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Design of Sewer Collection Network System

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Abstract: *Urban areas are characterized with dynamic change in terms of demography, land use, living standards of inhabitants, increase in per capita water demand and consequently in the waste water that is discharged from households and industries. The study designed hydraulic sewer collection network system in some selected areas of Maiduguri, Borno State Nigeria using PVC pipes with varying diameters ranging from 150mm - 600mm depending on the expected flow rates for the areas. Population Forecast for 10 years design period was adopted and Geometric Progression Population Forecasting Method was used for the prediction of the population growth pattern. The study observed highest flows rate of 46.4, 36.64 and 80.14 litres per second at pipe P1, P4 and P9 respectively. This is due to proximity of pipes from the wastewater source. However, lowest flow rates of 0.50, 1.57 and 7.26 litres were recorded from pipes P13, P12 and P3 respectively. Because of the distance from the source. Furthermore, lowest demands were also observed from junction J3 and J4 with a demand of 10LPS*

Key words: *Design, Network, Hydraulic, and Sewer*

Introduction

A sewerage system is a system that contains pipes of several lengths and diameters, which are very important to convey the wastewater, including domestic, residential, industrial and commercial treatment services (Ansari et al., 2013). Sewerage system plays a critical role in that it supports public health and environmental protection. Normally, the wastewater flow in the sewerage system is directly related to human usage for all kind of activities. A sewerage system is composed of various sewer lines terminating at the junction of a large sewer line. The large sewer line also terminates at the junction of a still larger sewer line. Finally, the main sewer line terminates at the outfall. Thus, a sewerage system can be viewed as a set of sewer lines collecting discharges at their nodal points and emptying into another set of sewer lines. In this paper attention is focused on the optimal

design of a sewer line, which is a basic unit of a sewerage system. The problem consists of minimization of a nonlinear cost function subjected to nonlinear constraints.

In developing countries the sewage disposal is not given proper priority so treatment and disposal of sewage is still area of major concern. Untreated sewage from cities and towns is the biggest source of pollution of water bodies in third world countries (CPCB Highlights, 2001). In India there are 211 Sewage Treatment Plants (STPs) in 112 of the 414 Class I cities and 31 STPs in 22 of the Class II towns (CPCB Highlights, 2005). Besides, 27 STPs are in 26 other smaller towns. In all there are 267 STPs, Including 231 operational and 38 are under construction. There remain 302 Class I cities and Class II towns together generate an estimated 29129 ml/day sewage (Nadeem et al., 2008). Against this, installed sewage treatment capacity is only 6190 ml/day. There remains a gap of 22939 ml/d between sewage generation and installed capacity. In percentage this gap is 78.7%. Another 1742.6 ml/day capacity is under planning or construction stage. If this is also added to existing capacity, even then there is gap of 21196 ml/day (equal to 72.2%) in total sewage treatment capacity.

Camp (1946) was the first to emphasize the need for hydraulic design of sewers, which was neglected in the technical literature at that time as well as by the sewage works engineers. Since then a large number of research workers contributed to this subject. These approaches employed heuristic methodologies, which can be adapted on a microcomputer (Liebman 1967; Cook and Lockwood 1977; Mays 1978; Lorine 1982: Dasher and Davis 1986; Miles and Heaney 1988; Charalambous and Elimam 1990). Using dynamic programming, Argaman et al. (1973), Merritt and Bogan (1973), and Walsh and Brown (1973) affected the design. Using piecewise linearization, the problem was solved by linear programming by Dajani et al. (1972), Dajani and Hasit (1974), and Elimam et al. (1989). On the other hand, Jain (1987) and Tyagi (1989) used a sequential linear programming method to find the sewer diameters. Gupta et al. (1976) used Powell's method of conjugate directions to search the optima of the cost function.

All these approaches use the Manning equation or Hazen- Williams's equation for resistance description. The Manning equation is applicable for a limited bandwidth, 0.004–0.04, of relative roughness (Christensen 1984). ASCE (1963) has disapproved the Manning equation and recommended the use of the Darcy-Weisbach equation for open-channel resistance. On the other hand, in a detailed study Liou (1998) strongly discouraged the use of the Hazen-Williams equation.

Sewerage networks are an important part of the infrastructure of any society. The main purpose of providing the sewer network is to carry away sanitary waste from a municipal area in such a way that it does not cause any public health related problems. It is known that urban sewerage system provide one of the basic infrastructure facilities to transport sanitary waste to sewage treatment plant. Sewerage network infrastructure conveys wastewater used by individuals, commercial and industrial establishments to wastewater treatment facilities, ultimately to be returned to the natural environment. A sewerage network is just a reverse action of water supply network. The cost of laying a sewerage system is appreciably high compared to the water supply system. It involves a large cost with need for daily maintenance, and the operational coast is one of the major expenditures (Katti et al, 2015).

Sewer systems are important for a modern city, but are often overlooked because of difficulty of maintenance, monitoring, and rehabilitation caused by underground burial.

However, sewages are apt to get cracks and defects due to corrosive wastewater inside and complex surroundings outside.

Serious cracks and leaks may result in the inflow to sewer treatment plants exceeding the design rate due to infiltration of rainfall or underground water. Also, the leakage of sewerage from failed pipes may cause a health hazard with the possible contamination of groundwater and soil. Negligence concerning these failures increases maintenance and rehabilitation costs significantly. In order to prevent worse failures and continue to provide designed functions, regular rehabilitation of sewages is necessary (Hernebring et al., 1998). Pipe rehabilitation can reduce either water infiltration into or leakage of sewage and increase the efficiency of treatment facilities and wastewater reuse opportunities (Wirahadikusumah et al., 1998; Bakir, 2001; Gupta et al., 2001). In addition to the construction of new municipal infrastructure, to appropriately allot limited budget on rehabilitation of the present infrastructure is another important job (Abraham et al., 1998; Sægrov et al., 1999; Gokhale and Hastak, 2000; Gupta et al., 2001; Ariaratnam and MacLeod, 2002). Generally, sewage authorities adopt a simple rehabilitation strategy that allots rehabilitation capital to "critical sewers", which are those pipes where collapse repair costs could be expected to be the highest (Fenner, 2000). In Taiwan, city governments used to fix all failed pipes (both critical and non-critical pipes) to keep the sewage system in good condition. However, when financial support runs into a limit, an optimization model to find the best sewerage rehabilitation plans becomes a valuable tool. Many researchers indicate that both rehabilitation method and substitution material affect rehabilitation cost and service life when sewage rehabilitation is executed (Ouellette and Schrock, 1981; Reyna, 1993; Gupta *et al.,* 2001).

Decentralized sewage treatment system (DTS)

DTS is the system in which instead of collecting whole sewer of town at one place and treating it, it provides small treatment units on site at many places. DTS provides treatment of waste water flows from 120 to 1200kl/d (kilo litre per day) or even more from domestic sources (CPHEEO, 1987). It is based on principal of anaerobic fermentation. The selection of which has been determined by its reliability, longevity, easy control and least maintenance. Actually in DTS the partial treatment is given to the sewage water as it can be utilized in urban agriculture irrigation purpose with drip or sprinkle irrigation technique instead of disposing it in to the streams (BORDA, 1998). So this small scale treatment plant can give real benefits in terms of money without polishing sewage with advance treatment like Activated Sludge Process etc. In this system a balance between the advantages of large scale treatment in terms of Economics of scale and individual Responsibility for domestic waste water treatment can be obtained by providing colony wise/sector wise treatment system. Demonstration plants using onsite DTS should be promoted throughout the developing nations for which not only Government Agencies and Non-Governmental Organizations (NGOs) but also progressive builders and resident welfare association may show the way.

Methodology

Population Forecast for 10 years design period was adopted.

Geometric progression population forecasting method (equation 3.1) was used due to the nature of rapid population growth pattern of the city.

$$P_t = P_o (1 - \frac{r}{100})^t \quad (3.1)$$

Table 3.1: Population forecasting

Zone(Maiduguri)	Population for design	
	Present Population	Future population in 10 years
Umarari	65,000	105879
Ngarannam	52,000	84,702
Total		190581

EPANET Software was used to determine the following:

- Pipe properties (roughness, diameter, length)
- Nodal properties (demand, elevation)
- Reservoirs, Tanks (location, elevation, operating levels, shape, volume)
- Pumps (operational/efficiency profile, scheduling)
- Patterns (diurnal demand profiles)

The key outputs from a network simulation include the spatial and temporal variation of:

- Nodal pressure/head
- Pipe flow
- Tank levels
- Energy consumption (pumping)
- Water quality (including age and chemical concentrations)

EPANET Hydraulic Pipe Layout and Analysis

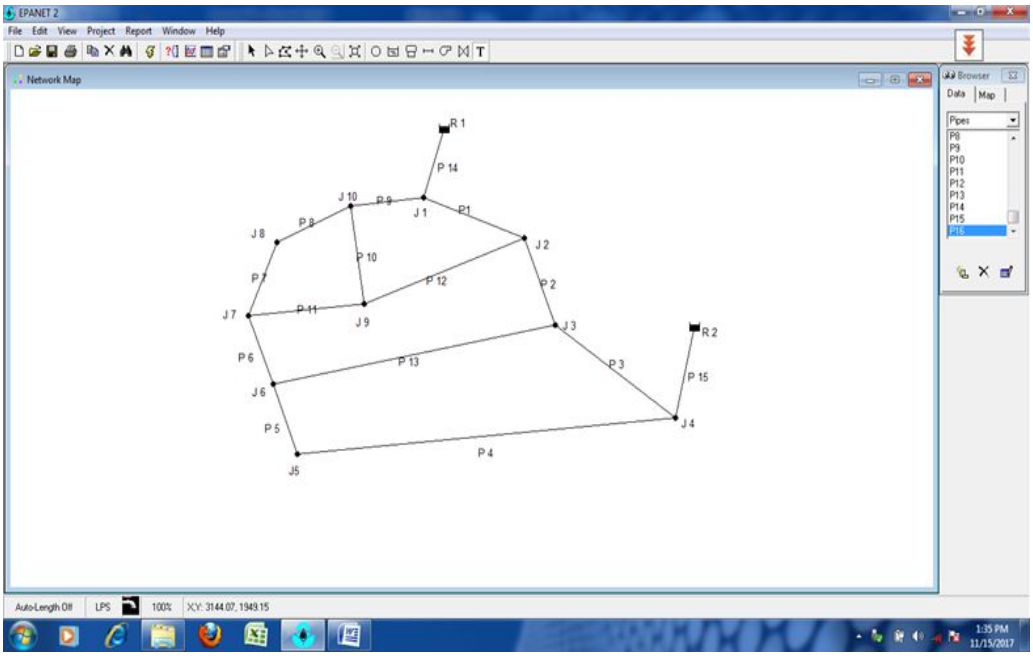

Figure 3.1: EPANET Runner Network Analysis

Designed Data for the sewer system

Table 3.2 Design Data for sewer Sanitary Pipe Sizing

Item	Value
Total population	190581
Expected water consumption per design	150 Litres per day
Total amount of water consumed	150 ×190581 = 2858710l/d
Wastewater produced (85% of water consumed becomes wastewater)	0.85 × 190581 = 161993.85
Adopted Peaking Factor, P.F	3.0
Discharge Q = wastewater produce × P.F	161993.85 × 3.0 = 485982 l/d
Assuming 80% of the population contributes to the wastewater generated	485982× 0.8 = 388785 l/d

Table 3.2: Time Range expressed in Percentage Wastewater Generated

7:00am – 8:00am	15% of 388785 = 58,317 l/d
8:00am – 5:00pm	5% of 388785 = 194,39 l/d
5:00pm – 6:30pm	20% of 388785 = 777.57 l/d
6:30pm – 7:00am	60% of 388785 – 233,271/d

Where
P_t=Expected Population
P_0 = Base years' population (i.e. 2006 census figure)
r =population annual growth rate which is estimated as 5% for urban area.
t = number of year from base years

The projected population is shown in Table 3.1 as computed from equation 3.1

Table 4.1: Flow and velocity of network links

Link ID	Length (m)	Diameter (mm)	Flow (Litres/Sec)	Velocity (m/s)	Unit Head Loss(m/k)
Pipe P1	1760	300	-46.41	0.12	0.10
Pipe P2	518	300	-12.06	0.13	0.09
Pipe P3	1340	300	-7.26	0.30	0.29
Pipe P4	2280	300	-36.64	0.58	1.00
Pipe P5	450	300	10.36	0.16	0.08
Pipe P6	466	300	16.28	0.27	0.22
Pipe P7	1890	300	-10.73	0.70	1.19
Pipe P8	1200	350	0.50	0.33	0.30
Pipe P9	692	300	80.14	0.59	1.24
PipeP10	1480	300	-30.27	0.02	0.01
PipeP11	623	300	-1.57	0.53	0.66
PipeP12	1650	300	-45.43	1.22	3.14
PipeP13	1680	300	-25.62	0.02	0.01
PipeP14	712	600	130.05	0.24	1.42
PipeP15	250	600	101.20	0.60	0.11

The pipes that have higher rate of flows reflect the proximity of these pipes to the pipes closed to source of supply. It can be observed that the pipes having the highest flows are P1, P4 and P9, the pipes having flows of 46.41, 36.64 and 80.14 litres per second respectively.

