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

Global Journal

of Science Frontier Research: D

Agriculture and Veterinary

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Highlights

Chlorophyll Fluorescence Parameters

Performance of White Leghorn

Discovering Thoughts, Inventing Future

VOLUME 15 ISSUE 7 VERSION 1.0

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

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Volume 15 Issue 7 (Ver. 1.0)

Open Association of Research Society

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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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Open Scientific Standards

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USA Toll Free: +001-888-839-7392
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Packaging & Continental Dispatching

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Contents of the Issue

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Invivo and Invitro Acaricide Efficacy Evaluation on Cattle Ticks in Selected Areas of Wolaita and Dawuro Zones, Ethiopia

By Amenu Asha & Eyob Eshetu
Wolaita Sodo University, Ethiopia

Abstract- This study was conducted from June, 2013 to May, 2014 in selected areas of Wolaita and Dawuro zones, with the core intentions of to assess the type and efficacy of the most frequently used acaricides in the areas, to identify the most prevalent cattle tick species and recommend the effective acaricide for cattle tick control. To achieve these objectives preliminary survey; invitro and invivo acaricide efficacy evaluation techniques have been conducted. The major tick species identified in order of their importance were *Rhip(Boophilus) decoloratus* (60.92%), *Amblyomma variegatum* (28.26%), *A. cohaerens* (7.82%) and *A. gemma* (3.0%). Diazinon 60%EC, Amitraz 12.5%, Ivermectin and Deltamethrin, according to their importance, was the acaricides frequently used in the areas. For the invitro technique, a total of 320 *Rhip(Booph) decoloratus* and 320 *A. variegatum* engorged adult female ticks were collected from each study sites and the standard modified adult immersion test (AIT) was employed for two successive round. On the other side of study, the efficacies of all the four acaricides at dose of concentration recommended by the manufacturer were assessed all the way through purposively selecting a total of 255 naturally tick infested cattle aged between 1 to 5 years.

Keywords: *acaricides, cattle, efficacy evaluation, invivo and invitro, ticks.*

GJSFR-D Classification : *FOR Code: 300599*

Strictly as per the compliance and regulations of :

Invivo and Invitro Acaricide Efficacy Evaluation on Cattle Ticks in Selected Areas of Wolaita and Dawuro Zones, Ethiopia

Amenu Asha [α] & Eyob Eshetu [σ]

Abstract- This study was conducted from June, 2013 to May, 2014 in selected areas of Wolaita and Dawuro zones, with the core intentions of to assess the type and efficacy of the most frequently used acaricides in the areas, to identify the most prevalent cattle tick species and recommend the effective acaricide for cattle tick control. To achieve these objectives preliminary survey; invitro and invivo acaricide efficacy evaluation techniques have been conducted. The major tick species identified in order of their importance were *Rhip(Boophilus) decoloratus* (60.92%), *Amblyomma variegatum* (28.26%), *A. cohaerens* (7.82%) and *A. gemma* (3.0%). Diazinon 60%EC, Amitraz 12.5%, Ivermectin and Deltamethrin, according to their importance, was the acaricides frequently used in the areas. For the invitro technique, a total of 320 *Rhip(Booph) decoloratus* and 320 *A. variegatum* engorged adult female ticks were collected from each study sites and the standard modified adult immersion test (AIT) was employed for two successive round. On the other side of study, the efficacies of all the four acaricides at dose of concentration recommended by the manufacturer were assessed all the way through purposively selecting a total of 255 naturally tick infested cattle aged between 1 to 5 years. The invitro result indicates as most of *Rhip(Booph) decoloratus* dipped in Diazinon at 0.06% solution laid eggs and in this case about 59.92% control achieved. Conversely, only a few *Rhip(Booph) decoloratus* ticks dipped in Deltamethrin (%C=93.03%) and Amitraz 0.025% (%C=89.08%) had laid eggs. *Amblyomma variegatum* immersed in Amitraz 0.025% (%C=94.51%) and Deltamethrin (%C=94.06%) had laid small batches of eggs. In contrast, almost all of the ticks in the control group (water treated) have successfully laid eggs. The overall mean oviposition response inhibition of both Amitraz 0.025% and Deltamethrin solution were higher than Diazinon 0.06% and it have shown statistically significant ($P<0.05$) variation. Diazinon 0.06% has also shown significantly fewer efficacies (79.79%C) than all the three drugs (Amitraz 0.025%=99.89%C, Deltamethrin 1%=99.22%C and Ivermectin 1ml/50Kg=99.14%C) in removing the adult ticks at field level assessment. Therefore, it can be recommended that, for effective cattle tick control in the area, threshold tick control approaches using most effective acaricide Amitraz, Deltamethrin and Ivermectin when tick infestation exceeds an acceptable level.

Keywords: acaricides, cattle, efficacy evaluation, invivo and invitro, ticks.

Author α σ: School of Veterinary Medicine, Wolaita Sodo University, Ethiopia. e-mail: eyobeshetu@ymail.com

I. Background and Justification

Ethiopia is a country that stands first in Africa and 10th in the world in the livestock population. The productivity of these animals is affected by many factors, among which animal diseases, inadequate nutrition, poor management, poor genetic makeup and recurrent drought are major causes. Dawuro and Wolaita zones of SNNP Region are potential for the production of livestock especially for cattle, sheep, goats, equine and poultry, but various diseases and disease related factors are affecting the production and productivity of these animals (CSA, 2007). The five years period (2005 – 2010) studies on the distribution of diseases by Sodo Regional Veterinary Laboratory have indicated that among more than 40 diseases and disease related problems stated by the live stock owners from 8 Zones (including Wolaita and Dawuro zones) and two special woredas, tick infestation stands second major problem (83.9%) following Blackleg. Ticks are of importance to veterinary medicine because they can be an annoyance, cause harm due to their blood feeding and they can transmit many pathologic organisms (Urquhart, 1996).

Tick infestation and tick born disease (TBD) control is based mainly on the use of acaricides, since alternative non-chemical tick control methods such as: predators and parasites, pasture spelling, sterile male release, use of tick resistant cattle, vaccination with tick antigens are either at experimental stage or have been shown to be inadequate. Thus, the most widely used method for effective control of ticks is the direct application of acaricides to host animals. However, acaricides are expensive and can be detrimental to the environment: their use should be minimized and integrated with alternative approaches (Cunningham, 1981; Minjauw and de Castro, 1999).

Repeated use of acaricides besides being the environmental hazard, it is exposed to be resisted by tick species through time, and this forces frequent application at high concentrations which is more critical to the environment. Tick acaricide resistance is reported in various parts of the countries where tick and tick borne diseases are of major problem. Since tick infestation is one of the major reported problems in the area, repeated use of acaricides is the only option in

high tick seasons (Jobre *et al.,* 2001). Therefore, this study was designed to identify the major cattle tick species in the area and to assess the efficacy of most frequently used acaricides for the control of ticks in selected sites of Dawuro and Wolaita zones, Ethiopia.

II. Materials and Methods

a) Description of study area

Wolaita and Dawuro zones of the SNNPR, the study areas, were located in southwest part of Ethiopia. The two zones are separated by the gorge of Omo River. Wolaita zone is located 380km south west of Addis Ababa with altitude between 700 and 2950 meters. Rainfall is with an annual average of 1200-1300mm. Mean monthly temperatures vary 11^0C to 26^0C. On the other hand, Dawuro zone is located at 512km south west of Addis Ababa. Altitude of the zone is 501-3000 meters with mean monthly temperature ranges 15.1^0C to 27.5^0C and annual rainfall of 1201-1800mm. Both zones practice a crop-livestock mixed farming and keep combination of livestock species. Equally, the zones receives a bimodal rainfall in short (February to March) and long (May to September) seasons. Agriculture is the main stay of rural livelihoods in the districts (CSA, 2007).

b) Study design

An experimental randomized controlled trial was used to assess the effect of Diazinon 60%EC, Amitraz 12.5%, Deltamethrin and Ivermectin against tick species under in-vitro and in-vivo on cattle kept under extensive and intensive production system in selected areas of Wolaita and Dawuro zones, Ethiopia.

c) Sample size determination

The sample size was determined by using the formula described by Schulz and Grimes (2005) by assuming =0.05, power=0.90 (table value=10.51) and equal sample size were used in the two groups (i.e. all treatment group and control). The overall expected efficacy of each tested acaricide was considered to be 100% according to Thrusfield (2005).

$$N = \frac{\text{Power } [(R+1)-P^2(R^2+1)]}{P^2(1-R)^2}$$ Where,

N= the sample size in each of the group

P1= Event rate in the treatment group

P2= Event rate in the control group

R= Risk ratio (P1/P2)

Thus, for each trial, the total sample size was 75 cattle

d) The study protocol

Prior to trial initiation, 150 ticks were randomly collected from cattle and preserved in screw cap bottles using 80% ethanol, 5% glycerin and 15% distilled water. The aim of the tick collection exercise is to get an idea on the tick species involved. Accordingly, the ticks were identified using the taxonomic criteria described by Kaiser (1987).

e) In-vivo acaricide efficacy evaluation trial

i *Experimental protocol*

Selection of cattle for the purpose of this experiment is dependent on two factors:

i) Presence of tick burdens in the farm/herd and

ii) Cattle that were not receive any acaricide treatment at least within one month from the commencement of the trial.

At all the study sites, a total of 255 naturally tick infested cattle aged between 1 to 5 years (from the dairy farm/38, Wolaita zone/114 and Dawuro zone/103) were purposely selected and randomly divided into five groups of cattle, each group having 6 to 10 cattle (n=6-10). Each selected animal was subject to each tested acaricide treatment (Diazinon 60%EC, Amitraz 12.5%, Ivermectin injectable, Deltamethrin and control). Each experimental cattle was identified with a name given by the owner, color of the animal, sex and other special marks on the animal.

f) Acaricide application procedures

Each tested Diazinon and Amitraz, was mixed with water at working dilution recommended as per the prescription of the manufacturer. Both Deltamethrin pour on and Ivermectin injection was also used as dosage prescribed by the manufacturer. And so, all cattle in Group-1, Group-2 and Group-3 were thoroughly wetted with freshly prepared emulsified concentrate of each tested acaricide at a volume and concentration recommended by the manufacturer. Cattle in Group-4 were injected with recommended dose of Ivermectin. Treatments were done only once at trial initiation (Day 0) after the first count of ticks (pre-treatment count). No acaricide was applied on cattle in Group-5 and they served as controls.

g) Ticks count on cattle

Basically, ticks were counted on the visible anatomical sites of half body, on alternative sides, of each cattle at defined body zones; namely the ears, head, dewlap, back, abdomen, anus-vulva and tail. All tick counts were conducted by the same person as per the procedure described by Bianchi *et al.* (2003). Ticks stage were identified and counted in situ, but none of them be removed. Tick collection was made regularly at defined intervals and time. Accordingly, counting was done at Day-0 (at trial initiation day) and then at D-7, D-14 and D-21 (after trial initiation days) (Ali Mohammed and De Castro, 1993). The parallel tick count results on Group-5 cattle were used as an index in computing the percentage tick control achieved (Rinkanya, 1984). Thus, the efficacies of one acaricide alone was estimated by comparing the tick loads on animals at the

time of the treatment (pre-treatment count) with those obtained at D-7, D-14 and D-21 after treatment and is calculated using the following formula described by Drummond, *et al.* (1981):

$$\text{Percent control} = \frac{\text{MTC-MTT}}{\text{MTC}} \text{X100}$$

Where, MTT and MTC are mean tick counts in treated cattle (Group-1, Group-2, Group-3 and Group-4) and untreated cattle (Group-5), respectively.

h) In-vitro acaricide efficacy evaluation trial

i *Adult Immersion Test (AIT): Oviposition response*

The in-vitro tested acaricides includes Diazinon 60%EC, Amitraz 12.5% and Deltamethrine which are commonly used by the communities and available at the market. For the evaluation of oviposition response inhibition of each tested acaricide, a total of forty (n=40) engorged female tick of each species of uniform size were collected from cattle and each tick species randomly allocated into four groups: Group-1 (n = 10), Group-2 (n = 10) and Group-3 (n = 10) are ticks subjected to each tested acaricide treatment and Group-4 (n=10) are untreated, ticks serve as control. During the study period, two successive replicates of the above trails for each acaricide treatment and control group were done. Therefore, during the study period a total of eighty (n=80) engorged female tick of each species were collected from cattle.

The weight of engorged female tick in all four groups was recorded. Ticks in Group-1 (n = 10), Group-2 (n =10) and Group-3 (n =10) were immersed in each evaluated acaricides at concentration recommended at field level. While ticks those assigned in Group-4 were immersed in distilled water. After 10 minutes of immersion all ticks were cleaned and air-dried at room temperature for an hour, pasted onto double-sided adhesive tape on glass test panels with their ventral sides facing upwards keeping their capitula clear of the tape and then were incubated at 25^{0}C to 28^{0}C and 85-90 % R.H. for 7 days. The effect of each tested acaricides on reproductive capacity of each immersed engorged female tick species was also determined and then compared with the control groups. All groups were then tested (evaluated) using the egg laying test method (Drummond, *et al.*, 1973 and modified by FAO, 2004) which involves the comparison of the egg mass of each engorged female tick treated in each tested acaricides with the egg mass of untreated engorged female tick and finally estimate the percentage control achieved by each test acaricide using the following formula:

$$\text{Percent control} = \frac{\text{MEC} - \text{MET}}{\text{MEC}} \text{X 100}$$

Where, MEC and MET are mass of eggs laid by control ticks and treated ticks, respectively.

i) Data management and Statistical analysis

All the collected data were entered to Microsoft Excel 2007 spread sheet then transferred to SPSS-Version 17. Descriptive statistics like mean and standard deviation were compared. Independent sample t-test was used to compare the mean tick burden between treated and control group. All analysis was performed at 95% CI and 5% significance level. After treatment, acaricides activity were assessed using arithmetic mean tick count which was calculated for treated and control group and the percentage reduction in mean tick count in both AIT and in-vivo tick count was determined as follows:

$$\%\text{efficacy} = \frac{\text{C-T}}{\text{C}} \text{x100}$$

Where:

C= Mean number of ticks/animal in the control group

T=Mean number of ticks/animal in the treatment group

III. Results and Discussions

a) Tick identification

The major tick species identified were *Rhipicephalus (Boophilus) decoloratus, Amblyomma variegatum, A. cohaerens and A. gemma. Rhip (Booph) decoloratus* was found to be the most prevalent tick species in the study areas. The total numbers of animals examined, total adult tick collected and identified from the different study areas were shown below in table-1.

Table 1 : Total adult tick collected and identified from the different study areas

Study area	Total animals	Total ticks	Tick species identified			
			Rhip(Booph) decoloratus	*A.variegatum*	*A.cohaerens*	*A.gemma*
Sodo zuriya	24	196	117	58	16	5
Dawuro zone	33	143	98	39	4	2
Dairy farm	11	160	89	44	19	8
Overall	68	499	304 (60.92%)	141 (28.26%)	39 (7.82%)	15 (3.00%)

b) The overall effect of in-vivo tested acaricides

i *The overall effect of Diazinon 0.06%*

The overall mean post treatment tick count result of Diazinon at 0.06% concentration had different efficacy at the Dairy farm, Sodo zuriya and Dawuro zone at each D-7, D-14 and D-21 post treatment (table-2). The result has shown higher statistical significant variation ($P<0.05$) of overall adult ticks removing in Dairy farm (98.17%) and Dawuro zone (75.56%) than Sodo zuriya woreda (65.64%).

ii *The overall effect of Amitraz 0.025%*

The overall mean pre-treatment tick count (D-0) was 286, 506 and 725 ticks in Dairy farm, Sodo zuriya and Dawuro zone, respectively. Following treatment with Amitraz 0.025% has showed statistically significant variation ($P<0.05$) between the overall mean pre-treatment and post treatment tick count at all the three study sites. Amitraz 0.025% results in maximum of 100% (D-21) total mean tick count reduction in Sodo zuriya and Dairy farm (table-2).

iii *The overall effect of Deltamethrin pour-on*

At all the three study sites, treatment of animals with Deltamethrin solution has shown the highest overall mean adult tick killing rate at D-21 of post-treatment. Deltamethrin has shown statistically significant ($P>0.05$) efficacy variation in removing adult ticks between Sodo zuriya woreda and Dairy farm at D-7 of post-treatment, and it was lesser at Sodo zuriya woreda (85.06%) than Dairy farm (95.73%).

iv *The overall effect of Ivermectin subcutaneous injection*

A similar, very good, efficacy was registered in the Ivermectin treated group at D-7 post treatment at Dawuro zone and Dairy farm, which has been maintained also at D-21 post treatment.

Table 2 : Total tick counts on cattle treated with each four tested acaricide and the %C achieved

Study sites	Type of acaricides	Day	Day-0	Day-7	Day-14	Day-21	Overall
Dawuro zone	Amitraz 0.025%	Treatment group	704	3 (99.64%)	2 (99.77%)	3 (99.61%)	8 (99.67%)
	Diazinon 0.06%	Treatment group	675	108 (87.38%)	166 (80.61%)	189 (75.56%)	463 (81.18%)
	Deltamethrin 1%	Treatment group	1020	48 (94.22%)	14 (98.36%)	8 (98.97%)	70 (97.15%)
	Ivermectin	Treatment group	615	41 (95.07%)	9 (98.95%)	5 (99.35%)	55 (97.76%)
	Water	% control	725	831 (99.82%)	856	773	2460
Sodo zuriya	Amitraz 0.025%	Treatment group	837	1 (99.82%)	1 (99.82%)	0 (100%)	2 (99.88%)
	Diazinon 0.06%	Treatment group	587	114 (78.97%)	156 (74.00%)	201 (65.64%)	471 (72.73%)
	Deltamethrin 1%	Treatment group	692	81 (85.06%)	7 (98.83%)	5 (99.15%)	93 (94.62%)
	Ivermectin	Treatment group	562	157 (71.03%)	40 (93.33%)	16 (98.97%)	213 (87.67%)
	Water	% control	506	542	600	585	1727
Dairy farm	Amitraz 0.025%	Treatment group	286	6 (97.17%)	3 (98.56%)	0 (100%)	9 (98.60%)
	Diazinon 0.06%	Treatment group	194	14 (93.36%)	9 (95.67%)	4 (98.17%)	27 (95.77%)
	Deltamethrin 1%	Treatment group	209	9 (95.73%)	4 (98.08%)	1 (99.54%)	14 (97.81%)
	Ivermectin	Treatment group	154	12 (94.31%)	5 (97.60%)	2 (99.09%)	19 (97.02%)
	Water	% control	203	211	208	219	638

c) The overall effect of in-vitro tested acaricides

Table-3 summarizes the total tick counts on the treated and control groups, and percentage control achieved during the invitro trial. The result indicates as most of the engorged female *Rhip (Booph) decoloratus* dipped in Diazinon at concentration of 0.06% solution laid eggs and in this case about 59.92% control was achieved. Conversely, only a few female *Rhip (Booph) decoloratus* ticks dipped in Deltamethrin solution and engorged female *Amblyomma variegatum* immersed in Amitraz at concentration of 0.025% solution and Deltamethrin had laid small batches of eggs. On the other hand, almost all of the ticks in the control group (water treated) have successfully laid eggs. As shown on table-4, through the in-vitro efficacy evaluation test, both Amitraz and Deltamethrin showed higher statistically significant ($P<0.05$) oviposition response inhibition than Diazinon. The mean, minimum and maximum overall oviposition response inhibition of each tested acaricides was listed on table-5 below. Accordingly, the highest mean oviposition response inhibition was recorded by Deltamethrin (93.54%) followed by Amitraz (91.79%) and Diazinon (65.3%).

