The water was clear with some deposits of organic matter at the base. There was a change in vegetation cover from a deciduous forest in 1976 to mainly crop cultivation fields and vegetable gardens. These land use patterns have continued to encroach the river and are now almost on the river bed.

Figure 11a above : Part of the River Bed at Site 5 and

Figure 11b below : Spot Image of Sample Site on 5 May 25 2010.

Both Picture 1 and Figure 11 depict the same site 5. In the picture 1 there are women further down washing their laundry.

IV. Discussion

Based on the interviews held with the communities living adjacent to the Mutirikwi River it is suggested that the river flow regime has changed. The river used to flow more often, was a source of large fish such as Seranochromis robustus, eel (Anguilla species) which were not recorded during this present study because it has been long ago when they last saw these fish species. The eel migrates between freshwater and salt water during its life cycle (March et al., 2003) and therefore, disappears when flow is disrupted. Wild animals also used to drink from the river but are no more, supporting the observation by Gandiwa et al. (2012) that damming of major rivers affects the availability of water for wildlife as recorded in Gonarezhou National Park, southeast Zimbabwe. Moreover, the older villagers living along the river claimed they would harvest riverine fruits from the riparian vegetation but these have gone almost extinct (Graf, 2005). According to them what used to be a perennial large river has now turned into a narrow channel (Graf, 2005) which only flows when the floodgates are opened for irrigation. The villagers

complained that when the floodgates were open and they coincided with a natural rain storm, their lives are put in danger as the river floods everything downstream. Lives of both livestock and humans were sometimes lost due to these floods. The loss of continuous flow has presented problems for watering livestock. Ploughing and gardens are now within the old high water mark levels as the villagers keep searching for water into the stream bed. At one site there was evidence of shallow holes dug within the sand in the river bed used as sources of clean drinking water.

The communities were of the opinion that the construction of the dam wall was of no benefit to them, instead a disadvantage (Baxter, 1977; Richter et al., 2010; Gwazani et al., 2012). The effect of the dam wall has extended hundreds of kilometres downstream (Williams and Wolman, 1984) as Bangala dam is over one hundred of kilometres down from Lake Mutirikwi. In support of the findings in this study, Kingsford (2000) states in Australia damming caused changes in aquatic vegetation, reduced vegetation health, led to decline in water-birds, decline in native fish and invertebrate populations.

The historic migration of eel was no longer evident as supported by their disappearance from the stream. The very small sized fish could not be caught by rod and line; therefore, the villagers had resorted to poisoning them. The clear water downstream (implying limited nutrients for fish) results from the trapping of sediments in the reservoir (Graf, 2005). The disruption in seasonal flow has interfered with sediment loading (Doremus, 2001) and river channel patterns hence decreasing habitat suitability for fish growth and breeding (Cudennec et al., 2007). The presence of isolated pools characterized by minimal flow promotes the success of exotic species in rivers (Bunn and Arthington, 2002) in this case O. niloticus and Micropterus salmoides, black bass.

The villagers thought the loss of natural large water pools was also the cause for the reduced rains as no more natural evapotranspiration processes were occurring. Rainfall variation due to likely climate change and loss of large pools is likely to have affected the occurrence of hippopotamus (Hippopotamus amphibius) (Gandiwa et al., 2012) which the elders said used to reside in the river.

The presence of gardens and fields along the river bank has also contributed to the heavy siltation, river bank erosion and flooding (Pradip et al., 2011). The usual recommendation that no farming was permitted within 30 m of the river bank was no longer being observed. The dependence on primary productivity for food increased the rate of degradation along the river bank as poverty demands were taking precedence over the river bank preservation.

The activities in the river of washing clothes and bathing has long term implications on sustainability of a healthy river ecosystem as the nitrogen and phosphorus loads that are contained in household detergents gradually increase (Mapira, 2011). Nitrogen and phosphorus can lead to eutrophication, i.e., nutrient enrichment of the river system which can accelerate plant growth at the expense of fish and other aquatic organisms. O'Connor (2001) established that tree die back increased with the distance of riparian woodland from the river as also observed in this study. Regulated rivers led to reduced river complexity with a shrunken and simplified ecosystem offering reduced habitat for aquatic and riparian vegetation (Graf, 2006).

Downstream changes in hydrology and geomorphology result from at least the influence of land use and hydro-climatic changes but these are difficult to separate (Graf, 2006). The GIS information has shown a 10-15% reduction in vegetation and over 20% increase in cropland, supporting the increases of settlements along the river bank and deforestation in response to demand for cultivation land (Pradip et al., 2011).There was a general observation of spatially smaller, less diverse ecosystem compared to the upstream reaches of river Mutirikwi (Graf, 2006). The challenge of the researcher is to reverse the impacts of damming through stream restoration. More studies are required to further investigate the ecological impacts of management practices of river flows and basin management in Zimbabwe, since more dams are being continually constructed. For such findings to be relevant there is need for actions to harmonize water use and management in order to achieve water security for all by advocating for commitment from policy makers, managers, communities and all stakeholders (Postel, 2003).

V. Acknowledgements

We would like to acknowledge the cooperation we received from the communities for interviewing them at short notice. We would also want to thank our various institutions for according us the time to go into the field for research, especially the Regional Manager for Parks and Wildlife Management Authority, Southern Region.

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FELLOWS

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The board can also take up the additional allied activities for betterment after our consultation.

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Note :

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4. Manuscript's Category,

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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

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ISSN 9755896