Table 4.2: water requirement and pressure heads at nodes.

I.D.	Demand(LPS)	Head (m)	Elevation	Pressure (m)
Junction J1	32.00	350.59	325.70	24.89
Junction J2	20.00	350.69	325.50	25.19
Junction J3	10.00	350.88	323.00	27.88
Junction J4	10.00	351.39	331.80	19.59
Junction J5	20.00	351.30	333.60	17.70
Junction J6	15.00	353.15	332.40	20.75
Junction J7	45.00	352.03	333.30	18.73
Junction J8	25.00	356.01	336.00	20.01
Junction J9	35.00	350.47	335.50	14.97
Junction J10	45.00	350.47	334.00	16.47
Reservoir1	93.50	354.00	330.00	24.00
Reservoir2	76.20	344.30	320.30	24.00

The demand was distributed to all junction depend on demand of each junction, for J3 and J4 with the lowest demand of 10LPS each due their less demand from the nodes. The highest demand was given to junction 7 and 10 with flows of 45LPS and 45LPS each respectively.

Conclusion

The study design hydraulic sewer collection network system in some selected areas using PVC pipes with varying diameters ranging from 150mm - 600mm depending on the expected flow rates for the areas. Based on the design, the following conclusions were drawn:

i. The study observed highest flows rate of 46.41, 36.64 and 80.14 litres per second at pipe P1, P4 and P9 respectively. This is due to proximity of pipes from the wastewater source.
ii. Lowest flow rates of 0.50, 1.57 and 7.26 litres were recorded from pipes P13, P12 and P3 respectively. Because of the distance from the source.
iii. Lowest demands were also observed from junction J3 and J4 with a demand of 10LPS.

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Performance Evaluation of a Motorized Groundnut Sheller

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Abstract: *Performance evaluation of a motorized groundnut Sheller was carried out to determine the efficiency of the machine, mechanical loss, and weight of shelled and unshelled groundnut and chaff weight in kilogram (kg). Two varieties of groundnut were used "Dan Kaduna" and "Dan Dakar". A 7kg of unshelled groundnut was bought and both of the varieties are divided into five portions, the weight of each portion were measured with weighing machine, and the result was recorded in a tabular form. The nut of the first portion was 2.5kg, and it was shelled at 50 seconds, the second portion also has the weight of 2.5kg, but it was shelled at 54 seconds. The third, fourth and fifth sets were recorded following the same procedure. The weight of the chaff was also measured in kilogram (kg). However, mechanical loss on both varieties of groundnut was calculated by subtracting the weight of shelled groundnut from the weight of unshelled groundnut (kg).The machine efficiency was determined by dividing the output by the input multiplied by 100% which gave us 67%. Finally, some recommendations were made: future researchers needs to carryout researches using a sieve of smaller diameter, the use of at least three (3) different varieties of groundnut be used and Government should provide an instrument like tachometer for universities and polytechnics to make things easier in determining the exact machine efficiency, due to high cost of the instrument.*

Key words: *Shelling, Motorized, Evaluation and Groundnut.*

1. Introduction

Groundnut (*Arachis hypogea*) is the sixth most important oil crop in the world (Ikechukwu *et al*., 2004). The major groundnut producing countries include India, Burma, China, Nigeria, Senegal, Sudan, and United state of America. With a world average yield of 1.4 metric tons per hectare (ha) (Madhusudhana, 2013). Shell of groundnut is a fundamental process as it allows the kernel and hulls to be available for use. It constitutes about 38% post harvest cost. (Butts *et al*., 2009). Traditional shelling method has been found to be inefficient, laborious, time consuming and result in low output (Gitau *et al*., 2013). Hence there is need for motorized shellers. Abubakar and Abdulkadir, (2012) categorized factors that affect groundnut shellers into three types, first are machine base that include a cylinder speed, concave clearance and fan speed. Next are crop factors such as; moisture contents, size and orientation. Last are operational based factors like feed rate, Operators

skills and experience performance of groundnut are evaluated by some measurable dependent variables. The most often used parameter includes throughput, shelling, efficiency, winnowing, or cleaning efficiency and mechanical charge.

Studies to determine optimum operating condition for shellers have been done using different design of experiment and varied result have been obtained (Gamal *et al*., 2009). Investigated the effect of moisture content on groundnut maximum stress, deformation and toughens. (Helmy *et al*., 2007) modified a rotary shellers into a reciprocating one and determined optimum shelling speed and feed rate of 1.4m/s and 160kg/hr respectively. Adedeji and Ajuebor, (2002) determined the best shelling speed. Concave clearance and feed rate for a motorized groundnut Sheller and evaluated the influence of moisture content, impeller fungal Bambara groundnut Shellers. There has been limited research work on comprehensive groundnut Sheller performance that involves the combined influence of four or more factors and levels lead to large number of experiment, using one factor at a time method when dealing with several variable fails to consider any possible factor interactions, hence it is less efficient than other method based on statistical approach to design (Ballal *et al*., 2012).

Groundnut shelling is a fundamental process in post harvest management. Motorized shelling experience less than 100% shelling efficiency and vary level of kernel damage. From the research, throughput per unit power consumption and shelling efficiency increased with reduction in percent moisture content (mm) with maximum output realized at 60% kernel mechanical damage decreased with increase in percent moisture content up to a minimum at between 15% and 18% moisture content then increased marginally with further rise in moisture content. Mean while, throughput per unit power consumption increased with bulk density of groundnut variety been shelled. In addition kernel pod diameter ratio had a significant influence on the output parameter under study. All the three output under review rose exponentially with increase in feed rate. Throughput per unit power consumption and shelling speed with the highest value obtained at a shelling speed about 12m/s. kernel mechanical damage remain low (less than 4%) for speed below 8m/s and then rose sharply with further increase in speed. All the output parameter increase with reduction in concave clearance with maximum values obtained at 10mm clearance. Steel and rubber paddles yielded the highest throughput per unit power consumption. At low shelling speed (less than 8m/s) rolling rubber and steel pipes resulted in lowest shelling efficiency and kernel mechanical damage, but a high speed resulted into both shelling efficiency and kernel mechanical damage.

2. Materials and Methods

2.1 Testing performance

It was explained by the fact that, the bigger the opening in the chamber, the more pods that can be shelled per revolution. Trains on a manual sheller showed that, in both rubber tyre and wood paddle shellers feed rate of between 50-100 kg/hr at an average of 75 rpm does not significantly affect the shelling performance (Chinsuwa, 1983).

2.2 Shelling Shaft Speed

The testing begins with selection of a desired output shelled kernel per unit time. A kernel throughput of 20kg was deemed adequate for experimental purpose and translates into 100kg kernel in two hours, an amount equivalent to the average Kenyan groundnut yield per hectare as indicated in the introduction section. Determination of shelling shaft speed,

in the revolution per minute (rpm) was done by considering groundnut characteristic of volume and both bulk and solid densities of pods and the sieve in shelling chamber was set to enable computation of the volume of pods shelling per unit revolution.

2.3 Shelling Performance

Groundnut were made ready or experiment by sorting and cleaning by hand removal of defective pods and unwanted materials like solid and stone particles. The nut were then divided into five different groups, each portion were measured on the weighing machine.

2.4 Feed Rate

A sliding gate in the form of rectangular plate fitted on one set of the slanting surface of the conical hopper was used to regulate the feed rate.

A fixed weight of groundnut was shelled at various gate positions and the corresponding feed rate in kilogram per hour (kg/hr) was recorded. In the first set of the experiment, a fixed quantity of 2.5kg in 50 second at pre-set level of moisture content, shelling blade type. Computation of shellers was done as described in section 2.3. The second; third, fourth and fifth sets of experiments were carried out in similar manner to the first one, but at feed rate of 2.4kg/54 seconds 2.3kg/57 seconds, 2.2kg/50 seconds and 1.9kg/48 seconds.

2.4.1 Shelling Speed

From the literature review, motorized shellers are commonly run at shaft speeds of between 160 rpm and 400 rpm, 350 rpm, 480 rpm and 580 rpm. The selected shaft are attained by mounting pulleys available on the world market with diameter range of 100mm to 250mm interchangeably on the two ends of fan shaft. Belt of appropriate length are utilized to transmit power from the fan shaft to the shelling shaft. Velocity ratio and belt length formulae are used to calculate the diameter and lengths of the required pulleys and belts for experiments.

Actual speeds during operation are measured by the use of tachometer. Five (5) levels of experiments are carried out in this section with a replication of three for each experiment; in the first level a specified weight of groundnut were shelled at a shaft speed of 150 rpm at a selected level of moisture content, variety, feed rate, concave clearance and shelling blade type. In the second, third, fourth and fifth level of experiment speed of 250 rpm, 350 rpm 480 rpm and 580 rpm are applied (Butts *et al.,* 2009).

Tangential velocity changes proportionally with radius of the shelling blade for a given constant angular speed. Hence there are tangential velocities for the shaft speed to obtain the shelling speed for the blade. The following formulae are used;

$$V = wr$$

$$w = \frac{2\pi N}{60}$$

Where:

V= tagential velocity

w= angular velocity

r= shelling blade radius

N= shaft in revolution per minute

Table 2.1 showing shaft speed, N (rpm) and tangential shelling speed, V (m/s)

Shaft speed, N (rpm)	Tangential Shelling Speed, V (m/s)
150	3.2
250	5.3

350	7.4
480	10.1
850	12.2

Source: Nyaanga *et al.,* (2007)

Concave Clearance

Concave clearances are normally determined by measuring the distance between the shelling blades and concave sieve at the point where clearance was at a maximum.

Shelling Blade Type

In most experiments five types of blades are employed. The first type was made of iron paddle having a curved shape of radius 20mm and thickness of 2mm, length of 420mm and distance of 32mm along the circumference, the second type was similar to the first, but with paddle curved with strips of rubber. Thirdly, steel pipe acted as the shelling blade. The thickness of the pipe was 2mm with a diameter of 10mm. the fourth type as similar to third but with extra circumscribe pipe free to roll around it axis. The fifth type consisted of pipe covered with rubber strips.

3. Results and Discussions

3.1 Result

The result shows that machine through put per unit power consumption increases with decrease in groundnut moisture content. This could be explained by the fact that the dry pods were more brittle than the wet ones hence they fractured faster upon been subjected to impact and frictional force during the shelling process. Fewer motor revolutions were required to achieve complete shelling of a given quantity of groundnut pods with less moisture contain. The highest throughput per unit power consumption was achieved at 6% moisture content

Shelling efficiency was found to increased with reduction in moisture content with the highest efficiency been released at 6% moisture content. The explanation of influence of moisture content on throughput per unit power consumption explained above also hold true for shelling efficiency. According to Nyaaga *et al.,* (2007) pods with higher moisture content tend to fix instead of cracking and breaking hence leading to a higher percentage of unshelled groundnuts.

It was observed that kernel mechanical damage was highest at the lowest moisture content between 15% and 18% and the increased marginally with further increase in moisture content. (Nyaaga et *al.,* (2007).On the other hand, damage of kernels with very high moisture content was observed to occur by the way of splitting along the middle axis. This could be attributed to a decrease in seed mechanical strength as explained by Gamal *et al*; (2009).