Table 3 : Mean oviposition response of adult *A. variegatum* and *Rhip(Booph)* decoloratus after immersion in tested acaricide at field recommended concentration and 7 day incubation

Trail	Tick species	Acaricides	N	Eng.wght (gm)	S	No.LE	Egg M (gm)	%C
Trail-I	*B. decoloratus*	Amitraz	30	8.01	1	1	0.03	96.91
		Diazinon	30	7.56	7	6	0.31	68.04
		Deltamethrin	30	7.77	1	1	0.04	95.87
		Control	30	8.04	30	25	0.97	
	A. variegatum	Amitraz	30	8.28	4	3	0.07	92.86
		Diazinon	30	7.75	10	8	0.32	67.35
		Deltamethrin	30	8.39	1	1	0.06	93.88
		Control	30	8.03	27	24	0.98	
Trail-II	*B. decoloratus*	Amitraz	30	7.89	3	3	0.21	81.25
		Diazinon	30	8.26	7	6	0.54	51.79
		Deltamethrine	30	7.20	3	2	0.11	90.19
		Control	30	7.76	27	22	1.12	
	A. variegatum	Amitraz	30	7.72	1	1	0.04	96.15
		Diazinon	30	7.57	6	5	0.27	74.04
		Deltamethrin	30	8.23	2	2	0.06	94.23
		Control	30	7.92	26	23	1.04	

Table 4 : Multiple comparisons-of Percent control of the acaricides

(I) Acaricide type	(J) Acaricide type	Mean difference	Std.Error	Sig.	95%CI	
Amitraz	Deltamethrin	-1.75	4.31	0.976	-14.54	11.04
	Diazinon	26.48	4.31	0.00*	13.7	39.28
Deltamethrin	Amitraz	1.75	4.31	0.976	-11.04	14.54
	Diazinon	28.24	4.31	0.00*	15.45	41.03
Diazinon	Amitraz	-26.49	4.31	0.00*	-39.28	-13.70
	Deltamethrin	-28.24	4.31	0.00*	-41.03	-15.45

Table 5 : Overall mean percent oviposition control of tested acaricides at field recommended concentration against adult female A. vareigatum and B. decoloratus

Acaricides	Min. Efficacy (%)	Max. Efficacy (%)	Mean efficacy (%±SD)
Amitraz 0.025%	78.38	100	91.79±7.25
Deltamethrin 1%	90.19	95.87	93.54±2.4
Diazinon 0.06%EC	61.11	97.06	65.3±9.5

IV. Conclusion and Recomendations

Amitraz 12.5% at field recommended concentration of 0.025% provides relatively a higher oviposition response inhibition of each *Rh. pulchellus* and *A. gemma* than Diazinon 60%EC at 0.06% concentration; but it isn't statistically significant variation. However, both acaricides showed relatively less effect against the oviposition of *Rh. pulchellus* than against oviposition of *A. gemma*. Regard less of the tick species, each evaluated acaricide had variable efficacy against oviposition responses of *A. gemma* and *Rh. pulchellus* with higher significant ($P<0.05$) percent oviposition control of Amitraz 0.025% than for Diazinon 0.06%. For Diazinon, but not for that of Amitraz, at field recommended concentration the mean oviposition %C is slightly below the International and National standards of most African countries ($\geq$85%C Vs 80%C). A long time usage of one acaricide type, abnormal concentration, usage of unknown acaricides type/source, and frequent or none-programmed use of acaricides are the common phenomenon of tick control methods in the area. Therefore, from the present study it was recommended that threshold tick control approaches using most effective acaricide when tick infestation exceeds an acceptable level in the area. Educating and/or awareness creation for farmers on the

ways of proper acaricide usage, application, dilution and systematic ways of substitution has also its own contribution. It would be valuable to conduct this in-vitro test using different tick species or other efficacy evaluation methods involving larval and nymphal stage. Further In-vivo efficacy trial (trial at field level) should be conducted to assess the residual effect of these acaricides. From government part attentions should be given: on strengthening veterinary service delivery, effective legislation of acaricide importation, marketing and monitoring in the area

V. Acknowledgements

Firstly, we would like to express our heart-felt thanks to all management bodies of Wolaita Sodo University (WSU) who established adequate research environment and fully sponsored this research work. Our special thanks and appreciations go to Dr. Berhanu Betako, Veterianarian at Sodo zuriya woreda Veterinary clinic and to all communities in the study area who provided us genuine and helpful information. Last but not least, we thank all our colleagues, families and friends for their moral and material support during our study.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Interrelations between Chlorophyll Fluorescence Parameters as a Tool for the Detection of Seasonal Changes in Photosystem II Kinetics in Two Strawberry (*Fragaria* X *Ananassa* Duch.) Cultivars

By Jadwiga Żebrowska & Władysław Michałek
University of Life Sciences, Poland

Abstract- The aim of this study was to establish relationships between parameters of chlorophyll fluorescence in two strawberry cultivars in order to detect the seasonal changes in their photosystem II (PSII) kinetics. Parameters of chlorophyll fluorescence (CF) such as: Fo, Fm, Fv/Fm, Fo`, Fm`, qP, qN and Y were measured in mature leaves of two strawberry cultivars 'Teresa' and 'Honeoye' in a late spring and an early autumn. Fluorescence of dark-adapted leaf samples was measured in the laboratory at room temperature, with the use of a portable pulse amplitude modulation (PAM) fluorometer in fifteen replicates for each parameter. Relationships between CF parameters calculated on the basis of Pearson's correlation coefficients were highly differentiated in the analyzed cultivars and depended on the genotype and its specific response to the various environmental conditions characterizing both seasons of the year.

Keywords: *correlation, environment, genotype, interaction, photosynthesis.*

GJSFR-D Classification : *FOR Code: 070199*

Strictly as per the compliance and regulations of :

Interrelations between Chlorophyll Fluorescence Parameters as a Tool for the Detection of Seasonal Changes in Photosystem II Kinetics in Two Strawberry (*Fragaria* X *Ananassa* Duch.) Cultivars

Jadwiga Żebrowska [α] & Władysław Michałek [σ]

Abstract- The aim of this study was to establish relationships between parameters of chlorophyll fluorescence in two strawberry cultivars in order to detect the seasonal changes in their photosystem II (PSII) kinetics. Parameters of chlorophyll fluorescence (CF) such as: Fo, Fm, Fv/Fm, Fo`, Fm`, qP, qN and Y were measured in mature leaves of two strawberry cultivars 'Teresa' and 'Honeoye' in a late spring and an early autumn. Fluorescence of dark-adapted leaf samples was measured in the laboratory at room temperature, with the use of a portable pulse amplitude modulation (PAM) fluorometer in fifteen replicates for each parameter. Relationships between CF parameters calculated on the basis of Pearson's correlation coefficients were highly differentiated in the analyzed cultivars and depended on the genotype and its specific response to the various environmental conditions characterizing both seasons of the year. In cv.'Teresa' highly positive significant correlation was observed between qP-Fm` and Fm`-Fo` in the autumn, and highly negative significant correlation was calculated between qN-Fo in the spring. In cv. 'Honeoye' the strongest positive significant correlation was evaluated between Y-Fm` in the autumn and between Fv/Fm-Fo in the spring. Besides, in the autumnal measurements the relationship between qP-Fo` was positively significant, but correlation between Fv/Fm-Fo was significantly negative in this cultivar. Differences observed between spring and autumnal CF relationships in both cultivars reflected the seasonal changes in their photosystem II kinetics. The different distribution of photons in the photosystem II responded to various light intensity and/or temperature characterizing the spring and autumn environmental conditions. In cv.'Honeoye' these changes were more evident when compared to cv.'Teresa'. The functioning of PSII in leaves of cv.'Teresa' was more stable in both seasons of the year. On the other hand, it could be stated, that the strongest significant relationships established between CF parameters in the analyzed strawberry genotypes might be applicable as the reliable indices of stability in their photosynthetic apparatus functioning in different seasons of the year.

Keywords: correlation, environment, genotype, interaction, photosynthesis.

I. Introduction

Chlorophyll fluorescence is an indicator of the primary photochemistry of photosynthesis (Krause and Weis, 1991) and allows as a rapid, non-destructive technique to examine photosynthetic process *in vivo*. Chlorophyll fluorescence (CF) replaces partly conventional measurements of photosynthetic efficiency. The measurements of CF parameters are particularly useful to assess the plant response to different environmental stresses (Bolhar-Nordenkampf *et al.,* 1989; Guidi *et al*.,1997; Jimenez *et al.,*1997; Maciorowski *et al.,*1996 Smillie *et al*.,1987; Havaux and Lannoye,1985; Krause and Somersalo, 1989; Murkowski and Skórska, 1988; Skórska and Murkowski, 1988). Fluorescence can give insights into the ability of a plant to tolerate environmental stresses and into the extent to which those stresses have damaged the photosynthetic apparatus. By measuring the intensity and nature of this fluorescence, plant ecophysiology can be investigated, also (Lichtenthaler *et al.,* 1986).

It has long been known that chlorophyll fluorescence emission kinetics from plants provide an indicator of plant photosynthetic performance (Mc Allister and Myers , 1940; Kautsky and Zedlitz, 1941; Kautsky, Appel and Amann, 1960). More recently, fluorescence parameters have been shown to relate directly to the photosynthetic CO_2 assimilation rate of leaves (Genty, Briantais and Baker, 1989; Genty *et al.,* 1990; Cornic and Ghashghaie, 1991; Harbinson, Genty and Baker, 1990; Krall and Edwards, 1990, 1991; Krall, Edwards and Ku, 1991; Edwards and Baker, 1993; Siebke *et al*., 1997) and have been widely used to study leaf photosynthetic performance (Maxwell and Johnson, 2000). Another application where fluorescence may be useful is in examining the acclimation of plants to

Author α: Department of Genetics and Horticultural Plant Breeding, Faculty of Horticulture and Landscape Architecture, University of Life Sciences in Lublin, Akademicka 15 street, 20-950 Lublin, Poland.
e-mail: jadwiga.zebrowska@up.lublin.pl
Author σ: Department of General Ecology, Faculty of Horticulture and Landscape Architecture, University of Life Sciences in Lublin, Akademicka 15 street, 20-950 Lublin, Poland.

different microenvironments. By measuring the light dependency of Φ_{PSII} it is possible to make simple and rapid estimates of the light saturation behaviour of different plants under field conditions. The technique of chlorophyll fluorescence has become ubiquitous in plant ecophysiology studies. A number of excellent reviews exist that discuss the theoretical background of both measurement and analysis of chlorophyll fluorescence, however, these are typically written from a biophysicist's or a molecular plant physiologist's point of view (Horton and Bowyer, 1990; Krause and Weis, 1991; Govindjee, 1995). In recent years no investigations into photosynthetic performance of plants under field conditions seems complete without some fluorescence data. In spite of the simplicity of the measurements, however, the underlying theory and the interpretation of data still remains complex and in places, controversial. Considering the above statement, further investigations in this area of plant physiology are needed.

In order to enlarge the knowledge of photosynthesis process *in vivo*, relationships between the CF parameters in different strawberry genotypes were investigated in this study. Such relationships give insight into the photosystem II kinetics and could be applicable to predict changes in the photosynthetic apparatus functioning of strawberry cultivars in different seasons of the year.

II. Material and Methods

Measurements of eight parameters of chlorophyll fluorescence were done in mature leaves of two strawberry cultivars 'Honeoye' and 'Teresa' using plants growing outdoors at the Experimental Station belonging to the University of Life Sciences in Lublin (51.240° N, 22.570° E). Both cultivars are commercially cultivated in Poland and belong to early and mid-early genotypes (respectively). Chlorophyll fluorescence was evaluated twice: in the late spring (after flowering) and in the early autumn (after yielding). Fluorescence of dark-adapted leaf samples was measured in the laboratory at room temperature, with the use of a portable pulse amplitude modulation (PAM) fluorometer (PAM 2000, Heinz Walz GmbH, Effeltrich, Germany) in fifteen replicates for each parameter. The leaves of 'Teresa' and 'Honeoye' were placed into the clip, darkened for 20 min and then illuminated with red light emitting diodes (peak at 650 nm, maximum photo-synthetic photon flux density-PPFD at leaf surface was 600 $\mu mol \times m^{-2} \times s^{-1}$). The following parameters of chlorophyll fluorescence were measured:

1. F_o – minimal fluorescence of dark-adapted leaves
2. F_m – maximal fluorescence of dark-adapted leaves
3. F_v/F_m – ratio of variable fluorescence (Fv=Fm-Fo) to maximal fluorescence (Fm); an indicator of maximum quantum photochemical efficiency of PSII (maximum quantum yield), an indicator of photoinhibition
4. Y – Yield of PS II, a light adapted test normally taken at steady state photosynthesis levels, to estimate of the effective portion of absorbed quanta used in PSII reaction centers
5. qP –photochemical quenching
6. qN – non-photochemical quenching
7. Fo` – minimal fluorescence in the light-adapted leaves
8. Fm` – maximal fluorescence in the light-adapted leaves.

Relationships between CF parameters were estimated by Pearson`s correlation r_{xy} and regression b_{yx} coefficients in the analyzed plant material. The significance of correlations was evaluated by Duncan's multiple range test at $P \leq 0.05$.

III. Results and Discussion

In this study the following relationships between CF parameters were evaluated: Fm-Fo; Fm`-Fo`; Fv/Fm-Fo; Fv/Fm-Fm; Y-Fo; Y-Fm; Y-Fo`; Y-Fm`; qP-Fo`; qP-Fm`; qN-Fo; qN-Fm; qN-Fo`; qN-Fm`. Some of them were strong and significant.

a) Relationships between CF parameters measured in leaves of cv.'Teresa'

In cv.'Teresa', as was shown in Table 1., the strong and significant correlation was observed for pairs of CF parameters qP-Fm` and Fm`-Fo` in the autumnal measurements. Both of them were positive, and correlation between Fm`-Fo` reached the higher value in comparison with the first one. High positive, though insignificant relationships were observed also for pairs of following parameters: Fm-Fo; qP-Fo`. On the contrary, following relationships between pairs of CF parameters Fv/Fm-Fo; Y-Fo; Y-Fm; Y-Fo`; Y-Fm`; qN-Fo; qN-Fm were negative. In these pairs of correlation, the highest values were estimated between qN-Fo and Y-Fo. The autumnal measurements of CF parameters showed, that with the increase in values of Fm`, photochemical quenching qP also reached the significantly higher values and Fm` was strongly, positively influenced by Fo` (Fig.1 and Fig.2.; respectively).

In the case of qN, it was observed that the increase in values of Fo and Fm caused a decrease in the value of this first parameter. Ratio Fv/Fm was negatively related to Fo, and positively to Fm. Y parameter was negatively and insignificantly related to Fo, Fm, Fo` and Fm` parameters.

In spring measurement, some of evaluated relationships were different when compared with the given above. So that, the strong negative and highly significant correlation was observed between qN and Fo (Fig.3). In the case of remaining relationships there was no significant correlation. On the contrary to autumnal relationships, parameter Y was positively correlated with Fm, Fo` and Fm`, and negatively only with Fo

parameter. Also, the contrary relation-ships were observed in the case of correlation between qN-Fo` and Fm`-Fo` (both of them were negative). Also, the negative correlation was observed between Fm-Fo and Fm`-Fo`. In the autumn measurement both of these relationships were positive. Correlation Fv/Fm-Fo and Fv/Fm-Fm showed the same tendency of relationships when compared to the autumn measurement (negative and positive, respectively).

b) Relationships between CF parameters measured in leaves of cv.'Honeoye'

In the autumn measurements, as was shown in Table 1. correlation between Fv/Fm-Fo, Y-Fm` and qP-Fo` were strong and significant. The first one was negative (Fig.4), the second and third relationships were positive (Fig.5 and Fig.6). The highest value reached the correlation between Y and Fm`. The remained relationships were insignificant. Besides, it should be noticed, that in this cultivar most of evaluated relationships were positive, negative correlation was observed in the case of Y-Fo`, qN-Fo, Fm-Fo and Fm`-Fo`.

In the spring, associations between CF parameters in cv. 'Honeoye' were mostly different when compared to those observed in the autumn. Only positive correlation between Fv/Fm-Fo (Fig.7) and negative between Y-Fm (Fig.8) were strong and significant. Only correlation between Y-Fo`, qN-Fo`,qN-Fm` and Fm`-Fo` showed the same direction of relationships in comparison with the autumn evaluation.

The high differentiation of relationships between CF parameters exhibited in the analyzed plant material reflected the seasonal changes in the photosystem II kinetics. The different distribution of absorbed photons (electron transfer) in the spring and autumn responded to the various light intensity and/or temperature characterizing these seasons of the year. Seasonal changes in the photosystem II functioning were more evident in cv.'Honeoye' in comparison with cv.'Teresa'. Only positive association between qN-Fo` and qN-Fm` as well as negative between Fm-Fo, Fm`-Fo` and Y-Fo` were seasonally unchangeable in this cultivar. On the contrary, in cv.'Teresa' all given above CF correlations, excluding qN-Fm` exhibited the seasonal changes in the photosystem II functioning. In the spring, relationships between Fm-Fo, Fm`-Fo` and qN-Fo` were negative, while in the autumn these associations changed into positive. Besides, the seasonal changes in the distribution of absorbed photons in the PSII were observed regarding correlations between Y-Fm, Y-Fo`, Y-Fm`, which were positive in the spring and negative in the autumn in this cultivar.

In this study, correlation between qN and Fm` was always positively stable, independently on the cultivar and the season of year.

To date, no published data considering the study on relationships between CF parameters in the strawberry were given. Some correlation between CF parameters were calculated by researchers like Genty *et al*. (1989) where the quantum yield of non-cyclic electron transport was directly proportional to the qP and Fv/Fm in *Silene dioica*; Genty *et al.* (1990) observed the relationship between qN and the rate of PSII photochemistry in leaves of barley and pea ; Bilger, Schreiber and Bock (1995) assessed the determination of the quantum efficiency of photosystem II and of non-photochemical quenching of CF in the field, where qN was closely correlated to excessive PPFD calculated from the PSII quantum yield. Regarding the high differentiation in the response of photosystem II functioning to the various environmental conditions characterizing the different seasons of the year observed in the analyzed plant material, further examinations focused on this problem in the strawberry are needed.

IV. Conclusions

1. Interrelations between chlorophyll fluorescence parameters were exhibited in the analyzed strawberry cultivars. Some of them were strong and significant.
2. In this study correlations between CF parameters were highly differentiated and depended on the genotype and its specific response to various environmental conditions (light intensity and/or temperature) characterizing the spring and autumn.
3. Differences observed between spring and autumnal CF relationships in both cultivars reflected the seasonal changes in their photosystem II kinetics. These changes were more evident in leaves of cv.'Honeoye'. The functioning of photosystem II in leaves of cv.'Teresa' was more stable in these both seasons of the year.
4. On the other hand, the strongest significant relationships between CF parameters evaluated individually for each strawberry cultivar, might be applicable as the indices of stability in their photosynthetic apparatus functioning in various environmental conditions and could be recognized as the cultivar characteristics.
5. Strong and significant correlations between CF parameters probably pointed out the occurrence of the genetic linkage between additive loci controlling these correlated CF parameters or exhibited the pleiotropic effect of these loci.

