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GC-MS Analysis for Structural Identification and Bioactive Compounds in Methanolic Leaf Extract of *Mallotus Oppositifolius*

By Igwe K. K., Madubuike A. J., Amaku F. J., Chika Ikenga & Otuokere I. E.

Michael Okpara University of Agriculture, Nigeria

Abstract- The aim of the present study is to investigate the bioactive compounds from the leaf extract of *Mallotus oppositifolius* using GCMS analysis. The chromatogram showed nine peaks indicating the presence of nine compounds in the extract. The major phytocompounds in the leaf were Glutaconic anhydride with the highest concentration in the extract, 40.19 peak area %, RT 22.686 and molecular formula $C_5H_4O_3$; 2-Mercaptophenol with 18.23 peak area %, RT 22.068 and molecular formula C_6H_6 OS. Iso-Valreic and Valeric acids with 12.39,2.53 peak area %, RT 3.676,7.037 and the same molecular formula C_5H_{10} O_2 which had been proposed to have anticonvulsant effect in valerian and act as neurotransmitter. Oleamide with the least concentration of 2.15 peak area %, RT 27.959 and molecular formula $C_{18}H_{35}NO$ which could induce sleep in animals, being studied as a potential medical remedy for mood and sleep disorder and cannabinoid–regulated disorder. The phytochemicals in *Mallotus oppositifolius* could be of therapeutic importance.

Keywords: *GCMS analysis, mallotus oppositifolius, anticonvulsant, neurotransmitter, sleep depressant.*

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I. Introduction

The use of plants in the treatment of ailments has been long time immemorial [1]. *Mallotus oppositifolius*(Geisel) is one the plant used by Nigerians for the treatment of skin diseases [2]. *Mallotus oppositifoliusis* an erect branching perennial shrub up to 3.6 m high when fully matured. The plant is commonly found in drier types of forest and grow throughout the West Africa region [3]. Ethnobotanically, *Mallotus oppositifolius* is used as chewing sticks for cleaning the teeth and the stem for yam stakes. The Ohafia people in Nigeria use the cold infusion to expel placenta blood clot after delivery, while the decoction is a vermifuge in Ivory Coast. In Ghana, the crushed leaves are applied to inflammation of the eye during an attack of small pox [3]. Rottlerin has also been found in its bark and leaves [4]. The aqueous and ethanol extracts of the plant show antifungal properties [5] and anti parasitic activity against blastocystishominis [6] The bioassay-guided fractionation of an ethanol extract of the leaves and inflorescence of *Mallotu oppositifolius* collected in Madagascar led to the isolation of the two new bioactive dimeric phloroglucinols mallotojaponins B and C, together with mallotophenone. These compounds show antiproliferative and antiplasmodial activities [7]. The crude extracts of *Mallotus oppositiformis* possess antifungal activity on most of the fungi and inhibits the growth of *Aspergillus flavus, Candida albicans, Microsporium audouinii, Penicillium spp, Trichophyton mentagrophytes, Trichoderma spp and Trichosporon cutaneum* [5]. The leaves are ingredients of common anti-malaria and anti-inflammatory remedies [8]. Phytochemical screening of *Mallotus oppositiformis* revealed the presence of secondary metabolites such as alkaloids, phenols, flavonoids, anthroquinones and cardenolides. A higher concentration of these resides in the leaves than in the root [9]. Hydroalcoholic extract of leaves of *Mallotus oppositifolius* plant is used for CNS conditions in Ghana, which exhibits antidepressant effects mediated by enhancement of serotoninergic neurotransmission and inhibition of glycine receptor activation [10].There is increase in fungal related cases for the last decade. Fungal related diseases may not be as common as other microbial infections but, when present, they are difficult to treat especially if patients immunity is low [11]. Therefore traditional doctor who tries to cure an ailment using plant may use the whole plant or extract from leave, stem, root, and seed or mix all together. This type of treatment is wrong so there is need to scientifically analyze the medicinal plant. GCMS analysis has been employed in this research to identify the phytochemicals responsible for bioactivities associated with *Mallotus oppositifolius*.

II. Material and Methods

a) Plant Materials

Fresh leaves of *Mallotus oppositifolius* was harvested at Ohafia town in Abia State, Nigeria. The plant leaves were identified by Prof M C Dike at the Taxonomy section of College of Natural and Environmental Management, Michael Okpara University of Agriculture, Umudike, Nigeria.

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Author ¥: Departmemt of Chemistry, Michael Okpara University of Agriculture, Umudike, Nigeria.

b) Preparation of Plant Extract

The plant material of *Mallotus oppositifolius* was collected from wild, shade dried for 10 days and pulverized to powder using mechanical grinder. The plant extract was prepared using Soxhlet method described by [12]. Thirty five grams (35 g) of powdered sample was introduced into the extraction chamber of the Soxhlet extractor using methanol as solvent. Temperature was maintained at 70o C throughout the extraction period of 48 hrs. At the end of the extraction period, the extract was concentrated using oven at 35o C to obtain dried extract which was sent for GCMS analysis.

c) GCMS analysis of Mallotus oppositifolius

The characterization of the Phytochemicals in *Mallotus oppositifolius* was done using GC-MS QP2010 Plus (Shimadzu, Japan). The identification of the phytochemicals in the sample was carried out using a QP2010 gas chromatography with Thermal Desorption System, TD 20 coupled with Mass Spectroscopy (Shimadzu). The ionization voltage was 70eV. Gas Chromatography was conducted in the temperature programming mode with a Restek column (0.25 mm, 60 m, XTI-5).The initial column temperature was 80oC for 1min, and then increased linearly at 70oC min-1 to 220oC, held for 3 min followed by linear increased temperature 10oC min-1 to 290oC for 10 min. The temperature of the injection port was 290oC and the GC-MS interface was maintained at 290oC .The sample was introduced via an all-glass injector working in the split mode, with helium carrier gas low rate of 1.2 ml min-1. The identification of compounds was accomplished by comparison of retention time and fragmentation pattern, as well as with mass spectra of the GC-MS.

d) Identification of Phytocompoments in Mallotus oppositifolius

GC-MS Chromatogram of *Mallotus oppositifolius* revealed nine peaks showing that nine different compounds were present. Identity of the active components in the extract was done by comparison of their retention indices, peak area percentage and mass spectra fragmentation pattern with those stored in the database of National Institute of Standards and Technology (NIST) and also with published literature, NIST08.LIB [13], WILEY8.LIB [14], PESTEI-3.LIB and FA-ME.LIB library sources were used for matching the identified components from the plant material. The name, molecular weight, formula, structure and bioactivities of the compounds were ascertained.

III. Results and Discussion

a) Results

GCMS chromatogram of the methanolic extract of *Mallotus oppositifolius* (Figure 1) showed nine peaks which indicated the presence of nine phytochemicals constituents.

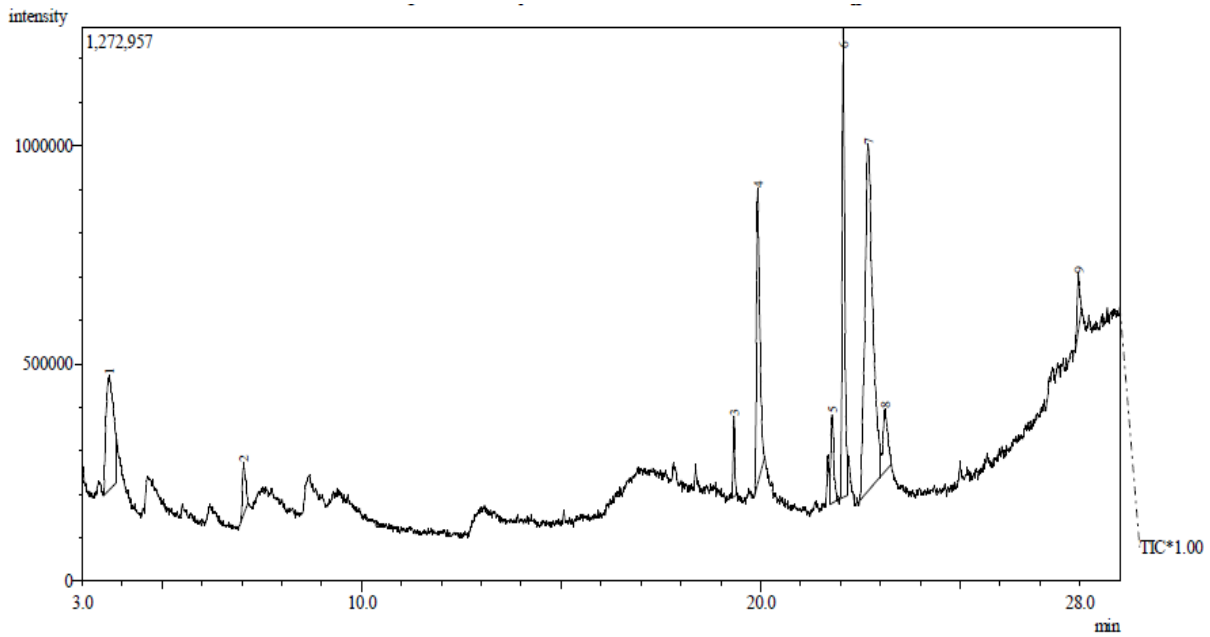


Figure 1 : Shows the chromatogram of *Mallotus oppositifolius*

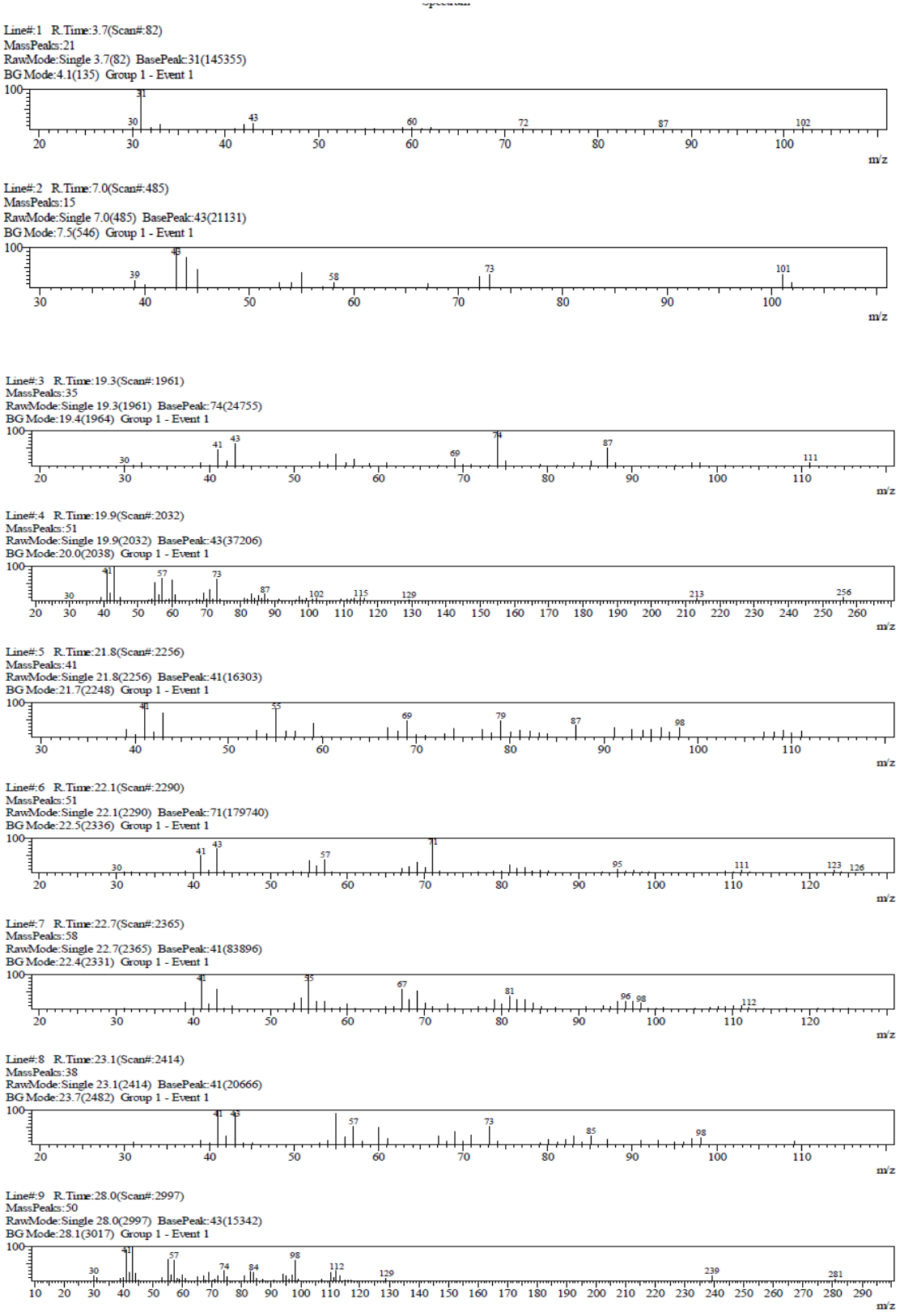
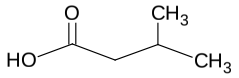
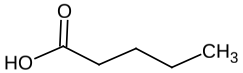
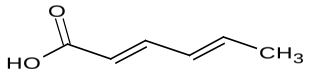
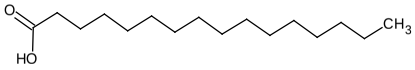
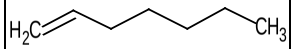
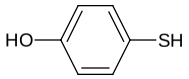
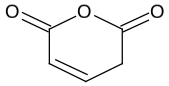
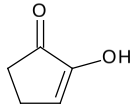
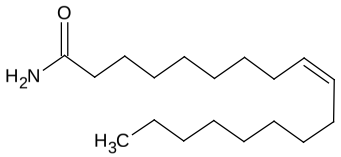


Figure 2 : Shows the mass spectra of the nine phytocompounds in Mallotus oppositifolius identified by GCMS analysis

Table 1 : Shows the names, retention time, peak area percentage, molecular weight, molecular formula and bioactivity of compounds identified in *Mallotus oppositifolius* by GCMS analysis

S.No	Name of Compound	Retention time	Peak area %	Molecular weight	Molecular formular	Molecular structure	Bioactivity
1	3-Methylbutanoic acid or more commonly isovaleric acid	3.676	12.39	102.13	$C_5H_{10}O_2$		It has been proposed that it is the anticonvulsant agent in valerian.
2	Valeric acid or pentanoic acid	7.037	2.53	102.13	$C_5H_{10}O_2$		Neurotransmitter
3	Sorbic acid	19.329	2.08	112.12	$C_6H_8O_2$		antibacterial drug fungicide
4	n-Hexadecanoic acid or Palmitic acid	19.926	14.22	256.42	$C_{16}H_{32}O_2$		Mild antioxidant and anti-atherosclerotic activity [15]
	Surfactant	21.791	3.87	98.18	C_7H_{14}		
6.	2-Mercaptophenol	22.068	18.23	126.17	C_6H_6OS		
7	Glutaconic anhydride	22.686	40.19	112.08	$C_5H_4O_3$		peroxisome proliferator activated receptor
8	2-Hydroxy-2-cyclopenten-1-one	23.115	4.33	98.09	$C_5H_6O_2$		estrogen receptor; agonist
9	Oleamide	27.959	2.15	281.47	$C_{18}H_{35}NO$		It accumulates in the cerebrospinal fluid during sleep deprivation and induces sleep in animals. It is being studied as a potential medical treatment for mood and sleep disorders, and cannabinoid-regulated depression [16].

b) Discussion

The chromatogram of *Mallotus oppositifolius* indicated the presence of nine phytocompounds. The compound 3-Methylbutanoic acid demonstrated anticonvulsion activity. Convulsion is produced by a number of metabolic disorder such as hypoglycemia, hypocalcaemia and hormonal imbalances [17].This compound identified by GCMS analysis could counter the effect of convulsion and therefore could be used as a therapeutic remedy for idiopathic seizures. A seizure represents the abnormal behaviour caused by an electrical discharge from neurons in the cerebral cortex presents clinical signs and symptoms that vary according to the site of neuronal discharge in the brain[18]. Manifestations of seizure generally include sensory, motor, autonomic or psychic phenomena. A convulsion refers to the specific seizure type of a motor seizure involving the entire body [18]. The neurotransmitter effect was demonstrated by phytocompound, Valeric acid or Pentanoic acid as was identified by GCMS analysis. Neurotransmitters carry nerve impulses across synapse and are small molecules that incorporate a positively charged nitrogen atom. They include several amino acids, peptides and monoamines. The amines acid, glutamine, glycine and gamma amino butyric acid (GABA) serve as neurotransmitters at most CNS synapse [19].

The compound Glutaconic anhydride with a retention time of 22.686 and a peak area percentage of 40.19% had a peroxisome proliferator activated receptor activity. Peroxisomes play important role in B-oxidation leading to the formation of acetyl Co A and hydrogen peroxide which is broken down by catalase. [20]. The peroxisome system facilates the oxidation of very long fatty acids example C_{20} and C_{22}. Peroxisomes shorten the side chain of cholesterol in the bile acid formation and also takes part in the synthesis of etherglycerolipids [21]. Therefore this compound Glutaconic anhydride could play a biochemical role of facilitating B-oxidation in the cell. Oleamide was identified also with GCMS at retention time of 27.959 with 2.15% peak area percentage. The compound exhibits a bioactivity of influencing mood and sleep disorder especially if it accumulates in the cerebrospinal fluid during sleep deprivation. The compound also induces sleep in animals [16].

IV. Conclusion

The result of this analysis showed the presence of various phytocompounds in methanolic extract of *Mallotus oppositifolius.* Glutaconic anhydride which had the highest concentration in the extract (40.19%; $C_5H_4O_3$) and n-Hexadecanoic acid (14.22%; $C_{16}H_{32}O_2$) showed peroxisome proliferetor receptor activation and antioxidantion, anti-atherosclerotic activity respectively. The compound 3-Methylbutanoic acid ($C_5H_{10}O_2$) commonly known as isovaleric acid and its isomer Valeric acid ($C_5H_{10}O_2$) which is also known as pantanoic acid were found to be anticovulsants and nuerotrasmitters respectively. Sorbic acid $C_6H_8O_2$ and Oleamide $C_{18}H_{35}NO$ with close range concentration of (2.08%; 2.15%) in the *Mallotus oppositifolius* extract exhibited activity of antibacterial,fungicidal, and sleep inducer respectively. The phytocompound,oleamide could therefore be pharmacologically useful as pre-anaesthetic agent. The plant has a wide array of medicinal usage and those compound identified by Gas Chromatography-Mass Spectrometry could undergo molecular docking to creat new roadmap for drug modelling.

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Determinants of Improved Forages Adoption in Doyogena District of Kembata Tembaro Zone, in Southern Nations, Nationalities Regional State, Ethiopia

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Abstract- The Doygana district are known as the undulating topography and highland agro ecology endowed with small plots of lands per households that needs improved forage development as a basic instrument for improved cattle production and soil and water conservation; and availability of introduced improved forage technology before more than three decades, Nevertheless, the level of adoption and utilization of improved forage technology is said to be minimal. This study, therefore, was initiated to identify factors that affect the adoption of improved forages decision in the Doyogena district of Kembata Tembaro Zone, Southern Nations Nationalities People Regional State of Ethiopia. The study was undertaken in two kebele. Structured and semi Structured questionnaires were used to undertake 140 sampled farmers.

Keywords: *adoption, farmers, feeds, improved forage, technology.*

GJSFR-D Classification : *FOR Code: 070199*

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Determinants of Improved Forages Adoption in Doyogena District of Kembata Tembaro Zone, in Southern Nations, Nationalities Regional State, Ethiopia

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Abstract- The Doygana district are known as the undulating topography and highland agro ecology endowed with small plots of lands per households that needs improved forage development as a basic instrument for improved cattle production and soil and water conservation; and availability of introduced improved forage technology before more than three decades, Nevertheless, the level of adoption and utilization of improved forage technology is said to be minimal. This study, therefore, was initiated to identify factors that affect the adoption of improved forages decision in the Doyogena district of Kembata Tembaro Zone, Southern Nations Nationalities People Regional State of Ethiopia. The study was undertaken in two kebele. Structured and semi Structured questionnaires were used to undertake 140 sampled farmers. From nine explanatory variables used in logistic regression model, six variables significantly affected the adoption probability. The access to formal education, training and number of dairy cattle owned affected positively the household choice to take part in adoption of improved forages in the district; while access to communal land, access to market point and farmers training center negatively affected the probability. Through enabling farmers to obtain training, improving market access and attendance in formal education, it is possible to accelerate the level of improved forage adoption. Organizing the farmers in form of cooperative that could access freely accessed communal land and linking to market, scaling up of technology generation and capacitating center in the vicinity to farmers and developing farmers research and demonstration center is believed to promote the improved forage introduction, utilization and improve production and productivity of livestock sector.