3.2 Groundnut Variety

The following varieties of groundnut were used to carry out test under this section, i.e “Dan Dakar and Dan Kaduna”

They were chosen to represent a wide spectrum of pod and kernel physical characteristic such as size, density as presented in table 3.1

The result shows that the variety of "Dan Dakar" yielded the highest throughput per unit power consumption. It can also seen from the experiment that influence of the variety under investigation on shelling efficiency and low kernel mechanical damage follow the same pattern. The variety of "Dan Kaduna" resulted in both high shelling efficiency and low kernel mechanical damage as explained by Adedeji and Ajuebor, (2002).

Experiments were carried out on several physical characteristics of groundnut varieties under study indeed to explain the observation observed above. It can be infrared from the results that throughput per unit power consumption increase with pod bulk density of the variety of groundnut been shelled in most researches thus variety (G7 with the highest pod bulk density of 301.16kg/m^3 had the highest while ICGV 99658 with lowest pod bulk density of 212.43 kg/m3 had the second last lowest throughput per unit power consumption. Groundnut kernel pod diameter ratio proved to be vital characteristics as far as shelling efficiency and kernel mechanical damage are considered. Some result has shown that a high ratio translated into low shelling efficiency and a high kernel mechanical damage. Following is a possible explanation for this scenario. A low kernel to pod diameter ratio corresponds to a wider air space between the husk and the kernel.

This makes it relatively easier for the kernels to be released when the pods are fracture and they are less prone to impact and frictional force occasioned by the rotating shelling blades. In addition, kernel been heavier collides with greater momentum than a small one, making it more variable to cracking or splitting during shelling process. However the collision and rubbing action that generates the forces that result in the shelling of groundnut pods as well as the momentum of the shelling speed blade.
This would lead to an increase in throughput per unit power consumption, shelling efficiency and kernel mechanical damage.

Table 3.1 showing the variety, weight of unshelled groundnut, weight of shelled groundnut and chaff weight (kg)

Variety	Unshelled g/nut (kg)	Shelled g/nut (kg)	Time taken (s)	Chaff weight (Kg)
Dan Dakar	2.5	1.8	50	0.8
	2.5	1.7	54	0.7
	2.4	1.5	57	0.6
	2.3	2.0	46	0.9
	2.4	1.6	50	0.8
Dan Kaduna	2.2	1.2	50	0.7
	1.9	1.0	1mins 5sec	0.6
	1.9	1.5	48	0.9
	2.2	1.6	59	0.8
	2.4	1.4	47	1.0

Mechanical loss= weight of unshelled g/nut (kg) - weight of shelled g/nut (kg)
Therefore, mechanical loss in "Dan Dakar" groundnut is equal to:
2.5+2.5+2.4+2.3+2.4-1.8+1.7+ 1.5+2.0+1.6= 12.1-8.6=3.5kg
Mechanical loss in "Dan Kaduna" groundnut is equal to 2.2+1.9+1.9+2.2+2.4-1.2+1.0+1.5+1.6+1.4=10.6-6.7=3.9kg
Mechanical loss in "Dan Kaduna" groundnut is 3.9kg, so in general, our mechanical loss is equal to:
=22.7-15.3=7.4kg
Machine efficiency =$\frac{\text{output}}{}$ ×100%

Input

= 15.3/22.7

=0.674×100%

=67%

Therefore, the machine efficiency is equal to 67%

3.3 Discussion

Table 3.1 shows the weight of shelled, unshelled and chaff differences in each of the varieties are different. As indicated in the table, the percentage of mechanical loss in “Dan Kaduna groundnut” is greater than that of “Dan Dakar” because of their differences in shape and size. The size of "Dan Kaduna" variety is bigger than the size of "Dan Dakar". However, the percentage of unshelled groundnut is higher in "Dan Dakar" because of their smallness in size. The sieve used under this research work has a larger diameter and some of the nut of “Dan Dakar” variety to escape unshelled due to their smallness in size. It has also been observed that the time taken in the process of shelling also differs due to the following reasons:

This had happened in the process of putting the groundnut to the hopper, because each set of the groundnut were not put to the machine at uniform time. Secondly, well dried groundnut can be shelled faster than partially dried groundnut some set of the groundnut had a much percentage of partially dried groundnuts than other sets. For this reason, the moisture content in the partially dried groundnut leads to the decrease in time during shelling process. The machine efficiency was calculated by dividing the output by the input multiplied by 100%. Finally, the mechanical loss was also calculated, by subtracting the shelled nut in kilogram (kg) from the unshelled nuts in kilogram (kg).

4. Conclusion

Finally, the objectives of this research work have been achieved, considering the result from this research work. The study shows that the groundnut and machine characteristic considered, influenced the throughput per unit power consumption, machine efficiency, kernels mechanical loss, weight of unshelled groundnut, weight of shelled groundnut and weight of the chaff in Kilogram (kg).

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Deficit Irrigation as a Technique for Maximizing Irrigation Water Productivity in Water-Scarce Regions: A Review

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Abstract: *In water limited areas , irrigation is essential for economic viability of individual producers and for the region. Irrigation practice at present and in the near future will shift from laying emphases on production per unit area towards maximizing production per unit water applied or consumed that is water productivity.The effects of water stress on crop growth and grain yield depend on the timing and magnitude of water stress as well as crop type, since different crops have different levels of tolerance to water stress.Litrature revealed that, modelling is useful tool to study and develop deficit irrigation strategies that would allow a combined assessment of different factors affecting yield in order to derive optimal irrigation quantities for different scenarios. Several papers were reviewed with common consensus that deficit irrigation reduces nutrient loss through leaching from the root zone, resulting in improved ground water quality and lower fertilizer needs on the field. However, by using deficit irrigation strategies, that is adoptation of water stress at certain developmental periods could benefit yield and quality in fruit tree and vine production, and also is a way of maximizing water use efficiency for higher yields per unit of irrigation water used in agriculture. Deficit irrigation defined as the application of less water than that required by plant, is an important tool of reducing irrigation water use and thereby maximizing irrigation water productivity. Since water scarcity is one of the key problems for crop production in arid and semi-arid regions, thus achieving great values of water use efficiency is more reasonable than maximum yield. Therefore, moderate to mild deficit irrigation, that is soil water between 60 to 70 percent is recommended by many researchers. Although a certain reduction in yield is observed.*

Key words: *Deficit irrigation, Water productivity, Water stress and Full irrigation.*

Introduction

In water limited areas, irrigation is essential for the economic viability of individual producers as well as for the region. Irrigation provides supplemental water for the crop, augmenting depleting stored soil water when precipitation is insufficient to meet crop water demands. Crop water requirements depend on several factors, including crop type, variety, and growth stage; soil water and nutrient availability; soil physical and chemical properties; micrometeorological conditions (i.e., evaporative demand); among others. Unfortunately, applying irrigation to meet full water requirements is not always an option due to the effects of drought, declining groundwater levels, reduced stream flow, water

allocations, insufficient irrigation system design capacity, load management (Rudnick et al., 2017).

Deficit irrigation

Deficit irrigation is a strategy that is often used when water is limiting factor (Rogers, Lawson and Kelly, 2016). It is a technique whereby crops are deliberately allowed to sustain a certain degree of water stress during tolerant growth stages (often the vegetative stages and the late ripening period), while ample water is applied during drought sensitive stages. The practice of deficit irrigation requires a precise knowledge of the crop yield response to water (Fereres and Soriano, 2007). Total irrigation application is therefore not proportional to irrigation requirements throughout the crop cycle. While this inevitably results in plant drought stress and consequently in production loss, deficit irrigation (DI) maximizes irrigation water productivity, which is the main limiting factor (English, 1990). In other words, DI aims at stabilizing yields and obtaining maximum water productivity (WP) rather than maximum yields (Zhang and Oweis, 1999). RDI is generally defined as an irrigation practice whereby a crop is irrigated with an amount of water below the full requirement for optimal plant growth; this is to reduce the amount of water used for irrigating crops, improve the response of plants to the certain degree of water deficit in a positive manner, and reduce irrigation amounts or increase the crop water use efficiency. In another words, it the application of less water than that is required by the plant. Reduced yield as the result of deficit irrigation, especially under water limiting situations, may be compensated by increased production from the additional irrigated area with the water saved by deficit irrigation (Ali et al., 2007).

Benefits of deficit irrigation

Deficit Irrigation causes maximization of water productivity with good harvest quality, it creates less humid environment for the crop, decreasing the risk of certain diseases (e.g fungi) in comparison with full irrigation (Cicogna et al., 2005), reduces the loss of nutrients due to reduction in leaching of the root zone, which result in better quality of the ground water table (Unlu et al., 2006), influencing Product Quality_ the effects of deficit irrigation on end use quality of products are inconsistent, varying with crop species or the quality traits evaluated. Tomato crop grown under partial root-zone deficit irrigation increased solid content and improved taste and sensory quality (Zegbe- Dominguez et al. 2003); and maintaining or increasing plant yield.

Deficit irrigation applied at the early growth stage or partial root-zone deficit irrigation has been shown to maintain or even increase yields in many field crops. Mild water deficit applied in the early stage is shown to enhance the level of drought resistance later in the life cycle and consequently maintain (Liu et al. 2006a) or even increase plant yields (Cui et al. 2009b; Xue et al. 2006).

Classification of deficit irrigation

According to Ali et al., (2007), deficit irrigation is classified into the following levels:

severe water deficit—soil water less than 50 % of the field capacity;

moderate water deficit: soil water between 50 to 60 % of the field capacity; mild water deficit: soil water between 60 to 70 % of the field capacity; no deficit (full irrigation): soil water is generally greater than 70 % of the field capacity during the plant growth period, and over-irrigation: the amount of water irrigated is greater than what plants required for optimal growth.

Deficit irrigation and water productivity

When water supplies are limiting, the farmer's goal should be to maximize net income per unit water used rather than per land unit. Recently, emphasis has been placed on the concept of water productivity (WP), defined here either as the yield or net income per unit of water used in ET (Kijne et al., 2003). WP increases under DI, relative to its value under full irrigation, as shown experimentally for many crops (Zwart and Bastiaansen, 2004; Fan et al., 2005). There are several reasons for the increase in WP under DI. Figure 1 presents the generalized relationship between yield and irrigation water for an annual crop. Small irrigation amounts increase crop ET, more or less linearly.

Fig. 1. Generalized relationships between applied irrigation water, ET, and crop grain yield. IW indicates the point beyond which the productivity of irrigation water starts to decrease, and IM indicates the point beyond which yield does not increase any further with additional water application.

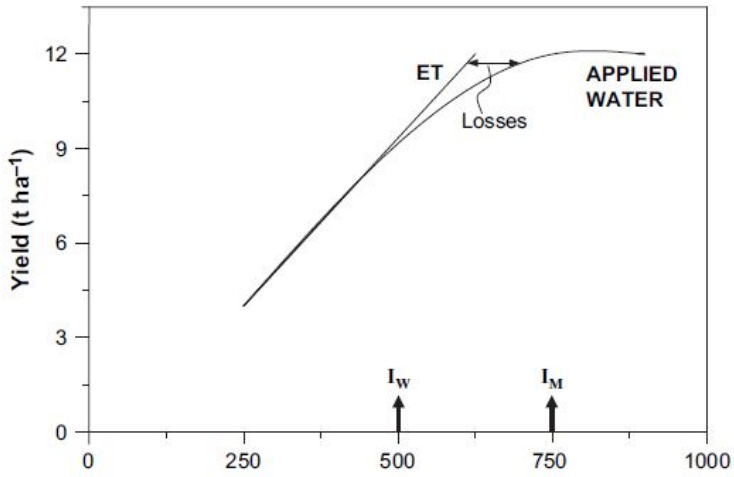

Figure 1: ET or Applied Irrigation Water (mm)

Source: Rudnick et al., (2017)

Deficit irrigation in annual crops

Harvestable yield of annual crops is normally a fraction of the biomass produced (Evans, 1993). Water deficits, by affecting growth, development, and carbon assimilation, reduce the yield of most annual crops (Hsiao and Bradford, 1983). The reduction in yield by water deficits is caused by a decrease in biomass production and/or by a decrease in the fraction

of biomass that is harvested, termed the harvest index (HI). It should be noted that here reference is only made to above ground biomass production. This is because, in most studies, information on roots is scant, given the difficulties in quantifying root biomass under field conditions. Past research has shown that the response to water deficits very much depends on the pattern of stress imposed (Dorenboos and Kassam, 1979). In one pattern that has been frequently used, the water deficit increases progressively as the season advances due to a combination of the uniform application of a reduced amount and the depletion of the soil water reserve.