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Table 1 : The most important Pearson`s correlation (r_{xy}) and regression (b_{yx}) coefficients evaluated between CF parameters in two strawberry cultivars

CF parameters y x	cv.'Teresa' spring r_{xy}	cv.'Teresa' spring b_{yx}	cv.'Teresa' autumn r_{xy}	cv.'Teresa' autumn b_{yx}	cv.'Honeoye' spring r_{xy}	cv.'Honeoye' spring b_{yx}	cv.'Honeoye' autumn r_{xy}	cv.'Honeoye' autumn b_{yx}
Fm- Fo	-0.2254	-0.4814	0.4106	2.0316	-0.1791	-0.3628	-0.1813	-0.9032
Fm`-Fo`	-0.3247	-0.7071	0.8498**	2.5310**	-0.1195	-0.0125	-0.1945	-0.7926
Fv/Fm-Fo	-0.1141	-0.3637	-0.1034	-0.2262	0.6562**	1.2269**	-0.4845*	-1.2243*
Fv/Fm-Fm	0.0376	0.0561	0.2379	0.1054	-0.2231	-0.2058	0.3124	0.1586
Y-Fo	-0.0132	-0.0328	-0.1849	-0.7218	-0.0341	-0.0238	0.0430	0.1554
Y-Fm	0.2905	0.3378	-0.1579	-0.1238	-0.5769*	-0.1995*	0.0980	0.0711
Y-Fo`	0.1834	0.4166	-0.0761	-0.2170	-0.3616	-0.9347	-0.3578	-1.9296
Y-Fm`	0.1102	0.1421	-0.1033	-0.0985	-0.0562	-0.0436	0.7358**	0.9884**
qP-Fo`	0.4231	1.8815	0.4361	1.4873	-0.2170	-0.8526	0.5602*	2.1315*
qP-Fm`	0.1798	0.4539	0.6487**	0.7402**	-0.0755	-0.0890	0.0905	0.0844
qN-Fo	-0.6982**	-1.0574**	-0.1862	-1.3590	0.1536	0.2318	-0.3372	-0.5141
qN-Fm	-0.2542	-0.1801	-0.1296	-0.1914	-0.3826	-0.2850	0.3763	0.1215
qN-Fo`	-0.3343	-0.4629	0.1466	0.7817	0.2679	1.4912	0.3717	0.9040
qN-Fm`	0.0941	0.0739	0.1560	0.2783	0.4173	0.6976	0.0406	0.0242

* = $P \leq 0.05$

** = $P \leq 0.01$

Figure 1.

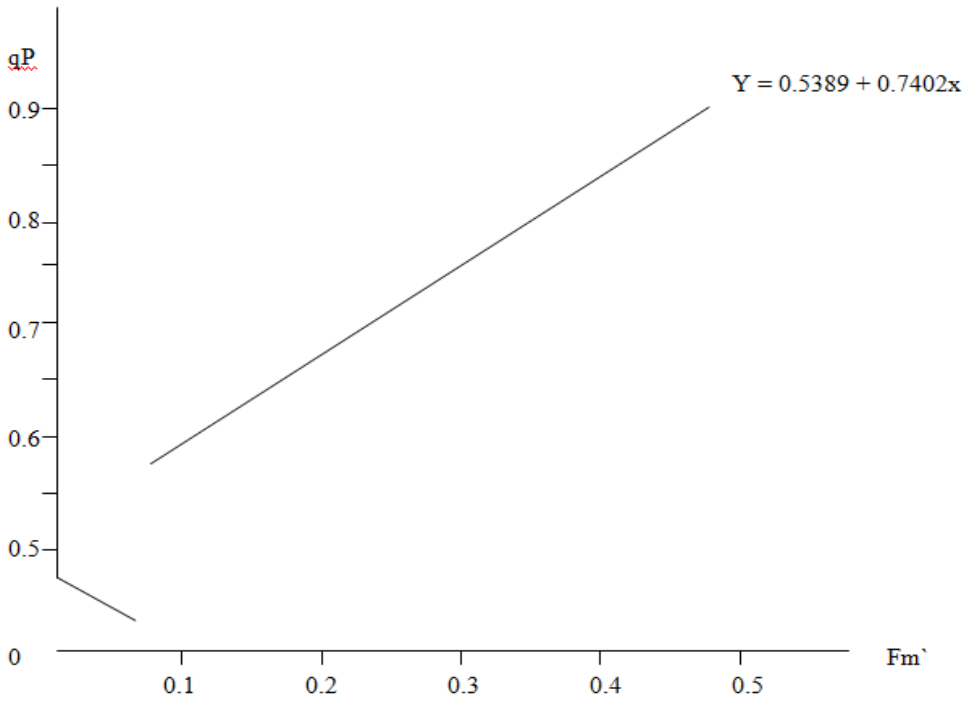

Figure 1 : Relationship between photochemical quenching (qP) and maximal fluorescence in the light-adapted leaves (Fm`) of cv.'Teresa' observed in the autumn. The line was fitted using the following linear regression equation: $Y = 0.5389 + 0.7402x$; $R^2=0.4208$; $P \leq 0.01^{(**)}$

Figure 2.

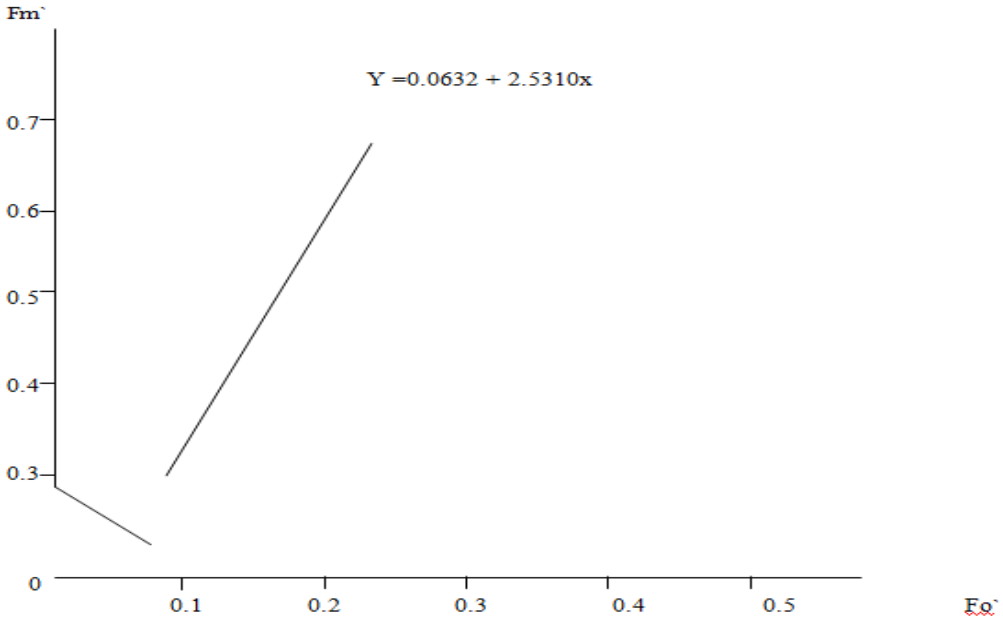

Figure 2 : Relationship between maximal fluorescence in the light (Fm`) and minimal fluorescence in the light-adapted leaves (Fo`) of cv.'Teresa' observed in the autumn. The line was fitted using the following linear regression equation: $Y=0.0632 + 2.5310x$; $R^2=0.7221$; $P \leq 0.01^{(**)}$

Figure 3.

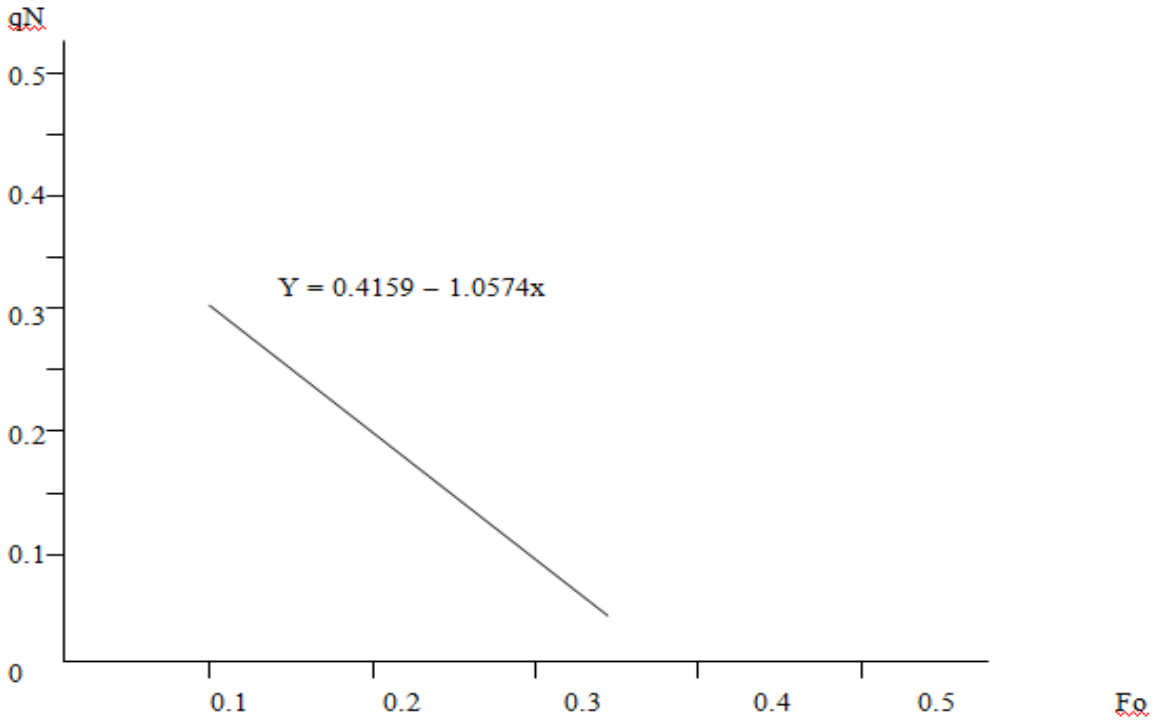

Figure 3 : Relationship between non-photochemical quenching (qN) and minimal fluorescence (Fo) in the dark-adapted leaves of cv.'Teresa' observed in the spring. The line was fitted using the following linear regression equation: $Y = 0.4159 – 1.0574x$; $R^2=0.4874$; $P \leq 0.01^{(**)}$

Figure 4.

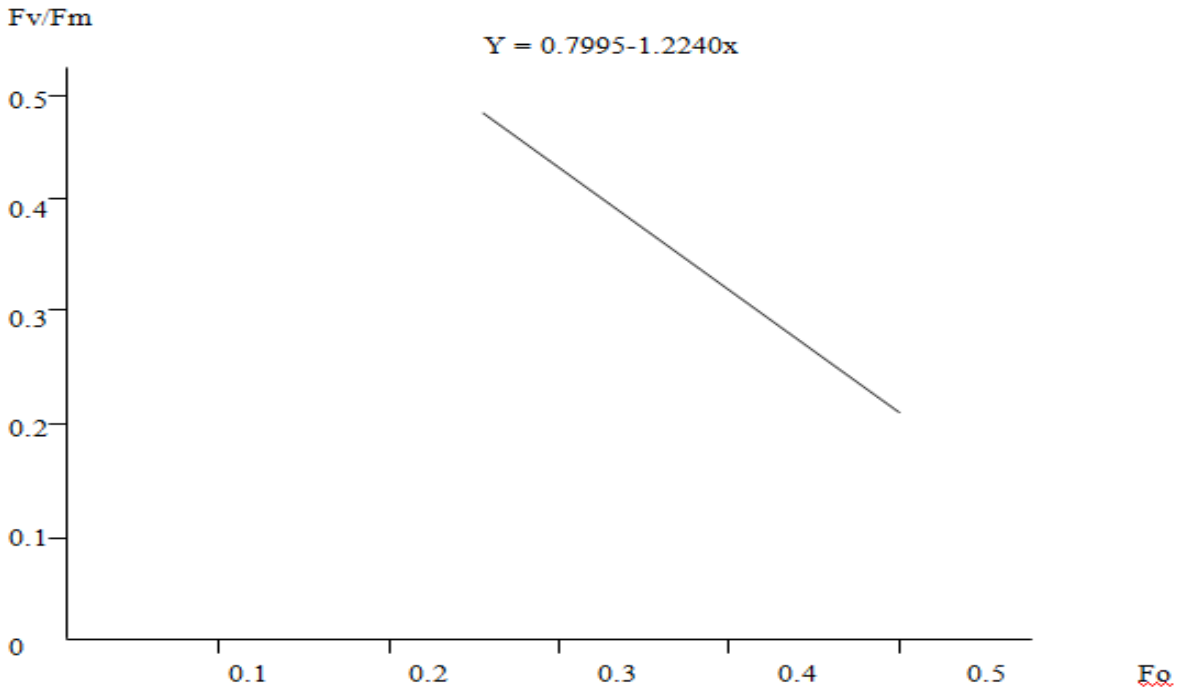

Figure 4 : Relationship between maximum quantum yield (Fv/Fm) and minimal fluorescence in the dark-adapted leaves (Fo) of cv.'Honeoye' observed in the autumn. The line was fitted using the following linear regression equation: Y = 0.7995-1.2240x; R^2=0.2347; P≤0.05 (*)

Figure 5.

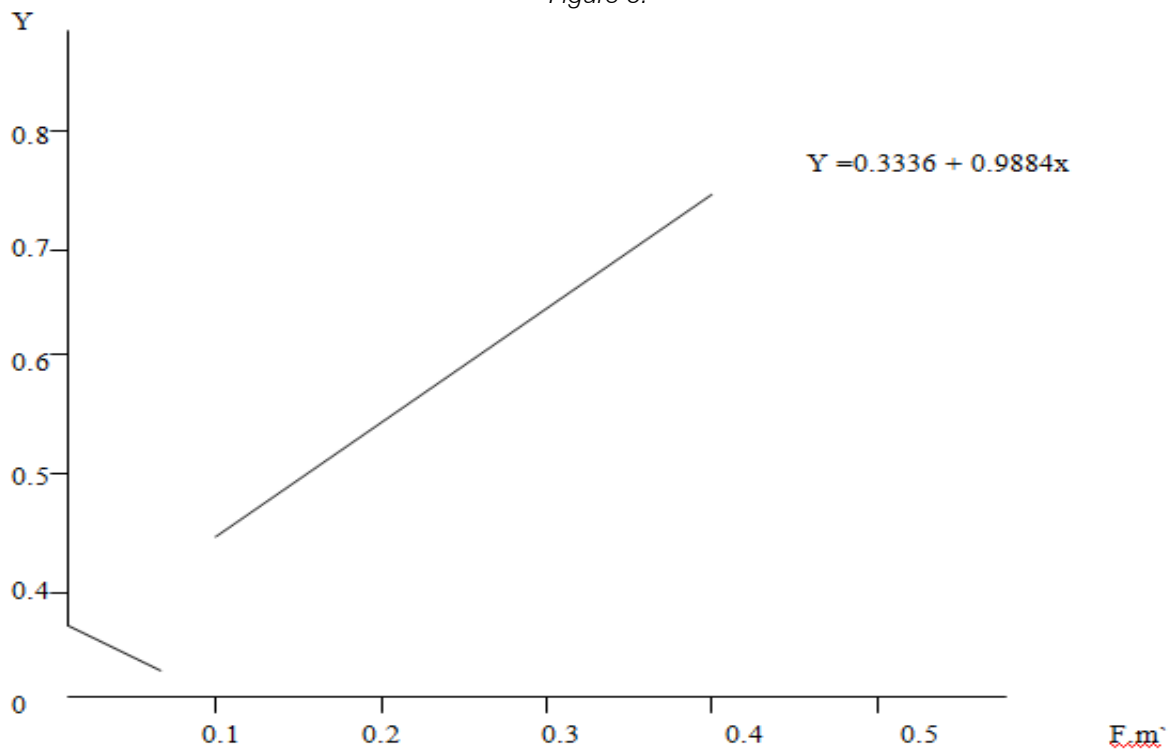

Figure 5 : Relationship between yield of PSII (Y) and maximal fluorescence in the light-adapted leaves (Fm`) of cv.'Honeoye' observed in the autumn. The line was fitted using the following linear regression equation: Y =0.3336 + 0.9884x; R^2=0.5414; P≤0.01 (**)

Figure 6.

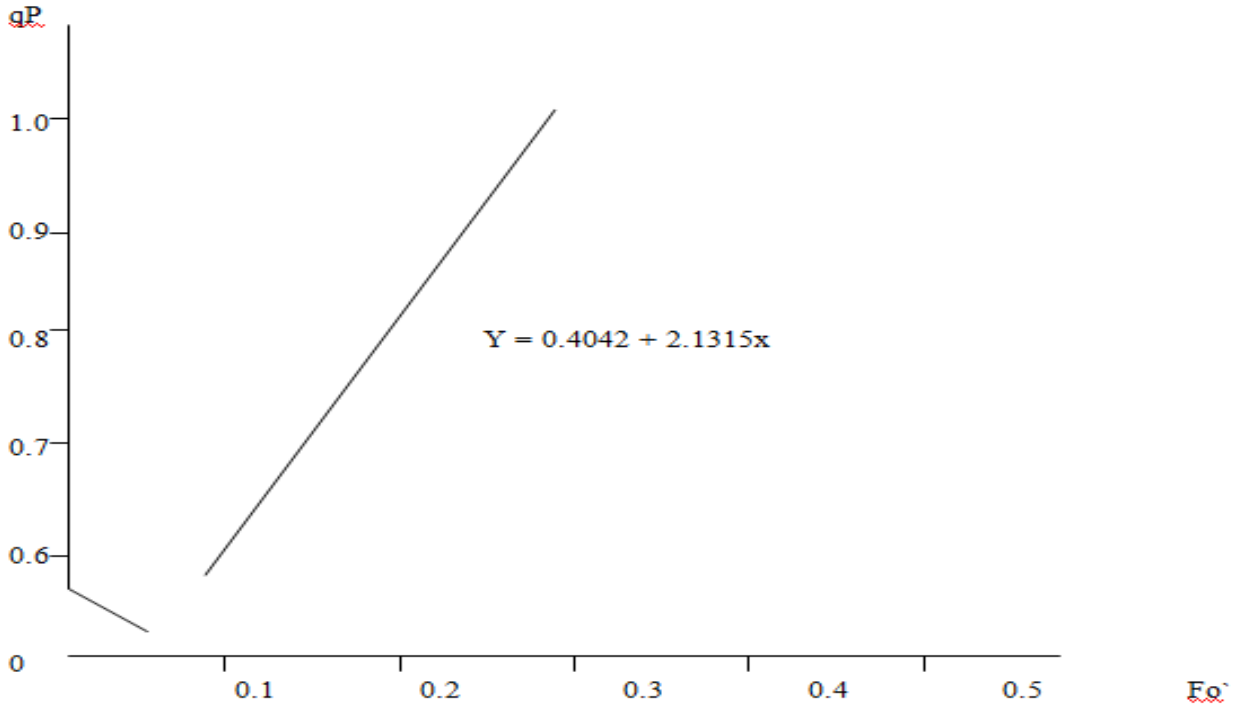

Figure 6 : Relationship between photochemical quenching (qP) and minimal fluorescence (Fo`) in the light-adapted leaves of cv.'Honeoye' observed in the autumn. The line was fitted using the following linear regression equation: Y = 0.4042 + 2.1315x; R^2=0.3138; P≤0.05(*)

Figure 7.