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I. Introduction

Ethiopia is known as the largest livestock producer in Africa and one of the largest in the world. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country. Ethiopia's estimated livestock population was approximately 56.71 million cattle, 29.3 million sheep, 29.11 million goats, 2.03 million horses, 7.43 million donkey, 0.4 million mules, 1.16 Camel, 56.87 million poultry and 5.89million bee hives (CSA, 2014/15).

Despite this huge potential of livestock population and its diversity, the benefits obtained from the sector are low compared to other African countries and the world standard. As cited in Asfaw et.al. (2011);Berhanu,(2007) and Pavanello, (2011) our country average beef yield per animal of 108.4 kg ,1.35 average daily milk yield per day for a cow,1.64 kg honey per hive and The average number of eggs laid per hen per egg- laying period in the country is about 12, 25 and 107 eggs for indigenous, hybrid and exotic breeds respectively.

The major challenges that made the livestock productivities and production in the country were identified as in low adoption of improved forages and utilization system, awareness problem on improved forage production and husbandries practices, inadequate market infrastructure, absence of market oriented cattle production system, prevalence of various diseases (Zekarias ,2015;ESAP,2003).

Inadequate feed and nutrition are major constraints to livestock production in Ethiopia. To ease such a constraints, national, regional and international research institutions have developed several feed production and utilization technologies. However, adoption of these technologies has so far been low (Gebremedihin, 2003)

The extension and credit service have positive impact in enhancing the probability of adoption of improved forage technologies. The intensity of use of improved forage in the study area was influenced by labor available, size of livestock ownership and farm size. Physical characteristics like distance from farmers' home to all weather roads, markets and input supply played a critical role in the adoption of improved forage technologies. Therefore, the results of the study suggest that the adoption of improved forage should be enhanced by raising farm household asset formation, and providing extension and credit services (Hassen.2013).

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In the southern Ethiopia where this study is conducted, crop and livestock productions are highly integrated as a means to generate income, cope up with market and environmental risks and meet household consumption requirements. The major crops grown by sample households were Enset, wheat, potato, barley, teff, faba bean, field pea, maize, vegetables. The major livestock reared by sample households were local and improved cattle, sheep, equine (donkey, horse and mule), improved and local poultry, local and improved beehives and goats.

The major improved forage crops adopted in the district were Desho grass, elephant grass,oat, vetch and sesbaniaya sesban and tree Lucerne. The straws of crops were used for animal feed. Animals like oxen used for draft power in plowing and planting and threshing crops such as wheat, barley and maize. This study tried to assess the factors responsible for the probability of adoption and utilization of improved forage technologies (desho, elephant grass, oat, vetch and tree Lucerne). The general objective of the study was to identify the determinants of the adoption of improved forage technology in mixed crop and livestock farming systems in Doyogena districts of Kembata Temabaro Zone (SNNPR) of Ethiopia.

a) Methodology

i. *Study location*

Doyogena district is located in Kembata-Tembaro zone, at a distance of 258 km to the South-West of Addis Ababa. It is comprised of 14 sub-districts and has a total area of 17,263.59 hectares. About 86% of the area is used for crop cultivation, 11.8% forest and bushes, 2% grazing land, and 0.2% degraded land. The maximum, average and minimum land holding per household is 3.5ha, 0.75 and 0.25ha, respectively. It has an altitude ranging from 1900 to 2748 meter above sea level (m.a.s.l) with significant on local climate. The district has two major agro-ecologies, Dega (70 %) and Woyina dega (30 %). It has a minimum and maximum temperature of 10°c and 16°c respectively and receives average annual rainfall of 1400 mm (WoA, 2012).

Figure 1 : Map of Doyogena district

Key informant interview

Using Key informant interview, major improved forage produced in the district, intensity of and utilization of improved forage, major constraints and opportunities of improved forage cultivation and factors that hinder/promote the production and improved forage utilization will be characterized. In line with key informant interview, the questioner pretested; awareness creation was made on data collection instrument for the data collectors. In Key informant interview the study considered 20 household from Wonjala keble and Gomora Gewada keble. The primary data has been supported by secondary information.

Table 1 : Sample size considered in household survey across kebele (N=140)

No.	Kebele	Sample size considered (N)
1.	Gomora Gewada	75
2.	Wonjala	65
	Total	140

ii. *Sampling method*

A purposive sampling procedure was followed where three kebele, one each from low, medium and best forage producer sub-districts were selected with experts from district office of agriculture and Non Governmental Organization (Inter Aid France). Based on the guidance from the Woreda experts, twenty farmers from each kebele were selected by kebele development agents for the purpose of focus group discussion and key informant interview. The criteria for selection of kebele and farmers used comprised of gender, existence of improved forage at the farm, intensity of utilization of improved forages and the like. The study considered 10 households for key informant interview and 50 farmers for focus group discussion. A total of 60 farmers were sampled for the study across the three kebele.

iii. *Data collection and sources*

In order to develop effective interventions, it is necessary to first understand farmers' current practices in forage seed and feed production. Thus, both primary and secondary data were collected for the study. To capture the required information for the forage seed production and marketing, a combination of different techniques were applied. Secondary information was collected from district and sub-district offices of agriculture. Different set of checklists and questionnaires

were used for different kebele farmer after group discussions and key informants interviews.

iv. *Review of secondary data*

Secondary sources of data have been consulted and reviewed for the study. Secondary data was collected from previous Feed Resources Assessment reports conducted by SARI (not published), journals, proceedings and Woreda reports and website reports.

v. *Focused group discussion (FGD)*

A team of researchers from different discipline (feed specialist, seed expert, range expert and socio economist) from Areka ARC and experts from WoA and NGO held discussion with different groups of forage sector stakeholders. To extract quantitative and qualitative data during focus group discussion, key informant interview and household survey the main instruments applied. The team also discussed with forages and forage seed producers based in the district. Focused group discussion with farmers was held with three groups of 20 farmers each from three study kebele in the district. The study included two Keble from the Woreda which are known as best adopter and leased adopter of improved forage and forage technologies. The two Keble located in opposite direction to one another (one in south and the other in the north. These two kebele are Wonjala and Gomora Gewada. In addition to these the topography of Wonjala was more of gentle flat, whereas as Gomora Gewada Keble topography was of undulating.

Improved forages developed in the area

Improved forage Adoption refers to the decision to use a new technology of improved forages, method, practice, etc. by a firm, a farmer. A farm level (individual adoption) adoption reflects a farmer's decisions to incorporate a new forage technology into the production process of farming. This study focuses on individual or farm household improved technology adoption.

The adoption of agricultural innovations can provide the basis for increased production and income. More precisely, farmers will adopt only those technologies that suit their needs and circumstances. As part of the effort to increase agricultural productivity, researchers and extension staff in Ethiopia have typically promoted a technological package consisting of a number of components. However, because of awareness problem, capital scarcity and risk considerations, farmers are rarely adopting complete packages.

b) Measurement and Definitions of Variables for Adoption

i. *The dependent variables of logistic regression models*

The dependent variable of the Log it model takes a dichotomous value depending on the farmers' decision either to adopt or not to adopt the improved forage technology. Adopters are farmers who developed and utilize improved forage technology (oat, vetch and tree lucerne, sesbainia sesban, desho grass and elephant grass). Non-adopters are farmers who did not developed and use either of this technology during the survey year (2007EC) production year.

ii. *The independent variables and their definitions in the Logistic regression model*

Adoption literatures provide a long list of factors that may influence the adoption of agricultural technologies. Generally, farmers' decision to use improved forage /improved forage technologies and at a given period of time are hypothesized to be influenced by a combined effect of various factors such as household characteristics, socioeconomic and physical environments in which farmers operate. The explanatory variables included in the empirical models comprised of family size, number of cow owned, Enset land, access to training, farmers training center, access to communal grazing land, market point and total land owned.

II. Results and Discussions

Table 2 : Socioeconomic Information of Doyogena Woreda (N =140)

Statistical variables & measurements	Minimum	Maximum	Mean	Std. Deviation
Age of the respondent	18.00	80.00	48.26	12.27
family size	3.00	12.00	6.90	1.94
total land owned in timad	.50	12.00	3.29	2.25
total cultivated land in timad	.10	75.00	3.23	6.42
private grass land in timad	.00	3.00	.34	.43
yearly off-farm income	0	12000	1048.99	2302.44

a) Socio-Economic characteristics of farmers

The socioeconomic characteristics looked in to in the survey duration comprised of age, family size, years of schooling, land owned & cultivated, grass land owned and yearly off farm income level.

i. *Age Distribution of farmers*

The average age of the Pastoralists household head was 48. However, it ranges in between 18 and 80. The proportion of sampled producers whose age lies active and independent age category in the range between 18 and 65 was 90%. The remaining 10% sampled farmers were aged more than 65 years. This findings show that majority the farmers were in the age range of active labor force and only few known to be under dependant age category. Thus, this is very important with respect to the adoption and utilization of improved forage technologies for productivity improvement of livestock and efficient natural resource management.

Table 3 : Age distribution of small scale farmers

Age	Frequency	Percent	Cumulative frequency	Farmers category
18-37	26	18.57	18.57	Youth farmers
38-65	100	71.43	90	Mature farmers
66-80	14	10	100	Dependant farmers
Total	140	100		

ii. *Family Size of small scale farmers*

Table 4 : Family size of small scale farmers

Group	Producers (N=140)	Percent	Cumulative percent
Low family size (3)	6	4.3	4.3
Medium family size (4-6)	50	35.71	40.00
Large family size (7-10)	81	57.86	97.86
Very large family size (11-12)	3	2.14	100

The family size distribution shows that the average family size of Doyogena farmers was 7. However, the range of family size for sampled pastoralist is between 3 and 12. From whole sample households in the area, the proportion of households with family size of 3 family sizes are 4.3%, 4 to 6 are 35.71 %, and 7 to 10 are 57.86 % and 11 to 12 are 2.14 %. The survey result reveals that majority of households belong to medium and large family size. The proportion of households with low and very high family size is few (6.34%).

iii. *Education level of farmers (N=140)*

Table 5 : education level of Pastoralist household head

Category of education level	Frequency	Percentage	Cumulative percentage
Not attended Formal education	34	24.29%	24.29
Primary school(1-4)	36	25.71%	50
Secondary school(5-8)	43	30.71%	80.71
High school (9-10)	20	14.29%	95
Grade above 10	7	5%	100
Total	140	100	100

Source: household survey 2015

The data in the table (3) revealed that 24.29 % of sampled households did not attend formal education whereas; the proportion of small scale farmers household who attended formal education was 75.71%.

The proportion of households attended formal education in the district was three fourth of the total that positively helps in adoption, pre-scaling up and utilization of agricultural technologies in general and forage technologies in particular.

Table 6 : Land ownership of farmers across kebele :(1ha=4timad area of land)(N=140)

Range of land owned (Timad)	Gomoroagewada	Percent	Wonjala	Percent	Total	Percent
0.5-1.5	25	33.33	10	15.38	35	25.00
1.51-2.5	19	25.33	8	12.31	27	19.29
2.51-3.5	21	28.00	14	21.54	35	25.00
3.51-4.5	4	5.33	11	16.92	15	10.71
>=4.51	6	8.00	22	33.85	28	20.00
Total	75	100	65	100.00	10	100.00

The study confirmed that the total land holding per household varies across peasant associations. Majority of the farmers in the district own less than one hectare of land (69.3%) that had its own role in adoption and utilization of improved forages in the district. The farmers dwell around wonjela peasant association where the adoption rate is lower, own larger land size than the farmers in Gomorogewada (where the farmers adopted relatively in better manner).

III. Factors Affecting Small Scale Farmers Household's Choice of Improved Forages Adoption

In order to estimate the participation decision of small scale farmers in adoption of improved forages in the area, Logistic regression Model was employed by (SPSS.v.20.). Here, the factors influencing the household's discrete choice behavior was modeled using a binary logistic model.

Table 7 : Econometric Regression Result of Logit Model: Adoption Determinants

Explanatory Variables	B	S.E.	Sig.	Exp(B)	Odds ratio
Eduformal	.906	.519	.081	2.475	11.88***
Family-siz	-.106	.110	.33	.899	2.46
Gotraing	1.15	.56	.001	2.39	10.91*
Enst-land-timd	-.030	.222	.891	.970	2.64
Access-communal	-2.080	.506	.000	.125	1.13*
FTC dist	-.057	.023	.016	1.058	2.88**
Dist.mkt	-.075	.040	.058	1.078	2.94***
Dairy cow owned	.670	.342	.050	.512	1.67**
Total land(timad)	-.075	.112	.501	.927	2.53
Constant	-1.559	1.347	.247	.210	1.23

*The explanatory variables considered *,**and *** as significantly affecting the probability of adoption in 1%,5% and 10% significance level respectively.*

Then binary logistic regression model allowed the estimation of a set of probabilities of improved forage adoption regimes for households with a given characteristic logit model where only one coefficient is estimated for all the outcomes. To investigate factors embedded in deciding probability of improved forages adoption variables used as explanatory variables include formal education attendance, family size, Enset land size ,land owned, training access, marketing point proximity, dairy cattle number owned and farmers training center proximity.

Access to formal education: The coefficient for the variable formal education attendance is 11.88. Because these coefficients are in log-odds units, they are not as such simple to interpret, so it is converted into odds ratios. The log odds units are converted in odds ration by taking exponentiation of the coefficient manually using excel sheet. As the result, odds ration coefficient for access to formal education=Exp (2.475) = 11.88. This is the proportional odds ratio of comparing farmers those attended formal education to that not attended formal education on improved forage adoption participation given the other variables in the model are held constant. For farmers that attended formal education, the probability of participation in improved forage adoption decision 11.88 times higher than that of farmers not attended formal education, given the other

explanatory variables are held constant. This is to mean that enabling farmers to attend formal education increase probability decision of improved forage adoption participation by about 11.88 units compared to famers not attended formal education. The study is in line with Gethun.et.al (2013) concluded literacy has significant role in adoption on utilization of small ruminants and related technologies in highland of Ethiopia.

Training access: The coefficient for the variable training access is 2.39. Because these coefficients are in log-odds units, they are not as such simple to interpret, so it is converted into odds ratios. The explanatory variable was defined as 1 for those accessed training and 0 otherwise. The log odds units are converted in odds ration by taking exponentiation of the coefficient manually in excel sheet. As the result, odds ration coefficient for training access equates Exp (2.39) = 10.91. This is the proportional odds ratio of comparing farmers accessed training to that not attended training on adoption of improved forages given the other explanatory variables in the model are held constant. For farmers capacitated on improved forage pre-scaling up and utilization, the probability of improved forage adoption decision exceeds 10.91 times higher than for farmers not accessed training, given the other explanatory variables are held constant. This is to mean that enabling farming communities to access capacity building in subject matter increase the probability decision of improved forage adoption participation decision by the probability about 10.91 units as compared to other farmers not accessed to training. The study is in line with findings of Yikaaly and Zebrhe (2015) that indicated that farmers' those had access for frequent extension advice have better adoption. Hence the study finding points out that through capacity building, it is possible to increase the rate of improved forage adoption and utilization in the district.

Access to communal grazing land: the parameter estimate for the variable access to communal grazing land is 0.125. This implies that for one unit distance increase in km in access and utilization to communal grazing land, we expect 1.13 factor decreases in the probability of improved forage adoption, holding all other explanatory variables constant. Since the main goal of introduction and development of improved forages is for providing adequate feeds for their livestock, having been acquainted with freely accessed communal grazing land in vicinity decreases the attention and probability of farming communities in development of improved forages. The study finding implies that if the farmers accessed with communal land that owns zero cost personally to access and utilize it, this by its own could provoke the farmers to own and herd more and more livestock number individually that is beyond the carrying capacity of given natural resource, would result finally in overgrazing and erosion. The study indicated that when the farmers dwell in nearby distance to communal grazing land, they become unwilling to give their plots of lands for improved forages as they are in the position to access to utilize communal land freely. Hence as policy option, enabling the farmers in the district to produce improved forages in freely accessed communal grazing land in form of cooperative could enhance the productivity of the sector and accelerate the adoption improved forage technologies.

Distance to Farming Training center: The coefficient for the variable distance from farmers residence to farmers training center is 1.058. The odds value of parameter estimate was calculated as 2.88. This indicates that for one unit increase distance from farmers' residence to farmers training center, we expect 2.88 decrease in probability of improved forage adoption, holding all other explanatory variables constant. When farmers found themselves in nearby distance to farmers training center, their access and utilization opportunity, visit and know knowhow of forage technology increases, this make higher adoption probability accordingly. Hence, as policy option creating decentralized farmers training center and scaled up improved forage demonstration plots availability at village level, would promote improved forage adoption.

Access to market point: The coefficient for the variable cattle owned is 1.078; which is in logs of odds unit. This indicates that for one unit increase distance from farmers' residence to market point, we expect 2.94 decrease in probability of improved forage adoption, holding all other explanatory variables constant. When farmers found themselves in vicinity distance to livestock and product market point, their access and utilization opportunity of market information, experience sharing and knowhow about improved forage technology increases, this by its own make higher adoption probability accordingly. Hence, as policy option linking improved forage producers to market and market information believed to promote improved forage adoption intensity and utilization. The study finding is in line with Berhanu and et.al (2003) that concluded households with higher proportion of cash income that are closer to livestock markets are more likely to adopt the improved forage technology.

Number of dairy cattle owned: The coefficient for the parameter estimate cattle owned is 0.512. The odds ratio of dairy cattle owned parameter estimate is 1.67. The sign of parameter estimate is positive, which shows number of dairy cow kept by small scale farmers increase the probability of improved forage adoption decision. This implies that one unit increase in dairy cattle owned results in increment of the probability of improved forages adoption by 1.67 times, holding all other explanatory variables constant. The finding is in

line with Solomon (2011) in which the household wealth (livestock) is major determinants for adoption of improved agricultural technologies. As the dairy cattle herd size increases, the probability of small scale farmer household to take part in improved forage adoption increases. The implication is that active adoption and utilization of improved forages depend on farmers attaining and maintaining sufficiently large dairy cattle herd sizes that they become willing to plant and scale up improved forages in his plots of land. Relatively wealthy farmers, with greater dairy herd size, have considerably higher technology adoption and utilization rates and thus adopt improved forages more frequently.

IV. Conclusion and Recommendation

From the study it was concluded that farm investment choice of improved forage modeled as a function of socio economic, institutional and household demographic characteristics. The market access, number of dairy cattle owned, availability of communal grazing land, access to farmers training center significantly affect the probability of investment in improved forage technology.

From explanatory variables used in logistic regression model, access to formal education, training and number of dairy cattle owned affected positively the household choice to take part in adoption of improved forages in the district; while access to communal land, access to market point and farmers training center negatively affected the probability.

Enabling farmers to obtain training, improving market access and attendance in formal education, it is possible to accelerate the level of improved forage adopting in mixed farming districts. Organizing the farmers in form of cooperative that could access freely accessed communal land, scaling up of technology generation and capacitating center in the vicinity to farmers and developing farmers research and demonstration center is believed to promote the improved forage introduction, utilization and improve production and productivity of livestock sector.

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Genetic Diversity among Nigeria '*Maiwa Type*' of Pearl Millet Germplasm

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Abstract- Characterization of pearl millet germplasm is imperative for categorization of germplasm and identification of the desirable genotypes for introgression into breeding programs. The available pearl millet genetic resources from Nigeria, and especially photoperiod-sensitive materials or stay-green traits, have so far been exploited only to a limited extent. The present study was undertaken for initial morphological and phonological characterization of unexploited 'maiwa' or stay-green pearl millet accession in geographical gaps of Nigeria, to ensure high precision in future genotyping and phenotyping. The germplasm displayed considerable variability for Downy mildew severity,,days to 50 % flowering, plant height, panicle length and grain weight. There was no significant differences to striga infestation since there was no experience of striga emergence, suggesting resistance.

Keywords: *pearl millet, maiwa, germplasm, staygree, phenotyping.*

GJSFR-D Classification : *FOR Code: 070399*

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Genetic Diversity among Nigeria '*Maiwa Type*' of Pearl Millet Germplasm

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Abstract- Characterization of pearl millet germplasm is imperative for categorization of germplasm and identification of the desirable genotypes for introgression into breeding programs. The available pearl millet genetic resources from Nigeria, and especially photoperiod-sensitive materials or stay-green traits, have so far been exploited only to a limited extent. The present study was undertaken for initial morphological and phonological characterization of unexploited 'maiwa' or stay-green pearl millet accession in geographical gaps of Nigeria, to ensure high precision in future genotyping and phenotyping. The germplasm displayed considerable variability for Downy mildew severity,,days to 50 % flowering, plant height, panicle length and grain weight. There was no significant differences to striga infestation since there was no experience of striga emergence, suggesting resistance. Cluster analysis for the traits depicted three clusters suggesting dissimilarity among genotypes although there are movements of materials across states within the maiwa millet growing areas as evidenced by genotypes from different states clustering together. The genetic potential of the genotypes can be exploited in future pearl millet breeding programs.