Deficit irrigation in fruit trees and vines

Deficit irrigation so far has had significantly more success in tree crops and vines than in field crops for a number of reasons (Fereres et al., 2003). First, economic return in tree crops is often associated with factors such as crop quality, not directly related to biomass production and water use. The yield-determining processes in many fruit trees are not sensitive to water deprivation at some developmental stages (Johnson and Handley, 2000). Because of their high water productivity (WP), tree crops and vines can afford high-frequency, micro-irrigation systems that are ideally suited for controlling water application and thus for stress management (Fereres and Goldhamer, 1990).

Moreover, experiments with regulated deficit irrigation (RDI) have been successful in many fruit and nut tree species such as almond (Goldhamer et al., 2000), pistachio (Goldhamer and Beede, 2004), citrus (Domingo et al., 1996; Gonza´lez-Altozano and Castel, 1999; Goldhamer and Salinas, 2000), apple (Ebel et al., 1995), apricot (Ruiz-Sa´nchez et al., 2000), wine grapes (Bravdo and Naor, 1996; McCarthy et al., 2002), and olive (Moriana et al., 2003), almost always with positive results. Thus, there is sufficient evidence at present that supplying the full ET requirements to tree crops and vines may not be the best irrigation strategy in many situations (Fereres and Evans, 2006).

Plant physiological responses to deficit irrigation

Stomata are pores on leaf surfaces through which plants exchange CO_2, water vapour, and other constituents with the surrounding environment. In general, stomatal conductance depends on stomatal density and size, and more stomata will provide more pores for transpiration. Under the given conditions, water stress caused by deficit irrigation may result in stomatal closure and thus reduce transpiration rate. Many researchers have reported that stomatal density responds to various environmental factors and water deficit leads to an increase in stomatal density and a decrease in stomatal size, indicating an adaptation to drought (Zhang *et al.*, 2006; Martinez *et al.*, 2007). A study on a perennial grass (*Leymus chinensis*) showed that moderate water deficits had positive effects on stomatal number but more severe deficits led to a reduction (Xu and Zhou, 2008). Furthermore, research on peanut suggested that soil drying reduced stomatal aperture and stomatal conductance but increased WUE, and the response was different among different peanut genotypes under moderate or mild water stress (Songsri *et al.*, 2013). The research progress in determining Wang et al. (2007) reviewed the genes regulating stomatal density and the possibility of increasing plant WUE. It appears that manipulating stomatal density

may be a more amenable approach than manipulating stomatal behaviour in achieving a better plant WUE.

The effects of water stress on crop growth and grain yield will depend on the timing and magnitude of water stress as well as crop type, since different crops have different levels of tolerance to water stress (Irmak and Rudnick, 2014). For many field crops the most critical period of water stress is during the transition from vegetative to reproductive growth or from flowering to fruit setting (Doorenbos and Pruitt, 1977). For example, the critical period of water stress on corn is during the early reproduction period. Çakir (2004) reported that a 66 to 93% yield reduction could be expected as a result of prolonged water stress during the tasseling and ear formation growth stages.

Plant response to water stress and implication for irrigation water saving

Stomata of plant leaf close when the leaf potential declines below a threshold value. This is manifestation of the development of plant water deficit. Stomatal closure can cause marked but indirect effect on cell metabolism; changes in CO2 influx, water loss, leaf temperature and solute transport within the plant (Zhang *et al*., 1990). Evidences showed that, stomatal regulation process works through a chemical signal; the increased concentration of abscisic acid (ABA), in the xylem flow from roots to shoots controlling transpiration (Zhang *et al*. 1991). Reduction of evapotranspiration to decrease crop water requirement or reducing irrigation requirement has been a long-standing goal in arid and semi-arid regions. In some cases, the reduction of transpiration is accompanied with a reduction in photosynthesis; the water use efficiency of the plant is, therefore, unaffected (Zhang *et al*., 1990).

Modeling as a tool for assessing and developing deficit irrigation strategies

Examining the yield response to different water applications in field and/or controlled experiments is laborious and expensive. Nor can such experiments cover all possible combinations of differential drought stress or all environmental aspects affecting yield. Moreover, differential response to drought stress during different phenological stages can cause considerable scatter in the crop water productivity (CWP_c) function. Against this background, modeling can be a useful tool to study and develop promising DI strategies. it allow a combined assessment of different factors affecting yield in order to derive optimal irrigation quantities for different scenarios (Liu et al., 2007). Furthermore, Sepaskhah and Akbari (2005) and Sepaskhah et al. (2006) developed a model with probability distributions for the amount of irrigation that should be applied for wheat and cotton in Iran.

It should be mentioned, however, that the quality and general applicability of derived DI strategies largely depends on the validity of the models describing crop growth and yield response to water, and these can only be derived from qualitative fieldwork. Dogan et al. (2007) mention their negative experiences with the modeling of soybean, which made it impossible to derive reliable DI strategies. When using models in different locations and for different crops, one should always be aware of the boundary conditions that were used when a particular model was developed and calibrated.

Deficit irrigation effects

The effects of water stress on crop growth and grain yield will depend on the timing and magnitude of water stress as well as crop type, since different crops have different levels of tolerance to water stress (Irmak and Rudnick, 2014). In deficit irrigation application, the crop is exposed to a certain level of water stress either during a particular growth period or throughout the whole growing season, without significant reductions in yields (FAO, 2000). The expectation is that the yield reduction by inducing controlled water stress will be insignificant compared with the benefits gained through diverting the saved water to irrigate additional cropped area (Kirda et al., 1999; Gijón et al., 2007). According to Birhanu and Tilahun, (2012) studies on deficit irrigation level have positively influenced marketable yield of tomato, with tomato yield decreasing as the water deficit level increased.

Effects of deficit irrigation, compared to full irrigation on water use efficiency and crop yields in some selected arid and semiarid areas are presented in the table below:

Author	Year	Region	Crop	Effects
Bekele and Tilahun	2007	Ethopia	Onion	6-13% increase in WUE
Yactayo et al.	2013	Lima, Peru	Potatoes	Saved water consumption by 32–54 % over full irrigation with early deficit application without yield penalty
Casa and Rouphael	2014	Portici, Italy	Tomato	WUE (in terms of marketable yield per unit of actual evapotranspiration) did not differ in crop yield.
Ma et al.	2014	Gangu, China	Wheat	Decreased grain yield by 43 % due to water stress imposed during reproductive growth stage
Li et al. (2010a)	2010	Yangling, China	Maize	Saved water by 11–32 %; increased canopy WUE by 10–42 %
Du et al.	2008	Minqin, Gansu	Cotton	Increased cotton yield by 5–21 % over full irrigation, due to improved harvest index

Advantages and constraints of deficit irrigation

The main advantage of deficit irrigation is that, it maximizes the productivity of water. Although a certain reduction in yield is observed, the quality of the yield (e.g. sugar content, grain size) tends to be equal or even superior to rain-fed or full irrigation (FI) cultivation (Hueso and Cuevas, 2008). In areas where water is the limiting factor for crop production, maximizing water productivity (WP) by deficit irrigation (DI) is often economically more profitable for the farmer than maximizing yield. Moreover, irrigated yields can be stabilized

at a particular level, guaranteeing a stable income for the farmer and allowing economic planning. An additional advantage is that deficit irrigation creates a less humid environment around the crop than full irrigation (FI), decreasing the risk of fungal diseases (Cicogna et al., 2005).

Reducing irrigation applications over the crop cycle will also reduce nutrient loss through leaching from the root zone, resulting in improved ground water quality (Unlu¨ et al., 2006) and lower fertilizer needs on the field. Field observations indicate that crops under serious drought stress during the season might still produce reasonable yields when only a small amount of fertilizer is applied. Over-fertilization may cause crops to be more susceptible to dry spells and may lead to decreased harvest indexes (Garabet et al., 1998). On the other hand, FI can only result in high yields if sufficient N-fertilizer is applied (Pandey et al., 2000). This indicates that each DI strategy has its optimum fertilizer level (Cabello et al., 2009).

Another benefit of deficit irrigation (DI) is the possibility of controlling sowing dates by irrigation, which allows improved planning of agricultural practices (Oweis et al., 1998). If a common irrigation strategy is adopted in a region, peaks in irrigation water supply will occur during drought sensitive stages. This might result in under-irrigation of land at the tail end of the irrigation network, causing more severe yield reductions than anticipated. Using modeling, Oweis and Hachum (2001) demonstrated that thanks to the higher level of crop cycle control and the lower sensitivity to climate resulting from (deficit) irrigation, sowing dates can be staggered, thus reducing peak supply by 20%. In this way, basin-wide WP is increased.

Due to drought stress in particular growth stages, the length of the cropping cycle might change under rain-fed cultivation. Farre´ and Faci (2006) report a delay in flowering (7 and 17 days) and maturity (5 and 12 days) for sorghum and maize, respectively, under water deficit conditions. McMaster and Wilhelm (2003) find that drought decreases crop cycle length for wheat and barley. Geerts et al. (2008) demonstrate that differences in the crop cycle length of quinoa between DI and FI are negligible. Under rain-fed conditions, the crop cycle length of quinoa may increase substantially if severe drought stress occurs before flowering. By controlling the length of the crop cycle (deficit) irrigation allows improved planning of agricultural activities.

Along with these advantages, DI also entails a number of constraints. The use of DI requires that the following conditions are met:

crop response to drought stress should be studied carefully (Hsiao, 1973). Determining optimal timing of irrigation applications is particularly difficult for crops with CWP functions in which maximal WP is found within a small optimum range of ET;

irrigators should have unrestricted access to irrigation water during sensitive growth stages. This is not always the case in large block designs (Zhang, 2003) or during periods of water shortage;

a minimum quantity of irrigation water should always be available for application (Geerts et al., 2008). This is not always possible in extremely dry regions where irrigation water is scarce (Enfors and Gordon, 2008).

Finally, DI can only be successful if measures are taken to avoid salinization. By using DI strategies, over-irrigation only rarely occurs. Therefore, leaching of salts from the root zone is lower under DI than under FI (Geerts et al., 2008).

Deficit irrigation management

According to Rudnick et al. (2017), one strategy for managing deficit irrigation consists of trying to mitigate the impact of water stress on crop growth and grain yield by withholding water at growth stages that are less sensitive to water deficit as compared to others. This strategy is often practiced when there are pumping restrictions (e.g., water allocations), yet no constraints limiting the system's ability to meet peak ET demands. However, under situations when peak ET demands cannot be met, such as insufficient irrigation system capacity, water availability restrictions, and/or irrigation scheduling delays, adopting a percentage of full irrigation requirement strategy may be more appropriate. Other alternative irrigation strategies available to producers that are subjected to water limitations include:

i. planting crops that match the available water supply (i.e., less water demanding crops),

ii.planting the desired crop on a reduced area in combination with a less water demanding crop, and

iii. reduce the total irrigated area and substitute with fallow or a dry land crop (Martin et al., 1989; Klocke et al., 2006; Klocke et al., 2011).

Conclusion

Based on the literature reviewed on deficit irrigation, the following conclusions were drawn:

i. Deficit irrigation reduces nutrient loss through leaching from the root zone, resulting in improved ground water quality and lower fertilizer needs on the field.
ii. By using deficit irrigation strategies, that is adoptation of water stress at certain developmental periods could benefit yield and quality in fruit tree and vine production, and also is a way of maximizing water use efficiency for higher yields per unit of irrigation water used in agriculture
iii. Modelling can be a useful tool to study and develop deficit irrigation strategies that would allow a combined assessment of different factors affecting yield in order to derive optimal irrigation quantities for different scenarios.
iv. Mild water deficit applied in the early stage enhances the level of drought resistance later in the life cycle and consequently maintained or even increase plant yields.