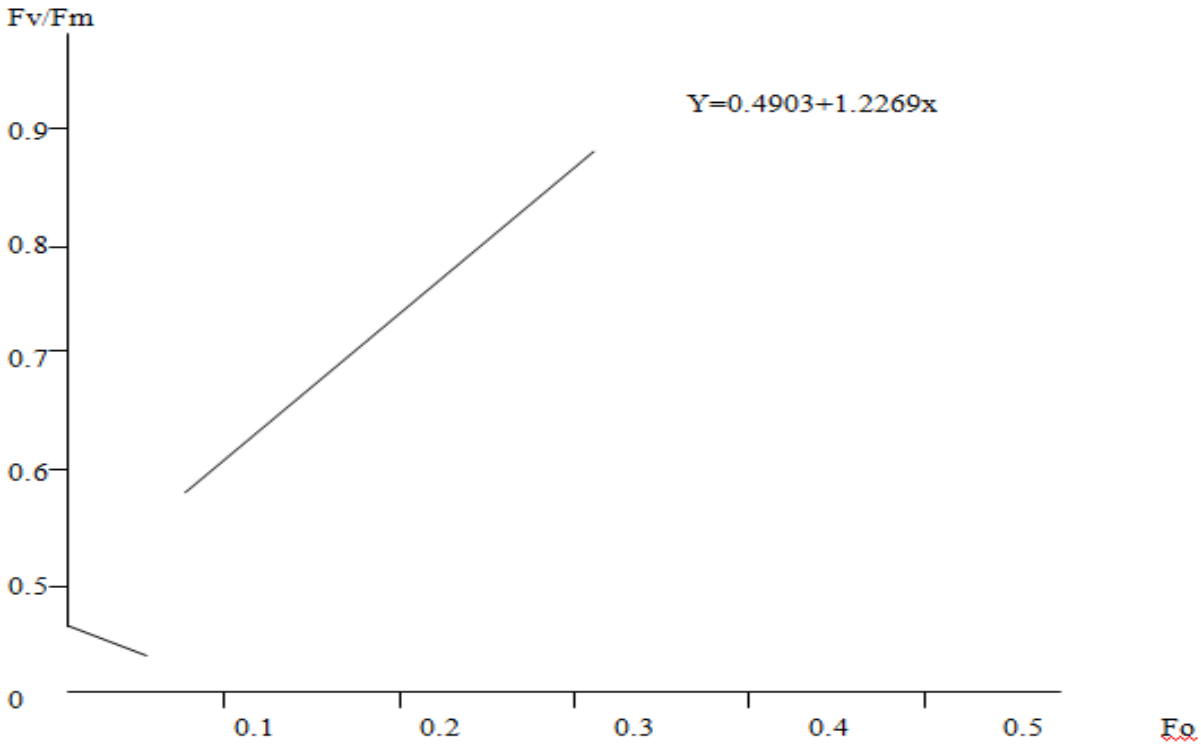

Figure 7 : Relationship between maximum quantum yield of PSII (Fv/Fm) and minimal fluorescence in the dark-adapted leaves (Fo) of cv.'Honeoye' observed in the spring. The line was fitted using the following linear regression equation: Y=0.4903+1.2269x; R^2=0.4305; P≤0.01(**)

Figure 8.

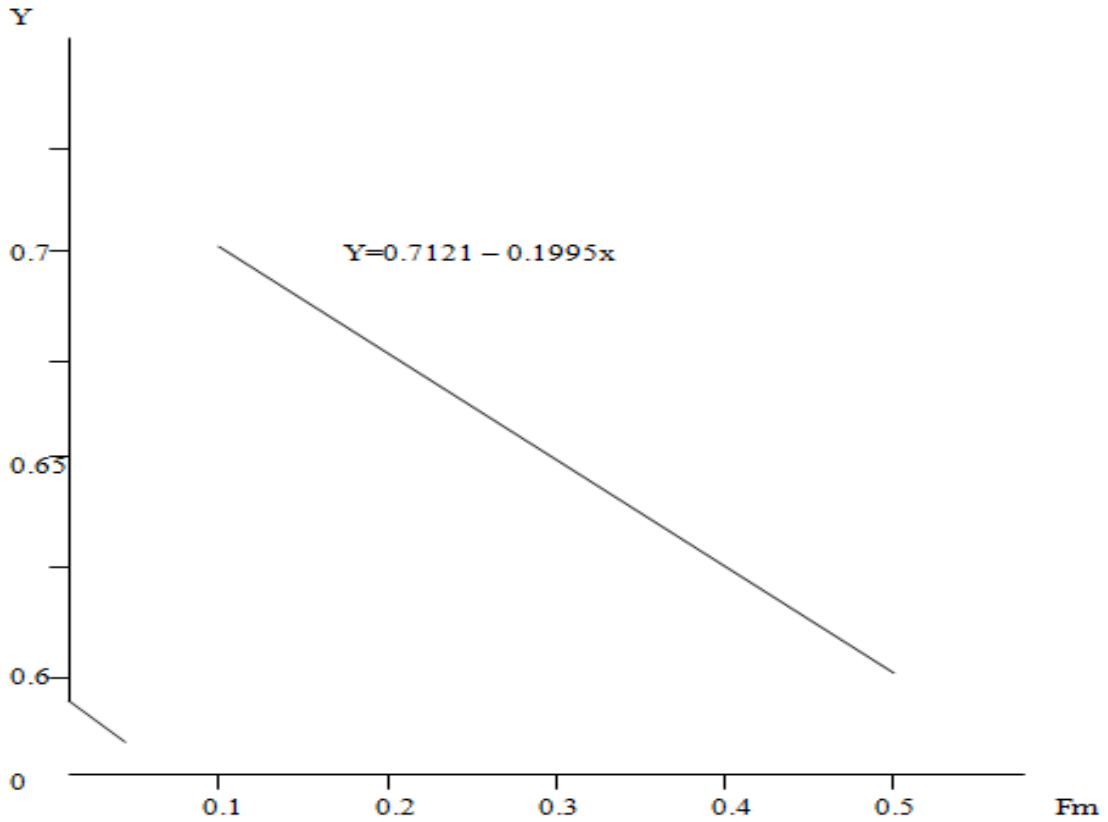

Figure 8 : Relationship between yield of PSII (Y) and maximal fluorescence in the dark-adapted leaves (Fm) of cv.'Honeoye' observed in the spring. The line was fitted using the following linear regression equation: Y=0.7121 – 0.1995x; R^2=0.3328; P≤0.05(*)

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Estimation of Percentage of Ascorbic Acid Contents in Selected Trophical Fruits

By Adewole E, Orisakeye O. I & Talabi J. Y.
Afe Babalola University, Nigeria

Abstract- Ascorbic acid content in *Citrus reticulata*, *Citrus sinensis*, and *Citrus limonum* were estimated. *Citrus reticulata* contained 30.60mg/100g, *Citrus sinensis* had 55.9 mg/100g, *Citrus limonum* ascorbic content was 57.5mg/100g.These values were higher than the literature values. The high ascorbic contents in the three samples showed that they are highly rich in vitamin C and they may be good for the prevention and treatment of scurvy.

Keywords: *ascorbic acid, citrus reticulata, citrus sinensis, and citrus limonum.*

GJSFR-D Classification : *FOR Code: 079999*

Strictly as per the compliance and regulations of :

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Adewole E [α], Orisakeye O. I [σ] & Talabi J. Y. [ρ]

Abstract- Ascorbic acid content in *Citrus reticulata*, *Citrus sinensis*, and *Citrus limonum* were estimated. *Citrus reticulata* contained 30.60mg/100g, *Citrus sinensis* had 55.9 mg/100g, *Citrus limonum* ascorbic content was 57.5mg/100g.These values were higher than the literature values .The high ascorbic contents in the three samples showed that they are highly rich in vitamin C and they may be good for the prevention and treatment of scurvy.

Keywords: ascorbic acid, citrus reticulata, citrus sinensis, and citrus limonum.

I. Introduction

A vitamin is an organic substance which is needed in trace quantity for normal cell functions. The vitamins that cannot be synthesized internally by an organism are called essential vitamins, in their absence in the external medium, the cells cannot survive. A typical example of this is ascorbic acid which has trade name of vitamin C. Ascorbic acid functions in a number of biochemical reactions, mostly involving oxidation. Thus, it is required to speed the conversion of certain proline residue in collagen to hydroxyproline in the course of collagen synthesis [1].Citrus fruits, which belong to the family of rutaceae are one of the main fruit tree crops grown throughout the world. Although sweet orange *(Citrus sinensis*) is the major fruit in this group accounting for about 70% of citrus output. The group also encompasses small citrus fruits such as tangerine tree (*Citrus reticulata*), grapefruit tree (*Citrus vitis*), lime tree (*Citrus aurantifulia*) and lemon tree (*Citrus limonum*) [2]. It is well known that citrus fruits contain a range of key nutrients including high levels of vitamin C and this necessitate the research article to find out the ascorbic acid contents of these citrus fruits obtained locally from a popular market.

II. Materials and Methods

a) Reagents

The analytical grade reagents used for this research work included; 2.6 dichlorophenbolindophenol (blue dye), 20% glacial acetic acid, standard L-ascorbic acid and distilled water.

b) Sample Collection and preparation

The samples namely; *Citrus limonum, Citrus reticulate, Citrus sinensis* were obtained from a local market called king's market in Ogbomosho, Nigeria on 10th, April, 2014. They were washed, pilled, blended using blender and sieved using sieve white cloth. The samples were stored in sterilized bottle and kept in a refrigerator for further use.10 ml of each filtrate was mixed with 20% glacial acetic acid in a 100 ml standard flask which was made up to 100 ml with distilled water.

c) Dye preparation

The standard dye solution was prepared by dissolving 50mg of blue dye in 50 ml of distilled water. The mixture was diluted to 200ml, filtered and kept.

d) Preparation of standard ascorbic acid solution

This was prepared by dissolving 100mg crystalline ascorbic acid in 50 ml of 20% glacial acetic acid and diluted to 100 ml with distilled water.

e) Titration Procedures

10 ml of the ascorbic acid solution was titrated with the dye solution. Each drop of the dye in contact with the solution turns pink. The end point was reached when the pink colour lasts for 10 seconds. Similarly, 10 ml of each sample prepared was in turn titrated with the due and the titre values were noted.

III. Results

Detailed estimations:

6.2 ml of the dye solution was needed to titrate 10 ml of the standard ascorbic acid solution which contained 1 mg of ascorbic acid per ml.

That is; 6.2ml ≡ 10mg

Therefore, 1ml = (10/6.2)= 1.613mg.

In the case of orange extract, the average ml of the dye used was 3.46ml.

That is; 3.46 ml ≡ 1.613 ×3.46= 5.581mg.

10 ml of the orange extract contained 5.58mg ascorbic acid.

Therefore, 100 ml of the juice extract contained 55.8mg of ascorbic acid. The same principle was applied to all the samples.

Author α σ: Department of Chemical Sciences, Afe Babalola University, Ado-Ekiti, Nigeria. e-mail: adewolen50@yahoo.com

Author ρ: Department of Human Nutrition and Dietetics, Afe Babalola University, Ado-Ekiti, Nigeria.

Table 1.0 : showing the results

Samples	Average titre volume (ml)	Estimation of ascorbic acid (mg/10ml)	mg/100ml	mg/100g
Citrus sinensis	3.47	5.59	55.90	55.90
Citrus reticulata	16.13	3.06	30.60	30.60
Citrus limonum	3.57	5.75	57.50	57.50

Table 2.0 : showing comparism of results with literature values

Samples estimated ascorbic acid (mg/100g)	literature values(mg/100g)	(Holand*et al.*,)
Citrus sinensis	55.9	54
Citrus reticulata	30.6	30
Citrus limonum	57.5	58

IV. Discussion

This research work has indicated that the citrus fruits were widely varied in their ascorbic content. All the three samples; *Citrus limonum, Citrus reticulate, Citrus sinensis* compared favorably with the recommended values as seen in table 2.0. It is well known citrus fruits contain a range of key nutrients including high levels of vitamin C and significant amounts of dietary fibre. Citrus is the main source from which primate's device vitamin C [2].It has been reported that the ascorbic acid in the body aids in iron absorption from the intestines. It is important for connective metabolism especially the scar tissue, bones and teeth[3,4]. In addition to its physiological functions, it is necessary as an anti-stress and protector against cold, chills and damp[2]. It prevents muscle fatigue and scurvy that is characterized by skin hemorrhages, bleeding gums, fragile bones, anemia and pains in joints and defects in skeletal calcification [2]. The function of ascorbic acid also accounts for its requirement for normal wound healing[5, 6]. It acts also as antioxidants in the skin by scavenging and quenching free radical generated by ultra violet radiation stabilization. The production of collagens is also dependent on vitamin C. It helps in the promotion and restoration of skin and improvement of fine wrinkles[7].

V. Conclusion

The research work has significantly showed the richness of *Citrus limonum, Citrus reticulate, Citrus sinensis* in vitamin C content and also the dye method employed has relatively degree of accuracy and low cost.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effect of Replacing Maize with Malted Barley Grain on Egg Quality and Laying Hen's Performance of White Leghorn

By Haftu kebede, Mengistu Urge & Kefelegn Kebede
Wachemo University, Ethiopia

Abstract- The effect of various levels of malted barley grain (MBG) on the laying performance and egg quality of white leghorn pullets was investigated. A total of 180 white leghorn pullets were randomly assigned to four dietary treatments consisting of 0%, 10%, 20% and 30% barley as a replacement for maize. There were 45 birds per treatment and three replicates of 15 birds and the experiment was laid in a completely randomized design. The evaluated traits were egg production, egg weight, egg mass, feed consumption, feed conversion ratio, shell thickness, yolk weight, shell weight, yolk index, yolk diameter, yolk height, albumen height, yolk color and Haugh unit. The result showed significant increase in feed consumption, yolk color, albumen weight and shell thickness ($P<0.01$) and body weight gain and sample egg weight ($P<0.05$), but it had no significant effects on other traits measured. Therefore, since MBG did not negatively affected laying performance and product quality, it can be replaced for maize grain as a source of energy up to 30%.

Keywords: *egg quality, laying hens, malted barley grain, performance.*

GJSFR-D Classification : *FOR Code: 300299*

Strictly as per the compliance and regulations of :

Effect of Replacing Maize with Malted Barley Grain on Egg Quality and Laying Hen's Performance of White Leghorn

Haftu kebede [α], Mengistu Urge [σ] & Kefelegn Kebede [ρ]

Abstract- The effect of various levels of malted barley grain (MBG) on the laying performance and egg quality of white leghorn pullets was investigated. A total of 180 white leghorn pullets were randomly assigned to four dietary treatments consisting of 0%, 10%, 20% and 30% barley as a replacement for maize. There were 45 birds per treatment and three replicates of 15 birds and the experiment was laid in a completely randomized design. The evaluated traits were egg production, egg weight, egg mass, feed consumption, feed conversion ratio, shell thickness, yolk weight, shell weight, yolk index, yolk diameter, yolk height, albumen height, yolk color and Haugh unit. The result showed significant increase in feed consumption, yolk color, albumen weight and shell thickness ($P<0.01$) and body weight gain and sample egg weight ($P<0.05$), but it had no significant effects on other traits measured. Therefore, since MBG did not negatively affected laying performance and product quality, it can be replaced for maize grain as a source of energy up to 30%.

Keywords: egg quality, laying hens, malted barley grain, performance.

I. Introduction

Poultry industry is a predominant source of animal protein in both developed and developing countries. Adenjimi *et al*. (2011) noted that the expansion of the poultry industry depends largely on the availability of good quality feed in sufficient quantity and at prices affordable to both producers and consumers. The production of ethanol from maize is increasing currently and expected to increase in the future as a result of rising cost of fossil oil and the environmental pollution issues IFAD (2008). Increased demands for domestically produced liquid fuel is increasing competition between animal feed and fuel production uses of maize. As a result, the recent rise in demand and consequent increase in the cost of maize has spurred interest in replacing it in poultry diets with locally grown other energy grains Mehri *et al*. (2009). Although there are quite many literatures in the utilization of barley by poultry, there is a scarcity of complete information on feeding malted barley (water treated barley) to domestic chicken. Accordingly, this study was designed to investigate the effects of feeding different levels of malted barley grain on egg quality and laying performance of white leghorn layers and to compare the profitability of replacing maize with different levels of malted barley grain.

Author α: Department of Animal Sciences, Wachemo University, P. O. Box 667, Hossana, Ethiopia.
Author σ ρ: School of Animal and Range Sciences, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia. e-mail: haftuk2001@gmail.com

II. Materials and Methods

The experiment was conducted at Haramaya University poultry farm. The study area is located, at a distance of 515Km from Addis Ababa capital city. The average annual temperature and rainfall ranges from 8 - 24°C and 650 to 800 mm. respectively Mishra *et al. (*2004).

III. Malted Barley Processing

Barley was mixed with water in the ratio of 1kg to 2 litters in a barrel, stirred/soaked gently and the container was tightly sealed and left for 24 h. Then water was removed after the barrel is covered with sieve and the moist barley left in the same container to germinate for 72 h. The grain were thinly spread on plastic sheet and dried under shade at room temperature for 72 h to prevent the seed internal enzymes activity. The grains were then ground into a leaf meal using a hammer mill of mesh size of 3mm.

IV. Experimental Diets

Four experimental diets at isocaloric and equiprotein composition were formulated, such that Diet 1 which served as the control had no malted barley (0%), Diet 2 had 10% malted barley, Diet 3: 20% and Diet 4: 30%; the ingredient composition of the experimental diets are shown in Table 2.

V. Experimental Animals/ Experimental Design

One hundred eighty white leghorn pullets used in the study were obtained from Haramaya university Farms. The birds were randomly allocated to four dietary treatment groups such that each treatment had three replicates comprising 15 pullets per replicate and 45 pullets per treatment in a CRD design. The pullets in each replicate were housed in a pen with 2 x 4m size. During the eight week period of the study, the birds were subjected to similar managerial and sanitary conditions

and equal quantities of feed and water were provided daily, such that the only source of variation was the levels of Malted barley in the diets.

VI. Data Collection

Egg production, egg weight and feed consumption were recorded daily for each replicate. Eggs collected three times a day from each pen at 10:00 am and in the afternoon at 2:00 and 6:00 pm were weighed in group immediately after collection for each replication and average egg weight was computed by dividing the total egg weight to the total number of eggs. After mean weight has been determined, the egg mass per pen on daily bases was calculated according to North (1984). The amount of DM consumed was determined as the difference between the DM offered and refused. Feed conversion ratio was determined per replicate by calculating the weight of feed, on DM basis, consumed per egg mass. Egg quality was assessed in terms of egg weight, albumen height and quality, shell thickness, yolk color, yolk index and Haugh Unit Score (HUS). For the measurements, 15 eggs per treatment/week (5 per replication) were taken randomly and the average was computed for each quality parameters once every week. The sample eggs were individually weighed, marked and broken on flat tray and the height of the thick albumen of each egg was measured with a tripod micrometer and the average Huagh Unit value for each replicates was calculated by using the formula given by Stadelman and Cotterill (1986). The egg shell thickness was measured at three sites, at equator, from the blunt and pointed end using a micrometer gauge. The average of the three measurements was taken as thickness of each egg Ajuwon *et al*. (2002). Yolk color was measured using Roche color fan. To compare the profitability of replacement of malted barley grain for maize grain the partial budget analysis developed by Upton (1979) was used.

Table 1 : Chemical composition of feed ingredients used to formulate experimental ration

	Ingredients				
Chemical components	Malted barley grain	Nouge seed cake	Soybean Meal	Maize grain	Wheat short
Dry mater (%)	90.8	93.7	94.4	90.9	90.7
Crud protein (% DM)	11.5	31	38	8.8	15.4
Ether extract (% DM)	2.1	5.1	8.2	5.1	5.1
Ash (% DM)	3.7	7.8	7.6	4	4.84
Crud fiber (% DM)	6.2	17.9	5.9	4.9	8.1
Calcium (% DM)	0.1	0.7	0.3	0.02	0.1
Phosphorus (% DM)	0.3	0.3	0.7	0.3	0.4
ME (kcal/kg)	3366.7	2339.1	3563.7	3630.6	3312.3

a) Chemical Analysis

Representative samples were taken from each of the feed ingredients and analyzed before formulating the actual dietary treatments. The results of the analysis were used to formulate the ration. Samples were also taken from each experimental diet at each mixing and bulked over the experimental period and sub sample was taken for chemical analysis. Thus, the total samples analyzed were 5 feed ingredients and 4 treatment rations (Table 1and 2), respectively. The samples were analyzed for dry matter (DM), ether extract (EE), crude fiber (CF) and ash according to AOAC (1990). Nitrogen (N) content was determined by Kjeldahl procedure and crude protein (CP) was calculated as Nx6.25. The total metabolizable energy content was estimated by using the formula of Wiseman (1987) as: ME (Kcal/kg DM) = 3951 + 54.4 EE – 88.7 CF – 40.8 Ash. Chemical analyses of feeds were done in Animal Nutrition and Soil Laboratories of Haramaya University.

b) Statistical Analysis

The data collected for egg production and egg quality parameters during the period of the study was subjected to analysis of variance using SAS (2005, version 9.13). The following model was used for data analysis. $Yij = \mu + Ti + eij$ Where: Yij = represents the j^{th} observation (experimental unit) taken under treatment i, μ = over all mean, Ti = feed effect and e_{ij} = random error

Logistic regression analysis was used for data recorded on yolk colour (1/2…/5). The general logistic regression model used is given below:

$$\text{Model: } \ln\left\{\frac{\pi}{1-\pi}\right\} = \beta_0 + \beta_1 * (X)$$

Test H_0: No treatment effect (i.e., $\beta_1 = 0$) vs. H_A: Significant treatment effect ($\beta_1 \neq 0$).
Where, π = probability, β = slope and x = treatment.