Keywords: pearl millet, maiwa, germplasm, staygree, phenotyping.

I. Introduction

Pearl millet [*Pennisetum glaucum (L.) R. Br.*], is one of the most important staple cereals for over 40 millions subsistence farmers living in the most marginal agricultural lands of Northern Nigeria, due to its high tolerance to drought, high temperatures, saline and marginal soils, and high capacity to buffer variable environmental conditions (Haussmann et al., 2012). Improving production of pearl millet while maintaining its production stability is crucial for food security for poor African smallholder farmers cropping under rain-fed farming systems (Pucher et, al., 2015). It is endowed with enormous genetic variability for various morphological traits, yield components, adaptation and quality traits accumulated over a long century which is gradually getting eroded due to climate change (Shah et, al., 2012, Upadhyaya and Reddy, 2009). Selection by farmers over a long period of time for adaption to local growing conditions and for local taste, plant type, etc are very valuable source of wide range of characters and represent the greatest reservoir of useful traits of any source which so far have been exploited only to a limited extent (Rai et, al,. 1999; Niangado 2001) and in a very unsystematic manner. For plant breeding effort to be successful there should be continuing and expanding supply of plant germplasm materials with sufficient variability to explore for improvement. Characterization of pearl millet germplasm is imperative for categorization of germplasm and identification of the desirable genotypes for introgression into breeding programs. The present study was undertaken for initial morphological and phonological characterization of unexploited '*maiwa'* or stay-green pearl millet accession in geographical gaps of Nigeria, so as to group them into maturity cycles, plant height, yield potentials, etc., to ensure high precision in future genotyping and phenotying through the application of biotechnological tools.

II. Methodology

a) Collection Routes

A total of 109 geographical gaps in 65 districts from 16 states (Figure1) were purposively selected to reflect areas where millet is predominantly grown using multi-stage sampling procedure, between October to November, 2011. These collection sites were grouped into three routes for effective coverage as follows:

Route 1 : Gombe, Benue, Taraba and Adamawa States

Route 2 : Zamfara, Kano, Katsina, Bauchi, Sokoto, Jigawa, Yobe and Kebbi States

Route 3 : Nasarawa, Jos and Kaduna States. Consequently, two teams were constituted for collection convenience in the three routes.

b) Sampling Technique

A total of 50 – 100 millet panicle samples were collected on-farm per village, spaced 5 – 10 km apart. However, more than 1 sample was occasionally taken per site based on distinct panicle features. Grains from one-third middle portion of each panicle were then sampled into a sampling bag and then labeled. In addition, robust panicles were collected from the lots in order to determine the edaphic characteristics of the cultivars.

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c) Sample Descriptors/Catalogue

Farmers were interviewed on the spot using a 15-point structured questionnaire (logbook) for standard gene-bank cataloguing as follows:

1. Collection date
2. Collection serial number
3. Cultivar name
4. Days to Maturity
5. Disease
6. Insect
7. Distinct traits
8. Donor name
9. Agro-ecology
10. State
11. Local Government Area
12. District
13. Village
14. Lat.^{0}
15. Long.^{0}

173 samples collected within Lat 7-13^{o}N and Long 4-12^{o}E, from119 geographical gaps in 63 districts across 14 states of Northern Nigeria.

d) Field evaluation

126 maiwa landrace accessions from the 2011 collections were evaluated on 2-row plot on 5m length spaced 0.75m inter-row and 50cm intra-row at Dadinkowa Gombe State of Nigeria. Data were taken for Downy mildew severity, stem borer, *striga* count, days to 50%flowering, plant height, panicle length, panicle weight and grain yield which was subjected to statistical analysis using SAS 9.3. Mean values were determined for all the studied quantitative traits. Pairwise Euclidean distance of genotypes was computed on all traits taken together, and the resulting matrices were used to synthesize dendrograms by unweighted pair- group method with arithmetic means (UPGMA) cluster analysis. Mean values per accession were used and standardized prior to analysis.

III. Result and Discussion

Variation for all parameters except for *striga* was observed among the studied accessions of *maiwa* pearl millet as presented on Table 1. Days to 50% heading serve as a useful criterion determining the maturity range of the genotypes. Performance of the genotypes for this trait depicted considerable variation. Means for days to 50% flowering among the germplasm lines ranged from 75 129 days. Variation for downy mildew resistance depicted by severity index (IS%) score had minimum score of 0% with Maximum score of 50%. Mean values from descriptive statistics showed SI% of 1.00 suggesting genotypes showed high level of resistance to downy mildew infestation. Differences for plant height and panicle length varied from 168-377cm and from 17-113cm for plant height and panicle length respectively. Highly significant variation were observed for panicle circumferences ranging from 5-13cm with mean value of 7.6cm. Result from the data analysis revealed significant variability among the genotypes ranging from 0-1150g/plot with mean yield of 446.75g/plot suggesting the need to improve on this traditionally valued crop considering its low performance for yield in comparison to gero types with higher as a result of its genetic improvement for OPVs and hybrids.

The traits dendrogram (Figure 2) showed that 3 clusters were formed at dissimilarity coefficient of 2.7. The first cluster consists of 26 genotypes which majority are materials from Adamawa and Taraba states which geographic similarity and at boundary with each other. The second cluster consists of 30 genotypes drawn mostly from Sokoto and Kebbi state showing local similarity among the two states as that of Adamawa and Taraba. The 3rd cluster consist of 70 genotypes with majority drawn from Bauchi state followed by Jigawa and few representations from Kano states.

Result from this cluster analysis revealed that materials Adamawa-Taraba, Sokoto-Kebbi and Bauchi are major *maiwa* millet farmers considering the distribution of the genotypes derived from this states in other locations. This also suggests that there are movement of materials across the different agro-ecologies other than from the origin of cultivation.

Table1 : Descriptive statistic on the performance of pearl millet (*maiwa* type) at Dadinkowa during 2012 cropping season

Variables	Mean	Std Error	Minimum	Maximum
Number of hills/row	5	0.1002476	1	7
Downy mildew severity (%)	1	0.3059489	0	50
Striga count at harvest	0	-	0	0
Days to 50% flowering (days)	104	7.0851912	75	129
Plant height (cm)	283.2	1.9666687	168	377
Panicle length (cm)	51.4	1.0753987	17	113
Panicle circumference (cm)	7.6	0.0622953	5	13
Number of panicles @ harvest	18	0.5366185	1	45
Panicle weight/plot (g)	907.25	31.3889824	50	2500
Grain weight/plot (g)	446.75	16.0194404	0	1150
Panicle compactness (score)	2	0.0482837	1	3

IV. Conclusion

Variation for all parameters except for *striga* was observed among the studied accessions of *maiwa* pearl millet Cluster analysis for the traits depicted three clusters suggesting dissimilarity among genotypes although there are movements of materials across states within the *maiwa* millet growing areas as evidenced by genotypes from different states clustering together. The genetic potential of the genotypes can be exploited in future pearl millet breeding programs.

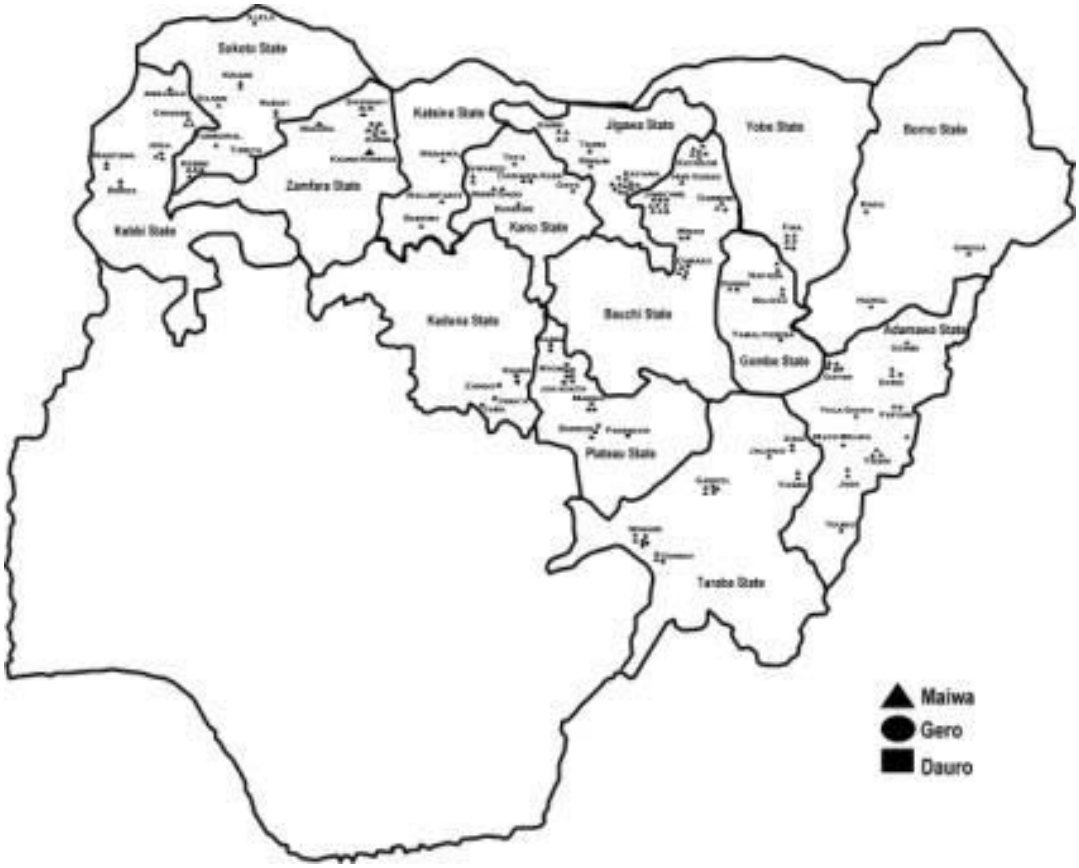

Figure 1 : Geographical districts for *maiwa* pearl millet collection

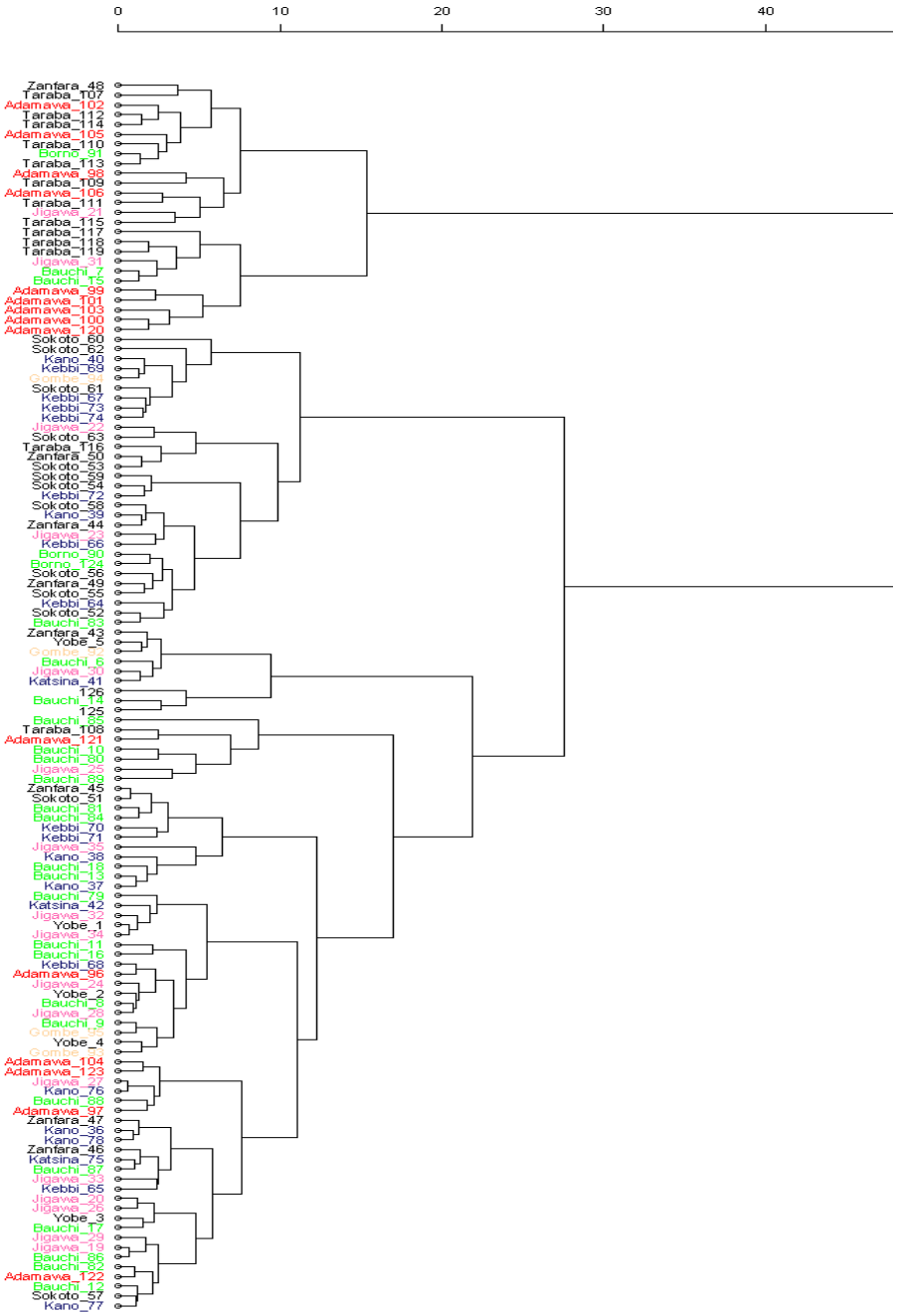

Figure 2 : Cluster analysis

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Evaluation of Crossbred Hifer Calves Rearing Practices and Growth Performace in Urban and Peri-Urban Dairy Systems of Sebeta Awas Wereda, Oromia, Ethiopia

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Abstract- The study was aimed at evaluating the rearing practice and growth performance of heifer calves in urban and peri-urban dairy systems of Sebeta Awas Wereda, Oromia National Regional State, Ethiopia. Stratified random sampling method was used to select target farms and sample respondents for the prepared questionnaire. Farms for monitoring study was selected from data collected during the survey. Eighteen farms, which had crossbred dairy heifer calves of (3-6 months of age), were purposively selected from both production systems and across the entire herd size category. Eighteen heifer calves were monitored from 18 different farms (2 production systems*3 farm sizes *3 replicates). The overall average crossbred dairy herd size per household was 10.6±2.1 in urban and 11.3±2 in peri-urban area, where, the proportion of heifers accounted for 50.5% for urban and 48.8% for peri-urban farms of their respective total herds.

Keywords: *heifer calf, urban, peri-urban, body weight, body condition score.*

GJSFR-D Classification : *FOR Code: 070399*

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Evaluation of Crossbred Hifer Calves Rearing Practices and Growth Performace in Urban and Peri-Urban Dairy Systems of Sebeta Awas Wereda, Oromia, Ethiopia

Dereje Shibru [α], Yoseph Mekasha [σ] & Getahun Asebe [ρ]

Abstract- The study was aimed at evaluating the rearing practice and growth performance of heifer calves in urban and peri-urban dairy systems of Sebeta Awas Wereda, Oromia National Regional State, Ethiopia. Stratified random sampling method was used to select target farms and sample respondents for the prepared questionnaire. Farms for monitoring study was selected from data collected during the survey. Eighteen farms, which had crossbred dairy heifer calves of (3-6 months of age), were purposively selected from both production systems and across the entire herd size category. Eighteen heifer calves were monitored from 18 different farms (2 production systems*3 farm sizes *3 replicates). The overall average crossbred dairy herd size per household was 10.6±2.1 in urban and 11.3±2 in peri-urban area, where, the proportion of heifers accounted for 50.5% for urban and 48.8% for peri-urban farms of their respective total herds. Stall-feeding system is commonly practiced in urban and peri-urban farms, mostly feeding hay, straw, high-energy and protein feeds. Above 91.7% households raised their heifer calves through bucket feeding, where, 60%, 26% and 14% of overall farms weaned their calves at three, four and above four months of age respectively. Crude protein (CP) to Metabolizable energy (ME) ratio of offered feeds to heifer calves were slightly below the desired level (66:1) in most farms. Body weight change, body condition score, girth height and average daily body weight gain (adg) of heifer calves were not affected (P>0.05) by production systems. There was significant difference (P<0.05) in body weight changes and adg due to difference in herd sizes. The overall observed heifer calf rearing and growth were good. However, relatively inferior performance and prominent management problems were observed in medium sized farms.

Keywords: heifer calf, urban, peri-urban, body weight, body condition score.

I. Introduction

Sustainability of a dairy production system depends on good herd management. However, lack of dairy replacement heifers is one of the major limitations to the development of smallholder dairy production in developing countries (De Jong, 1996). Formerly, Smallholder farmers sourced dairy replacement stock from public and private large-scale farms at a subsidized price (Tesfaye, 1991). However, rapid expansion of smallholder dairy farms steps forward as large-scale farms rapidly declined (Stotz, 1979; Conelly, 1998). Hence, Sourcing of dairy replacements from large-scale farms was becoming very minimal. On the other hand, demand driver factors such as rapidly growing urbanization, high population growth rate, changing consumer preferences are contributing towards the need of expansion of dairy farms in Ethiopia. Since lifetime performances of dairy cows are influenced by the rearing practices at their calf hood, age at which they are weaned, post-weaning management practice and rearing environments (Etgen *et al.*, 1987; Beyene, 1992); evaluation of calf rearing in existing farm is essential as it represents future replacement stock and plays its vital role in dairy farm expansion. Moreover, dairy farms are heterogeneous in terms of resources they own such as land, capital, feed, knowledge of farm owner, objectives of dairy raising, herd number they have, it is inevitable to bring difference in heifer calf rearing and growth performances. Therefore, evaluating and understanding of the existing heifer calf rearing practice and growth performance necessitate in the area to devise appropriate development interventions.

II. Materials and Method

a) Description of the Study Area

The study was conducted in Sebeta Awas Wereda, particularly in and around Sebeta town, which is located between 24 and 45 km southwest of the capital city, Addis Ababa, in Oromia Region, central Ethiopia. It is situated at latitude 8°55′N-8.917°N and longitude 38°37′E -38.617°E. It has a total area of 87,532 hectare.

b) Sampling procedures

Dairy production systems were stratified in to two based on relative distances from the centre of the town, farmland size and the existence of crossbred cows. These were urban dairy farms, those farms that are located within the town and peri-urban dairy farms,

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those farms that are located in the periphery of the town at a distance accessible to the nearby towns. Hence, this study considered those farms located at a distance of 3 km and farther as peri-urban, while farms located within three km radius were considered as urban. Each production system was further stratified into three based on herd size: small holders (farms having ≤3cows), medium level (farms having >3-10 cows) and large scale (farms having>10 cows) as suggested by ILRI (1996) and cited by Yoseph (1999). One hundred twenty farms, 20 from each herd size of both production systems (20*3=60 from urban and 20*3=60 from peri urban) were selected for survey following stratified random sampling methods. Semi-structured questionnaire was prepared for data collection and pre-tested before commencement of the actual survey (ILCA, 1990). Information was gathered by interviewing the household heads or persons directly responsible for handling of animals and making decisions.

c) Sampling for monitoring

Selection of monitored farms was based on the survey information. Hence, 15% of the farms, with heifer calves of 3-6 months of age, were selected purposively from both production systems and across the entire herd sizes category. The total number of farms monitored were 18 (3 farms *3 herd sizes *2 production systems). A single calf per each farms were monitored for feed intake and growth performance for three months.

d) Monitoring feed intake

Type and amount of feed offered and refused by heifer calf was weighed by using a portable spring balance and recorded per farm on weekly bases.

e) Monitoring growth of calves

Heart girth and wither height at shoulder measurements of calves were taken in morning before feed was offered, at two weeks interval with the aid of plastic measuring tapes calibrated in cm. Body condition of calves was also scored on a scale of 1-5 (Edmondson *et al*., 1989) and determined concurrently with the weight estimate of the calves. Body weight of calves was estimated from heart girth measurement using the following formula as suggested by Masanga *et al.* (2006).

$$Y=1.60X-81.6$$

Where Y= Body weight in kg

X = Heart girth in cm

f) Statistical Analysis

Both quantitative and qualitative data collected during the survey were analyzed using SPSS, 2008. Descriptive statistics such as means, percentages, standard deviations, standard error of mean were used to describe the various variables in the production systems. General Linear Model (GLM) procedure of SAS (2008) was used for analyzing those monitored data stratified into production systems and herd size. Mean comparison was done using the Least Significant Difference (LSD) for variables whose F-values showed a significant difference at 5% level of significance.