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Application of Correlation and Regressin Analysis on Student Performance in West African Examination Council (WAEC)

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Abstract: *The main aim of this research is to assess an* Applications of Correlation and *Regression Analysis on Student Performance in West African Examination Council (WAEC) Base on the finding it is revealed that the result of the analysis of correlation coefficient in table 4.1,4.3, and 4.5 shows a negative and weak correlation and table 4.2 and 4.4 show positive and weak correlation and the Test at 5% and 1% level of significance of correlation coefficient of both tables shows there is no significant difference in performance between maths and physics, and the covariance method of estimation of regression parameters for β1 shows there is a significant difference in student performance and β0 shows there is no significant difference.it also reveals that the regression equation, In table 4.1, 4.3 and 4.5its indicates that the graph is moving downward and it is also shown that there is a slight decrease in student performance, and also that the regression equation in table 4.2 and 4.4 its indicates that the graph is moving upward and it is also shown that there is a slight increase in student performance. It's recommended that the government would employ qualified teachers; Students would dedicate themselves to hard work and dedication to learning and Provision of more laboratory equipment to enhanced student and learning process.*

Key words: *correlation, Regression and performance .*

Introduction

Statistical knowledge is an important skill in today's' technological societies. Statistics is widely practiced in science, economics, engineering, social sciences, health, sports, and many others Razak F. A *etal* (2017).

A Binary Logistic Regression model is used to determine the probability of the student performing rate founded on the stated factors. These factors play a significant role at 5% level of significance. Thus, a Logistic Regression model to forecast the Academic Performance will be an effective tool for the decision-making method Surendheran R (2017).

Galadanci (2017) Presented that there is a statistically significant and strong nonnegative relationship between students' theoretical and practical scores as a result of which the null hypotheses were rejected.

Ahono T. A *et al* (2018) investigate that the research reveals that there was a statistically significant, weak, and positive correlation (r=.142, n=396, p=.005) between self-efficacy of expectation and Mathematics achievement. The findings showed that self-efficacy of expectation predicted the achievement in mathematics among secondary school students

Izaak (2015) Investigate that there is a positive relationship between concentration in Physics and knowledge of Mathematics basic ideas with students' ability to solve physics problems.

A weighted ordinary least square hierarchical multiple regression method was employed to the achieved quantity and quality of computer usage, significant predictors of achievement were established, Jehanzeb R. C (2013).

A significant relationship between self-concept and the respondents' academic performance in Mathematics was found by Merson P eta (2020)

Pearson's correlation coefficients of four independent are correlated with student's academic performance although two are not. Though, using the regression analysis four variables is significant which include: Time appropriateness, people-friend connection, nature of Usage, and health addiction while Time duration and security/privacy problems are not significant, Sandra (2016).

The results obtained by the analyses conducted revealed that there were significant relationships between the students' academic achievement and student engagement as well as between their academic achievement and especially the dimensions of cognitive engagement, behavioral engagement, and sense of belonging, Selim G, Y. Y (2014).

A relationship between two quantitative variables usually involves a discussion of correlation and regression. When data is expressed in a standardized form, correlation and regression methods can be described very simply. The difference between fitting a line to points, and regression, is clarified by this simpler presentation. The use of n-1 in formulas for the standard deviation and the correlation coefficient is an unnecessary complication Weldon K. L. (2018).

Bayesian classification technique is used on student database to predict the student's division based on former year database and the study also shows that academic performances of the students are not always depending on their effort. It shows that other factors have got significant influence over students' performance Brijesh K. B. (2011).

A Binary Logistic Regression model is used to determine the probability of the student performing rate founded on the stated factors. These factors play a significant role at 5% level of significance. Thus, a Logistic Regression model to forecast the Academic Performance will be an effective tool for the decision-making method Surendheran R (2017).

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Sandra (2016).

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2. Methodology

CORRELATION COEFFICIENT

The correlation coefficient.

$$r = \text{Cov}\,\frac{\sum(x,y)}{\sqrt{x}\sqrt{y}}$$

This is the formula of correlation coefficient.

$$r = \frac{\sum xy}{\sqrt{(\sum x)^2(\sum y)^2}}$$

Let x be $x - x$ and $y - y$

$$r = \frac{\frac{1}{N}\sum(x-x)(y-y)}{\sqrt{\frac{1}{N}\sum(x-x)^2((\sum x-x)^2)\times\frac{1}{N}\sum(y-y)^2((\sum y-y)^2)}}$$

$$r = \frac{\frac{1}{N}\sum(xy+xy-xy+xy)}{\sqrt{\frac{1}{N}\sum(x-x)^2((\sum x-x)^2)\times\frac{1}{N}\sum(y-y)^2((y-y)^2)}}$$

$$r = \frac{\sum xy\,\frac{\sum xy}{N}}{\sqrt{\frac{1}{N}\sum(x-x)^2((\sum x-x)^2)\times\frac{1}{N}\sum(y-y)^2-((y-y)^2)}}$$

$$r = \frac{N\sum xy-\sum x\sum y}{\sqrt{[N\sum x^2-(\sum x)^2\times N\sum y^2-(\sum y)^2}}$$

OF HYPOTHESIS FOR CORRELATION COEFFICIENT

H_o: $\rho = 0$

H_i: $\rho \neq 0$

In this, r has a student's t-distribution given by tcal = $\frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$ with n-2 degree of freedom we reject H_o. If tcal > t$\frac{\alpha}{2}$, n-2 degree of freedom or otherwise accept.

Decision Critical

Obtain $t_{\alpha/2}$, n-2 d.f if $t_{cal} > t_{\alpha/2}$, n-2.

The population correlation coefficient is often estimated, hence to test hypothesis concerning ρ this is the stage we try to test the null H_o: ρ = 0 in this case, ρ student's t-distribution is given by:

$$tcal = \frac{r\sqrt{n-2}}{\sqrt{1+r^2}}$$

With n-2 degree of freedom, were r is the sample correlation, n is the number of observation. In this case, if t_{cal} is greater than t_{tab} then we reject H_o: ρ = 0. Which is the null hypothesis and if t_{tab} is greater than t_{cal} then we accept H_o: ρ ≠ 0. Which is alternative hypothesis where is given significant level, and t_{tab} value with n-2.

SIMPLE LINEAR REGRESSION MODEL

The simplest linear regression model is given by

$$y = \beta_o + \beta_1 x + e. \quad \text{Where:}$$

x = independent variable

β_o = population that gives the intercept

β_1 = population that gives the gradient

e = random error

3.0 DATA ANALYSIS

This sections is the data analysis and it's finding where mathematics as the independent variable (x), while the other science subject is the dependent variable (y)

DECISION RULE:

H_0: There is a relationship between the two subjects.

H_1: There is no relationship between the two subjects.

3.1 COMPUTATION OF CORRELATION COEFFICIENT ON STUDENT PERFORMANCE (r) BETWEEN MATHS(x) AND PHYSICS(y) 2016 TABLE 3.0 ORIGINAL DATA

S/N	X	Y	x^2	y^2	xy
1	50	39	2500	1521	1950
2	60	70	3600	4900	4200

3	40	50	1600	2500	2000
4	50	80	2500	6400	4000
5	60	79	3600	6241	4740
6	75	60	5625	3600	4500
7	65	73	4225	5329	4745
8	67	80	4489	6400	5360
9	39	50	1521	2500	1950
10	50	60	2500	3600	3000
11	60	50	3600	2500	3000
12	70	60	4900	3600	4200
13	50	40	2500	1600	2000
14	40	50	1600	2500	2000
15	49	70	2401	4900	3430
16	39	59	1521	3481	2301
17	40	70	1600	4900	2800
18	60	80	3600	6400	4800
19	40	50	1600	2500	2000
20	50	70	2500	4900	3500
21	59	60	3481	3600	3540
22	50	90	2500	8100	4500
23	39	73	1521	5329	2847
24	70	49	4900	2401	3430
25	60	50	3600	2500	3000
26	39	90	1521	8100	3510
27	40	80	1600	6400	3200
28	50	59	2500	3481	2950
29	60	60	3600	3600	3600
TOTAL	1521	1851	83205	123783	97053

n = 29

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}$$

$$r = \frac{29(97053) - (1521)(1851)}{\sqrt{\left[29(83205) - (1521)^2\right]\left[29(123783) - (1851)^2\right]}}$$

$$= \frac{2814537 - 2815371}{\sqrt{(2412945 - 2313441)(3589707 - 3426201)}}$$

$$= \frac{-834}{\sqrt{(99504)(163506)}} = \frac{-834}{127551.9542} \Rightarrow r = -0.0065$$

REMARK

The relationship is negative and is also a weak correlation between maths and physics

TEST FOR SIGNIFICANCE OF CORRELATION COEFFICIENT AT α = 5% AND 1% LEVEL

Test statistics

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{-0.0065\sqrt{29-2}}{\sqrt{1-(-0.0065)^2}}$$

$$= \frac{-0.016(5.19615)}{0.99997} = -0.0338$$

Therefore t_{cal} = -0.0818

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 27 = 2.052

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.771

Remarks

The result shows that t_{tab} > t_{cal} that is 2.052>2.771, 2.771>-0.0338, 2.771>0.0338, therefore, H_0 is accepted and H_1 is rejected and concluded that there is no significant difference between the student performance in maths and physics in both 5% and 1% level of significance.

COVARIANCE METHOD OF ESTIMATION OF REGRESSION PARAMETERS

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 83205 - \frac{(1521)^2}{29}$$

$$= 83205 - 79773.82759 = 3431.1724$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 123783 - \frac{(1851)^2}{29}$$

$$= 123783 - 118144.8621 = 5638.1380$$

$$S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 97053 - \frac{(1521)(1851)}{29}$$

$$= 97053 - 97081.75862 = -28.7586$$

Where $b_1 = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{Sxx} = \frac{-28.75862}{3431.1724} = -0.0084$

$$\overline{X} = \frac{\sum x}{n} = \frac{1521}{29} = 52.4483$$

$$\bar{y} = \frac{\sum y}{n} = \frac{1851}{29} = 63.8276$$

$$b_0 = \bar{y} + b_1 x \bar{x} = 63.8276 + 0.44056 = 64.2682$$

$\hat{y} = b_0 + b_1 x = 64.2682 - 0.0084x$ Is the fitted regression line

THE VARIANCE OF ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$\sigma^2 = \sum e_i^2 = \frac{1}{n-2}\left(S_{yy} - b_1 S_{xy}\right)$$

$$= \frac{1}{27}\left(3431.1724 - (-0.0084)(-28.7586)\right)$$

$$\frac{1}{27}\left(3431.1724 - 0.241137\right) = 90.0345$$

$$Var(b_1) = \frac{\sigma^2 n}{S_{xx}} = \frac{90.0345}{3431.1724} = 0.0262$$

THE STANDARD ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$S.E(b_1) = \sqrt{Var(b_1)} = \sqrt{0.0262} = 0.162$$

$$Var(b_0) = \sigma^2\left(\frac{\bar{x}^2}{S_{xx}} + \frac{1}{n}\right)$$

$$= 90.0345\left(\frac{(52.4483)^2}{3431.1724} + \frac{1}{29}\right)$$

$$= 90.0345(0.8017 + 0.03448)$$

$$= 90.0345(0.8361) = 75.2853$$

STANDARD ERROR ABOUT β_0 IS GIVEN BY:

$$S.E(b_0) = \sqrt{\text{var}(b_0)} = \sqrt{75.2853} = 8.6767$$

TEST FOR REGRESSION PARAMETERS β_0 AND β_1

Test for hypothesis for β_0

$$t_{cal} = \frac{b_1 - \beta_{00}}{S.E(b_0)} = \frac{64.2682}{0.1620}$$

$$= 396.7173$$

Test statistic

$t_{tab} = t_{\frac{\alpha}{2},n-2} = 0.025,27 = 2.052$

$t_{tab} = t_{\frac{\alpha}{2},n-2} = 0.005.27 = 2.771$

REMARK:

The result shows that $t_{tab} < t_{cal}$ that is 2.052 < 396.7173 , 2.771<396.7173 ,therefore, H_0 is rejected and H_1 is accepted and concludes that there is no significant difference between the student performance in maths and physics in both 5% and 1% level of significance.