VII. Results and Discussion

Table 2 : Ingredients used in formulating the experimental rations and calculated chemical analyses of the layer rations

Ingredients (kg)	Treatments			
	T1	T2	T3	T4
Maize	48.0	38.0	28.0	18.0
Malted barley	0.0	10.0	20.0	30.0
Wheat short	14.0	14.0	15.0	15.0
Noug seed cake	18.8	18.8	18.8	18.8
Soybean meal	11.0	11.0	10.0	10.0
Lime stone	7.0	7.0	7.0	7.0
Salt	0.5	0.5	0.5	0.5
Vitamin premix	0.7	0.7	0.7	0.7
Total	100	100	100	100
Chemical composition				
Dry mater (%)	92.4	92.4	92.3	92.3
Crud protein (% DM)	16.5	16.8	16.8	16.9
Ether extract (% DM)	5.1	5.0	4.9	4.8
Ash (% DM)	10.7	11.8	10.0	10.4
Crud fiber (% DM)	9.4	9.5	10.4	10.4
Phosphorus (% DM)	0.4	0.4	0.4	0.5
Calcium (% DM)	3.1	3.1	3.2	3.2
ME (kcal/kg)	2959.4	2898.8	2887.1	2861.3

a) Production Characteristics and Feed Intake

The result showed that replacing maize with malted barley grain had no significant effect ($P > 0.05$) on egg production, egg mass, feed conversion ratio and egg weight, but there was significant difference on feed consumption and body weight (Table 3). The present result agree with that of Fafiolu *et al.* (2006) who reported increase in average final body weight of experimental birds with increasing levels of malted sorghum sprouts (MSP) up to 30% in the ration of layers. Similarly, Mohammed *et al*. (2010) noted significant increase in feed consumption due to substitution of yellow maize with enzyme supplemented barley grain in laying hen diets. Apparently, production was largest for T4 (53.8 %) followed by those of T3 (51.3 %), T2 (48.3 %) and T1 (46.5 %) without significant ($p > 0.05$) difference among treatments. Furthermore, Mahdavi *et al*. (2005) showed no significant difference in egg production as barley is supplemented with probiotic substituted maize diets. The present result disagree with Mohammed *et al*. (2010) who reported that egg production, egg weight and egg mass increased when maize replaced with enzyme supplemented barley.

The dry matter intake of birds fed T2 diet (10% MBG + 38% MG) were similar with the group fed diet without MBG (T1, control), but birds fed T3 diet (20% MBG + 28% MG), and T4 (30% MBG + 18% MG) resulted in a significantly ($P<0.01$) higher dry matter intake than T1 and T2 groups. The results demonstrated that inclusion of malted barley grain improved daily dry matter intake of birds, which could be attributed to the relatively higher crude protein content of malted barley grain. The findings of this study were in agreement with that of Ebadi *et al*. (2005) who reported a significant increment in feed take as a result of replacement of maize with sorghum grain in layers diet. Similarly, Mohammed *et al*. (2010) noted significant increase in feed consumption due to substitution of yellow maize with enzyme supplemented barley grain up to 50 % in laying hen diets.

Table 3 : Effects of different levels of malted barley grain as a substitute for maize on production characteristics of white leghorn laying hens

Parameter	Treatment				SEM	SL
	T_1	T_2	T_3	T_4		
DMI (g/hen/d)	90.6[b]	90.8[b]	91.9[a]	92.2[a]	0.24	**
Initial BW (g)	1010.5	1034.2	1039.2	1060.9	8.98	NS
Final BW (g)	1049.6[b]	1077.7[ab]	1091.9[ab]	1120.3[a]	9.92	*
Body wt. change	39.1[b]	43.4[b]	52.8[ab]	59.4[a]	3.00	*
BW gain(g/head)	0.4[b]	0.5[b]	0.6[ab]	0.7[a]	0.03	*
Total egg/bird	41.8	43.5	46.5	48.4	1.06	NS
HDEP (%)	46.5	48.3	51.6	53.8	1.18	NS
Egg weight	47.8	49.1	48.0	48.3	0.21	NS
EM (g)	22.2	23.7	24.7	26.1	0.58	NS
FCR	5.2	4.8	4.7	4.4	0.12	NS

[a,b]Means with in a row with different superscripts are significantly different,=Significant at (P< 0.05), **=Significant at (P<0.01), NS=Non- significant (P>0.05), SL = significant level, SEM = standard error of mean, DMI = dry matter intake, g = gram, BW = body weight, HDEP = hen day egg production, FCR = feed conversion ratio, EM = daily egg mass, MBG = malted barley grain, T1 = 0% MBG +100% maize, T2 = 10% MBG + 90% maize, T3 = 20% MBG + 80% maize, T4 = 30% MBG + 70% maize.*

b) Egg mass and Feed Conversion Ratio

There was no significant (P>0.05) difference in feed conversion ratio and egg mass between the treatments. However, egg mass (P=0.091) and feed conversion ratio (P=0.08) tended to increase with increasing level of MBG as a substitution for maize grain up to 30% (Table 3). The present result agree with Mahdavi *et al*. (2005) who reported absence of significant (P>0.05) difference in egg mass as barley supplemented with probiotic substituted maize up to 100%. This result disagree with the finding of Mohammed *et al*. (2010) who reported that egg mass increased when enzyme supplemented barley replaced up to 50 % of yellow corn. The present result also disagree with the finding of Mahdavi *et al*. (2005) who noted that feed conversion ratio decreased as barley supplemented with probiotic substituted corn beyond 50%.

c) Egg Quality Traits

Replacing maize with malted barley grain had no significant effect (P>0.05) on Yolk weight, Shell weight, Yolk index, Yolk diameter, Haugh unit, Yolk height and Albumen height. However, there was a significant effect on sample egg weight, Yolk color, Albumen weight and Shell thickness (Table 4). These results agree with previous research conducted by Fafiolu *et al.* (2006) who reported that there was no significant difference in yolk weight and Haugh unit by feeding malted sorghum sprout (MSP) up to 30%. Similarly Ebadi *et al*. (2005) reported no significant effect of replacement of maze with sorghum grain up to 25% on Haugh unit. Moreover, Mahdavi *et al*. (2005) reported absence of significant (P>0.05) difference in Haugh unit when barley supplemented with probiotic substituted for corn up to 100%. The yolk index values of the eggs from the various treatment groups ranged from 0.43–0.44, which is within the accepted range of 0.33 – 0.50 for fresh eggs Ihekoronye and Ngoddy, (1985). These results disagree with previous research conducted by Ebadi *et al*. (2005) who reported significant increase in Yolk index as a result of replacement of maize with sorghum grain up to 25% in layers diet.

d) Albumen, Yolk and Shell Weight

There was no significant (P>0.05) differences in shell and yolk weight between the treatments. However, Albumen weight was significantly (P<0.01) higher in T3 (20% MBG + 28% MG) and T4 (30% MBG +18% MG) than birds fed diet T2 (10% MBG +38% MG) and the diet without MBG (T1, control; Table 4). These results agree with previous research conducted by Fafiolu *et al.* (2006), who noted no significant (P>0.05) difference in yolk weight and albumen weight by feeding malted sorghum sprout (MSP) up to 30%. The present results disagree with Ebadi *et al*. (2005) who reported that there was no significant (P>0.05) difference in albumen weight, but significant increase in yolk and shell weight as a result of replacement of maize with sorghum grain up to 25% was observed.

Table 4 : Various levels of malted barley grain as a substitute for maize on egg quality treats

Parameters	Treatments				SEM	SL
	T_1	T_2	T_3	T_4		
Sample egg wt. (g)	49.0^{c}	49.4^{bc}	50.4^{ab}	50.8^{a}	0.28	*
Albumen weight (g)	28.3^{c}	28.5^{bc}	29.5^{ab}	29.7^{a}	0.20	**
Yolk weight (g)	14.4	14.3	14.8	14.7	0.10	NS
Shell weight (g)	5.7	5.7	5.9	5.9	0.05	NS
Yolk index	0.43	0.44	0.44	0.44	0.002	NS
Yolk diameter (cm)	3.7	3.6	3.6	3.6	0.01	NS
Yolk color	1.58^{c}	2.02^{b}	2.26^{a}	2.24^{a}	0.092	**
Haugh unit	91.0	93.7	93.0	91.3	0.698	NS
Shell thickness	0.32^{c}	0.32^{bc}	0.34^{ab}	0.35^{a}	0.004	**
Yolk height	15.8	15.7	15.7	15.9	0.04	NS
Albumen height	7.8	8.4	8.3	7.9	0.13	NS

*$^{a, b \& c}$ = Means with in a row with different superscripts are significantly different,**=Significant at (P< 0.01), * =Significant at (P< 0.05), NS=Non- significant, SL = significant level, g = gram, cm = cent meter, SEM = standard error of mean, T = treatment,T_1 = 0% MBG +100% maize, T_2 = 10% MBG + 90% maize, T_3 = 20% MBG + 80% maize, T_4 = 30% MBG + 70% maize, MBG = malted barley grain*

e) Yolk Color

The mean and logistic regression results for yolk color showed significant difference (pr >chisq <0.0001 at α = 0.05) with Wald chi Sq value of 66.3209 among the treatments (Table 4 and 5, respectively). The odd ratio value of T1 vs. T4 shows that T1 has 0.146 times the odds of receiving a lower score than T4 (Table 7). This shows that malted barley grain induced slightly higher yolk color values in eggs than the white maize used. Malted barley sprouts may have certain pigment that confers such status on egg yolk. The result of the study is comparable with Fafiolu *et al*. (2006) who noted a slightly higher yolk color with increased level of malted sorghum grain up to 30% in substitution for maize. The Roche color fan reading recorded during the experiment ranges from 1 (pale yellow) to 5, with majority of the egg having 1 and 2 values on the yolk color point (Table 6).

Table 5 : Results of logistic regression of yolk color in white leghorn chicken fed diet containing different levels of malted barley grain as a substitute for maize

Wald			
Parameter	DF	Chi-Square	Pr >ChiSq
Yolk color	3	66.3209	<.0001

f) Egg Shell Thickness

The mean egg shell thickness, as a measure of egg shell quality, resulting from feeding the four treatment rations is shown in Table 4. The results showed that there was significant (P<0.01) difference among treatments in egg shell thickness. Increased egg shell thickness observed in this experiment may be related to the increase in β-glucans digestibility. Similarly, Rimsten (2003) reported that activating enzyme phytase during germinating increase Ca and P digestibility. Moghaddam *et al.* (2009) reported that Ca and P digestibility improved by 4.5% and 4%, respectively when malted barley grain was replaced with barley in broilers feed. This result disagree with results of previous studies conducted by Ebadi *et al*. (2005) who reported a significant decrease in shell thickness as a result of replacement of maize with sorghum grain in layers. Mahdavi *et al*. (2005) reported absence of significant difference in shell thickness between treatments when different levels of barley supplemented with probiotic substituted maize up to 100%. The results of this study implied that feeding layers with diets containing different proportions of malted barley grain and maize would improve the egg shell quality of chicken.

Table 6 : Yolk color points of egg samples from different experimental diets

Treatments	Roche color fan number					
	1	2	3	4	5	Total
T1	60	53	5	2	0	120
T2	29	63	25	3	0	120
T3	14	70	28	7	1	120
T4	15	65	36	4	0	120
Total	118	251	94	16	1	480

T1= T1 = 0% MBG +48% maize, T2 = 10% MBG + 38% maize, T3 = 20% MBG + 28% maize, T4 = 30% MBG + 18% maize,

The economic return in terms of partial budget from egg sale, commercial feed costs and other cost are presented in table 8. The highest value for marginal rate of return was recorded in 20% inclusion (T_3). According to partial budget analysis, hen fed T_4 returned a higher total net income, followed by T3, T2 and T1. Although T4 has higher total return and superior egg sale to feed cost ration, it has lower profit margin than hen fed the 20% (T3) malted barley grain (MBG) inclusion. This means, the income obtained from 30% MBG (T_4) inclusion returned less per unit of expenditure, suggesting T3 to be the treatment of choice in terms of profit. Therefore, substitution of maize with malted barley is profitable because of the increased egg production, although cost of barley is higher than maize. Thus, barley can be substituted for maize up to 30% economically without affecting body weight, egg quality and laying hens performance.

Table 7 : Analysis of Maximum Likelihood Estimates of Yolk Color of white leghorn chicken fed diet containing different levels of malted barley grain as a substitute for maize

Parameter		DF	Estimate	S. E	Wald Chi-Sq	Pr > ChiSq	Exp(Est)
Intercept	5	1	-5.7555	1.0102	32.4599	<.0001	0.003
Intercept	4	1	-2.8810	0.2834	103.3588	<.0001	0.056
Intercept	3	1	-0.7152	0.1804	15.7152	<.0001	0.489
Intercept	2	1	1.9107	0.2053	86.6240	<.0001	6.758
TRT	T_1vsT_4	1	-1.9255	0.2651	52.7487	<.0001	0.146
TRT	T_2 vsT_4	1	-0.6301	0.2517	6.2648	0.0123	0.533
TRT	T_3 vsT_4	1	-0.0378	0.2476	0.0233	0.8788	0.963
TRT	T_1vsT_2	1	-1.2954	0.2571	25.3818	<.0001	0.2738
TRT	T_1vsT_3	1	-1.8877	0.2646	50.8774	<.0001	0.1514
TRT	T_2vsT_3	1	-0.5923	0.2517	5.5403	0.0186	0.5530

DF= Degree of Freedom; SE = Standard Error

VIII. Conclusion

The result of the present study indicated that malted barley can replace maize economically up to 30% without adversely affecting egg laying performance and quality parameters.

IX. Acknowledgements

We would like to thank ministry of education (MOE) for providing us fund.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Agricultural Changes in the Rice Terraces of the Cordillera Region, Northern Philippines and their Impacts on Labor Dynamics and Food Security

By Robert T. Ngidlo
Ifugao State University, Philippines

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GJSFR-D Classification : *FOR Code: 309999*

Strictly as per the compliance and regulations of :

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Keywords: agricultural changes, rice terraces, labor dynamics, food security.

I. Introduction

The Cordillera region in the northern central part of the Philippines is home to the most extensive rice terraces in the Philippines. Carved along the steep sides of mountains, it is consideredan ingenious agricultural system built by the industry and shear agility of a peculiar group of people. It is estimated to be more than 2000 years old (Conklin 1980) and shaped the lives of many families who depend on it for survival. Rice terraces cultivation has become a part of the people's cultural heritage. For over many centuries, the rice terraces operates traditionally relying mainly on human labor, crude farming implements and organic systems. Since the 1980s a growing literature within environmental sciences, ecological anthropology, and resilience theory has stressed the potential role of traditional knowledge for nature conservation and sustainable natural resource management (Gadgil et al. 1993; Toledo 2002; Ballard &Huntsinger 2006; Berkes& Turner 2006).

The 70's to the 80's saw the intrusion of modern agriculture within the tradition farming system. According to Baggethun et.al (2009) as societies modernize, the traditional role of local ecological knowledge in natural resources management are being contested by rapid transformation. Rice terraces cultivators continue to endure persistent pressure to adopt new farming innovations to combat declining productivity, control the emergence of new pest and diseases and meet changing demographic trends.

The study was conducted to understand the changes that has occurred in the rice terraces and how they impact on labor dynamics and food security. The end goal is to compare these changes with other agricultural heritage systems and facilitate a platform for interactions among various stakeholders of traditional agricultural systems around the world.

II. Materials and Methods

To understand the series of changes that has occurred in the rice terraces, an agricultural timeline was derived based on the narration of ten (10) key informants in each of the study sites. Each timeline was obtained through a series of workshops conducted with key informants. A Focus Group Discussion (FGD) involving a separate set of 10 farmers was assembled to validate the correctness of the timelines that was obtained from the first group. Corrections were made in the timelines to reflect what was perceived to be the correct information.

Author: faculty of the College of Agriculture and Forestry of the Ifugao State University, Potia Campus, Alfonso Lista, Ifugao 3608 Philippines. e-mail: r.ngidlo@gmail.com

The timelines was based purely on oral recalls wherein key informants are tasked to recall different time periods that new agricultural innovations were introduced in the rice terraces.

III. Results and Discussion

The summarized timelines for each of the study site is shown in Figures 1, 2, 3 and 4. The timelines were traced from its initial phase covering the earlier years prior to the 1970's and succeeding years from the 1970's up to year 2010. Three important features of the rice terraces was included in the timelines namely: farming practices, consumption and marketing patterns and the sources of information that aided farmers to adopt the series of changes that has occurred in the rice terraces.