The statistical model used for analysis of growth of heifer calves was:

$Y_{ij} = \mu + di + P_j + b(Bwt_{ij} - Bwt) + e_{ij}$

Y_{ij} = Response variable

μ = Overall mean

di = Fixed effect of the production system

P_j= Fixed effect of herd size.

Bwt_{ij}= initial body weight of each calf at three months age

Bwt = average body weight of calves

b = Linear regression of initial weight on subsequent weights.

e_{ij} = effect of random error for calf growth.

III. Results and Discussion

a) Household Characterization

Among overall respondents 71.7% were male, while 28.3% were female-headed households (Table 1).Male headed-households dominated in peri-urban large sized farms whereas, higher proportion of female-headed households was recorded in small and large sized urban farms. This finding is in agreement with what has been reported in Mekelle, 27% for female-headed (Negussie, 2006) but slightly higher than what has been reported for Addis Abeba (24.1%), (Yoseph *et al*., 2003), Awassa (23.3%) (Ike, 2002) and Bahir Dar and Gonder (23%) (Yitaye, 2008). This indicates that women involvement in dairy sector play an important role in the study area. The high percent of female-headed households in the present study was due to better access for market to sell milk and encouraging opportunity of credit services from different micro finance institutes.

Educational status of the household heads, about 81.3% households had gone through the formal primary and above primary level of education, while 11.7% of members were limited to informal education, which enabled them to read only (Table 1). The result obtained is comparable with what has been reported for Addis Ababa milk shade where 78% of the households were literate (Yoseph *et al.*, 2003) and that of Shashamene-Dila (Sintayehu *et al.*, 2008) where the proportion of illiterate farmers was 19% but greater than what has been reported for Mekelle (73.5% literate) (Negussie, 2006). In the current study, since most of the dairy farm holders are literate, it is easy to address dairy production improvement strategies through good extension and training programs.

Table 1 : Sex and educational status of households in Sebeta Awas Wereda

Variables	Urban farms			Peri urban farms			
	Small N=24	Medium N=28	Large N=8	Small N=22	Medium N=28	Large N=10	Overall N=120
Gender of household head (%)							
Male	64.7	75	66.7	70.6	71.4	78.6	71.7
Female	35.3	25	33.3	29.4	28.6	21.4	28.3
Educational level of household head (%)							
Illiterate	0	6.3	16.7	5.6	14.3	7.14	8.3
Read and write only	6.3	15.6	16.7	16.7	3.6	14.3	11.7
Primary school level (1 to 6 Grades)	12.5	6.3	8.3	27.8	10.7	7.1	11.7
Junior school level (7 to 8 Grades)	25.0	3.1	0	0	3.6	0	5
Secondary school level	25.0	40.6	33.3	44.4	42.9	28.6	36.7
Certificate and diploma level	18.8	18.8	33.3	0	17.9	14.3	16.7
Degree (Bsc) level and above	12.5	9.4	0	5.6	7.1	28.6	10

N=number of farms

b) Family size and age distribution

The average family size per household in urban and peri-urban areas was 5.9±2.6 and 6.5± 2.9, respectively with an overall mean of 6.2±2.7 persons per family (Table 2). Larger family size in peri-urban farms, might be associated with the labour requirement for various farm activities in the areas. Family size observed in this study is less than the value reported by Ike *et al.* (2005) for urban and peri-urban dairy farmers in Awassa which was 7.55± 2.92 and 8.64 ± 2.70, respectively. Higher result of 7.2±0.3 was reported from urban farms of Shashemene-Dila area(Sintayehu *et al*., 2008). Result from West Shoa Zone indicated slightly higher family size (7.1±2.0) per household (Deresse, 2008).

The distribution of age along the different age groups varied within the three-farm categories. In both production systems, highest numbers of respondents were found in the age group of 51–65 years and 36–50 years whereas, the lowest number of respondents in the age groups of 66-80 years old. The overall mean age of respondents was 48.8±1.1years with an average age of 49.2± 1.7 years in small, 46.2± 1.6 years in medium and 52.9 ± 2.6 years in large sampled farms. The smallest mean age of respondents was found in medium farms. As respondents age indicated, most dairy cow owners were adults in their late forties. Negussie (2006) indicated that the overall mean age of respondents' in Mekelle was 51.35 ± 1.01 years with an average age of 51.01 ± 1.17 years in small, 51.3± 2.38 years in medium and 56 ± 3.19 years in large sampled farms which is slightly greater than the present result. Higher percentage (63.2%) of respondents was reported for the age groups between 25-50 years in Shashamene-Dila areas (Sintayehu *et al*., 2008). In general, fifty percent of the respondents' ages were in between 20-50 years old, the other 43% were between 51-65 years old for present study. From the results it can be deduced that most of the respondents were in their productive age's category.

Table 2 : Family size and age distribution of interviewed households in Sebeta Awas wereda

Variables	Urban(N=60)	Peri-urban(N=60)	Overall(N=120)
Family size (Mean±SD)	5.9±2.6	6.5±2.9	6.2±2.7
Age distribution (%)			
20-35 years old	13.95	17.65	15
36-50 years old	32.56	41.18	35
51-65 years old	44.19	41.18	43
66-80 years old	6.98	5.88	7

N=number of farms

c) Division of labours

Most activities of dairying in small sized farms were done by, the family members. Majority of large (80.2%) and medium (73.6 %) sized farms use hired labour to run their dairy activities (Table 3). This figure is comparable to the urban dairying reported for Mekele town, where the involvement of hired labour goes as high as 75.7% in large and medium-scale farms (Negussie, 2006) but lower results (5 to 11.7%) were reported in Shashamene-Dila area (Sintayehu *et al*., 2008). Relative to small and medium sized farms, majority of urban and peri-urban large farm activities were done by hired labour.. Among the total number of farms considered, 62.5 % of dairy farm activities in the study area were done by hired labour. The high percentage involvement of hired labour was probably related to the more frequent engagement of the owners in off-farm activities such as government job, trading (businessmen) and private work, as indicated above.

Table 3 : Labour division in urban and peri-urban dairy farms of Sebeta Awas wereda (N=120)

	Urban			Peri-urban			
Farm activities	Small	Medium	Large	Small	Medium	Large	Overall
Feeding, herding and Selling milk (%)							
By family	48.6	33.9	26.7	75	28	12.5	37.5
By hired labour	51.4	66.1	73.3	25	72	87.5	62.6
Selling cows (%)							
Owner	100	100	85.3	100	100	85.3	95.2
Manager	0	0	14.3	0	0	14.3	4.8

N=Number of farms

d) Establishment ages of dairy farms

The overall age of dairy farms indicated that most of the farms were established recently; only 9.8% were established before sixteen years ago. About 83.4% and 73.4 % of the urban and peri-urban farms were established over the last 10 years respectively. This revealed that there is an increment in milk production due to the gradual increment of milk demand in the area that is alarmed with expansion people in the urban and peri urban areas. Similarly, Mekonnen *et al*. (2005) indicated that 51% of smallholder dairy farms near Addis Ababa had less than six years of age. Sintayehu et al. (2008) reported lower percentage for urban dairy farms in Shashamene-Dila area for dairy farms established during the last six years.

Table 4 : Establishment ages of urban and peri-urban dairy farms in Sebeta Awas Wereda

Farm age (%)	Urban (%) N=60	Peri-urban (%) N=60	Overall (%) N=120
1-10 years	83.4	73.7	80.3
11-15years	7.1	15.8	9.8
>16 years	9.5	10.5	9.8

N=number of interviewed households

e) Herd composition of crossbred dairy

The average herd size owned per household in urban and peri-urban production systems is shown in Table 5. In this study, the overall average herd size of crossbred dairy herds per household was 10.6±2.1 in urban and 11.3±2.0 in peri-urban areas. Slightly lower result was reported in Bahir Dar and Gonder areas where the average herd size per household was 9.2 cows per urban farm (Yitaye, 2008). Lower herd size of 6.9 ±5.8 and 4.7± 3.9 was reported in urban and peri-urban farms of Awassa and West Shoa zone, respectively (Ike *et al.,* 2005 and Deresse, 2008). Mekonnen *et al*. (2005) also reported lower herd size of 4 per farm around Addis Ababa.

The proportion of cows in the total herd in the current study is 46.3%. This result is lower than 50% reported for urban and peri-urban dairy farms in Addis Ababa milk shed (Yoseph *et al.*, 2002). The overall proportion of milking cows accounted for 76.7 and 81.2 percent of the total cows in the herd of urban and peri-urban farms, respectively indicating that slightly higher proportion of productive cows were held in both cases. Comparatively less milking cows were kept in West Shoa Zone (Deresse, 2008) that is, 71.8 and 67.5% of the total cows in the herd in urban and peri-urban farms, respectively. Hoffman (1999) reported lower value of 42% lactating and 27% dry cows in urban and peri-urban dairy farms of Addis Ababa. Higher numbers of cows were reported in urban (9.3%) than peri-urban (7.4%) farms that were kept dry and non-pregnant. This suggests the existence of reproductive management problem in the farms, letting an unnecessary extra expense for their feeding and other management aspects which is uneconomical. The less existence of male animals indicated that cattle are predominantly kept for milk production to generate income through sale of milk and milk products. Similarly, Kurtu *et al*. (2003) reported that larger percentage of dry and non-pregnant cows were recorded in large and specialized farms of the Harar milk shed. Earlier works by Hoffman (1999) reported almost similar value of 9% for dry non-pregnant cows. Comparatively, the current study shows a lower number of dry non-pregnant cows owing to better awareness and improved reproductive management provided to the cows in the study area. The overall proportion of calves in urban farms (50.5%) and peri-urban farms (48.8%) which is in better state for future herd replacement. Moran and Tranter (2004) reported that farmers should aim to rear 20 to 25% of their milking cows each year as replacements heifer.

Table 5 : Number, percent and Mean±SE of means of crossbred herd composition of urban and peri-urban dairy farm of Sebeta Awas Wereda

Variables	Urban				Peri-urban			
	Small	Medium	Large	urb.-Total	Small	Medium	Large	peri-urb total
No of respondents	N=24	N=28	N=8	N=60	N=23	N=27	N=10	N=60
Milking cows	n	n	n	n (%)	n	n	n	n (%)
Pregnant	10	40	29	79(33.5)	17	45	61	123(35.)
Non-pregnant	20	44	38	102(43.2)	14	56	91	161(46)
Dry cows								
Pregnant	9	16	8	33(14)	5	22	13	40(11.4)
Non-pregnant	1	14	7	22(9.3)	2	11	13	26(7.4)
Total cows	40	114	85	236(**44.8**)	38	134	178	350(47.4)
Heifer (2-3 years age)								
Pregnant	10	30	21	61	5	18	41	64
Non-pregnant	1	29	16	46	3	19	34	56
Heifer(1-2 years age)								
All non -pregnant	11	38	19	68	5	30	79	114
Heifer(1-12months age)				91				
1-3months age	1	11	15	27	4	14	26	44
3-6months age	5	22	13	40	6	10	21	37
6-12 months age	2	16	6	24	6	13	27	46
Total heifers	**30**	**146**	**90**	266(**50.5**)	**29**	**104**	**228**	**361(48.8)**
Male calves	1	12	12	25(**4.7**)	1	16	11	28
Overall Total herds	**71**	**272**	**184**	**527**	**68**	**254**	**417**	**739**
Overall(Mean±SE)				**10.6±2.1**				**11.3±2.0**

N= Number of respondents'; n=number of herds in farms.SE= standard error

f) Crossbred Heifer Calf Rearing Practices

A good heifer rearing program is critical to produce animals at first calving that have well-developed mammary glands capable of producing to the animal's genetic potential and that have good body size and body condition capable of high feed intake and delivery of nutrients to the mammary gland. Since urban and peri-urban dairy production system of Sebeta Awas Wereda was dominated by landless type of production system, the only option for calf rearing was stall feeding. Among the overall interviewed dairy cattle producers, 91.6% of households raised their calves through bucket feeding whereas, few farmers (8.3%) raised their calves through suckling (Table 6). Of those calves raised through suckling 25% were from Peri-urban small scale farms. Slightly higher percent (94%) of calves were raised through bucket feeding in Dire Dewa areas (Emebet, 2006).

About 74.3% of dairy farmers in the study area fed their calves with 3-4.5 liters of milk per day while 22.4% fed more than 4.5 liter per day during the first months of calves' life. Lower amount (<3liter) of milk provision was observed in small urban (22.2%) and peri-urban (33.3%) farms, which might be in search of high milk for market. Likewise, in the second months of calf life, 88.3% of the dairy farmers provide 3-4.5liter of milk per day, 8.3% more than 4.5 liter and 3.3% less than three litters. However, in the third months of calf life, from those which didn't weaned their calf, 65.6% of overall interviewed household provided less than three liter of milk per day, 30.4% provided 3-4.5 liter of milk /day and 4.07% provided more than 4.5 liter of milk /day. In this study about 95% of dairy cattle producers sold their male calves within 3-15 days of age. Losada *et al*. (1996) reported that in suburban Mexico city, high percentage of producers (80%) sell male calves within three days of age for slaughtering, whereas, large dairy farms in China slaughtered bull calves at birth, because of high milk price. Contrarily, 37% of new born male calves were wasted for dog and wild beasts (Kurtu *et al.*, 2003) in Harar region. This study further demonstrated that calves within the age ranges of seven to fifteen days age had a better market opportunity.

Table 6 : Calf milk feeding practices in urban and peri-urban farms in Sebeta Awas Wereda

Variables	Urban farms			Peri-urban farms			Overall
	Small N=24	Medium N=28	Large N=8	Small N=23	Medium N=27	Large N=10	N=120
Milk feeding systems (%)							
Suckling	7.7	4.2	16.7	25	0	18.2	8.3
Bucket feeding	92.3	95.8	83.3	75	100	81.8	91.7
Amount of milk offered (%)							
1st month 1-3 liter/day	22.2	12.8	0	33.3	0	18.2	14.4
3-4.5 liter /day	77.8	61.7	83.3	66.7	75	81.8	74.4
> 4.5 liter /day	0	25.5	16.7	0	25	0	22.4
2nd month 1-3 liter/day	15.4	4.3	0	0	0	0	3.3
3-4.5 liter/day	84.6	87.2	83.3	100	75	100	88.3
> 4.5 liter/day	0	8.5	16.7	0	25	0	8.4
3rd month1-3 liter/day	61.5	68.9	80	100	37.5	45.4	65.6
3-4.5 liter/day	38.5	26.7	0	0	62.5	54.6	30.3
> 4.5 liter/day	0	4.4	20	0	0	0	4.1
Male calves (%)							
Culled	100	95.5	100	75	100	81.8	95
Grown for bull	0	4.5	0	25	0	18.2	5

N=number farm household interviewed

g) Beginning of dry feed supplementation and Weaning age of calves

Among the overall interviewed dairy producers 59.9% weaned their calves at three months of age, while the remaining 25.9% and 14.1% weaned at fourth months of age and more than four months of age, respectively (Table 7). Majority of the peri-urban large farms weaned their calves early, which was due to the fact that these farms have a chance to let their calves graze and practice early supplementing of roughage feed within 30 days of age and concentrate feed within eight weeks of age. About fifty percent of urban and peri-urban medium (25.9%), sized farm weaned their calves at four months of age, because most of them start supplementing either roughage or concentrate lately. Of the interviewed households, 55.3% urban medium and 100% of peri-urban medium farms start feeding concentrate after six weeks of age. From those farms which provide milk for calves for more than four months, the large sized farms in urban and peri-urban took the highest share (14.1%), these farms started supplementing grass (before-30 days) and concentrate (within 6 weeks) early. Prolonged supplementation practice was aimed for better growth and early maturity of heifer calves. In agreement with this study, Matthewman (1993) and Roy (1980) reported that concentrate and hay were introduced and accepted by the calf during the 4th week of life for cross bred calf. Previous study indicated that most farms in Sebeta area practiced stall feeding of their calf and body weight and body condition loss were common in majority of small holders in intra-urban and secondary towns due to shortage of quality roughage and concentrates supplementation (Yoseph, 1999).

Table 7 : Beginning of dry feed supplementation and weaning age of calves

Variables	Urban farms			Peri-urban farms			Overall
	Small N=24	Medium N=28	Large N=8	Small N=23	Medium N=27	Large N=10	N=120
Weaning age calf (%)							
Three months	46.1	68.9	50	50	62.5	81.8	59.9
Four months	46.1	22.2	12.5	50	25	0	25.9
> Four months	7.7	8.9	37.5	0	12.5	18.2	14.1
Roughage suppl.(%)							
7- 15 days	23.1	38	12.5	0	25	22.2	20.1
15-30 days	46.2	40	50	75	50	77.8	56.5
>30 days	30.8	22	37.5	25	25	0	23.4
Concentrate suppl.(%)							
15 -45 days	7.7	44.7	50	0	0	36.4	23.1
46-75 days	53.8	42.6	12.5	100	100	45.5	59.0
>75 days	38.5	12.8	37.5	0	100	18.2	34.5

N= number of farms.

h) Dry Matter and Nutrient Intake by Heifer Calves

Feed dry matter and nutrient intake by heifer calves in Sebeta Awas Wereda is shown in Table 8. Dairy heifer should be fed properly in order to be large enough to breed early. Underfeeding and overfeeding have their own side effects on heifer physiological development. Under feeding delays breeding age and age at first calving. Dry matter intake, dietary energy to protein relationship, having an adequate daily gain without fattening are key elements of any good heifer-growing. Dry matter intake (DMI) of heifers progressively increases as heifers grow larger, but their DMI as a percentage of BW progressively decreases from a high of about 3% around weaning to a low of about 1.8% near calving. Along with this change in relative DMI, there is also a suggested change in the ratio of dietary protein to energy in grams of crude protein/M cal of metabolizable energy/kg of DM (Vande Haar, 1998 as cited in NRC, 1989). For the first 6 months of age, this ratio is recommended to be 66, declines to 63 for months 8 to 12, declines further to 60 for months 12 to 16, bottoms out at 56 for months 14 to 23, and then increases to 60 for months 23 to calving at 24 months of age (NRC, 1989). On the other hand, there is a need to grow heifers without fattening. Hence, an average daily body weight gain (ADG) of 0.68 to 0.77 kg during the first two months of a calf's life results in a doubling of body weight (BW) by 2 months of age. An ADG of .82 to .91 kg during the subsequent 22 months results in a BW of 636 kg at 22-24 months of age. This is a reasonable pattern of growth for heifers to first calve at 24 months of age. But an ADG of 1.14 to 1.36 kg based on the maximum rate of protein deposition being about 1 kg per day (Meyer, 2007 as cited in NRC, 1989) growth rates greater than that would be fattening. This overfeeding leads to the accumulation of fatty tissue at the expense of secretary tissue in the developing udder. Where, excessive growth before puberty may limit formation of milk secretary tissue which may permanently impair the milk producing ability of the heifer.

Present study result showed that, the ratio of CP to ME in urban medium and peri-urban large was lower than the desired level (66:1), which might contribute to prolonging the age at which heifer reach puberty. On the other hand, the result for urban small and large sized farms peri-urban medium farms was in better feeding status according to the CP to ME ratio recommendation made by NRC (1989). Regarding CP to ME ratio in diet, analysis of variance showed non-significant difference ($P>0.05$) between the production systems and the different farm scales.

Table 8 : Feed DM and nutrient intakes (Mean±SE) of calves in urban and peri-urban farms.