3.2 COMPUTATION OF CORRELATION COEFFICIENT (r) BETWEEN MATHS AND BIOLOGY 2016

TABLE 3.1 ORIGINAL DATA

S/N	X	Y	XY	X^2	Y^2
1	50	80	2500	6400	4000
2	60	40	3600	1600	2400
3	40	59	1600	3481	2360
4	50	89	2500	7921	4450
5	60	70	3600	4900	4200
6	75	39	5625	1521	2925
7	65	70	4225	4900	4550
8	67	45	4489	2025	3015
9	39	60	1521	3600	2340
10	50	70	2500	4900	3500
11	60	80	3600	6400	4800
12	70	73	4900	5329	5110
13	50	80	2500	6400	4000
14	40	40	1600	1600	1600
15	49	50	2401	2500	2450
16	39	60	1521	3600	2340
17	40	50	1600	2500	2000
18	60	70	3600	4900	4200
19	40	70	1600	4900	2800
20	50	50	2500	2500	2500
21	59	70	3481	4900	4130
22	50	50	2500	2500	2500
23	39	60	1521	3600	2340
24	70	70	4900	4900	4900
25	60	60	3600	3600	3600
26	39	70	1521	4900	2730

27	40	39	1600	1521	1560
28	50	59	2500	3481	2950
29	60	49	3600	2401	2940
TOTAL	1521	1772	83205	113680	93190

N = 29

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}}$$

$$r = \frac{29(93190) - (1521)(1772)}{\sqrt{\left[29(83205) - (1521)^2\right]\left[29(113680) - (1772)^2\right]}}$$

$$= \frac{2702510 - 2695212}{\sqrt{(2412945 - 2313441)(3296720 - 3139984)}}$$

$$= \frac{7298}{\sqrt{(99504)(156736)}} = \frac{7298}{124883.3814}, \Rightarrow r = 0.0584$$

REMARK

The correlation is positive but weak correlation

TEST FOR SIGNIFICANCE OF CORRELATION COEFFICIENT AT α = 5% AND α = 1% LEVEL

Test statistics

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.0584\sqrt{29-2}}{\sqrt{1-(0.0584)^2}}$$

$$= \frac{0.0584(3.196\grave{5})}{0.9983} = 0.3040$$

Therefore $t_{cal} = 0.3040$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 27 = 2.052

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.771

Remark

Since $t_{tab} > t_{cal}$ (2.052 > 0.3040, 2.771>0.3040), therefore (H_0) is accepted and H_1 is rejected and concluded that there is no significance difference between the student performance in maths and biology in both 5% and 1% level of significance.

COVARIANCE ESTIMATION OF REGRESSION PARAMETERS

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 83205 - \frac{(1521)^2}{29}$$

$$= 83205 - 79773.82759 = 3431.1724$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 113680 - \frac{(1772)^2}{29}$$

$$= 113680 - 108275.3103 = 5404.6897$$

$$S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 93190 - \frac{(1521)(1772)}{29}$$

$$= 93190 - 92938.34483 = 251.6552$$

Where $b_1 = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{Sxx} = \frac{251.6552}{3431.1724} = 0.0733$

$$\overline{X} = \frac{\sum x}{n} = \frac{1521}{29} = 52.4483$$

$$\overline{y} = \frac{\sum y}{n} = \frac{1772}{29} = 61.1034$$

$$b_0 = \overline{y} + b_1 \overline{x} = 61.1034 + (0.0733)(52.4483) = 61.1034 - 3.8445 = 57.2589$$

$$\hat{y} = b_0 + b_1 x_1 = 57.2589 + 0.0733 x_1 \text{ is the fitted regression line}$$

THE VARIANCE OF ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$\sigma^2 = \sum e_i^2 = \frac{1}{n-2}\left(S_{yy} - b_1 S_{xy}\right)$$

$$= \frac{1}{29-2}\left(3431.17724 - (0.0733)(251.6552)\right)$$

$$\frac{1}{27}(3412.7261) = 126.3973$$

$$Var(b_1) = \frac{\sigma^2 n}{S_{xx}} = \frac{126.3973}{3431.17724} = 0.0368$$

THE STANDARD ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$S.E(b_0) = \sqrt{Var(b_0)} = \sqrt{0.0368} = 0.1919$$

THE VARIANCE OF ERROR TERM ABOUT (β_1)

$$Var(b_0) = \sigma^2 \left(\frac{\overline{x}^{\,2}}{S_{xx}} + \frac{1}{n} \right)$$

$$=126.3973\left[\frac{(52.4483)}{3431.1724}+\frac{1}{29}\right]=126.3973\times 0.8362=105.6912$$

STANDARD ERROR TERM ABOUT β_1 IS GIVEN BY:

$$S.E(b_0)=\sqrt{\text{var}(b_0)}=\sqrt{105.6912}=10.2806$$

THE TEST FOR REGRESSION PARAMETERS β_0 AND β_1

$$t_{cal}=\frac{b_1-\beta_{00}}{S.E(b_0)}=\frac{57.2589}{0.1919}=298.3788$$

TEST STATISTIC

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 27 = 2.052

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.771

REMARK

The result shows that $t_{tab} < t_{cal}$ that is 2.052 < 298.37788, 2.771< 298.37788, therefore, H_0 is rejected and H_1 is accepted and conclude that there is significance difference between the student performance in Maths and Biology in both 5% and 1% level of significance.

TEST FOR HYPOTHESIS FOR β_1

$$t_{cal}=\frac{b_1-\beta_{10}}{S.E(b_1)}=\frac{0.0733}{10.2806}=0.0071$$

TEST STATISTIC

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 27 = 2.052

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.771

REMARK

The result shows that $t_{tab} > t_{cal}$ that is 2.052 > 0.0071, 2.771> 0.0071 therefore H_0 is accepted and H_1 is rejected and conclude that there is no significance difference between in Maths and Biology in both 5% and 1% level of significance.

4.3 COMPUTATION OF CORRELATION COEFFICIENT (r) BETWEEN MATHS AND CHEMISTRY 2017

TABLE 3.2 ORIGINAL DATA

S/N	X	Y	X^2	Y^2	XY
1	85	89	7225	7921	7565
2	83	39	6889	1521	3237

3	72	50	5184	2500	3600
4	50	65	2500	4225	3250
5	66	48	4356	2304	3168
6	80	43	6400	1849	3440
7	45	45	2025	2025	2025
8	58	58	3364	3364	3364
9	50	53	2500	2809	2650
10	40	40	1600	1600	1600
11	45	81	2025	6561	3645
12	50	73	2500	5329	3650
13	70	40	4900	1600	2800
14	39	88	1521	7744	3432
15	70	70	4900	4900	4900
16	66	39	4356	1521	2574
17	37	88	1369	7744	3256
18	60	80	3600	6400	4800
19	50	76	2500	5776	3800
20	60	60	3600	3600	3600
21	47	49	2209	2401	2303
22	70	90	4900	8100	6300
23	90	49	8100	2401	4410
24	49	42	2401	1764	2058
25	50	72	2500	5184	3600
26	70	80	4900	6400	5600
27	50	78	2500	6084	3900
28	80	39	6400	1521	3120
29	59	80	3481	6400	4720
30	73	66	5329	4356	4818
TOTAL	1814	1870	116034	125904	111185

N = 30

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}}$$

$$r = \frac{30(111185) - (1814)(1870)}{\sqrt{\left[30(116034) - (1814)^2\right]\left[30(125904) - (1870)^2\right]}}$$

$$= \frac{3335550 - 3392180}{\sqrt{(3481020 - 3290596)(3777120 - 3496900)}}$$

$$= \frac{-56630}{\sqrt{(190424)(280220)}} = \frac{-56630}{230999.1629} \Rightarrow r = -0.2452$$

REMARK

The correlation is negative but week correlation

TEST FOR SIGNIFICANCE OF CORRELATION COEFFICIENT AT α = 5% AND 1% LEVEL

Test statistics

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{-0.2452\sqrt{30-2}}{\sqrt{1-(-0.2452)^2}} = \frac{-0.245(5.2915)}{0.9695} = -1.3235$$

Therefore t_{cal} = -1.3235

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

Since $t_{tab} > t_{cal}$ (2.048 > -1.3235 and 2.763>-1.3235), therefore H_0 is accepted and

H_1 reject and conclude that there is no significant difference between the student performance in maths and chemistry in both 5% and 1% level of significance.

COVARIANCE METHOD ESTIMATION OF REGRESSION PARAMETERS

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 116034 - \frac{(1814)^2}{30}$$

$$= 116034 - 109686.533 = 6347.4667$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 125904 - \frac{(1870)^2}{30}$$

$$= 125904 - 116563.3333 = 9340.6667$$

$$S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 111185 - \frac{(1814)(1870)}{30} = 111185 - 113072.6667 = -1887.6667$$

Where $b_1 = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{Sxx} = \frac{-1887.6667}{6347.4667} = -0.2974$

$$\overline{X} = \frac{\sum x}{n} = \frac{1814}{30} = 60.4667$$

$$\overline{y} = \frac{\sum y}{n} = \frac{1870}{30} = 62.3333$$

$$b_0 = \overline{y} - b_1\overline{x} = 62.3333 - (-0.2974)(60.4667) = 80.3161$$

$$\overline{y} = b_0 + b_1 x_1 = 80.3161 - 0.2974 x_1 \ \textit{fitted the regression line}$$

THE VARIANCE OF ERROR TERM ABOUT (β_1) IS GIVEN BY:

$$\sigma^2 = \sum e_i^2 = \frac{1}{n-2}\left(S_{yy} - b_1 S_{xy}\right)$$

$$= \frac{1}{30-2}\left(6347.4667 - \left(-0.2974\right)\left(-1887.6667\right)\right)$$

$$\frac{1}{28}\left(6347.4667 - 561.3921\right) = 206.6455$$

$$Var(b_1) = \frac{\sigma^2 n}{S_{xx}} = \frac{206.6455}{6347.4667} = 0.0326$$

THE STANDARD ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$S.E(b_1) = \sqrt{Var(b_0)} = \sqrt{0.0326} = 0.1804$$

THE VARIANCE OF ERROR TERM ABOUT (β_1)

$$Var(b_0) = \sigma^2\left(\frac{\overline{x}^{\,2}}{S_{xx}} + \frac{1}{n}\right)$$

$$= 206.6455\left(\frac{(60.4667)^2}{6347.4667} + \frac{1}{30}\right) = 206.6455(0.57600 + 0.0333) = 125.9160$$

STANDARD ERROR TERM ABOUT β_1 IS GIVEN BY:

$$S.E(b_0) = \sqrt{\text{var}(b_1)} = \sqrt{125.9160} = 11.2212$$

THE TEST FOR REGRESSION PARAMETERS FOR β_0 AND β_1

Test Statistics

$$\frac{b_1 - \beta_{00}}{S.E(b_0)} = \frac{80.3161}{0.1804} = 445.2112$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

REMARK:

The result obtained shows that $t_{tab} < t_{cal}$ that is 2.048<445.2112, 2.763<445.2112, therefore, H_0 is rejected and H_1 is accepted and concludes that there is a significant difference between the student performance in maths and chemistry in both 5% and 1% level of significance.

Test Statistics

$$\frac{b_1 - \beta_{00}}{S.E(b_0)} = \frac{-0.2974}{11.2212} = -0.0265$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

REMARK:

The result obtained shows that $t_{tab} > t_{cal}$ that is 2.048>-0.0265, 2.763>-0.0265, therefore, H_0 is accepted and H_1 is rejected and concludes that there is no significant difference between the student performance in maths and chemistry in both 5% and 1% level of significance.