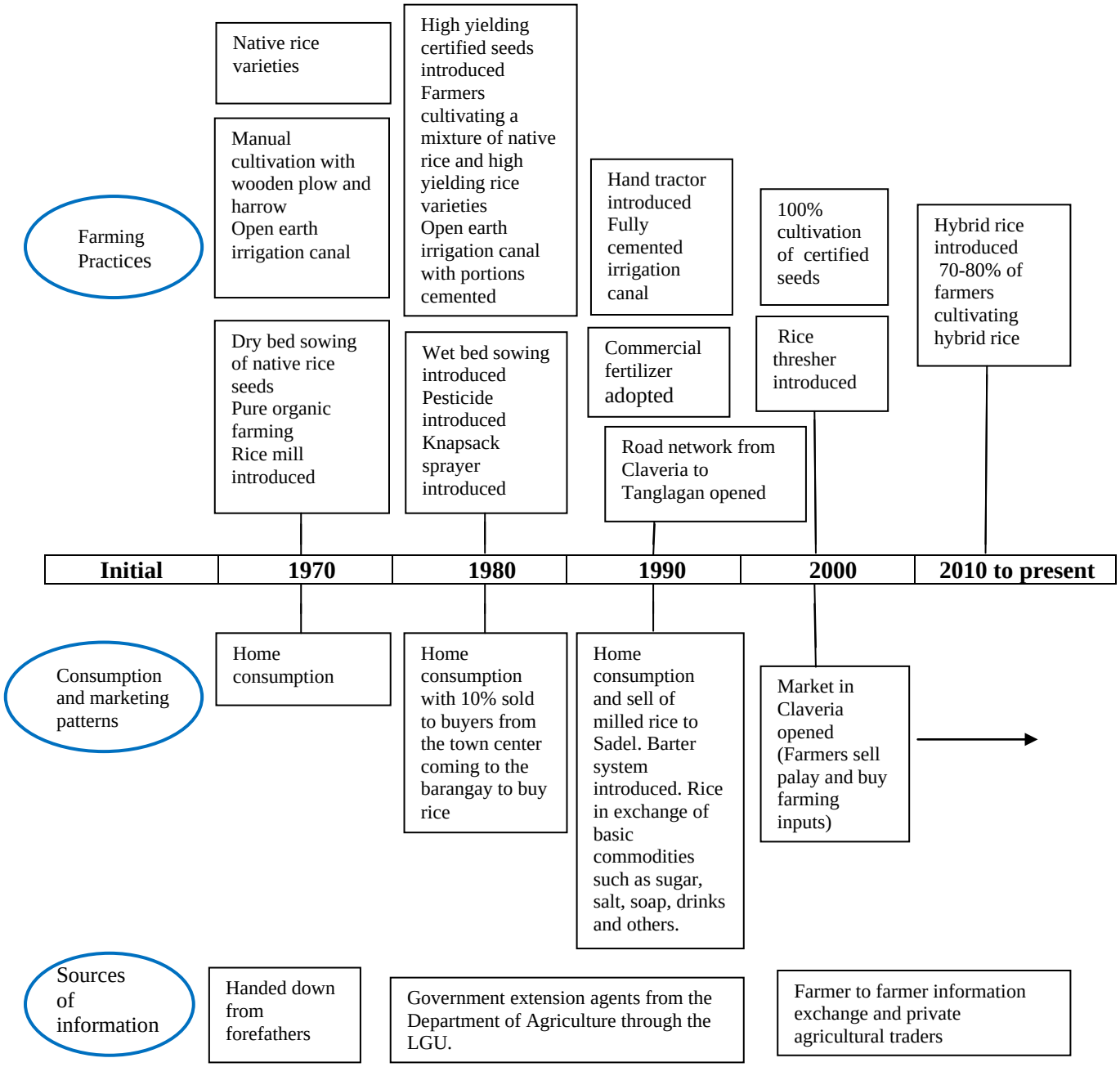

Figure 1 : Tanglagan timelines

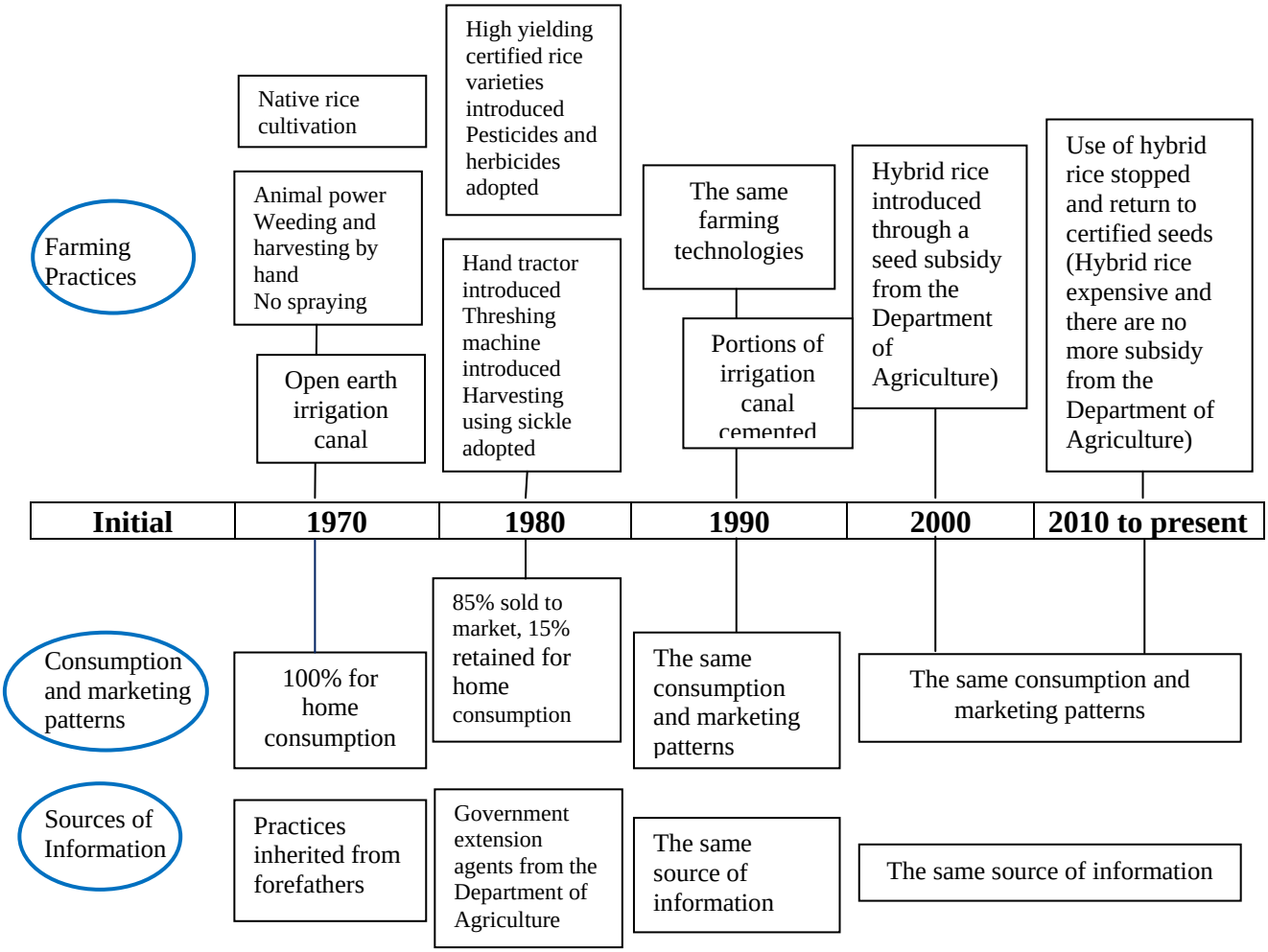

Figure 2 : Bagumbayan timelines

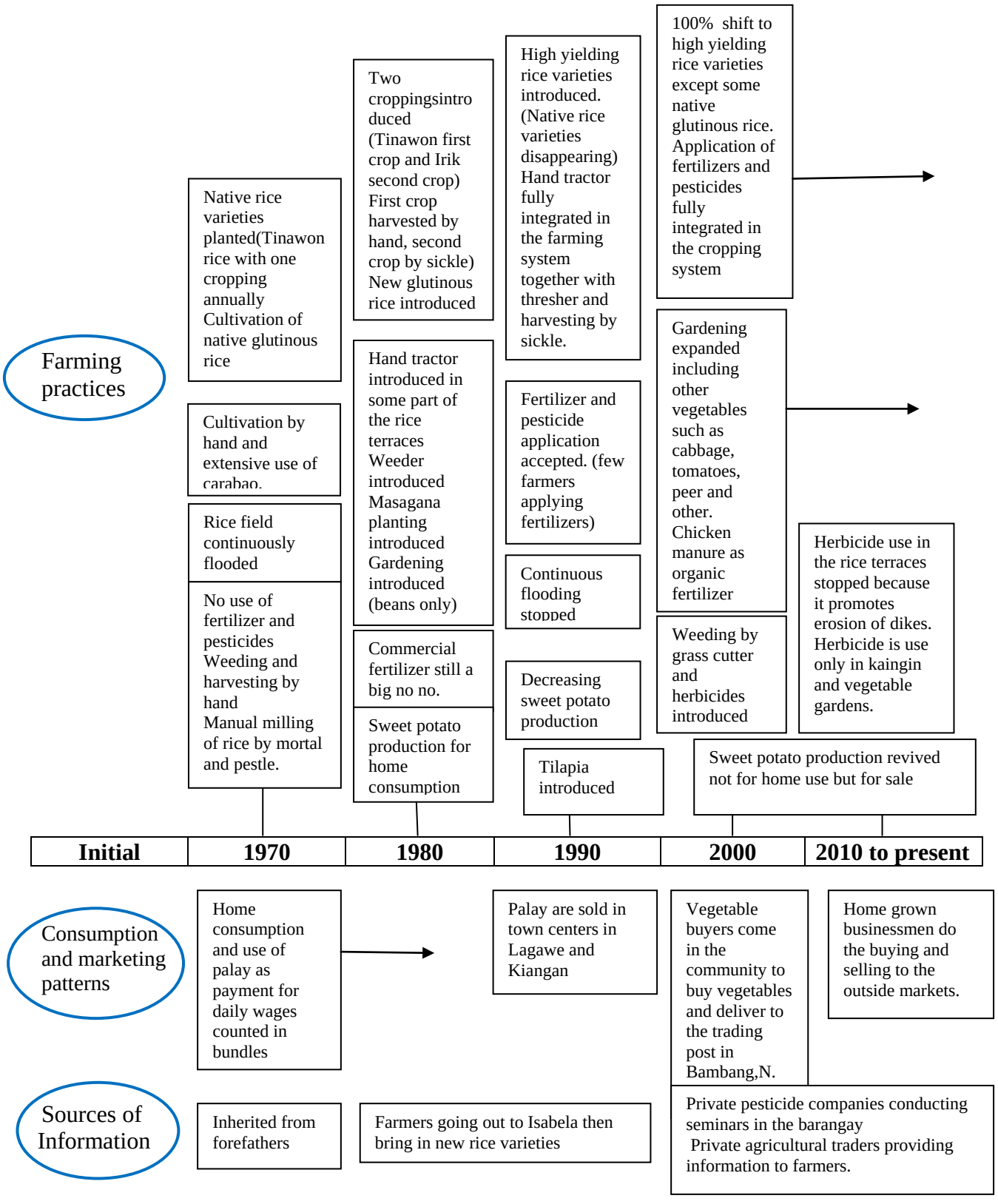

Figure 3 : Asipulo timelines

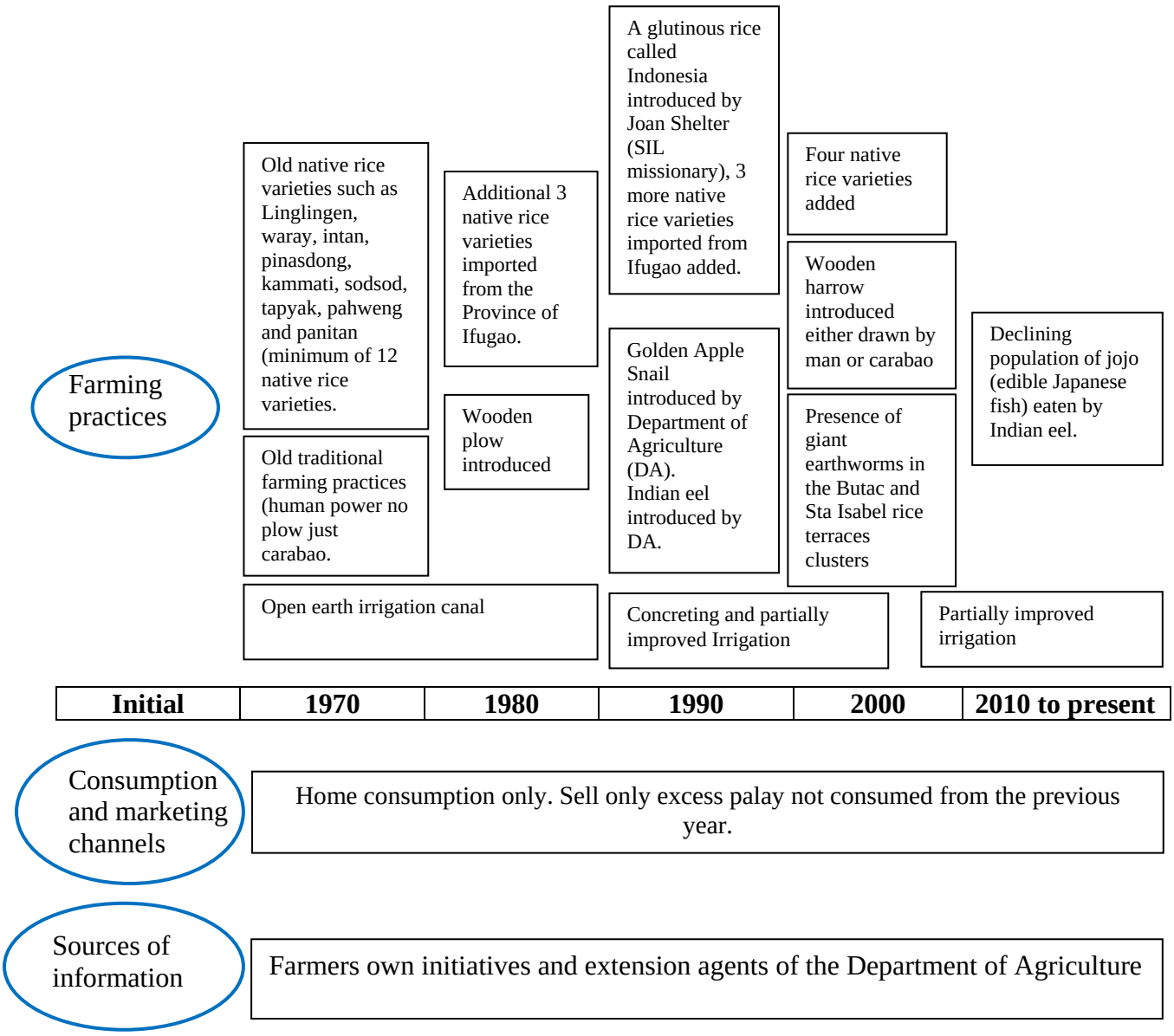

Figure 4 : Natonin timelines

IV. Lessons Learned from the Timelines

a) Farming Practices

It is clear from the timelines that the rice terraces started as a traditional farming system based purely on organic systems and the cultivation of traditional rice varieties. Land preparation is done manually by hand and foot with the aid of simple implements such as shovel and spade. In some of the study sites, cultivation is aided by draft carabaos with the wooden plow and harrow. Farming practices evolved locally without any form of external intervention and handed down from one generation to generation.

The 1970's to the 80's were the years that saw the intrusion of modern farming innovations and practices in the traditional rice terraces system. The entry of these modern farming innovations transformed the rice terraces into a mixtureof both traditional and modern farming systems. Modern farming innovations led to the alteration of the rice terraces into three types namely: a) rice terraces that persist with the old farming systemb. rice terraces that combines both old and new farming practices and c) rice terraces that shifted to modern farming practices.

Of the four rice terraces clusters evaluated, the rice terraces in Natonin, Mt. Province resemble the old and enduring old farming system. Farmers continue to cultivate the traditional rice varieties which was handed down to them by the older generation of farmers. The tedious preparation of the rice paddies is done extensively by both human and animal power. Cropping is done once a year but in recent years farmers have learned to do two croppings annually out of the need to produce more food.

The rice terraces in Asipulo, Ifugao featured the combination of both old and new farming practices. Farmers do two cropping annually, wherein the first cropping is devoted to the cultivation of the old traditional varieties while high yielding rice varieties are grown as second crop.

The rice terraces in Bagumbayan, Tabuk City and Tanglagan, Apayao are the two rice terraces clusters that completely reverted to modern farming systems. The short harvest cycle of 3-4 months allow farmers to do two to three cropping annually. These modern types of rice terraces are mostly found in the low lying areas in between mountains flanks that are traversed by roads and highways making them easily accessible to land transportation.

There are four prevailing modern farming innovations adopted by farmers in the rice terraces and these includes: the substitution of traditional rice varieties by high yielding varieties; use of fertilizers and pesticides, farm mechanization with the adoption of hand tractors, rice threshers and rice mills and improvement in the irrigation systems.

The adoption of high yielding rice varieties was the precursor to the adoption of modern farming practices in the rice terraces. The terraces clusters in Tanglagan were the first to migrate to high yielding rice varieties followed by those in Bagumbayan, Tabuk city in the province of Kalinga. In the case of Asipulo in Ifugao, high yielding rice varieties came only during the earlypart of the 1990's, however, farmers still continue to cultivate the traditional rice varieties alternately with the high yielding rice varieties. Almost all of the rice terraces clusters that has shifted to high yielding rice varieties are using commercial fertilizers and pesticides. However, in a 50-50 setting like those of Asipulo, Ifugao, farmers are still very prudent in using pesticides being restricted by local legislation. The underlying reason for the restricted use of pesticides is the preservation of aquatic resources which constitute an important diet of the local population. In the case of Natonin, Mt. Province, the major significant changes in the traditional farming system is the addition of three other traditional rice varieties imported from the province of Ifugao and the use of draft carabao and wooden plow replacing to a certain extent some of the manual cultivation practices being done by farmers.

Hand tractors replaced the tedious manual preparation of rice paddies. On the other hand, rice threshers and rice mills made post- harvest processing much easier replacing the tedious carabao threshing method and the old mortar and pestle de-hulling process.

b) Impacts of modern farming innovations/practices in the rice terraces

The adoption of modern farming practices in the rice terraces has numerous impacts on labor dynamics and food security in the rice terraces. First and foremost, the substitution of traditional rice varieties with high yielding rice varieties boosted rice yield from 50 to 70% comparedto the traditional rice varieties. This substantial increased in rice production enhanced the food security situation in the rice terraces where families no longer experienced acute food shortages during the rest of the year. High yielding rice varieties created a fit between subsistence and the cash market where farmers produced rice not only for home consumption but also fed in the local market (Ngidlo, 2014).However, the rugged topography prevents further expansion of the rice terraces space. The area of rice terraces owned by families ranges from a few hundred meters seldom exceeding one hectare.

The use of commercial fertilizer and pesticide came only as a precursor to the adoption of high yielding rice varieties. Commercial inputs such as fertilizers and chemical sprays are indispensable to the cultivation of high yielding rice varieties. Farmers have no other recourse but to dispense these expensive inputs to sustain yield and control pest and diseases. Commercial fertilizers has made nutrient management in the rice terraces much easier and continuously sustain higher levels of production. On the other hand, pesticides supplanted the labor intensive manual removal of pest reducing crop losses substantially.

c) The use of hand tractors, rice threshers and rice mill

The rice terraces clusters in Tanglagan, Apayao province were the first to break the tradition of manual cultivation by employing draft animals (water buffalo) in the preparation of the rice terraces. Subsequently, farm mechanization was adopted with the introduction of hand tractors and rice threshers. Rice milling was also introduced later when the volume of harvest increased making it impractical to mill rice manually. Farm mechanization made the work much easier and lessen the number of man days spent by farmers in tending the rice terraces. It has removed labor bottlenecks associated with land preparation, weeding, pest management and post-harvest processing. However, in spite of mechanization, the carabao still remain an indispensable partner of the farmer used in cutting corners which could not be reached by the blade of the hand tractor.

d) Improvement in the irrigation system

The improvement of the irrigation system in many parts of the rice terraces started way back in the 1990's chiefly through the intervention of the National government of the Philippines through the National Irrigation Administration. In earlier years prior to the 1980's most of the irrigation system in the rice terraces are considered crude sourced out along creeks and channeled along open earth canals. Poor irrigation and drainage in earlier years may have led to enormous water losses but today, most of the rice terraces in the

Cordillera region is serviced by improved irrigation system courtesy of the national government. Farmers in Bagumbayan, Tanglagan, Natonin and Asipulo enjoy the services of a much improved and centralized irrigation systems. The importance of water in securing a good harvest cannot be overemphasized thus, improved design and better management of irrigation water by farmer stakeholders contributed to higher productivity in the rice terraces.

e) Consumption and marketing patterns in the rice terraces

Throughout the Cordillera region in the northern central part of the Philippines rice growing in the terraces is purposely for subsistence or home consumption. The early builders of the rice terraces never intended to grow rice for commercial purposes. Under the traditional management scheme, 80-90% of the rice harvest are kept for home consumption while only around 10-20% are sold to buyers within the community. At other times only the excess palay not consumed from the previous harvest are the ones being sold locally. In Tanglagan, a barter system was introduced in the early 1990's wherein rice was bartered for basic commodities such as salt, sugar, soap, coffee and other forms of groceries. In Ifugao, traditional rice is given as payments for labor services rendered in the terraces. Five bundles of unhusked rice is the equivalent pay for a day's work which roughly corresponds to 8-10 kilos of clean milled rice. Under traditional rice varieties, palay harvest is seldom enough to support the food needs of families the whole year round except for those who own wider rice terraces and fewer mouth to feed.