Herd size	Urban				peri-urban			Ratio
	DM (kg/day)	ME (MJ/day)	CP (g/day)	CP:ME (g/MJ)	DM (kg/day)	ME (MJ/day)	CP (g/day)	CP:ME (g/MJ)
Small (N=6)	3.1±0.2	31.2±6.4	485.3±137.8	**65.3**	3.7±0.9	40.9±10.7	589.3±113.2	**60.4**
Medium(N=6)	2.7±0.5	28.0±4.6	337.7±44.1	**56.6**	3.3±0.9	35.8±4.1	545.5±95.7	**63.9**
Large(N=6)	3.4±0.7	36.8±7.8	565.8±148.4	**64.6**	3.4±1.0	36.5±8.9	477.5±163.4	**54.9**

DM=Dry matter, CP=Crude protein, ME=Metabolizable Energy; MJ=Mega joule SE= standard error; g= gram; the ratio obtained must be multiplied by 4.2 because 1calore=4.2 joule.

i) Body Weight Changes of Heifer Calves

Body weight of growing heifers and relationships to mature body weight are management targets to consider for poverty, breeding, first calving age and subsequent lactation. puberty begins at 50-55% of mature body weight, this occurs at about 317kg for large breeds and 227-272 kg for smaller breeds and when heifer reach 60-65% of their mature body weight they are usually bred after exhibiting three to five estrus cycle (Hoffman, 2003). Heifers within breed should reach 85% of mature body weight after their first calving, 92% after their second calving 96% after their third calving (Van Amburgh, 2005). The overall least square mean estimated body weight of present study indicates a linear increment as the age of heifer calves advanced in urban and peri-urban farms Table 9. This implies that the level of management might be good in these farms. Body weight change, body condition score and girth height at shoulder of calves were not affected ($P> 0.05$) by production system. However there was significant difference ($P<0.05$) in body weight due to difference in herd size. Thus, better growth performance was attained in small and large herd sizes than in the medium ones, which was probably due to the fact that in small farms a single or at most two heifer calves were raised at once which favors them to receive better management, on the other hand, in large farm there was well constructed separate heifer calves pens though, they were managed in group, they received better feeding. Gojjam *et al*. (2010) indicated that heifers fed a ration with 50% concentrate and 50% roughage had higher ($P<0.05$) daily body weight gain (0.532 kg) and attained puberty at 221 kg (65% of the mature body weight) in 15 months, while heifers fed a diet with 30% concentrate and 70% roughage gained 0.434 kg/day and reached puberty at 247 kg (70% of the mature body

weight), about 3 months later. Abdelgadir *et al.* (2010) reported that heart girth was significantly ($P<0.01$) affected by the plane of nutrition on which the heifers were reared; Heifers fed on high level of concentrate reached puberty at a significantly ($P<0.05$) younger age and heavier live weight than those fed on low level of concentrate. However, heifers in group did not reached puberty during days on test. The present weight falls in the range of 65-130kg set by NRC (1989) but below girth height at shoulder (86.61cm-103.63cm) of heifer calves of two to six months of age. Relatively lesser weight was reported by Addisu *et al.* (2008) for crossbred calf of Fogera crossed Holstein Friesian attaining 92.7 kg at their six months of age.

The present study weight is lower than what has been reported for on farm managed calves by Sendros *et al. (*1987) but in agreement with on-station data. Friesian crossbred calves consistently grew better at on farm than on station. That is on farm average weights at three months of age was 89kg and at six months it has 165kg, while heifer calves at on station had 73 and 114kg at three and six months respectively. The same author deduced that better on-farm performance was achieved probably because calves grazed on improved pasture throughout the dry season as opposed to on-station calves' which were kept on natural pasture. MaiVan Sanh *et al*. (1997) also reported comparable result of crossbred calves reared under restricted suckling attaining 109 kg at their six months of age, whereas Lyimo *et al.* (2004) reported slightly lower weight attainment of 95.6 kg at six months of age.

The average daily body weight gain of heifer calves statistically was not significantly ($P>0.05$) different between production system but the numerical figure indicated by far greater average daily body weight gain in urban farms than peri-urban farms. However there was a significant($P<0.05$) difference in average daily body weight gains due to difference in herd sizes, hence those calves in large sized farms were superior in average body weight gain than those in medium herd sized and small one.

Present study average daily body weight gain is within the range that was recommended by Rosete and Zamora (1985) as cited by Ugarte (1997) which was between 300gm to 600gm per day but less than that reported by Sendros *et al*. (1987). Similar results were reported for crossbred calves from Andasa research center where, the overall mean daily body weight gain of calves from birth to one month, three months, six months, of age were 591, 374, 321, grams respectively (Addisu *et al*., 2010).

Table 9 : LSM (±SE) of body weights of crossbred heifer calves of Holstein Friesian after weaning (three to six months of age)

	Weight in (kg)									
	adj.Initial weight		Final weight		ADG(gm)		Wither height		BCS	
Parameters	N	LSM±SE		LSM±SE		LSM±SE	N	LSM±SE	N	LSM±SE
Overall	18	74.93±5	18	108.6±3.8	18	374.3±100.2	18	75.9±0.9	18	2.84±0.0
Production system		NS		NS		NS		NS		NS
Urban	9	89.4±9	9	113.48±4.7	9	482.6±165.1	9	75.61±1.4	9	2.83±0.1
Peri-urban	9	77.7±3.4	9	103.8±4.9	9	266.1±105.9	9	75.93±1.2	9	2.91±0.1
Herd size		NS		*		*		*		NS
Small	6	82.8±0.2	6	105.2 ± 2.5^{ab}	6	356.8 ± 129.1^{ab}	6	77.28 ± 1.5^{a}	6	2.89±0.1
Medium	6	74.7±3.4	6	102.8 ± 7^{b}	6	149.8 ± 45.6^{b}	6	73.28 ± 1.9^{b}	6	2.89±0.1
Large	6	93.3±14	6	117.9 ± 5^{a}	6	616.3 ± 150.7^{a}	6	76.75 ± 1.4^{a}	6	2.83±0.1

Adj. = adjusted, Means in the same column with different subscript letters were significantly different;: P<0.05; NS: Non-Significant; LSM: Least Square Mean. SE: Standard Error, ADG=average daily body weight gain; N= number of calf monitored in eighteen farms.BCS=body condition score.*

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Evaluation of the Effect of Different Nursery Media on the Emergence and Growth of Three Tropical Tree Species

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Abstract- An experiment was conducted at the Nursery section of the Department of Crop, Soil and Pest Management, The Federal University of Technology, Akure, Ondo State from June to evaluate the effect of different nursery media on the emergence and growth of three tropical tree species: *Citrus paradise* (Grape), *Citrus aurantium* (Bitter orange) and *Anona muricata. L* (Sour sop) June to August 2014. Seven nursery media were evaluated for their seedling emergence and early growth. Physiochemical analysis was performed on the three growing medium. The experiment was laid out in Randomized Complete Block Design. Growth and yield parameters (number of leaves, plant height, root length, root weight, shoot length and shoot weight) were taken. It was observed that treatment with top soil only performed significantly higher as pertaining to plant height followed by treatment with combination of top soil and river sand in *Citrus paradise* (Grape). Treatment with top soil only, significantly had the highest number of leaves followed by treatment with top soil +river sand, rice hull + river sand + rice hull and river sand in grape. Plant height of *Anona nuricata. L* (Sour sop) was greatly supported significantly by treatment with the combination of rice hull+ river sand+ top soil followed by treatment with river sand only.

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I. Introduction

Growing media are an integral part of most horticultural production system. Growing media are the substrates in which plant will grow, they provide anchorage for the plant's roots, air spaces to allow respiration and retain sufficient available water to enable plant growth. [2][6]Different growing media that can be used are cocoa shells, sewage sludge, tobacco waste, sugar waste, vermin-compost, saw dust, paper waste, biomass by product, leaf mould, straw products, loam sea weed, hop waste, wood waste, spent mushroom compost, lignite, rice hulls, animal waste, food processing wastes[1]. Growing medium is known to affect plant performance in bare roots and container nursery production [9].

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Nursery medium have been found to influence the emergence and growth of seedling produced and it is therefore necessary to find a suitable medium that will enhance its vigour [7]. It is necessary to find a suitable soil mixes that will help to produce vigorous root growth in the nursery before they are transplanted to their permanent site to ensure good seedlings for plantation or orchard establishment[10][1].

Citrus auratium (bitter orange) belong to family Rutaceae and it is distributed in tropical and sub-tropical region. It is commonly used in various traditional systems as an antihelmintic, mosquito repellent and antiseptic and many other chronic diseases. *Anona muricata. L* (sour sop) is also known as guanabana, graviola and sir sak in African and some countries [3]. It has a wide spread pan tropical distribution and has been pridely known as corossol. It is a wide spread small tree and has its native in Central American. It is cultivated throughout the tropical regions of the world. The most abundant antioxidants in fruits are polyphenols and vitamin a, b, c and e. this plant contains annonaceous acetogenins in the twigs, unripe fruits, seeds, roots and bark tissues which display antitumor, pesticidal, anti-malaria, antiviral and antimicrobial effect [7].

Citrus paradisa (grape) have a long and abundant history. During the ancient Greek and roman civilizations, grapes were revered for their use in wine making. Grapes fruits contain various nutrient elements, such as vitamins minerals, carbohydrates, edible fibers and phytochemicals [14][5].Thus this study was to determine the effect of different growing media on seedling emergence and early seedling growth of three tropical tree species (grape, sour sop, and bitter orange) so as to identify the most appropriate medium for each species that will ensure the production of vigorous seedlings for plantation or orchard establishment. And also to evaluate the vegetative growth response of selected fruit tree crops to rice hulls, top soil and river sand. And the examination the bio active components of the selected fruit trees for their medicinal functions were also done.

II. Materials and Method

The experiment was conducted at the nursery of the department of Crop, Soil, and Pest management,

Federal University of Technology, Akure with (7°16′N, 5°12′E) located in the rain forest vegetation zone of Nigeria between July and August 2014. The rainfall pattern of Akure is bimodal with a wet season of about seven months occurring during April to October/ November and through February to March. The mean daily temperature ranges between 25°C and 37°C.The mean monthly maximum and minimum relative humidity were 83% and 65%.

The seed were obtained from Isinkan Market, Akure, Ondo State and were authenticated at the Department of Crop, Soil and Pest Management. The seeds were air dried and planted. Three different growing medium were used during the experiment viz; top soil, river sand and rice hulls. Top soil was collected from Oba Kekere, Futa Area, Akure, Ondo State, river sand was collected by the river side of Ilara- Mokin, Ondo State and rice hulls was collected from rice milling factory, Ipetu-Ijesha, Osun State, Nigeria. The different media were thoroughly mixed on a flat surface in ratio 1:1 and were filled into a perforated polythene pots with diameter 11.4cm and length 20cm, the pots were prepared, filled with the medium and arranged in the nursery. Different media were used with the following treatment combination;T1=Rice hulls +River sand + Top soil, T2= Top soil + River sand, T3=River sand only, T4=Top soil only, T5=Rice hulls only, T6=Rice hulls + Top soil, T7=Rice hulls +River sand.

The major agronomic practice was thinning (removal of excess seedling from each poly pot), weathering and manual weeding. Data collection began at 4 weeks and 5 weeks which was when the seed emerged. It was taken weekly till the seedlings were 12 weeks old. The parameters considered included plant height, number of leaves, leaf area and root length. The data were collected with the use of ruler for the length of the shoot and Root length. Resultant plant parameters were analysed using SPSS statistical software package and means separated by Duncan Multiple Range Test.

The soil analysis was done using the procedure in the csp laboratory manual booklet. Soil pH was determined. Magnesium was determined with an atomic absorption spectrophotometer. Exchange acidity was determined by Cabonoglu *et al*., [3] titration method. Soil organic C was determined by the procedure of Walkley and Black using the dichromate wet oxidation method, total N was determined by micro-Kjeldahl digestion method, available P was determined by Bray-1 extraction followed by molybdenum blue colorimetry. Exchangeable K, Ca and Mg were extracted using 1.0 N ammonium acetate. Thereafter, K was determined using flame photometer and Ca and Mg were determined using the EDTA titration method while sodium (Na) was determined by flame emission photometry. Particle size distribution was determined with a hydrometer [11]Juice were extracted with the use of a blender, sieved and taken to the laboratory for analysis. The following were considered for test;

The total phenol content of the juice was determined by the method [12]. The total flavonoid content of the juice was determined using a colourimeter assay developed by [9]. The reducing property of the juice will be determined by [15].The free radical scavenging ability of the juice against DPPH(1, 1-diphenyl-2-picryhydrazyl) was tested using Rauf [13] method.

III. Results

Table 1 : Physiochemical Properties of the Growing Medium

Media	OC%	OM%	N%	P	K	Ca	Mg	Ph
M1	0.71	1.22	0.06	5.17	0.93	2.3	3.3	6.30
M2	1.51	2.60	0.13	2.95	0.59	0.8	5.2	6.33
M3	98.98	170.64	8.53	28.70	0.67	2.8	4.4	5.86

**M1=Topsoil, M2=River sand, M3=Rice-hulls, OC=Water holding capacity, OM=Organic matter,*

The results from the physiochemical properties of the growing medium in Table 1 showed that rice hulls contains moderate to high level of organic carbon and organic matter which can support plant growth. Additionally all the media pH levels shows moderately acidic level.

Table 2 : Effects of the Growing Media on the Plant Height (Cm) of Grape (*Citrus Paradisi*)

Treatments	4	5	6	7 (WAG)	8	9	10	11	12
T1	1.29a	2.58ab	2.58b	2.77ab	2.77b	3.13b	3.30b	3.45a	3.73a
T2	0.71a	2.97a	3.74a	4.08a	4.24a	4.54ab	4.69ab	4.96a	4.96a
T3	0.71a	1.41b	1.41c	2.36b	2.77b	3.13b	3.13b	3.45a	3.59a
T4	1.1a	3.36a	4.08a	4.24a	4.68a	4.96a	5.09a	5.23a	5.34a
T5	1.1a	2.34ab	2.58b	3.13ab	4.24a	4.24ab	4.54ab	4.54a	4.81a
T6	1.1a	3.36a	3.55a	3.91ab	4.53a	4.83a	5.09a	5.23a	5.34a
T7	1.1a	3.36a	3.91a	3.91ab	4.24a	4.24ab	4.09a	4.96a	5.10a

**T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand, T3 = River sand only,T4 = Top soil only, T5 = Rice hull only, T6 = Rice hull + top soil , T7 = Rice hull + river sand, WAG= weeks after planting. Means are separated with Duncan Multiple Range Test*

The data shows (Table 2) that the different growing media had significant effect in the plant height of grape at 5-10 weeks after germination. The maximum plant height (4.67 cm) was recorded at T 4 (top soil only) followed by (4.0 cm) in T7 (rice hull+ river sand) and (3.83cm) in T 6 (rice hull +top soil) while the minimum height was (2.33cm) was observed in T 1(rice hulls+ river sand+ top soil)

Table 3 : Effects of the Growing Media on the Number of Leaves Grape (*Citrus Paradisi*)

Treatments	4	5	6	7 (WAG)	8	9	10	11	12
T1	1.29a	2.58ab	2.58b	2.77ab	2.77b	3.13b	3.30b	3.45a	3.73a
T2	0.71a	2.97a	3.74a	4.08a	4.24a	4.54ab	4.69ab	4.96a	4.96a
T3	0.71a	1.41b	1.41c	2.36b	2.77b	3.13b	3.13b	3.45a	3.59a
T4	1.00a	3.36a	4.08a	4.24a	4.68a	4.96a	5.09a	5.23a	5.34a
T5	1.00a	2.34ab	2.58b	3.13ab	4.24a	4.24ab	4.54ab	4.54a	4.81a
T6	1.00a	3.36a	3.55a	3.91ab	4.53a	4.83a	5.09a	5.23a	5.34a
T7	1.00a	3.36a	3.91a	3.91ab	4.24a	4.24ab	4.69a	4.96a	5.10a

**T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand T3 = River sand only, T4 = Top soil only, T5 = Rice hull only,T6 = Rice hull + top soil, T7 = Rice hull + river sand, WAG=weeks after planting. Means are separated with Duncan Multiple Range test.*

No significant difference was noticed at 4, 11 and 12 weeks of germination but there was significant differences in the number of leaves of grape across the treatment. There was a significant difference across the weeks for all the treatment except T1, T4 and T7

Table 4 : The Effect of Growing Media on Yield Parameters of Grape (*Citrus Paradisi*)

Treatment	Shoot length(cm)	Shoot weight(kg)	Root length(cm)	Root weight(kg)
T1	9.50a	0.52b	11.75bc	0.43b
T2	10.00a	1.02ab	12.67abc	0.82ab
T3	8.75a	0.52b	15.00a	0.35a
T4	13.50a	1.87a	11.33bc	1.20a
T5	9.00a	0.80ab	9.67a	0.35b
T6	8.00a	0.37b	14.00ab	0.75ab
T7	9.67a	0.76ab	12.00abc	0.75ab

**T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand, T3 = River sand only, T4 = Top soil only, T5 = Rice hull only,T6 = Rice hull + top soil, T7 = Rice hull + river sand, WAG= weeks after planting. Means are separated by Duncan Multiple range test*

In the table above (Table 4) it was observed that there was no significant difference in the shoot length across the treatments but there is significant difference across and along the treatment

Table 5 : Effects of the Growing Media on the Plant Height (Cm) of Sour Sop (*Annona Muricata*)

Treatments	4	5	6	7 (WAG)	8	9	10	11	12
T1	0.00	2.67a	3.17a	3.17a	4.00a	4.00a	6.33ab	9.16a	11.17a
T2	0.00	2.30a	2.50a	3.17a	4.67a	4.67a	4.83ab	5.33a	9.33a
T3	0.00	0.00	1.33a	1.83a	7.33a	7.67a	9.33a	10.00a	11.33a
T4	0.00	0.00	0.00	0.00	0.00	0.00	1.00b	6.50a	10.00a
T5	0.00	0.00	0.00	0.00	0.00	0.00	0.33b	5.00a	9.00a
T6	0.00	0.00	0.00	0.00	0.00	1.83a	1.33b	7.67a	11.00a
T7	0.00	0.00	0.00	0.00	0.00	0.00	1.67b	7.50a	10.00a

**T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand, T3 = River sand only, T4 = Top soil only, T5 = Rice hull only, T6 = Rice hull + top soil, T7 = Rice hull + river sand, WAG=weeks after germination. Means are separated with Duncan Multiple Range Test*

According to the data in Table 5 there was delay in the emergence and growth of sour sop, this may be due to environmental variation. Significant difference was only noticed at week 10 after germination. The maximum plant height (6.33cm) was recorded at T 1 (rice hull + river sand + top soil) followed by (5.33cm) in T 3(river sand only) and (4.83cm) in T 2(river sand + top soil) while the minimum height (0.3) was noticed in T 5(rice hull only).

Table 6 : Effects of the Growing Media on the Number of Leaves Sour Sop (*Annona Muricata*)

Treatments	4	5	6	7 (WAG)	8	9	10	11	12
T1	0.00	0.71a	0.88a	1,39a	1.72a	1.72a	1.80a	2.06a	2.36a
T2	0.00	0.71a	0.71a	1.00ab	1.57ab	1.57ab	1.72a	1.32a	1.77a
T3	0.00	0.71a	0.71a	0.71b	0.71b	0.71b	0.71a	2.18a	2.39a
T4	0.00	0.71a	0.71a	0.71b	0.71b	0.71b	0.71b	1.93a	2.24a
T5	0.00	0.71a	0.71a	0.71b	0.71b	0.71b	0.71b	1.29a	1.48a
T6	0.00	0.71a	0.71a	0.71b	0.88ab	0.88ab	0.88ab	1.66a	1.94a
T7	0.00	0.71a	0.71a	0.71b	0.71b	0.71b	0.71b	1.77a	2.04a

**T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand, T3 = River sand onlyT4 = Top soil only, T5 = Rice hull only, T6 = Rice hull + top soil, T7 = Rice hull + river sand, WAG=weeks after planting. Means are separated with Duncan Multiple Range Test*

The data in table 6 showed that there was significant difference across the treatment at week 7-10. There was no significant difference in T1 across the week but other treatment has significant differences in the number of their leaves, there was also no significant differences across the treatments at 4, 11 and 12 weeks respectively.

Table 7 : The Effect of Growing Media on Yield Parameters of Sour Sop (*Annona Muricata*)

Treatment	Shoot length(cm)	Shoot weight(kg)	Root length(cm)	Root weight(kg)
T1	10.75a	0.57a	12.00a	0.31a
T2	9.33a	0.61a	9.67a	0.26a
T3	11.00a	0.70a	11.00a	0.32a
T4	10.67a	0.53a	9.67a	0.37a
T5	10.67a	0.59a	9.00a	0.35a
T6	10.83a	0.59a	9.00a	0.39a
T7	11.50a	0.57a	7.67a	0.24a

T1 = Rice hull + river sand + top soil, T2 = Top soil + river sand, T3 = River sand only,T4 = Top soil only, T5 = Rice hull only, T6 = Rice hull + top soil, T7 = Rice hull + river sand, WAG=weeks after planting. Means are separated with Duncan Multiple Range Test

There no significant differences in all the yield parameters

Table 8 : Phytochemical and Antioxidant Test on the Juice of Sour Sop and Bitter Orange. (*Annona Muricata and Citrus Aurantium*)

Samples	Tannin (mg/100g)	Phenol (mg/100g)	Phytate (mg/g)	Oxalate (mg/g)	Saponin (g/100g)	Alkanoids (g/100g)	Flavoids(g/100g)
A1	2.70	1.28	5.77	2.61	ND	ND	0.02
A2	2.65	1.30	5.78	2.57	ND	ND	0.01
AVG	2.68	1.29	4.17	2.59	ND	ND	0.02
B1	1.15	0.60	6.59	2.25	ND	ND	0.03
B2	1.18	0.63	6.62	2.16	ND	ND	0.05
AVG	1.17	0.62	6.61	2.21	ND	ND	0.04

**A=Sour Sop, Avg=Average, B=Bitter Orange*

Based on the juice of sour sop and bitter orange, it was observed that bitter orange has higher phytate than sour sop. Sour sop was higher than bitter orange in the other component.