3.4 COMPUTATION OF CORRELATION COEFFICIENT (r) BETWEEN MATHS AND GEOGRAPHY 2017

TABLE 3.3 ORIGINAL DATA

S/N	X	Y	x^2	y^2	Xy
1	85	50	7225	2500	4250
2	83	60	6889	3600	4980
3	72	70	5184	4900	5040
4	50	45	2500	2025	2250
5	66	90	4356	8100	5940
6	80	60	6400	3600	4800
7	45	49	2025	2401	2205
8	58	50	3364	2500	2900
9	50	39	2500	1521	1950
10	40	63	1600	3969	2520
11	45	59	2025	3481	2655
12	50	39	2500	1521	1950
13	70	40	4900	1600	2800
14	39	39	1521	1521	1521
15	70	40	4900	1600	2800
16	66	48	4356	2304	3168
17	37	82	1369	6724	3034
18	60	39	3600	1521	2340

19	50	62	2500	3844	3100
20	60	58	3600	3364	3480
21	47	50	2209	2500	2350
22	70	66	4900	4356	4620
23	90	72	8100	5184	6480
24	49	55	2401	3025	2695
25	50	70	2500	4900	3500
26	70	59	4900	3481	4130
27	50	53	2500	2809	2650
28	80	49	6400	2401	3920
29	59	80	3481	6400	4720
30	73	90	5329	8100	6570
TOTAL	1814	1726	116034	105752	105318

N = 30

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}$$

$$r = \frac{30(105318) - (1814)(1726)}{\sqrt{\left[30(116034) - (1814)^2\right]\left[30(105752) - (1726)^2\right]}}$$

$$= \frac{3156540 - 3130964}{\sqrt{(3481020 - 3290596)(3172560 - 2979676)}}$$

$$= \frac{25576}{\sqrt{(190424)(193484)}} = \frac{25576}{191947.9023}$$

$r = 01332$

REMARK

The correlation is positive but weak correlation

TEST FOR SIGNIFICANCE OF CORRELATION COEFFICIENT AT α = 5% AND 1% LEVEL

Test statistics

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.1332\sqrt{30-2}}{\sqrt{1-(0.1332)^2}} = \frac{0.1332(5.2915)}{\sqrt{1-0.0177}} = \frac{0.7048}{0.9911} = 0.7112$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab} > t_{cal}$ that is 2.48> 0.7112, 2.763>0.7112, therefore, H_0 is accepted and H_1 is rejected and conclude that there is no significance in maths and Geography in both 5% and 1% level of significance

COVARIANCE ESTIMATION OF REGRESSION PARAMETERS

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 11634 - \frac{(1814)^2}{30} = 11634 - 109686.5333 = 6347.4667$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 105752 - \frac{(1726)^2}{30} = 105752 - 99302.5333 = 6449.4667$$

$$S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 105318 - \frac{(1814)(1726)}{30} = 105318 - 104365.4667 = 952.5333$$

Where $b_1 = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{Sxx} = \frac{952.5333}{6347.46667} = 0.1501$

$$\overline{X} = \frac{\sum x}{n} = \frac{1814}{30} = 60.44467$$

$$\overline{y} = \frac{\sum y}{n} = \frac{1726}{30} = 57.5333$$

$$b_0 = \overline{y} - b_1 \overline{x} = 57.53333 - (0.1501)(60.46667) = 57.5333 - 9.0761 = 48.4572$$

$$\overline{y} = b_0 + b_1 x_1 = 48.4572 + 0.150 x_1 \ \textit{fitted the regression line}$$

THE VARIANCE OF ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$\sigma^2 = \sum e_i^2 = \frac{1}{n-2}\left(S_{yy} - b_1 S_{xy}\right)$$

$$= \frac{1}{30-2}\left(6347.4667 - (0.1501)(952.5333)\right) = \frac{1}{28}\left(6347.4667 - 112.9552\right) = 222.6611$$

$$Var(b_1) = \frac{\sigma^2 n}{S_{xx}} = \frac{222.6611}{6347.4667} = 0.0351$$

THE STANDARD ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$S.E(b_1) = \sqrt{Var(b_1)} = \sqrt{0.0351} = 0.1873$$

THE VARIANCE OF EROR TERM ABOUT (β_1)

$$Var(b_0) = \sigma^2 \left(\frac{\overline{x}^{\,2}}{S_{xx}} + \frac{1}{n} \right)$$

$$= 222.6611\left(\frac{(60.4667)^2}{6347.4667}+\frac{1}{30}\right)=222.6611(0.576+0.0333)=222.6611(0.60933)=135.6741$$

STANDARD ERROR ABOUT β_1 IS GIVEN BY:

$$S.E(b_0)=\sqrt{\text{var}(b_0)}=\sqrt{135.6741}=11.6479$$

THE TEST FOR REGRESSION PARAMETERS β_0 AND β_1

Test Statistics

$$t_{cal}=\frac{b_1-\beta_{00}}{S.E(b_0)}=\frac{48.4572}{0.1873}=258.7144$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab} < t_{cal}$ that is 2.048<258.7144, 2.763<258.7144, therefore, H_0 is rejected and H_1 is accepted and conclude that there is significance in maths and Geography in both 5% and 1% level of significance

Test Statistics

$$t_{cal}=\frac{b_1-\beta_{10}}{S.E(b_1)}=\frac{0.1501}{11.6479}=0.0129$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab} > t_{cal}$ that is 2.048>0.0129, 2.763>0.0129 therefore H_0 is accepted and H_1 is rejected and conclude that there is no significance in maths and Geography in both 5% and 1% level of significance

3.5 COMPUTATION OF CORRELATION COEFFICIENT (r) BETWEEN MATHS AND AGRIC 2018

TABLE 4.4 ORIGINAL DATA

S/N	X	Y	X^2	Y^2	XY
1	85	70	7225	4900	5950
2	75	50	5625	2500	3750
3	63	90	3969	8100	5670
4	73	100	5329	10000	7300

5	72	83	5184	6889	5976
6	62	88	3844	7744	5456
7	70	86	4900	7396	6020
8	81	87	6561	7569	7047
9	73	78	5329	6084	5694
10	60	89	3600	7921	5340
11	82	88	6724	7744	7216
12	90	77	8100	5929	6930
13	43	75	1849	5625	3225
14	50	48	2500	2304	2400
15	98	67	9604	4489	6566
16	89	78	7921	6084	6942
17	75	91	5625	8281	6825
18	81	67	6561	4489	5427
19	63	55	3969	3025	3465
20	70	58	4900	3364	4060
21	73	39	5329	1521	2847
22	49	78	2401	6084	3822
23	80	69	6400	4761	5520
24	90	68	8100	4624	6120
25	54	83	2916	6889	4482
26	62	90	3844	8100	5580
27	72	76	5184	5776	5472
28	49	46	2401	2116	2254
29	45	59	2025	3481	2655
30	55	78	3025	6084	4290
TOTAL	2084	2211	150944	169873	154301

N = 30

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}}$$

$$r = \frac{30(154301) - (2084)(2211)}{\sqrt{\left[30(150944) - (2084)^2\right]\left[30(169873) - (2211)^2\right]}} = \frac{4629030 - 4607724}{\sqrt{(4528320 - 4343056)(5096190 - 4888321)}}$$

$$= \frac{21306}{\sqrt{(185264)(207669)}} = \frac{21306}{196146.8573} \quad \Rightarrow r = 0.1086$$

REMARK

The correlation is positive but weak correlation

TEST FOR SIGNIFICANCE OF CORRELATION COEFFICIENT AT α = 5% AND 1% LEVEL

Test statistics

$$t_{cal} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.1086\sqrt{30-2}}{\sqrt{1-(0.1086)^2}} = \frac{0.57465}{0.9941} = 0.5781$$

Therefore $t_{cal} = 0.2931$

$t_{tab}, t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

$t_{tab}, t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab} > t_{cal}$ that is 2.048>0.5781, 2.763>0.5781, therefore, H_0 is accepted and H_1 is rejected and concluded that there is no significance in maths and Agric in both 5% and 1% level of significance

COVARIANCE METHOD ESTIMATION OF REGRESSION PARAMETERS

$$S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n} = 150944 - \frac{(2084)^2}{30} = 150944 - 144768.5333 = 6175.4667$$

$$S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n} = 169873 - \frac{(2211)^2}{30} = 169873 - 162950.7 = 6922.3$$

$$S_{xy} = \sum xy - \frac{\sum x \sum y}{n} = 154301 - \frac{(2084)(2211)}{30} = 154301 - 153590.8 = 710.2$$

Where $b_1 = \frac{\sum xy}{\sum x^2} = \frac{S_{xy}}{Sxx} = \frac{710.2}{6175.4667} = 0.1150$

$$\overline{X} = \frac{\sum x}{n} = \frac{2084}{30} = 69.4667$$

$$\overline{y} = \frac{\sum y}{n} = \frac{2211}{30} = 73.7$$

$$b_0 = \overline{y} - b_1\overline{x} = 73.7 - (0.1150)(69.4667) = 73.7 - 7.98867 = 65.7113$$

$$\overline{y} = b_0 + b_1x_1 = 65.7113 + 0.115x_1 \ \textit{fitted the regression line}$$

THE VARIANCE OF ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$\sigma^2 = \sum e_i^2 = \frac{1}{n-2}\left(S_{yy} - b_1 S_{xy}\right)$$

$$= \frac{1}{30-2}\left(6175.4667 - (0.1150)(710.2)\right) = \frac{1}{28}\left(6175.4667 - 81.673\right) = 217.6354$$

$$Var(b_0) = \frac{\sigma^2 n}{S_{xx}} = \frac{217.6354}{6175.4667} = 0.03524$$

THE STANDARD ERROR TERM ABOUT (β_0) IS GIVEN BY:

$$S.E(b_1) = \sqrt{Var(b_0)} = \sqrt{0.03524} = 0.1877$$

$$Var(b_0) = \sigma^2\left(\frac{\bar{x}^2}{S_{xx}} + \frac{1}{n}\right)$$

$$= 217.6354\left(\frac{(69.4667)^2}{6175.4667} + \frac{1}{30}\right) = 217.6354(0.81472) = 177.31153$$

STANDARD ERROR TERM ABOUT β_1 IS GIVEN BY:

$$S.E(b_0) = \sqrt{\text{var}(b_1)} = \sqrt{177.31153} = 13.3158$$

THE TEST FOR REGRESSION PARAMETERS β_0 AND β_1

Test Statistics

$$t_{cal} = \frac{b_1 - \beta_{00}}{S.E(b_0)} = \frac{65.7113}{0.1877} = 350.0868$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab} < t_{cal}$ that is 2.048<350.0868, 2.763<350.0868, therefore, H_0 is rejected and H_1 is accepted and conclude that there is no significance in maths and Agric in both 5% and 1% level of significance

Test Statistics

$$t_{cal} = \frac{b_1 - \beta_{10}}{S.E(b_1)} = \frac{0.1150}{13.3158} = 0.0086$$

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.025,}$ 28 = 2.048

t_{tab}, $t_{\alpha/2}$. n-2 = $t_{0.005,}$ 27 = 2.763

Remarks

The result obtained shows that $t_{tab}>t_{cal}$ that is 2.048>0.0086, 2.763>0.0086, therefore, H_0 is accepted and H_1 is rejected and conclude that there is no significance in maths and Agric in both 5% and 1% level of significance.

4.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

4.1 SUMMARY

This project is summarized in five chapters, chapter one is the introduction, historical background of government girl's secondary school, aims and objectives, method of data collection, the significance of the study, scope, and limitation of the study, and definition of terms and concept used. Chapter two includes a literature review. Chapter three Methodology. Chapter four data analysis and chapter five Summary, Conclusion, and Recommendations.

4.2 CONCLUSION

From table 4.1 the result of the analysis of correlation coefficient r = -0.0065 which shows a negative and is also a weak correlation between maths and physics, Table 4.2 shows that r = 0.0584 which shows a positive and is also a weak correlation between maths and biology, Table 4.3 reveals that r = -0.2452 which shows a negative and is also a weak correlation between maths and Chemistry, From table 4.4 r = 0.1332 which shows a positive and is also a weak correlation between maths and Chemistry, From table 4.5 r = 0.10038 which shows a positive and is also a weak correlation between maths and agric.

Test at 5% and 1% level of significance of correlation coefficient of both tables shows there is no significant difference in performance between maths and physics, and the covariance method of estimation of regression parameters for β1 shows there is a significant difference in student performance and β0 shows there is no significant difference.