The consumption and marketing patterns for palay derived from high yielding rice varieties differ with that of the traditional rice. Farmers adopt a 50:50 split arrangement wherein 50% of the harvest is kept for home consumption and the other 50% is sold in the market. In Bagumbayan, palay grains are sold to rice traders in nearby Tabuk city while in Tanglagan, palay is sold to rice traders in Claveria, Cagayan province approximately 35 kilometers away. In Asipulo palay is sold either in the municipalities of Kiangan or Lagawe where rice traders are stationed.

V. Sources of Information

The capacity of farmers to change their agricultural practices is hinge on two important resources and these are: information/communication networks and the availability of financial resources to support the intended changes. Four modes of information sources can be picked from the timelines namely: inheritance and tradition, government extension agents, farmer to farmer contact and agricultural traders/ technicians. The timeline shows that prior to the 1980's, the rice terraces was purely traditional in nature meaning farming practices are inherited from one generation to another. The repetitive nature of these practices could have lasted for more than 2000 years. The transition to modern agriculture paved the way for the adoption of high yielding rice varieties and other modern farming practices associated with it. The entry of high yielding rice varieties did not came by accident but the deliberate efforts of government extension agents from the Local Government Units. Seeds were given free to farmers and followed by lectures and teaching sessions on how to grow these new rice varieties. On the other hand, the spread of pesticides and fertilizers is said to have come from the works of pesticides and fertilizer dealers where farmers buy their farming inputs. In the Tanglagan area rarely visited by extension agents, agricultural traders were the most dominant sources of information. Farmers and private agricultural traders interact constantly seeking to negotiate and create opportunities to fulfill their needs and pursue their business interest. In the process of negotiation, information is exchange on the latest product, market prices, technology and practices.

At the farm level, the supply of information on the efficiency of a particular rice variety or a brand of pesticide is spread through farmer to farmer contact. Farmers themselves (particularly the early users) are the vital source of information by sharing their farming experiences to other farmers who in turn try the same innovation or product. Rice terraces farmers are a closely knitted groups, thus they share information quite easily on the usefulness of a particular product which they used or are currently using. In the same manner, input/output price information also comes from other farmers but businessmen provide the information as well.

The financial capability of farmers is one aspect that may either promote or limit changes in agricultural production. Except for Asipulo being serviced by credit cooperative, the other three sites do not have access to credit. Farmers depend on credit facilities from immediate family members, neighbors and friends. Farmers in Bagumbayan displayed a keen interest on government subsidy for hybrid seeds for them to increase returns from the rice terraces. However, government subsidy cannot be relied upon at all times. Farmers themselves have to develop local strategies to continue with newly introduced innovations

VI. Conclusion and Recommendations

The 70's to the 90's of the last century where the most critical years in the history of rice terraces cultivation in the rice terraces. Under constant pressure to produce more food, farmers with the help of extension workers from the Local Government Units started to experiment on the cultivation of modern rice varieties. With very promising results, farmers started to

abandon the traditional rice varieties in favor of these modern rice cultivars. The transition to high yielding rice varieties converted the once subsistence economy to a market oriented agricultural economy. Although limited in scale compared to lowland standards, it has open new ways wherein famers can earn additional income from the sale of palay harvest. Modern rice cultivars substantially increased the level of rice production and has improved the food supply situation in the terraces. In recent years, farmers alleged that it has become doubly difficult to find hired hands to help families do the tedious manual works in the rice terraces. The arrival of the hand tractor eliminated the need for hired labor and families can do the work alone in their own rice field. Farm mechanization reduced the number of man-hours spent by farmers in preparing their rice terraces which they can use for other productive activities. It has also removed labor bottlenecks by eliminating the tedious manual labor situation in the terraces.

The contemporary issues affecting the rice terraces are poverty and food insecurity. To secure a more stable food supply, farmers must learn to go beyond subsistence to create surplus production for the market. However, committing the rice terraces to the commercial production of rice is not possible considering spatial limitation and the need to preserve traditional knowledge. The rice terraces is a complex social-ecological system in which the biophysical system (land, forest and water), human culture and livelihoods are linked together. With these complex interaction, there is a need to balance the utilization of the rice terraces to both modern and traditional agriculture. Higher elevation terraces made up of approximately 70% of the total land area of the rice terraces must continue to retainits traditional character for the preservation of traditional knowledge and practices. On the other hand, the relatively flat to slightly rolling terraces (typical of the rice terraces in Tanglagan and Bagumbayan) found along river systems and easily accessible by land transportation can be committed to the growing of modern rice cultivars. The concentration of modern rice cultivars to the relatively flat terraces facilitates the transfer and movements(from the road to the rice paddies and from one rice paddy to another) of hand tractors and isolate the possible negative impacts of insecticides and fertilizers on water and aquatic biodiversity. To improve income flow and food security in the rice terraces, it is necessary for farmers to learn how to use their rice terraces to create other alternative sources of income. The following are the policy recommendation to enhanced food security in the rice terraces.

1. Increase investments in agricultural productivity- there is a need to design an investment program that can possibly diversify sources of income. Aside from rice production, the rice terraces offer various options for investment in fisheries, duck production and shell-fish integration schemes. Investment in irrigation infrastructure is also needed and should form part of the investment policy to promote agricultural productivity.
2. Extension programs- changes in the rice terraces is inevitable and therefore extension programs can play a vital role in thetransfer of appropriate technology, facilitating interactions and promoting capacity among farmers. Extension services that caters to the conservation of the multi-functionality of the ice terracesis very much needed. In addition, extension services that help enhanced the skills of farmers to diversify livelihoods as mentioned above are very much welcome.

VII. Acknowledgement

The author acknowledged with gratitude the local barangay officials who assisted in selecting the key informants of the study. The author also acknowledged with same gratitude the Ifugao State University through its top management for allowing the author to work in this project.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 7 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Impact of Agro-Ecological Belts and Rainfall Distribution on Poultry Production in the Major Tropical Regions of Nigeria

By T. Omodele, I. A. Okere, M. O. Oladele-Bukola, A. J. Omole, A. K. Tiamiyu & O. A. Morakinyo

Obafemi Awolowo University, Nigeria

Abstract- This study investigated the factor responsible for poultry production in the Northern and Southern regions of Nigeria. Using Geographic Information System (GIS) and applying the FAO categories of poultry farm production for the Northern Nigeria: 55.6% of Household free-range (HHFR) farms (<200 birds) produced at 67.7%, 58.6% of Backyard commercial (BYC) farms (200-4,999) produced at 56%, 52.7% of Medium-scale commercial (MSC) farms (5,000-19,999) produced at 51.5% and 32.6% of Large-scale commercial (LSC) farms (with≥20,000 birds) produced at 23.7%. In the South: 44.4% of Household free-range (HHFR) farms (<200 birds) produced at 32.3%, 41.4% of Backyard commercial (BYC) farms (200-4,999) produced at 44%, 47.3% of Medium-scale commercial (MSC) farms (5,000-19,999) produced at 48.5% and 67.4% of Large-scale commercial (LSC) farms (with ≥20,000 birds) produced at 76.3%. Agro-ecological production distribution showed Arid/Semi-Arid (14.2%), Derived Savanna (38.7%), Humid Forest (28.5%), MidAltitude (9.9%), Northern Guinea Savanna (6.3%) and Southern Guinea Savanna (2.4%).

Keywords: *ADP, GPS, heat stress, poultry meat type, rainfall pattern.*

GJSFR-D Classification : *FOR Code: 079999*

Strictly as per the compliance and regulations of :

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I. Introduction

The existing acute shortage of protein in Nigeria and the ever increasing demand for livestock products point to poultry meat and eggs as a quick means of bridging the protein deficiency gap Adegeye and Dittoh (1982). Production of food has not increased at the rate that can meet the increasing population in Nigeria. The evident disparity in rate of food production and demand for food in Nigeria has led to adverse increase in food importation and consequently resulting in high rates of increase in food prices. Agriculturists and Nutritionists generally agreed that developing the poultry industry of Nigeria is the fastest means of bridging the protein-deficiency gap presently prevailing in the country. The obtainable quality of poultry management system in Nigeria lacks modern techniques which require adequate funding. A report made by Omodele and Okere (2014) showed that the highest production of poultry is in Ogun State in the South-west geopolitical zone of Nigeria. This highest production of poultry is not only as a result of population but also due to availability of market in the neighbouring States and other zones in the country.

According to Udoh and Etim (2007), poultry is by far the largest livestock group, consisting mainly of chickens, ducks and turkey. The types of poultry that are of commercial or economic importance are chickens, guinea fowls and turkeys, amongst which chickens predominate. As a result of this, poultry farming is generically used to refer to chicken farming in Nigeria because it provides meat for delicacies and no tribe or religion in Nigeria forbids chicken meat. In communities where food shortages are uncommon, chickens are kept to supplement the meals or to honour a guest (Nwagu, 2002). Chickens comprise: Broilers, Breeders, Layers and Cockerels (Omodele and Okere 2014). The Layer bird and its products (eggs) are very rich source of protein. Estimates from consumption of poultry and demand surveys in Nigeria indicated that the consumption of poultry meat is gradually outstripping most other kinds of meat except beef.

Various factors in the bird's environment affect its well being and its levels of productivity (Smith, 2001). In tropical areas, the effect of the tropical environment varies from area to area. For example, humidity in the air is of more importance near the equator in the rain forest areas; high temperatures are important in the seasonally dry areas away from the equator and very important in hot desert areas. The sun is hotter in equatorial regions than in temperate regions, although this effect is modified in heavy rainfall areas by the presence of a thick cloud cover. The actual temperatures at the lower and upper extremes of the zone of thermal neutrality depend on insulation of the bird (feather cover) and its level of feeding. Below the zone of thermal neutrality food is used wastefully and above this zone the bird suffers heat stress (Smith, 2001). Birds are more cold tolerant than heat tolerant and they are much more likely to die from heat stress than cold stress. It should however be emphasized that under 'modern' systems of management poultry are normally intensively housed and therefore live in a modified microenvironment. The modern technology requires substantial funding which is not affordable by most farmers in the tropical regions of Nigeria.

FAO has divided the production system into 4 categories based primarily on scale of production and

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

level of bio-security: sector 1: industrial integrated system with high bio-security systems; sector 2: commercial poultry production system with moderate to high bio-security; sector 3: commercial poultry production system with low to minimal bio-security; and sector 4: village or backyard production system with minimal bio-security (Adene and Oguntade 2006). Researchers simulated farm locations and animal populations by randomly locating the farms within restrained areas determined by several geographic factors, such as roads and water bodies (Geter, 2006; Miller *et al*., 2007). Although promising, this approach resulted in local farm densities that were too high as well as an unreasonably large spatial distribution.

The use of GIS in qualitative livestock production is needed to collect data, store, manage, analyze and produce useful information from production stage to decision making stage. Unlike any other type of information handling tool, GIS can understand the concept of location and will help poultry producers with optimal and cost-effective poultry management. A report made by Omodele and Okere (2014) showed that GIS capability in poultry management is achievable in land type description, feed cost monitoring, disease spread analysis and monitoring credit facility sources. This study was undertaken to technically assess the poultry production in the two major regions of Nigeria and to help the decision makers in creating a competitive environment where poultry production is optimized in order to meet the rising demands of the increasing population in the regions and also knowing the geographic boundaries or areas where rescue operations are essential.

II. Materials and Methods

a) Survey of poultry farms

An intensive survey was carried out in 2010 for the creation of an accurate spatial dataset of poultry farms contributing to the development of the poultry sector in the Northern and Southern geographical regions of Nigeria (Figure 1). This determination of positions of the poultry farms required the use of Global Positioning System (GPS) for the purpose of assessing and evaluating the development of the poultry sector in their respective localities (Figure 2). Through interview sessions conducted by Agricultural Development Programme (ADP) Officers, a set of questionnaire were also administered to obtain information on the characteristics of the sampled farms.

Figure 1 : Map of the study area

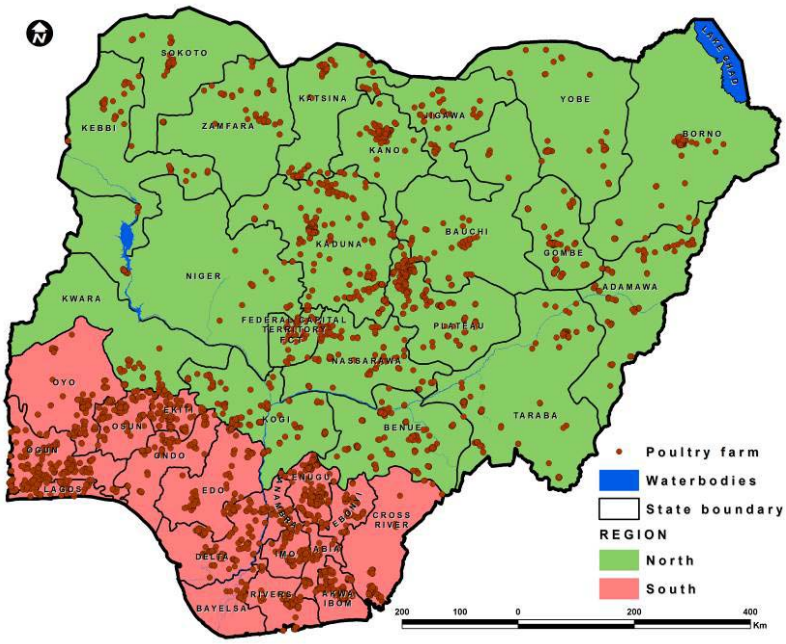

Figure 2 : Spatial distribution of poultry farms in the Northern and Southern Nigeria

b) Integration of spatial and attribute data of poultry farms

Integrating the logically structured spatial and attribute data of the surveyed poultry farms using ArcGIS 10.1® capabilities, the obtained data of the poultry farms within the study area were logically queried and analyzed. The geographical spreads of the farms with respect to their locations were determined for an easy determination of the poultry production capabilities of the regions as displayed in Table 1. The regional identification of all farms was geographically defined based on the centroid of each poultry farm. The adopted GIS mapping procedure is shown in Figure 3 (*Source: Omodele and Okere (2014)*).

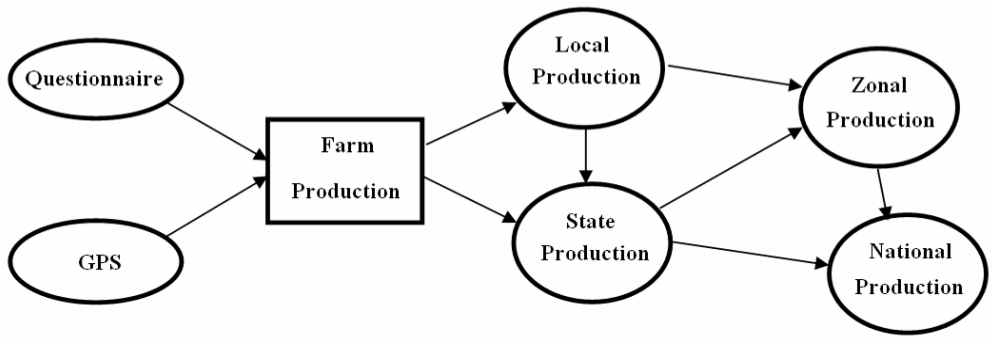

Figure 3 : Mapping procedure for poultry production in a GIS environment

III. Results and Discussion

a) Landmass and farms proportion

According to Figure 2, the Northern land mass of 720,782.1 SqKm contained 3,452 poultry farms while the Southern land mass of 188,678.6 SqKm contained 2,629 poultry farms. From these results, it is presumed that the Northern part of Nigeria should emerge as the higher producer of poultry products especially with the advantage of larger available space (land) and proportion of contributors (farms) in Nigeria. Agriculture and poultry in particular thrives with the availability of conducive space (land).

b) Northern and Southern disparity in poultry production

Table 1 shows the poultry meat types and their production in the North and South regions while Figure 4 displays the percentage production profile of the surveyed poultry meat types between the regions. With the expectation of the North to outstrip the South in production, it was revealed that the Southern region produced more than the Northern region except in Breeders production where the North dominated. This is a clear indication that the high number or proportion of poultry farms in an area does not guarantee a high production in such a locality as reported by Omodele *et. al.* (2014a). Assessing the non-producing farms in

Nigeria, 51.3% and 48.7% of farms in the North and South respectively are not producing. The non-production percentages by these farms was considered negligible for the assessment because of their closeness.

Table 1 : Year 2010 regional poultry meat production in Nigeria (birds)

Region	Broilers	Breeders	Layers	Cockerels	Total
North	708836	469995	3916344	119251	5214426
South	1163479	378650	5506864	210608	7259601
Total	1872315	848645	9423208	329859	12474027

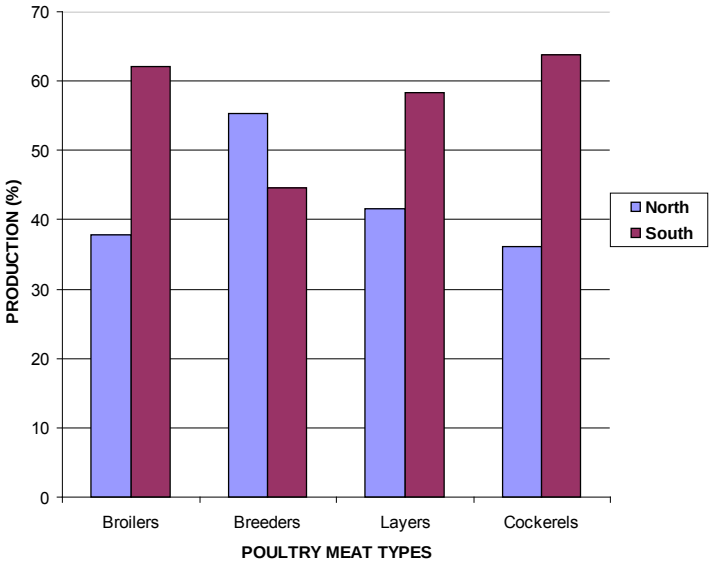

Figure 4 : North and South Percentage production of poultry meat types

c) Farms proportion and production

As stated in Table 2 and displayed in Figure 5: In the North, 56.8% of farms produced 41.8% of poultry products and in the South, 43.2% of farms produced 58.2%. This implies that despite the lower percentage of poultry farms in the South, the Southern region still emerged the higher producer of poultry products in Nigeria. Hence, this requires further investigation.

Table 2 : Poultry farms proportion and production in the Northern and Southern Nigeria

Region	No of farms	Production (birds)
North	3452	5171919
South	2629	7210962

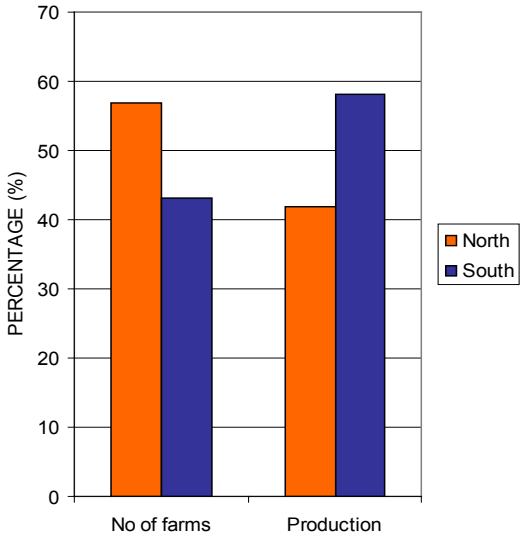

Figure 5: Percentages of disparity in farms proportion and production in the Northern and Southern parts of Nigeria

d) Application of FAO categories of poultry farms

Applying the FAO categories and adopting the classes of poultry farms production applied by Omodele *et. al.* (2014a): Household free-range (HHFR) farm (<200 birds), Backyard commercial (BYC) farm (200-4,999), Medium-scale commercial (MSC) farm (5,000-19,999), Large-scale commercial (LSC) farm (with ≥20,000 birds) made the farm production capacity assessment achievable. However, because farm size is not necessarily directly related to level of bio-security, these four categories were proposed for the benefit of this assessment. According to the classes, regional justification of poultry farms performance was applied. Figure 6 displays the spatial distribution of the poultry farms according to FAO categories of production while Table 3 shows the applied classes of production in the Northern and Southern regions of Nigeria. As in Figure 7, the Northern region outstrips the Southern region in the Household free-range (HHFR), Backyard commercial (BYC) and Medium-scale commercial (MSC) farms categories which was as a result of the North having more farms contributing in these 3 categories than the south. The Southern region recorded a higher number of farms in the Large-scale commercial (LSC) category which is the highest production class. As a result, the South had a higher production than the North. This position of production connotes that there is an appreciable production of poultry meat in the South due to higher number of farms in the highest production category (LSC). This qualitative analysis has given the agriculturists and decision makers' broader perception of the overall performance of all farms across the regions.