IV. Discussion

Nursery medium has been found to influence the quality of seedling emergence and growth, this research confirms the efficacy of rice hulls which has been successfully used as growing media [16]. The reason for the use of rice hulls is due to its light weight than top soil or river sand, it provides good aeration, high water retaining capacity and it stimulate warmth which facilitate growth and germination[3]. According to the research work, top soil support the growth of seedling significantly which was in support to the research by Agbo et al., [1]. Jessica [9] also worked on top soil as a medium for *M.myristica* but his work was in contrast to this research.

According to Mehwish, 2007 who stated that river sand showed the least response to the growth of *Dahlia pinnata* was in contrast to this research as it was not the medium that showed the least in response to seedling emergence and growth. Top soil supported significantly taller seedlings, all through the experiment, the tallest seedling were those with top soil only. It was

noticed that when rice hulls was mixed with top soil or river sand, humus increases and vigorous growth is supported [4][20]. This was in support of this research.

Agbo, 2006 stated that rice hulls and top soil performed the same way was in contrast to this research. During the research, it was noticed that rice hulls had micro-organisms more than other media which help to break down litter and release nutrients. Rice hulls had organic matter and improve the structure of the soil. Rice hulls, fresh or aged can be successfully used as a sphagnum peat moss substitute for the production of selected short term cut flowers because it support taller seedlings. Einert and Baker,[6] stated that rice hulls increases root weight which was in support with this research. Laiche and Nash [10] stated that rice hulls are a good replacement in growing medium. Although during this research, there was adequate rainfall which helps the seedlings performance, as high humidity helps in quick decomposition of the organic component.

According to the analysis ran on the juices of *Annona muricata and C.aurantium* reveals the phytate was the highest bio active component presence and this indicate several positive effect on human health. [12][15]. Phytate was reported to prevent kidney stone formation, protect against diabetes mellitus and coronary heart diseases as well as a variety of cancer.[14][15]. Saponin was noticed to be absent from the juices this could be due to Jessica [9], who stated that saponin occurs in a wide range of plants, including pulses and oil seeds and since the fruit of the juices was neither pulses nor oil seed, it could be the reason for its absence. The oxalate presences in the juices help to bind calcium and prevent its absorption to human body.

Presence of flavoids, phenol and tannins leads to the use of the fruit for pharmaceutical activities. It has been investigated that high flavoids intake may be correlated with a decreased risk of cancer.[17][19]. Flavoids possess wide spectrum of biological activities that may be able to influence some process during cardiovascular diseases [18][21]. Phenols acts as resistance mechanism of plants against fungal pathogen and insect, they are used in plant pigmentation, growth and reproduction [21]. They are also regarded as preservatives against microbes and oxidation for food [20]. Tannin has been closely associated with plant defence mechanism towards mammalian, herbivores, and insects. They defend plant against large herbivores by decreasing protein availability [11][12]. Fruits with both flavoids and phenolic acids component plays an important role in the control of cancer and other human diseases [8][15]. This research work indicate the use of these fruits (*Annona muricata and C.aurantium)* for medicinal purposes, for example, cure of different types of cancer, cure of kidney diseases, protection against coronary diseases, diabetes mellitus e.t.c. The result from my experiment shows that top soil and river sand are the best media for planting Citrus *paradisi (*grape) and river sand is the best for planting sour so*p Annonamuricata*. Rice hull supports seedlings vigour. As the data was recorded on three month research trail, therefore, it is recommended that for the confirmation of the results, this trial should be repeated for another year.

V. Conclusion

The result from my experiment shows that top soil and river sand are the best media for planting Citru s*paradisi (*grape) and river sand is the best for planting sour so*pAnnonamuricata*. Rice hull supports seedlings vigour. As the data was recorded on three month research trail, therefore, it is recommended that for the confirmation of the results, this trial should be repeated for another year.

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Characterization of Common Horse Feeds in Selected Areas of Ethiopia

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Abstract- *Introduction:* Horses, along with a number of other domesticated species, are still used for work power animals in many developing countries. A study was conducted in Debrezeit, Adama, Debre brihan and Hawassa towns in Ethiopia in 2012/13 with the objective of determining the chemical composition of the common horse feed resources.

Methods: Feed samples were collected from three major groups namely; carthorse owners, horse feed traders and feed processors as replication for determination of chemical composition. The samples were collected systematically. Feed analysis was done at the National Veterinary Institute (NVI) Bishoftu, Ethiopia, based on the proximate feed analysis method.

Keywords: *carthorse, feed characterization, dry matter, chemical composition.*

GJSFR-D Classification : *FOR Code: 070799p*

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Characterization of Common Horse Feeds in Selected Areas of Ethiopia

Eyerus Muleta [α], Ashenafi Mengistu [σ], Diriba Geleti [ρ], Nigatu Aklilu [ω] & Getahun Asebe [¥]

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Result: The overall mean dry matters of wheat bran in Bishoftu, Adama, Debre Berhan and Hawassa were 90.96%, 91.56%, 91.9% and 89.96% accordingly. The overall mean of crude protein of wheat bran were 7.39%, 16.64%, 5.07% and 18.83% in Adama, Debre Berhan, Bishoftu and Hawassa respectively. Dry matter and crude protein of wheat bran across towns was highly significant. The dry matter and crude proteins of barley grain were 91.29% &12.23% and 87.78% & 8.92% in Debre Berhan and Hawassa respectively. There is no significant difference over towns in all chemical composition of barley grain over towns in all proximate compositions.

Conclusion: The chemical feed characterization indicated that there is a significant difference on the percentage of nutritive components of the feed pooled over towns. There is also a significant difference in dry matter and crude protein of wheat bran in all towns. However, there is a great difference utilizing percentage of all feed types in a proportion way. Authors recommend on the delivering of the inputs and improved technologies on types of feed based on the available resources, which is relevant to cart horse.

Keywords: carthorse, feed characterization, dry matter, chemical composition.

I. Introduction

Ethiopia is believed to have the largest livestock population in Africa (CSA, 2011). The population of horses, donkeys, and mules (Draft animals) are 2.03 million, 6.20 million, 0.38 million, respectively (CSA, 2011) in all the regions of the country excluding the non-sedentary population of three zones of Afar & six zones of Somali regions. These draft animals give services like transport and traction mainly (Thornton *et al*., 2002). Indeed, research suggests that working animals supply approximately 50% of agricultural power needs globally (Swann, 2006). In Ethiopia, it is estimated that among the horses aged 3 years and older (1,666,353); about 1.24 million were used for transportation, 0.21 million were for draught and the remaining 0.21 million were used for other purposes (CSA, 2012).

Horses, along with a number of other domesticated species, are still used for work power animals in many developing countries. They facilitate participation of the poor in the market economy (The Brooke, 2011). Despite their invaluable contributions, equines in Ethiopia are accorded low status and are consequently the most neglected animals. Working equines are prone to painful, debilitating and often fatal tropical illnesses. In addition, these animals work under difficult environmental conditions including intense heat, difficult terrain, and often inappropriate equipment, with inadequate feed and water, resulting in exhaustion, dehydration, malnutrition, lesions and hoof problems (Wilson, 2002). In some situations these animals experience the worst cases of abuse and neglect seen in all classes of horses. Owners of these animals usually find it difficult to make a living, and animal welfare is not their biggest concern (Schwean, 2005). The horses found in these situations are often overworked, abused and beaten as a method of extracting more work from the animal. Additionally, money is not available for proper nutrition or veterinary care in developing countries (Ramaswamy, 1998).

However, nutrition is a very important aspect which must be considered when examining the welfare of horses. One of the major costs of equines is feed, especially for those households residing in urban areas. According to The Brooke (2011), average annual costs of supplementary feeds (e.g. wheat bran, cereals, grass hay, green grass and rented grazing land) per house hold are high. Moreover, lack of knowledge on the nutritional requirements of horses and feeding systems opens more rooms for the mishandling by owners which in turn raises animal welfare concerns with a possible implication on loss of wealth.

Estimating the actual and potential horse feed resources available in a given region is a prerequisite for planning and launching sound cart horse power utilization and welfare issue, that largely benefits cart horse owners in which feed shortage is one of the major

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constraint of carthorses (cart horse) (Shilma, *et al*., 2006). In most urban regions of Ethiopia, where the major transfers are supported by cart horses; the utilization, supplementation of nutrition and welfare issue of horses are under appraisal. Various surveys have been conducted on fodder production and employment in Ethiopia for ruminants. Dinka, *et al*.(2006) also studied on the socio economic importance and feeding management of carthorse (cart horse) in the mid rift valley of Ethiopia. However, the focus of the studies was limited to the assessment of the socio economical importance and the feeding management of carthorse (cart horse). Very few studies have addressed issues on characterizing of common horse feeds and feeding system. The lack of such information could have a far-reaching consequence on the productivity and profitability of the horse owners, and potentially restricts the need to boost earn from horse by considering the welfare of horse. Therefore, dealing with feed availability and its quality is important to improve management practices and feeding system; which are required to enhance horse performance and welfare. Thus, this study was conducted with the objective of characterizing the common feed resources chemically in the selected areas of the Ethiopia.

II. Materials and Methods

a) Description of the Study Area

This study was conducted in four purposively selected areas of Ethiopia namely; Adama, Bishoftu, Debre brehan and, Hawassa in the period from November 2012 to April 2013. The towns were selected based on that as they are project area of SPANA, which have high cart horse distribution as well geographically distributed in Ethiopia from other project areas. Description of each area, based on information collected from respective *woreda* Agriculture Offices, is given below:

Adama is one of the major cities in the Oromia Regional State located in East Shewa Zone. It's located at 8.55°N 39.27°E at an elevation of 1712 meters above sea level, 99 km southeast of Addis Ababa.

Bishoftuis a town lying 47 km south east of Addis Ababa. The town is located in the East Shewa Zone of the Oromia Region, and has a latitude and longitude of 8°45′N38°59′E with an elevation of 1,920 meter above sea level. It has an annual average rainfall of 851 mm with mean annual temperature of 17.9°C.

Debre Berhanis found in North Shewa administrative zone of the Amhara National Regional State and is located at 130 km north of Addis Ababa, at 09°36' N latitude and 39°30' E longitude. It is a typical highland area with an elevation of 3,360 meters above sea level. It receives an annual average rainfall of 731 to 1068 mm and has an annual temperature range of 6 to 20°C.

Hawassa, the regional capital of Southern Nations, Nationalities and People's Regional State (SNNPR), is found 275 km south of Addis Ababa. It has an altitude of 1750 meter above sea level, and is located at 6°83' to 7°17' N and 38°24' to 38°72' E. It has an annual average rainfall of 955 mm with mean annual temperature of 20°C. The map of the study areas is shown in Figure 1.

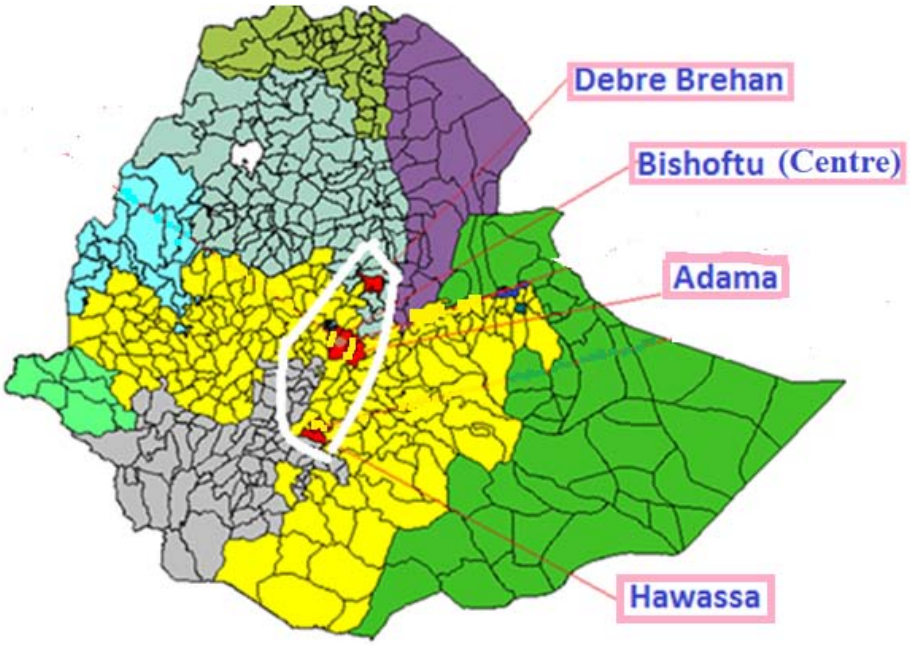

Figure 1 : Map of Ethiopia, indicating the study area (Adama, Bishoftu, Debre brehan, and Hawasa).

III. Study Methodology

a) Sample size determination and sampling procedure

All carthorse owning households living in the four selected towns of Ethiopia were considered as the study population. Before undertaking any sampling procedure, background information on carthorse population in four selected towns through rapid exploratory field visits coupled with secondary information from cart horse association leaders and municipalities was collected. Then, 10% of cart horse owners or responsible person for carthorses which has town identification (cart plate number) for cart at each town was selected for the informal stage of the study. Each carthorse owner or responsible person was considered systematically from working line, every third person at carthorse stations. Totally, 355 carthorse owners/responsible persons were considered which became 101, 110, 39 and 105 in Bishoftu, Adama, Debre Berhan and Hawassa, respectively.

After conducting the informal survey, feed samples were collected from three major groups namely; cart horse owners, horse feed traders and feed processors as replication for determination of chemical composition. The samples were collected systematically based on order of interview where every fifth cart horse owner, and those randomly selected from horse feed traders and feed processors were the sources for sampling. For the purpose, the most commonly used feeds were considered from which half a kilogram of composite samples were taken from each feed for laboratory.

b) Data Collection

The whole design of the study involved collection and analyses of both primary and secondary data collected following qualitative and quantitative research methodologies involving surveys and feed composition analysis, among others. Descriptions of the methods are presented in the subsequent sub-sections.

c) Feed Analysis

Feed analysis was done at the National Veterinary Institute (NVI) Bishoftu, Ethiopia, with the objective of determining the chemical composition of the common horse feed resources, according to the proximate method of feed analysis.

d) Data management and statistical analyses

Descriptive statistics (mean, maximum, minimum, percentages, cross tabulation and t-test) were employed to summarize data on feeds and feeding systems, and cart horse management practices. Moreover, ANOVA (one-way) was run to see the effect of location difference on the chemical composition of common feedstuffs using the SPSS software (version 20) (SPSS 2011).

IV. Results

a) Horse Feeds and Feeding Practices

i. *Common horse feeds*

The lists of commonly used feed types in each of the towns are shown in Table 1. The major feed resources for horse in the study towns were agro-industrial byproduct, crop residues from cereals and legumes and non-conventional feedstuffs. Wheat bran, wheat straw, chickpea straw, lentil straw, vetch straw, poultry litter, barley grain, barley '*gird*' (unproductive barley seed and weed seeds) were the common horse feeds type in Bishoftu. Mill house scraps (a mixed form of a flour factory byproduct including seed covering straw, unproductive wheat seed and weed seeds) and wheat bran were the common horse feeds type in Adama. Wheat bran, barley straw, '*Atela*' (byproduct of traditional alcohol production mainly from '*areqe*'), barley grain, barley '*gird*' (unproductive barley seed and weeds) and oat seed were the common horse feeds type in Debre Brehan. Wheat bran, chopped cane, native grass fodder and barley grain were the common horse feeds type in Hawassa.

Table 1 : Common horse feeds type across towns according to utilization percentage.

Feed type	Bishoftu N (101)	Adama N (110)	DebreBerhan N (39)	Hawassa N (105)	Total (N=355)
Percentage (%)					
Wheat bran	100	80.1	100	100	93.5
Barley grain	80.1	0	38.4	58.8	43.5
Mill house scraps	0	96.4	0	0	29.5
Chick pea straw	98.0	0	0	0	27.9
Native fodder grass	0	0	0	84.8	25.1
Wheat straw	53.2	0	0	0	20.8
Chopped cane	0	0	0	64.7	19.2
Barley straw	0	0	100	0	11
Barley '*gird*'	26.7	0	5.1	0	8.2
'*Atela*'	0	0	43.7	0	4.8
Poultry litters	4	0	0	0	1.1
Oat seed	0	0	5.1	0	0.6
Lentil straw	1	0	0	0	0.3
Vetch straw	1	0	0	0	0.3

N=number of respondents

b) Feed Characterization

The chemical composition of feeds at varies towns is shown in Table 2, 3 and 4. The overall mean dry matters of wheat bran in Bishoftu, Adama, DebreBerhan and Hawassa were 90.96%, 91.56%, 91.9% and 89.96% accordingly. The overall mean of crude protein of wheat bran were 7.39%, 16.64%, 5.07% and 18.83% in Adama, Debre Berhan, Bishoftu and Hawassa. The significance test shown in Table 3, dry matter and crude protein of wheat bran across towns was highly significant. But there is no significant difference in ash, crude fiber, ether extract and calcium. The dry matter and crude proteins of barley grain were 91.29% and 12.23% and 87.78% and 8.92% in Debre Berhan and Hawassa respectively. There is no significant difference over towns in all chemical composition of barley grain.

Table 2 : The effect of location on variation proximate composition of wheat bran and Barley grain

Feed type	Towns	DM	Ash	CF	CP	EE	Ca
Wheat bran	Adama	91.38±0.18^{c}	4.78±0.26	10.81±3.2	7.39±0.36 ^{a}	4.49±0.56	12.61±2.54
	Debre Berhan	91.5±0.22 ^{a}	5.19±0.32	10.26±3.9	16.64±1.79^{c}	4.84±0.68	10.92±3.14
	Bishoftu	91.15±0.18^{d}	5.12±0.26	9.36±3.2	5.07±1.46 ^{d}	3.87±0.56	4.33±2.54
	Hawassa	89.88±0.18^{b}	5.02±0.26	8.66±3.2	18.83±1.36^{b}	2.75±0.56	1.91±2.54
Significance		**	NS	NS	**	NS	NS
Barley grain	Bishoftu	91.29±0.69	6.28±1.57	4.59±3.18	12.23±3.13	1.94±0.21	1.45±0.52
	Hawassa	87.78±0.69	2.99±1.57	5.76±3.18	8.92±3.13	1.28±0.21	0.85±0.52
Significance		NS	NS	NS	NS	NS	NS

*** =significance at 1%, NS not significance, a, b, c, d = location means followed by different letters vary significantly, DM= dry matter, CF= crude fiber, CP= crude protein, EE= ether extract, Ca= calcium*

The descriptive statistics for chemical compositions of six horse feeds are shown in Table 3. The average dry matter, ash, crude fiber, crude protein, ether extract and calcium for the feeds was observed to be 94.76±2.98, 8.58±1.89, 26±17.75, 10.91±9.09, 2.09±0.92 and 22.82±15.66, respectively.

Table 3 : Chemical compositions of six horse feeds that were prevalent at single tows and from single source

		Percentage (%)					
Feed type	Towns	DM	Ash	CF	CP	EE	Ca
Barley grain	Dbere Berhan	92.6	4.96	6.47	9.45	2.2	7.19
Barley *'gird'*	Dbere Berhan	92.2	8.78	10.52	8.44	3.42	32.53
vetch straw	Bishoftu	97.03	8.34	43.69	4.63	1.97	39.19
lentil straw	Bishoftu	98.03	9.41	39.37	15.88	2.75	37.4
Poultry litter	Bishoftu	91.43	9.84	12.9	26.32	1.24	3.46
Wheat straw	Bishoftu	97.26	10.17	43.08	0.74	0.96	17.13
Mean		94.76	8.58	26	10.91	2.09	22.82
SD		2.98	1.89	17.75	9.09	0.92	15.66
Min		91.43	4.96	6.47	0.74	.0.96	3.46
Max		98.03	10.17	43.69	26.32	3.42	39.19

DM= dry matter, CF= crude fiber, CP= crude protein, EE= ether extract, Ca= calcium, SD= standard deviation, Min= minimum, Max= Maximum

The chemical compositions of eight horse feeds are given in Table 3. The average dry matter, ash, crude fiber, crude protein, ether extract and calcium for eight feeds were 91.91±4.44, 10.79±5.07, 27.64±16.73, 11.01±3.96, 3.77±2.22 and 7.60±5.39 accordingly.