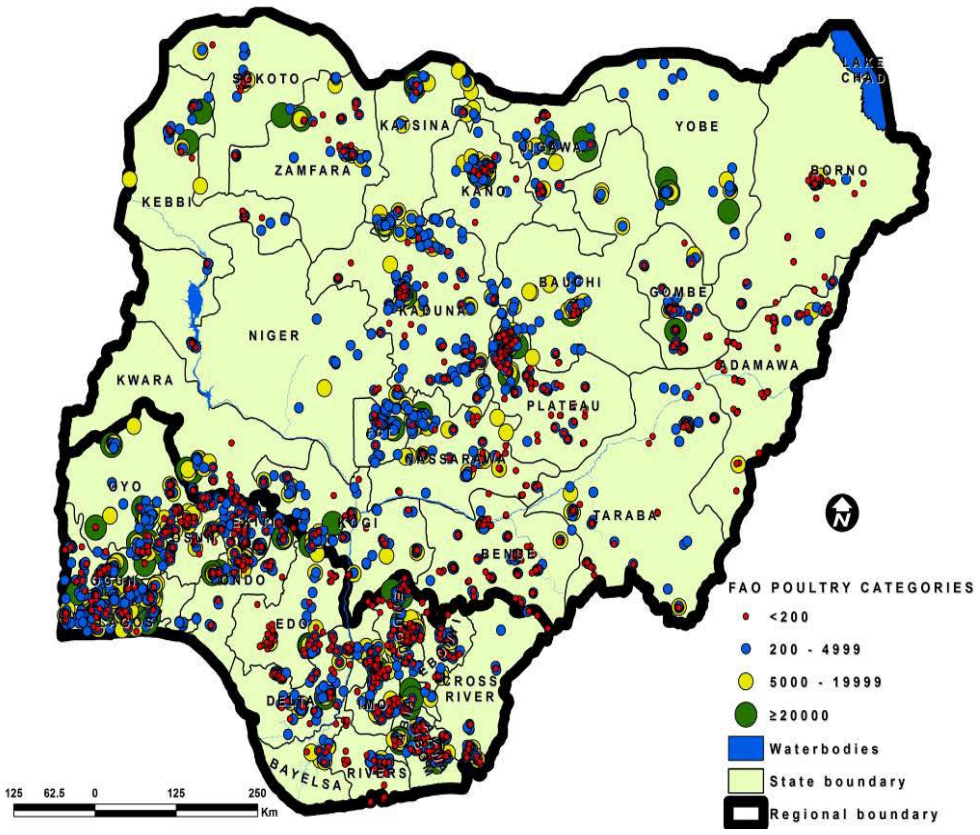

Figure 6 : Northern and Southern distribution of poultry farms according to FAO categories

Table 3 : Categories of poultry farms in the Northern and Southern Nigeria

Class	No of farms (North)	Northern Production (birds)	No of farms (South)	Southern Production (birds)
<200 (HHFR)	1183	40228	946	19192
200-4999 (BYC)	2024	2212258	1429	1741489
5000 – 19999 (MSC)	216	1729811	194	1630458
≥20000 (LSC)	29	1189622	60	3819823

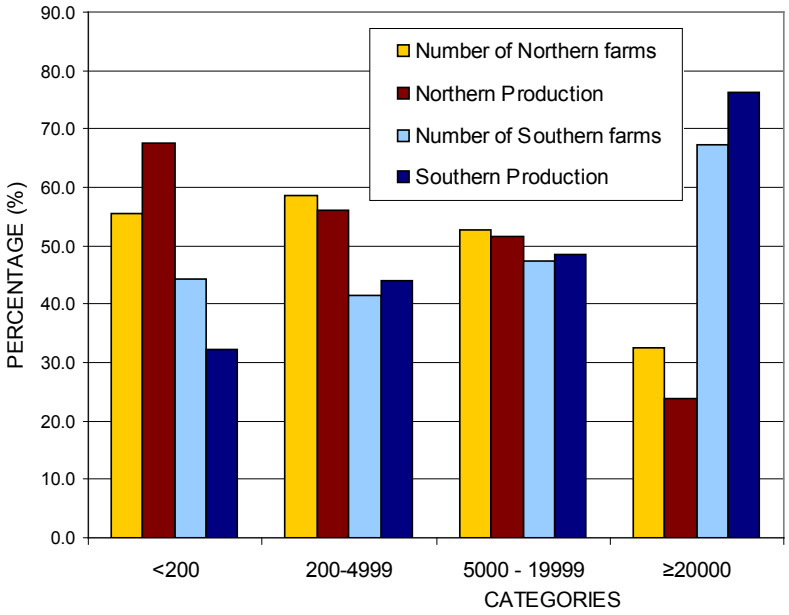

Figure 7 : FAO categories comparison of percentages of farms and their percentage production in the Northern and Southern parts of Nigeria

e) Market availability

Availability of market is one of the most important determining factors of poultry production. As stated by Omodele *et. al.* (2014b), population attracts increase in consumption of poultry products (meat and eggs) and that high population connotes more of commercial activities as agricultural products have ready markets. As confirmed that market access plays an important role in the development of the poultry industry in Delta State, Omodele *et. al.* (2014b) stated further that human population attracts increase in production and consumption of poultry products in the Niger Delta area. Therefore in the same perspective, Table 4 shows the human population distribution in the Northern and Southern regions which were 53.6% and 46.4% respectively. The higher population in the North did not guarantee a higher production as confirmed in the South. It could be stated that the purchasing power of the Southern region is higher than that of the Northern region. The poverty level in the North is also presumed to be higher. This implies that human population does not always determine poultry production in the wide regions of the North and South of Nigeria.

Table 4 : The Northern and Southern human population

Region	Human Population
North	75269722
South	65162068

f) Agro-ecological distribution of production

Poultry production distribution was assessed across the various agro-ecological zones in Nigeria. In order of the six identifiable zones displayed in Figure 8, the quantities of birds produced across the zones are listed in Table 5. As shown in Figure 9, agro-ecological distribution of poultry production was Arid/Semi-Arid (14.2%), Derived Savanna (38.7%), Humid Forest (28.5%), Mid Altitude (9.9%), Northern Guinea Savanna (6.3%) and Southern Guinea Savanna (2.4%). The differential production output across the agroecological zones is the fact that all the commercial birds either for egg or meat type are bred or selected under temperate conditions. Expectedly, they perform below their potentials in accordance to the severity of the heat stress elicited by their production system in the tropical regions. Since the Southern region is where rainforest agro-ecological zone and a part of the derived savanna is domicile, there existed an appreciable production of birds in the region (Figure 9). The derived savanna belt which spreads across the Northern and Southern regions recorded the highest production while the Mid Altitude zone which experiences a cool climate produced remarkably as compared with the vast land areas of the Northern and Southern Guinea Savannas of the North.

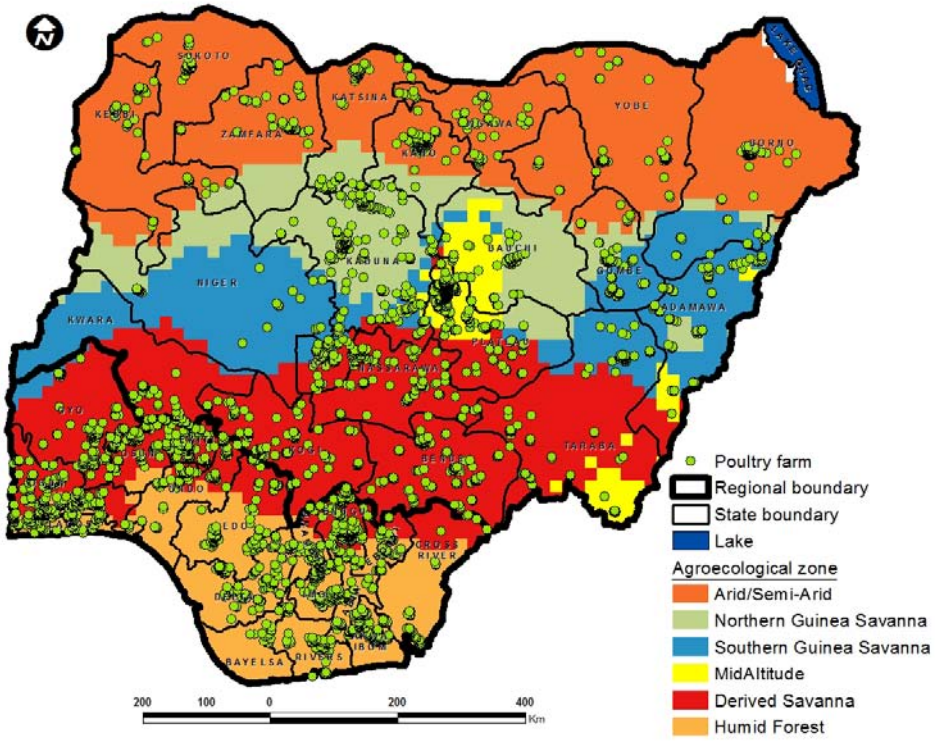

Figure 8 : Spatial distribution of poultry farms across agro-ecological zones

Table 5 : Agro-ecological distribution of poultry production

S/N	Agro-ecological zone	Land area (SqKm)	Total production (birds)
1	Arid/Semi-Arid	271974.1	1763008
2	Derived Savanna	249834.4	4797111
3	Humid Forest	109262.4	3524441
4	MidAltitude	31423.4	1223440
5	Northern Guinea Savanna	114203.6	783450
6	Southern Guinea Savanna	132782.7	291431

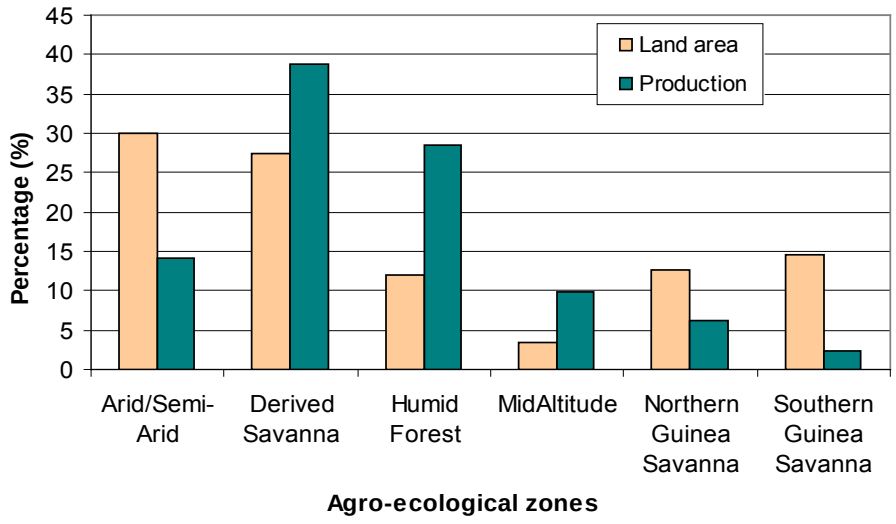

Figure 9 : Percentage production of poultry birds across agro-ecological zones

g) Regional division of the derived savanna

For the purpose of comparing the production of the two major regions, the derived savanna was sub-divided using the regional boundary. Figure 10 shows the distribution of the farms across the savanna while Table 6 shows the proportions of farms and their production across the derived savanna (Northern and Southern Guinea Savanna). As displayed by Figure 11, their existed a higher production of birds in the Southern derived savanna than the Northern derived savanna. It was reconfirmed that the Southern tropical region of Nigeria had an intensified production of poultry. The Southern derived savanna is also believed to experience a lower heat stress as a result of its closeness to the humid agro-ecological zone. Omodele and Okere (2014) had revealed that the highest production of poultry was from the South-Western Nigeria where Ogun State took the lead.

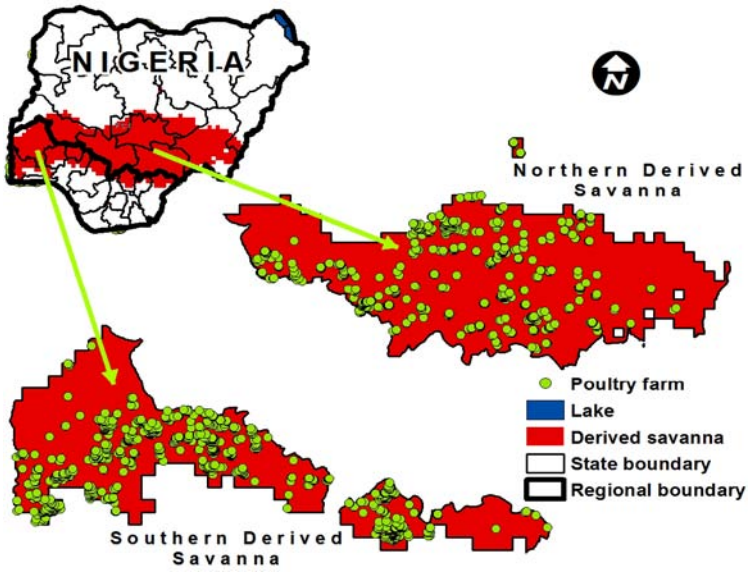

Figure 10 : Spatial distribution of farms across the Northern and Southern derived savanna

Table 6 : Derived savanna belt farms proportions and their production

S/N	Derived Savanna	No of farms	Production (birds)
1	North	938	1159640
2	South	1185	3636871

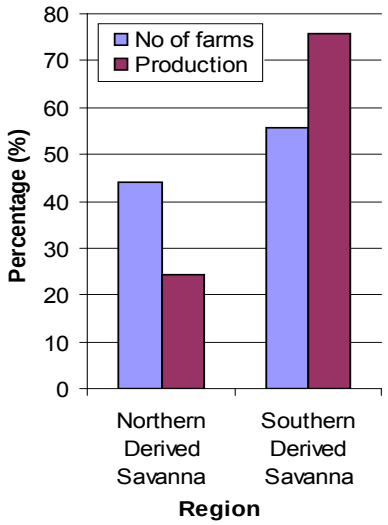

Figure 11 : Percentage production of poultry birds across the Northern and Southern derived savanna

h) Climatic precipitation

Poultry birds are much more likely to die from heat stress than cold stress. It has already been reported that food intake by laying birds declines exponentially as environmental temperature is increased. Consequently a reduction occurs in the number of eggs produced by laying hens. The revelation made by Omodele and Okere (2014) showed that most poultry farm operations in Nigeria are into Layers production. The major production of Layers is due to the derivation of meat and eggs. The most obvious constraint on poultry production in these regions is the climate. High temperature, especially when coupled with high humidity, imposes severe stress on birds and leads to reduced performance (Daghir, 2008). Using the rainfall pattern assessment as displayed in Figure 12, it was observed that the Southern region of Nigeria experiences a higher magnitude of annual rainfall while the Northern region experiences a warmer climate. In Nigeria, most production of poultry is done under open-sided housing system which relies mostly on natural ventilation. Heat stress had been observed as one of the major factors determining turn-over in the poultry industry. Expectedly, poultry farmers are encouraged into more production as production turnover are to be well favoured in the cooler Southern region of Nigeria. Most highly productive poultry are kept in temperate zones where the effect of cold stress is likely to be more

important than the effect of high ambient temperatures. The hot regions of the world have probably the greatest potential for further growth since the level of consumption is still very low (Daghir, 2008).

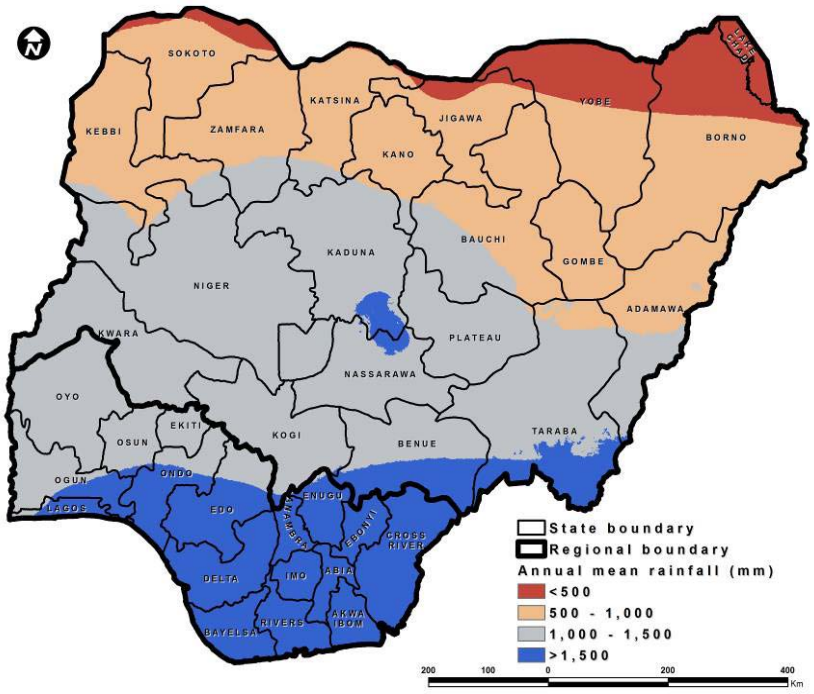

Figure 12 : Northern and Southern annual mean rainfall distribution

IV. Conclusion and Recommendation

In conclusion, this technical study revealed that landmass is not directly proportional to poultry production in Nigeria; it does not guarantee high production of animal especially in the poultry sector. A high number or proportion of poultry farms in an area does not also guarantee a high production in that locality. An appreciable number of Large-scale commercial farms in the Southern region were responsible for the higher production of poultry meat in the region while the higher human population in the Northern region did not guarantee a higher production of poultry products in the region. Poultry production is well favoured in the cooler Southern region of Nigeria due to its higher rainfall pattern as compared with the Northern region. Higher production is realized when heat stress is reduced in poultry birds and this encourages farmers into more production in the South. Provision of substantial funding for construction of modified microenvironment would control heat stress in poultry in the tropical regions especially in the northern part of Nigeria. The GIS approach to the study of poultry development has assisted in assessing the development of the sector in the Northern and Southern regions of Nigeria and has provided a database of the areas where developmental strategies are essential in poultry production in Nigeria. Therefore, GIS techniques could strengthen monitoring and assessment of poultry production from local to the regional level.

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FELLOWS

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Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
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3. Submission of Manuscripts,

4. Manuscript's Category,

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

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Informal Guidelines of Research Paper Writing

Key points to remember:

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

Final Points:

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

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

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

General style:

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

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

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

In every sections of your document

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

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

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

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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

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

Title Page:

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

Abstract:

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

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

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

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

Approach:

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

Introduction:

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

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

Approach:

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

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

Procedures (Methods and Materials):

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

Materials:

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

Methods:

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

Approach:

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

What to keep away from

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

Results:

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

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

Content

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

What to stay away from

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

Approach

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

Figures and tables

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

Discussion:

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

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

Approach:

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

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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Global Journal of Science Frontier Research

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ISSN 9755896