Table 3 : Chemical compositions of eight feeds prevalent in a town from two sources.

		Percentage (%)					
Feed type	Town	DM	Ash	CF	CP	EE	Ca
Barley *'gird'*	Bishoftu	91.33	6.77	7.38	17	3.13	1.37
Chick pea straw	Bishoftu	97.68	14.82	38.29	8.9	3.02	12.14
Mill house scraps	Adama	92.4	16.89	21.56	11.22	5.57	13.12
Barley straw	Dbere Berhan	96.73	7.93	37.89	9.78	1.64	8.19
Oat seed	Dbere Berhan	92.39	5.87	12.06	9.48	5.68	12.6
'Atela'	Dbere Berhan	93.49	9.26	12.68	16.05	7.44	10.7
Chopped cane	Hawassa	85.35	6.48	36.19	4.69	1.09	1.01
Native grass fodder	Hawassa	85.95	18.32	55.08	10.98	2.55	1.7
Mean		91.92	10.79	27.64	11.01	3.77	7. 60
SD		4.45	5.07	16.73	3.96	2.22	5.39
Min.		85.35	5.87	7.38	4.69	1.09	1.01
Max.		97.68	18.32	55.08	17.00	7.44	13.12

DM= dry matter, CF= crude fiber, CP= crude protein, EE= ether extract, Ca= calcium, SD= standard deviation, Min= minimum, Max= Maximum

V. Discussion

In horses, for normal growth, reproduction and performance provision of good nutrition is essential. Every day, horses should receive feeds that are adequate, but not excessive in required nutrients. Nevertheless, just providing the right feeds is often not enough to ensure that horses are receiving optimal nutrition. It showed be known the types of feed horses are taking and the number and timing of meals that a horse receives.

Feed types classified into three main types: (1) roughages, (2) concentrates, and (3) mixed feeds. Roughages include pasture forages, hays, silages, and byproduct feeds that contain a high percentage of fiber. Concentrates are the energy-rich grains and molasses, the protein- and energy-rich supplements and byproduct feeds, vitamin supplements, and mineral supplements. Mixed feeds may be either high or low in energy, protein, or fiber; or they may provide "complete" balanced rations.

The present study showed that the major feed resources for horse in the study towns were mainly as agro-industrial byproduct, crop residues from cereals, legumes, and non-conventional feedstuffs. Similar findings by Berhanu *et al*. (2009) supported as fine wheat bran to horse is a good source of nutrients in Wukro Northern, Ethiopia areas. Berhanu *et al.* (2009) also indicated, as wheat bran is a major feed resource in the area, which is similar with present study (93.5%). Besides as reported in (http://www1.agric.gov.ab.ca/ $department/ deptdocs.nsf /all/hrs6287), forages such as pea straw can also be used for horses. Pea straw nutrient values for this feed is highly variable with feed nutrient analysis of as found Dry matter (90%), Crude protein (6.0%)and calcium (1.5%), in which analysis of these feed values are lesser in values except the calcium value in the current study. This suggests that these feed could be reasonable sources of digestible energy and protein as shown in Table 3.

On the other hand, about 4% of horse owners in "*Bishofitu"* town use poultry litter as a horse feed, which is not recommended. Based on a report in (http:// agriculture.vic.gov.au/agriculture/livestock/beef/feeding-and-nutrition/Use-of-Poultry-Litter,-Manure-and-Feed-in-Livestock-System) feeding of poultry litter to any type of farm animal is a highly unsanitary practice, which may result in the spread of diseases such as salmonellosis. Horses are much more sensitive to salmonella than other livestock because of their digestive tract physiology (http://www.equinews.com/article/poultry-litter-not-recommended-fertilizing-horse-pastures). This implies that there should be an intervention to be done in this area regarding the horse feeding management to avoid risks associated poultry litter feeding.

The average for the combined feeds of (Barley grain, Barley '*gird',* vetch straw, lentil straw, poultry litter and wheat straw) at "*Debere Berhan*" and "*Bishofitu*". The dry matter, ash, crude fiber, crude protein, ether extract and calcium contents of these feeds were observed as 94.76±2.98, 8.58±1.89, 26±17.75, 10.91±9.09, 2.09±0.92 and 22.82±15.66, respectively as shown in Table 3. In this study, lentil straw, barley grain and barley "*gird*" showed high proportion of crude protein source in a single town analysis survey.

VI. Conclusions

From the present study it could be concluded that the general feed types in the study towns were not similar to each other except wheat bran, barley grain and barley '*gird'*. Wheat bran, wheat straw, chickpea straw, lentil straw, vetch straw, poultry litters, barley grain, barley '*gird'* (unproductive barley seed and weed seeds) were the common horse feed resources in Bishoftu. Mill house scraps (a mixed form of a flour factory by products including seed covering straw, unproductive wheat seed and weed seeds) and wheat bran were the common horse feed resources in Adama. Wheat bran, barley straw, '*Atela'* (byproduct tin traditional alcohol production mainly from '*areqe'*), barley grain, barley '*gird'* (unproductive barley seed and weeds) and oat seed were the common horse feed resources in Debre brehan. Whereas, wheat bran, chopped cane, native grass fodder and barley grain were the common horse feed resources in Hawassa. The chemical feed characterization indicated that there is a significant difference on the percentage of nutritive components of the feed pooled over towns. As well, there is a significant difference in dry matter and crude protein of wheat bran in all towns. However, there is a great difference utilizing percentage of all feed types in a proportion way. Authors recommend on the delivering of the inputs and improved technologies on types of feed based on the available resources, which is relevant to cart horse.

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Impact of Water Harvesting Techniques on Growth of Some Indigenous Tree Species in Jebel Awlia Locality, Sudan

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Abstract- The broad objectives of this study were to investigate the impact of water harvesting techniques on trees growth and soil moisture content. Field experiments were conducted for one rainy season (2010) around west Omdurman, Jebel Aulia Locality in Khartoum New International Air Port, 40 km south of Khartoum city and 25 km west of the White Nile River in south west direction. The study site lies in the semi-desert region. The experimental design followed was the randomized block design. The water harvesting techniques used were strips, semi-circles, pits and control. The tree species grown were *Acaia tortilis* subsp *raddiana, Acacia senegal* and *Zizphus spina- christi.* The three tree species were planted by using seedlings. The shoot length, number of leaves and diameter of stem of seedlings of the three tree species were measured every three weeks after transplanting, during the rainy seasons. Soil moisture content was measured three times during the rainy seasons (beginning, middle and end).the soil samples taken from three different depths: 0-30cm, 30-60cm and 60-90cm.

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The results showed that the shoot length of *Acacia senegal* was more than *Acacia tortilis* subsp *raddiana* and *Zizphus spina christi*. The growth variables of the three tree species were significantly better (P ≤0. 001). The best height and number of leaves were recorded by *Acacia senegal.* The diameter of stem of seedlings of the three tree species showed variation in values. The growth variables of the three tree species planted in the pits were superior to those grown in the semi- circles.

I. Introduction

Water is essential to all forms of life human, animal and vegetation. It is therefore important that adequate supplies of water be available to sustain such life. Development of water supplies should, however be undertaken in such a way as to preserve the hydrological balance and the biological functions of all ecosystems, which is crucial for marginal lands. Water harvesting is the general name used for all the different techniques to collect runoff or flood water for storage in the soil profile or in tanks so that it can be used for the production of crops, trees or fodder. Water harvesting also can be the collection of runoff water for human or livestock consumption. The water harvesting methods strongly depend on local conditions and include such widely differing practices as ponding, pitting micro catchment water harvesting, flood water and ground water harvesting (Prinz, 1996; Critchley and Siegert, 1991). Water harvesting for dry-land agriculture is a traditional water management technology to ease future water scarcity in many arid and semi-arid regions of the world (Prinz and Singh, 2000). In Sudan, where the major part of it falls within the arid and semi-arid zones, different traditional water harvesting techniques and systems are being practiced since long and are still referred to in the literature by their traditional names, e. g. Haffir and Teru (Oweis *et al*., 1999). In Sudan, the climate ranges from arid in the north and northwest to wet-and-dry tropical weather in the southwest. In semi-arid zones of Sudan such as the west region, safe drinking water is rare. In particular, areas in North Darfur and South Kordofan states rely on groundwater supply (wells) or water storage methods called hafir or earth dams for their water supply. Rainfall collection is one of the water sources in Sudan and rainwater harvesting (RWH) methods implemented to improve the production of crops and livestock in the region. Several water harvesting techniques and agricultural practices were and still practiced by the local farmers, on sloping land and in areas with variable and unreliable rainfall, to reduce the risk of crop failure .Farmers adopted bench – terracing systems, for many thousands years ago, the signs of which are still found in hilly areas such as Jabel Marrah(HTS, 1958). In Kassala region, eastern Sudan, earth embankments (terus) are constructed to intercept sheet-wash runoff, from adjacent catchments, following heavy storms (Van Dijk and Ahmed, 1993), thus harvesting nutrients and controlling erosion (FAO, 1994).

Water is not only one of the world's most important resources, but also a scarce resource in many parts of the world. Water has always been a critical issue. It has been in short supply for many years, but the situation is alarming now. Water harvesting for aforestation is applied in arid and semi-arid regions where rainfall is not sufficient to sustain a good seedling / tree growth. Water harvesting can significantly increase the rate of tree establishment in drought prone areas by concentrating the rainfall/runoff.

Limited water availability is the primary factor controlling plant establishment and growth in the dry

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lands and deserts of the world. Water shortages are accentuated in disturbed areas where vegetation removal and alteration of the surface soil further limit surface water retention and infiltration into the soil. The construction of micro catchments, alterations in the topography of a site to direct precipitation runoff to plants, offers a low cost, passive means of increasing the amount of water available to plantings (Fidelibus and Bainbridge, 1995).

Rain water is good for plants because it is free of salts and other minerals that harm root growth. As rain water percolates into the soil, it forces salt down and away from root zone, allowing root to grow better and making plants more drought tolerant. For the maximization of the use of surface runoff rain water at Khartoum New International Air Port area in aforestration and tree cover some water harvesting techniques using *macro catchments were tried for different indigenes tree species*.

The objectives of this study were: (a) to investigate the influence of some water harvesting techniques on growth of three tree species namely; *Acaia tortilis sub sp raddiana, Acacia senegal, and Ziziphus spina Christi* (b) Determine the effect of the different water harvesting techniques on growth rate, shoot length, number of leaves, and stem diameter of the *Acaia tortilis sub sp raddiana, Acacia senegal, and Ziziphus spina Christi* seedlings. (c) Evaluation the effect of water harvesting techniques used in improving moisture conservation and increasing and stabilizing trees cover.

II. Material and Methods

The study was conducted around Khartoum New International Air Port (KNIA), to study the influence of three water harvesting techniques on trees growth rate and soil moisture content.

a) The study Area

i. *Location*

Khartoum New International Air Port (KNIA) is located in the south west of Omdurman, Khartoum State (Figure 1), at a distance of about 40 km south of Khartoum center and 25 km west of the White Nile River .It lies between latitude 15°13`N and longitude 32°19`E.

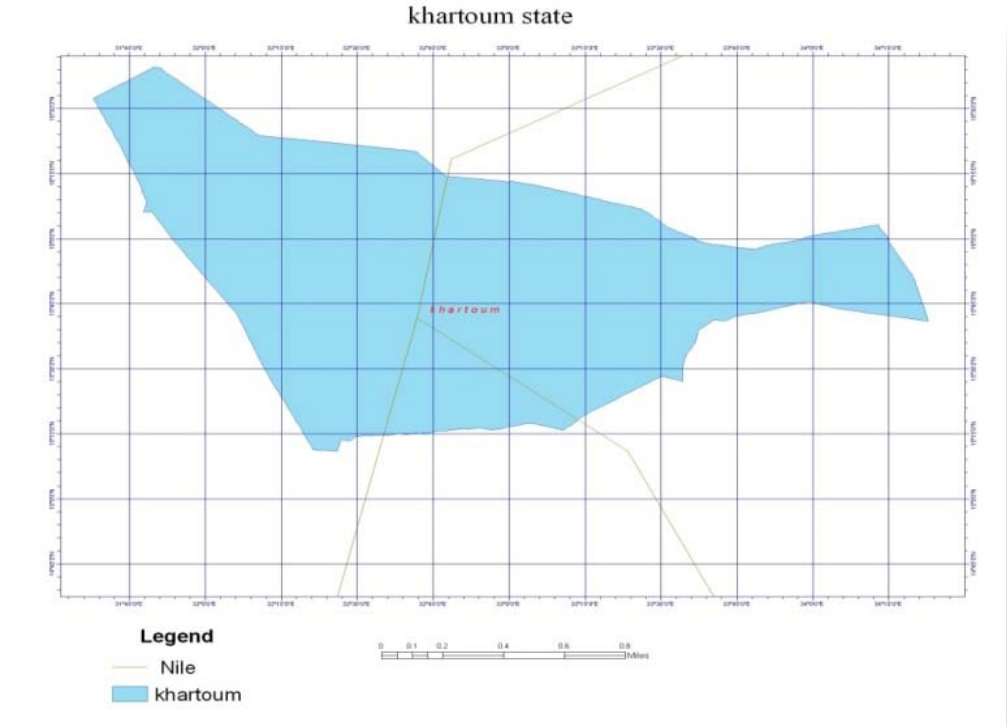


Figure 1 : The study area

ii. *Climate*

The prevailing climate is semi-desert to dry (Van der Kevie, 1973) it is hot, dry and rainy during summer and cold dry in winter. Most of the rainfall is received during July and August. The average annual rainfall is 75-160mm/year and the dry season covers 8-10 months. According to (Khartoum Metrological Station, 1998) the daily average maximum temperature 37.7C° while the daily average minimum temperature 21.6C°, maximum temperature in summer exceeds 40C°, while the minimum temperature reaches 5.2C° in winter.

The daily evaporation rate according to the (penman equation) is 7.7mm and the highest rate take place in April with average of 9.3mm. The daily mean of relative humidity is 38 at am and 21 at 2pm, while the mean wind speed is about 9 miles/hr before autumn. The area is known for its strong wind storms (Haboub) that reaches a speed of 11miles/hr.

iii. *Vegetation cover*

Vegetation cover is dominated by poor desert and semi desert type with different distribution (high density in eastern part and low density in the western part).

Generally the vegetation is dominated by some trees species of *Acacia tortilis sub sp. raddiana (*sayal*), Acacia ehrenbergiana* (salm), *Acacia nubica* (laut), *Ziziphus spina-christi* (sidir), *Acacia tortilis subsp. Tortilis* (samar),and there were some grasses and herbs included *Aristida plumosa* (Gabash), *Solanum dubium* (Jubiun), *Aristida mutabilis* (Gaw), *cenchrus biflorus* (Haskaniet) and *Cassia senna* (sena kalib).

iv. *Topography*

The topography is fairly flat but few isolated ridges and sand dunes may be observed in the western part of the site and the ground surface slopes gently to the east. The area is covered by a light brown and very thin gravely sand layer (about 10mm thick), and few angular to sub-angular, 20 to 60 mm sized fragments of ferruginous sandstone. The southern part of the site is covered by sandy gravel probably formed due to the weathering of Nubian Group rocks which are outcropping in some places in the area.

v. *Water courses*

The generally flat area of the site is confined by two wadis (shallow and relatively wide water course valleys), namely Wadi Al Howeda in the south and Wadi Al Mansourab, Shemela, Sewail in the north, which are believed to drain storm water from the upper lands of North Kordufan State into the White Nile River.

III. Methods

Field experiments were conducted during the growing season (2010) around Khartoum New International Air Port (KNIA) to investigate the effect of water harvesting techniques on growth of tree species namely (*Acaia tortilis sub sp raddiana, Acacia senegal*, and *Zizphus spina christi*). The water harvesting techniques used were: strips, pits and semi-circular.

a) Layout of the experimental field

Randomized block design with four replicates of each treatment was adopted. Each block was divided into four plots. The plot size was 20x20m.One of the four plots used as a control.

The three water harvesting techniques were designed as follows:

i. *Strips*

The land was prepared by bulldozer driven plough to make a big crescent with radius of 150m.Inside this crescent the land was divided into small strips (straight strips) by using a disc plough. The strips were 0.5m deep, 2m wide and 4m long .Each plot consisted of four trees with and in row-spacing of 3m, and the distance between strips was 4m.After the first shower the seedlings were planted in the bottom of the strips.

ii. *Semi-circles*

The land was prepared similar to the strips mention before except the land inside the big crescent was divided into semi-circles (small crescent). The small crescent was prepared by a disc plow. The crescent was 0.5m deep and of radius of 30m. The distance between the crescents was 5m. The seedlings were planted at the bottoms of the small crescent.

iii. *Pits*

The Pits were 2m deep and of radius of 2m. The Pits were prepared by a bulldozer-driven plough. The seedlings were planted in the bottom of the Pits. The Pits consisted of four trees with an in-row spacing of 2m, and the distance between the pits was 5m.

b) The planting of seedlings

After the first shower the seedlings were planted in prepared strips, pits and semi circle. Seedlings of *Acaia tortilis sub sp raddiana, Acacia senegal, Zizphus spina christi were* raised at Khartoum New International Air Port nursery.

i. *Organizing of data*

Data collected included plant variables and soil variables.

c) Plant variables

i. *Growth variables*

To monitor growth performance of the seedlings of the three trees species, number of leaves, plant shoot length and diameters of stem of seedlings were measured every three weeks from the day of the starting of the experiment.

The following variables were measured:

1- Shoot length using ruler to the nearest centimeters.
2- Diameter of seedlings using vernier caliper to the nearest millimeter.
3- Number of leafs were calculated.

d) Soil variables

i. *Soil moisture content%*

Soil samples were randomly taken from three depths, 0-30, 30-60, and 60-90cm at three locations per plot, using the auger.

Sampling was done three times during the rainy season.

Soil samples were weighed fresh, oven dried at 105C^{o} for 24 hours and reweighed.

Soil moisture content% =

$$\frac{\text{Soil fresh mass (g) - soil oven dry mass (g)} \times 100}{\text{Oven dry mass (g)}}$$

e) Data analysis

Results were analyzed using SAS system. Analysis of variance (ANOVA) was made to determine the significance of variation between the species seedlings and micro catchments during the experiments period.

Duncan Multiple Range Test was used to compare mean values of various growth variables and soil moisture content in each treatment.

IV. Results and Discussion

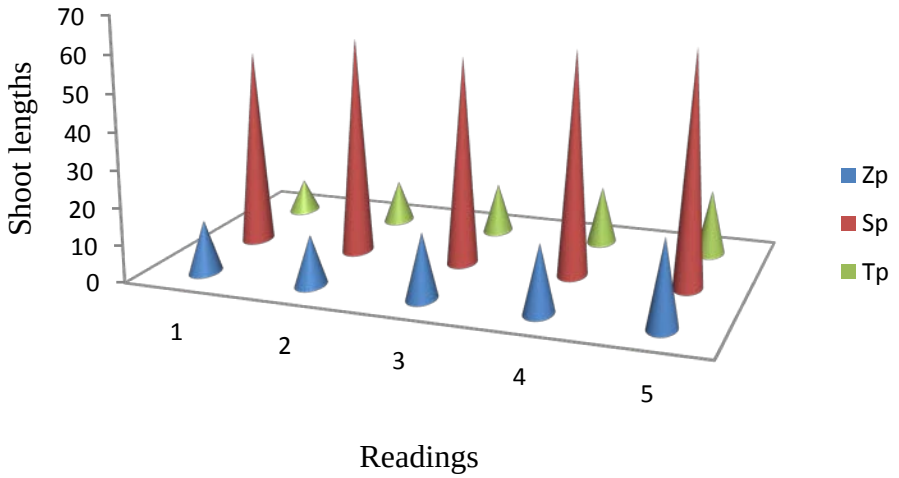
The results of this study are presented in two parts. The first part demonstrates the variations in growth rate between the species and the micro catchment used. The second part deals with the variations in soil moisture content due to micro catchment used.

After the first shower, control, and strip treatments were washed out with rain water, pits and semi-circle treatments survived.

a) The effect of micro catchments on the plant shoots length

The shoot length for the three trees species, (Figure 2), after the 1st, 2nd, 3rd, 4th, 5th readings showed no significant difference. For all the readings the best height was given by *Acacia senegal* flowed by *Ziziphus spina christi* and *Acacia tortilis subsp. raddiana.* In all the readings *Acacia senegal* and *Zizpihus spina christi* grown in the semi- circle were better than those grown in the pits. While *Acacia tortilis subsp. raddiana* showed no significant difference from the pits and semi-circle treatments. The growth of seedling and root development depend on water availability which can be achieved by micro catchment water harvesting techniques', by applying these techniques' we can enhance soil moisture storages and overcome dry spells in critical growing stages and hence secure good water for plant when rainfall is erratic.

Several studies investigate the effect of water harvesting techniques on plant growth; Gupa *et al*., (1995) investigated the effect of different water harvesting and conservation techniques. Their research indicated that the benefit of water harvesting is high and showed an 8 times increase in total biomass compared with the control plot and also proved that there was an increase in tree height by 20% and water use efficiency from 4.78 to 39.6 Kg /cm ha. Mutai (1986) reported a high survival rate for seedlings of fruit trees planted in modified semi-circle hoops in Kenya. Ojasvi *et al*., (1999) showed that *Zizyphus maurutuana* growth rates in the Jodhpur province of India were from 25-33% higher in shallow 1.0-meter.



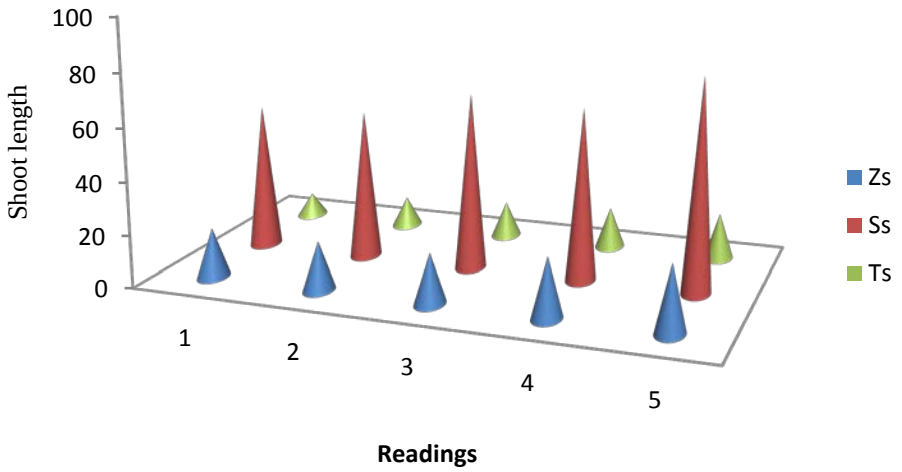


Figure 2 : Variation in shoot length between the three trees species planted in the pits and semi-circle treatment

Where: Zp: *Zizpihus spina -christi,* planted in the pits, *Sp*: *Acacia senegal,* planted in the pits, Tp: *Acacia tortilis subsp. raddiana*, planted in the pits, Zs: *Zizpihus spina -christi,* planted in the semi-circle, Ss: *Acacia senegal,* planted in the semi- circle, and Ts: *Acacia tortilis subsp. raddiana*, planted in the semi-circle.

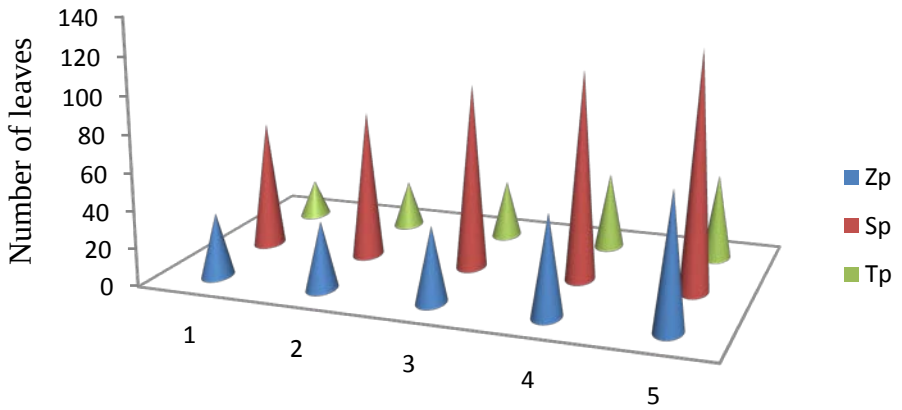
b) The effect of micro catchments on the number of leaves per plant

Plants need large quantities of water for growth, this water used during photosynthesis for producing the carbohydrates which is necessary for plant growth.

The numbers of leaves after the 1st, 2nd, 3rd, 4th, 5th readings (Figure 3) were not significantly different for the entire three tree species planted in the pits and semi-circles. The best means were given by *Acacia Senegal* planted in the pits. Number of leaves for the tree species planted in the pits was higher than those planted in the semi-circles. In this study the high growth rate of *Acacia Senegal* may be related to the fact that part of the study area situated on the gum Arabic belt which dominated by Acacia Senegal tress, and the germination of this tree occur naturally.

Leaves are important organs for photosynthesis and play an important role in survival and growth of a plant. The high water availability for plants had significantly increase leaf growth.

This result agreed with the results obtained by Sharma *et.al*. (1986). Shatanawi (1994) used rock dams, contour stone bunds, trapezoidal bunds and earth contour bunds to increase soil moisture around the trees planted on steep lands, he found that better growth was obtained by olive and almond trees. Hernandez *et al*., showed that micro catchment water harvesting increased the height and (development of canopy) number of leaves of *Psydium guajava*. The reduced growth of plants in this study concurs with the widely accepted recognition that lower soil moisture content reduces photosynthesis, growth and survivability of plants (Kozlowski et al. 1991; Condit 1998). This study supports the view that an increase in water availability results in a significantly increase in growth of plants on the basis of both plant height and new leaves.



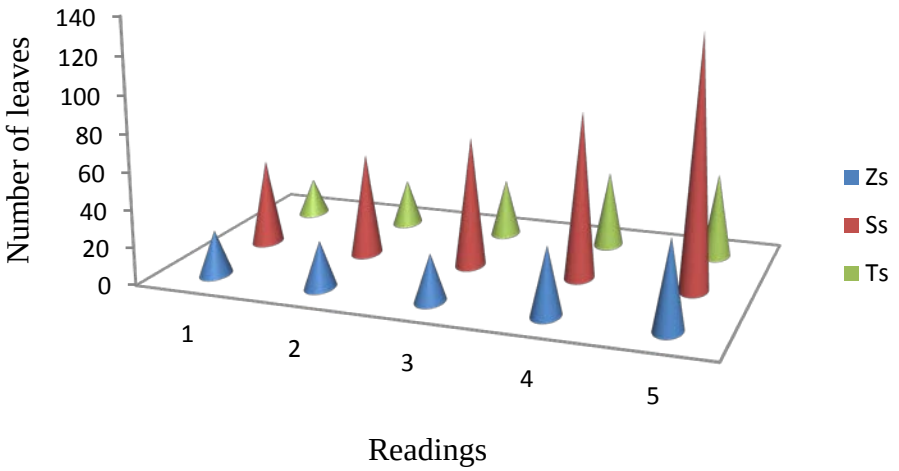


Figure 3 : Variation in number of leaves of the three trees species planted in the pits and semi circle treatments.

Where: Where: Zp: *Zizpihus spina -christi,* planted in the pits, *Sp*: *Acacia senegal,* planted in the pits, Tp: *Acacia tortilis subsp. raddiana*, planted in the pits, Zs: *Zizpihus spina -christi,* planted in the semi-circle, Ss: *Acacia senegal,* planted in the semi- circle, and Ts: *Acacia tortilis subsp. raddiana*, planted in the semi-circle.

c) *The effect of micro catchments on the diameter of seedlings*

The diameter of seedlings (Figure 4) the best mean was recorded by *Acacia senegal* followed by *Zizpihus spina christi* and *Acacia tortilis subsp. raddiana.* In all cases the pits were better than semi-circles catchments. . Diameter of seedlings for the tree species planted in the pits was larger than the same species planted in the semi-circles.

These results agreed with the results of Hamid (2004), and the results of Pacey and Cullis, (1986) who showed that the effective use of micro catchments water harvesting systems in growing trees and shrubs. Salih and Inanga, (1997) showed that Water harvesting techniques as contour diking proved to increase sorghum and *Acacia senegal* growth in Butana area especially for trees. Xiao-Yan Li *et al.,* (2005) showed that water harvesting treatments had a pronounced effect on the growth characteristics of *T. ramosissima*. Tree height, crown diameter and collar girth were significantly higher ($P < 0.05$) for the water harvesting treatments than the controls.

This obviously agreed with the result obtained in this study. The results of this study clearly indicated that the reforestation in this region is possible using micro catchment systems. Also this study demonstrated the potential of rain water harvesting and conservation methods in enhancing growth of trees under semi desert conditions. However, the application of various rain water methods depends on local rainfall characteristics, construction materials, site conditions, and installation methods.

Water harvesting has proved to be a valuable tool, especially in dry marginal areas to establish trees and to allow reforestation .It makes the best use of available water resources and supplements other sources.

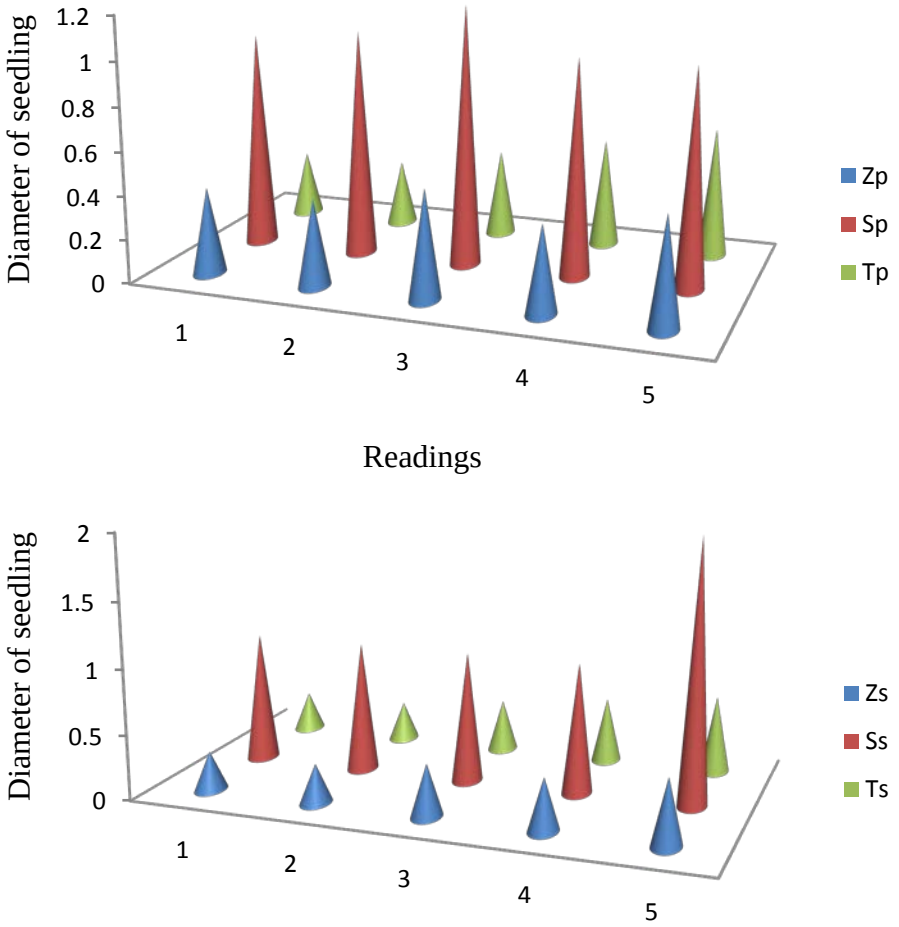


Figure 4 : Variation in diameter of seedlings for the three trees species planted in the pits and semi circle treatments.

Where Where: Zp: *Zizpihus spina -christi,* planted in the pits, *Sp*: *Acacia senegal,* planted in the pits, Tp: *Acacia tortilis subsp. raddiana*, planted in the pits, Zs: *Zizpihus spina -christi,* planted in the semi-circle, Ss: *Acacia senegal,* planted in the semi- circle, and Ts: *Acacia tortilis subsp. raddiana*, planted in the semi-circle.

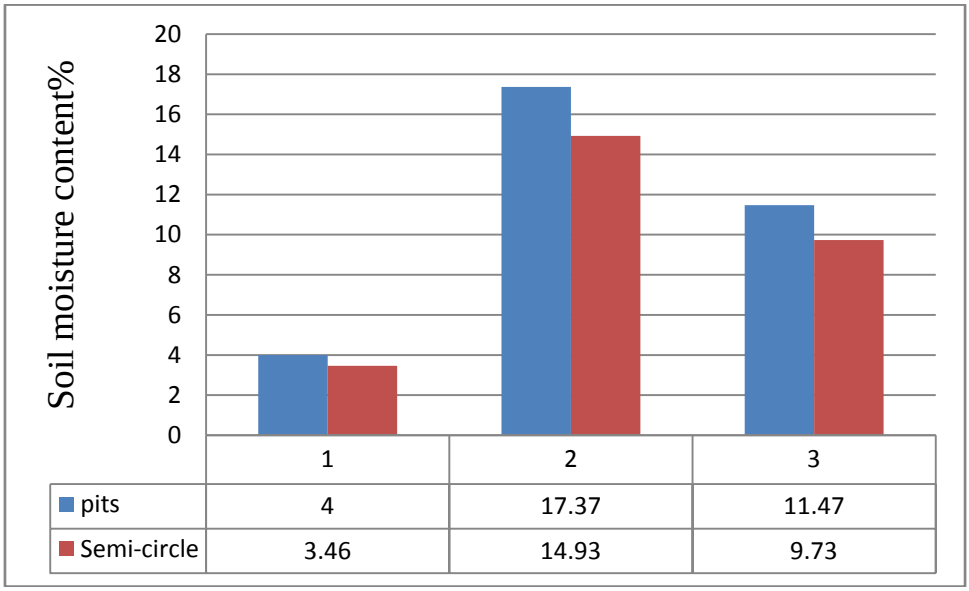
d) The effect of micro catchments on soil moisture content

The soil moisture content (Figure 5.a, b, and c) for the 1st, 2nd, 3rd readings showed no significant difference due to type of micro catchments. The highest values were given by pits micro catchments. The effect of water harvesting on soil moisture was obvious in the middle of the rainy season, while it's low in the first and end of the rainy season. The micro catchments techniques showed to be most effective in enhancing the plant production and growth. It was also the best technique to retain soil moisture which allowed the plants to continue growing in spite of the high evaporation rates during the dry season. The reason for the low moisture content measured in this study may be related to the fact that the study area is located in the semi desert region, and the main characteristic of the climate in this region is the erratic nature of the rainfall in terms of distribution, intensity and periods of episodes. The soil moisture content closely depends on the amount of rainfall during the rainy season. This technique has proved to be a valuable tool especially in dry marginal areas to boost reforestation. Moisture stress, however, remains a major constrains. Semi-arid areas are characterized by low poorly distributed and highly variable rainfall and it is almost impossible to plant trees in these areas without some form of water management (Rocheleau *et al*., 1988). Insufficient moisture greatly hinders tree development and survival; roots are still relatively shallow and young tree cannot take advantage of deeper ground water. Of the few options available, water harvesting technology is currently the most economical means by which survival of young seedling can be enhanced (Hai, 1996).

The results of this study were agreed with the results obtained by Gupta (1995) who showed that the use of micro catchment systems in forestry plantations can significantly increase soil moisture storage, tree

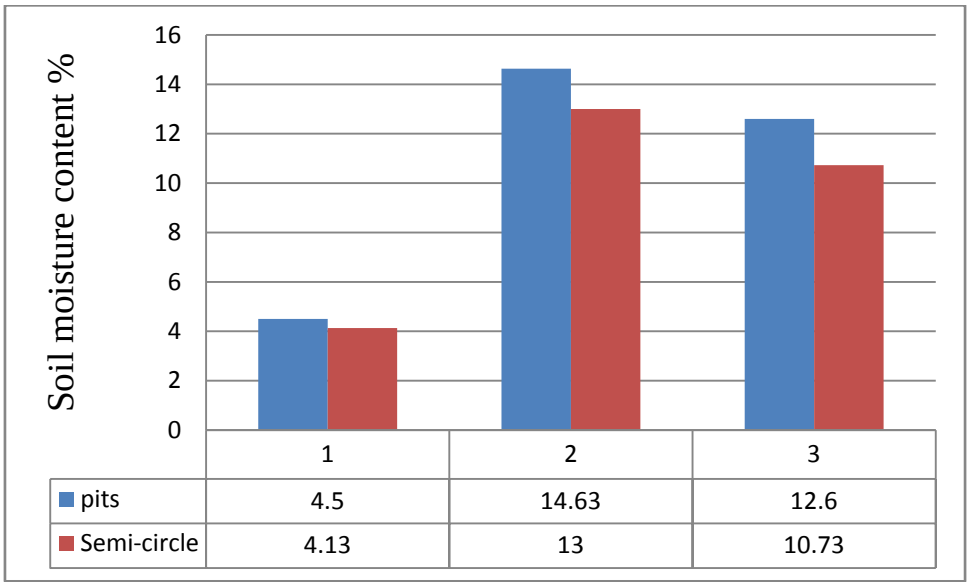
growth, accumulated biomass, root growth, nitrogen uptake, and phosphorous uptake over traditional planting methods. Suleman *et al.,* (1995) achieved increases in soil moisture content of 59% from 0-15cm, 63% from 15-30cm, and 80% from 30-45cm in Pakistan through the use of micro catchment systems in soils with high clay and silt contents. Moisture and its availability using water harvesting techniques proved efficient in many cases in Western Sudan, Omer and Eltighani, (1997) used different tillage systems and found that it resulted in improved soil physical properties pertaining to water conservation. Aldon and Springfield, (1975); Boers and Ben-Asher, (1982); Sharma *et al*., (1986); Brooks *et al.,* (1991) who reported that micro catchments water harvesting techniques can be successful in years of normal or above normal rainfall and are best suited for situations in which drought-resistant trees or other drought hardy perennial species are grown.

A-for soil depth 0-30cm



	1	2	3
pits	4	17.37	11.47
Semi-circle	3.46	14.93	9.73

B for soil depth 30-60cm



	1	2	3
pits	4.5	14.63	12.6
Semi-circle	4.13	13	10.73

C for soil depth 60-90cm

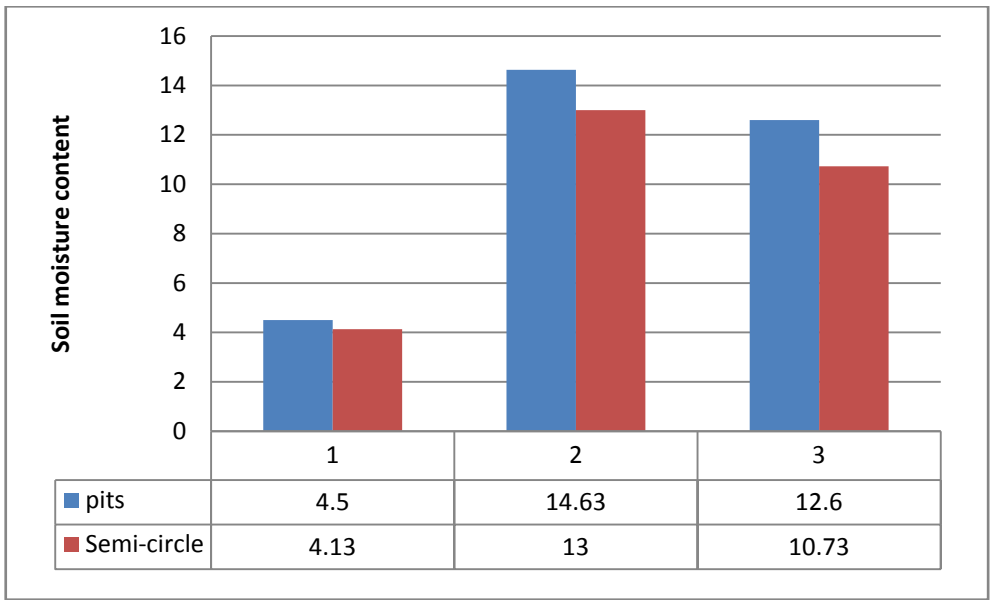


Figure 5 : Variance Analysis of the soil moisture content for the pits and semi-circles of different depth (cm)

V. Conclusions

The results of this study revealed that pits water harvesting techniques method proved to be more effective in enhancing soil moisture and produced better growth of the trees species studied.

The growth variables of the three species planted in the pits is better than semi circle.

The soil moisture content is higher in the pits than in the semi circle.

The pits water harvesting technique showed to be the most effective in enhancing the trees growth. It was also the best technique to retain soil moisture which allowed the trees to continue growing in spite of the high evaporation rates during the dry season.

The pits method shows great promise in increasing tree establishment rates. This method can greatly aid trees through helping to harvest rainwater and protecting them.

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

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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.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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

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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.

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Key points to remember:

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- Please note the criterion for grading the final paper by peer-reviewers.

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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.

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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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