In table 4.1the regression equation it reveals that a = 64.2682 and b = -0.008, its indicates that the graph is moving downward and it is also shown that there is a slight decrease in student performance, and table 4.2 show the regression equation that a = 57.2589 and b = 0.0733, its indicates that the graph is moving upward and it is also shown that there is a slight increase in student performance, table 4.3 it reveals that the regression equation a = 80.3161 and b = -0.2974, its indicates that the graph is moving downward and it is also shown that there is a decrease in student performance, Table 4.4 found that the regression equation a = 48.4572 and b = 0.1501, its indicates that the graph is moving upward and it is also shown that there is a increase in student performance, Table 4.5 From the result of the regression equation, it reveals that a = 80.3161 and b = -0.2974, its indicates that the graph is moving downward and it is also shown that there is a decrease in student performance. Therefore in general the performance of the students is fluacting over the period of years. However the correlations indicate that student's performance shows independency. The government would employ qualified teachers. Students would dedicate themselves to hard work and dedication to learning. Provision of more laboratory equipment to enhanced student and learning process

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Modification Design and Construction of Small Size Hammer Mill

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Abstract: *A small size hammer mill was modified designed and constructed using locally available materials. The modification of the design was done in such a way that the hammer of the machine can be mounted directly onto the shaft of the prime mover (petrol engine) which replaced electric motor that is mostly used. This makes possible that the machine can be used without the need for electric source of power supply and also reduces cost of production and maintenance since use of transmission device such as the belt has been eliminated. Efficiency and fuel economy tests were carried out upon completion of the machine. It was found that the efficiency was 85% and with a liter of petrol the machine can mill about 60kg of maize. However, this largely depends on the ability of the operator.*

Key words: *hammer, milling, economy and efficiency*

Introduction

Cereals are main energy providers and give significant amount of protein, vitamins especially vitamin A and C, and minerals like potassium and calcium. Cereals are made into various forms in order for them to be consumed as food by human and animals, these forms include; paste, noodles cakes breads etc. depending largely on the ethnic group and culture of the people. The residues of the processed cereals are important in feeding animals (Ismail *et al.,* 2010). Cereals provide about 80% of the energy requirements in most parts of Africa. Cereals crops produced in larger quantity in Nigeria include maize, millet, sorghum and sugarcane. However, most of these cereals cannot be eaten without their sizes being reduced; this calls for the use of various methods and means of size reduction. In the ancient time, two stones were used to crush the cereal grains to the required sizes before they were prepared as a food for human consumption. But these were gradually replaced by modern tools such as grinding machines, and Hammer mills that are made from steel

material (Donnel, 1983). Most of the modern machines are power-driven and the availability and reliability of power supply presented serious challenge in the use of these modern machines. The unreliability and unavailability nature of the power supply has even hindered other economic activities in the country especially small business. Most businesses now decided to use on-site diesel powered generators as their means of power supply (Etukudor *et al.,* 2015). Nigeria's electricity capacity was lower than that of Slovakia, a country with about 3% Nigeria's population, the (Economist group, 2020).

Efforts have been made in the recent time, in design and construction of cereal size reduction machines. However, most of the machines developed have one problem or the other. Grinding machine that used two plates to crush the cereals grains for instance has the disadvantage that the part of plates goes into the ground product as a result of friction between the two plates. Other machines include hammer mills that used electric motor which need source of power supply (external), hammer mills that have many component parts etc.

This paper therefore, aimed at producing hammer mill of simple design that utilizes petrol engine (Prime Mover) instead of the electric motor that needs external source of power supply. The machine consists of few component parts as such it will be easier to operate and maintain.

Material and methods

Materials: The materials selection for the construction work is based on the availability of the material in the market, Cost, durability, malleability, rigidity and ease of fabrication. Therefore, mild steel sheet and angle- iron were chosen in the construction of the machine.

Methodology

The design method adopted in this work was conceptual design, which is based on analysis. The design analysis of various component parts was carried out and the machine was constructed according to the results obtained from the analysis.

Hub design

As the hammers are mounted directly onto the petrol engine shaft by means of a hub, there is no need to design the hammer shaft.

Hub is designed as a hollow shaft subjected to torsion. Thus

$$T = \frac{\pi}{16}\frac{(d_o^4 - d_i^4)}{d_o} \times \tau_h$$

Where τ_h = permissible shear stress in hub

d_o=outer diameter of hub

d_i=inner diameter 0f hub

Empirically

$d_o = 2d_i$ (i.e. outer diameter is twice the inner diameter or diameter of shaft)

$$t_n = \frac{d_o - d_i}{2}$$

The diameter of the petrol engine (Prime Mover) which is the d_i = 20mm

Therefore, d_h = 2x20mm = 40mm

The thickness of the hub $t_n = \frac{d_o - d_i}{2}$

$$t_n = \frac{40 - 20}{2} = 10mm$$

Hammer weight was determined using the formula

$W_h = m_h xg$

Where:

M_h= mass of the hammer in (g)

The material used was mild steel, density of 7.85g/cm^3

W_h= 0.79kg

Determination of Power & Torque

The main engine drives the milling beater through power from the shaft of the engine under definite physical specification.

The amount of power transmitted is given by equation.

$P = \frac{2\pi NT}{60}$

Since power of the prime mover is known and the hub was directly mounted to the shaft of the prime mover, it was assumed that the power transmitted to the hub is the same. Based on this, the power was taken as

5.5×745=4097.5w

Torque acting upon the shaft is given by

$$T = \frac{\pi}{16}\frac{(d_o^4 - d_i^4)}{d_o} \times \tau_h$$

And from this relation

$$\frac{t}{j} = \frac{t}{r}$$

Where J polar moment of inertia of the shaft about the axis of rotation
T= Torsional sheer stress
r =Distance from neutral axis to the outer most fiber, that is $\frac{d}{2}$
Torque transmitted to the hub was found to be 20.363Nm

Determination of centrifuge force (f_c)

$F_c = \frac{mv2}{r}$
But v = ωr
And $\omega = \frac{2\pi N}{60}$
N= 3000 rpm (manufacturer specification)
$\omega = \frac{2\pi 3000}{60}$
= 314.2 rad/sec
r= radius of the prime mover shaft =10mm (manufacturer specification)
$F_c = m\omega^2 r = 2 \times 0.08 \times 314.2^2 \times 0.1 = 1580N$

Damping Characteristics

Damping characteristic of the machine is determined as below:
The mass of the machine = 43.8kg
The coefficient of damping C = 75u/m
The stiffness of the material k = 750N/m
The natural frequency $w_n = \sqrt{\frac{k}{m}}$

$$w_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{750}{43.8}} = 4.13$$

The damping factor of the material

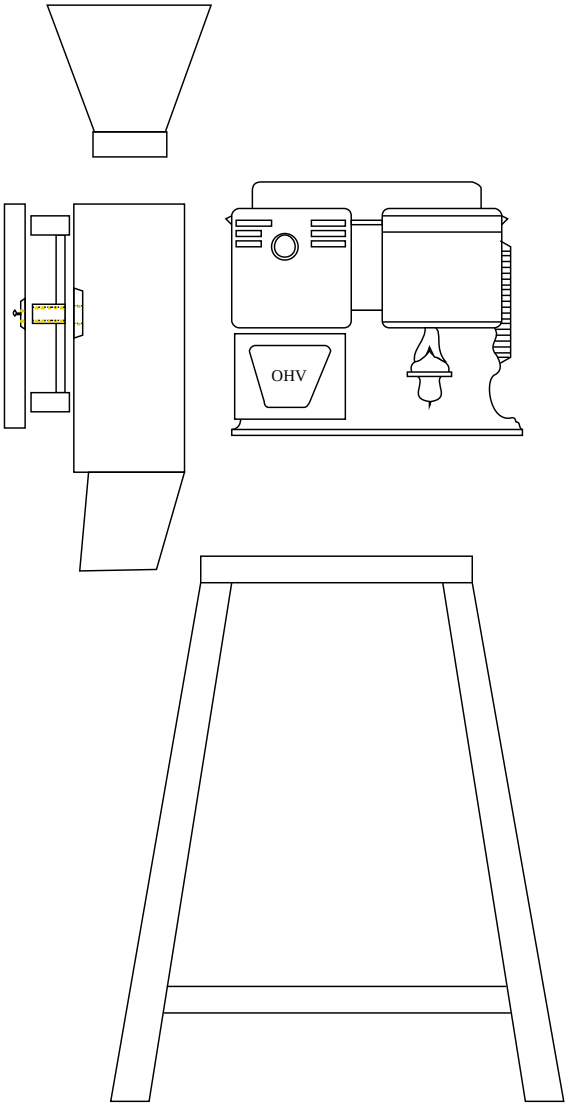
$$\eta = \frac{c}{2mwn}$$

$$\eta = \frac{750}{2 \times 45.56 \times 16.46} = 0.50$$

$$w_d = w_n\sqrt{1-\eta^2}$$

$$w_d = 4.13\sqrt{1-0.5^2}$$

$$w_d = 3.6rad/s$$



S/NO	Part
1	Hopper
2	Milling Chamber Cover
3	Hammer
4	Milling Chamber
5	Main Frame
6	Prime Mover

Figure 1 exploded view of the machine

Figure 2 photograph of the milling machine

Results and Discussion

Table (1) Milling results

test	types of organ	input (kg)	Output(kg)	time taken (s)
1.	Maize	2	1.6	3.06
2.	Maize	2	1.8	3.30
3.	Maize	2	1.5	3.34
4.	Maize	2	1.7	3.19
5.	Maize	2	1.9	3.47

Average output (kg) = 1.6+1.8+1.5+1.7+1.9 = 8.5/5 = 1.7kg
Average time taken (min) = 3.06+3.30+3.34+3.19+3.47/6 = 3.27min
Rate of milling = 1.02/3.27 = 0.31kg/min
Efficiency = output/inputx100=1.7/2.0 x 100 = 85%

Table 2 Quantity of petrol consumed using two hammers

Test	Mass (kg)	Initial reading	Final reading	Quantity of fuel (ml)
1	2	6.7	48.2	41.5
2	2	6.4	36.7	30.3
n	2	2.1	36.6	34.5
4	2	1.2	33.8	32.6
5	2	1.3	48.7	47.4

Average quantity of petrol consumed 2kg = 41.5+30.3+34.5+32.6+47.4/5=35.3ml/2kg
Therefore, quantity of petrol consumed per kg = 35.3/2 = 17.7ml

Discussion

The modification of the machine has been achieved by eliminating some component parts of the machine like the belt and pulleys which were used to transmit power from the prime mover. Moreover the hammer shaft has also been eliminated instead the hammers were mounted to the shaft of the prime mover by means of a hub and thus the design was simplified. The machine was the constructed based on the modified design. The tests for determination of efficiency and fuel economy conducted has yielded positive results in that the efficiency was quite impressive and the fuel consumption of the machine revealed that the machine is economical to use.

Conclusion

The hammer mill has been designed and constructed in accordance with the design parameters. And tests were carried out to determine the efficiency and the fuel economy of the machine. It was found that the efficiency was 85% and fuel consumption of the machine was 17.7ml per/kg.

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Impact of Landscape on Tourism Development, A Case Study of Abuja Millennium Park Abuja, Nigeria

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Abstract: *It is widely recognized that landscaping can in enhance city amenities, but it role in tourism has rarely been examined. This project assesses the impact of landscape in tourism development. The development of tourism industry and the in-burst of masses of tourists will have broad and deep impact on the landscape of tourist destinations. The Aim and method used to carry out the study is discussed. The meaning of landscape, tourism, and their relationship are explained in this project. From the point of view of both natural and human landscape, both positive and negative impacts of tourism development on landscapes of the destinations are discussed. On the whole, the positive impacts are that tourism can improve people's consciousness on landscaping and provide financing, while the negative impacts are that it will increase the pressure on the environment and push the characteristic to disappear. At the end of the project, a principle is brought up, which is that the development of tourism industry and the protection of local landscapes should be balanced*

Key words: *Landscape, Tourism, Sustainability, & Plants*

BACKROUND OF STUDY

1.1 INTRODUCTION

Nigeria falls within the tropical forest zone in the West Africa sub region. Nigeria community is heterogeneous with an estimated 250 ethnics group and a population of about 140 million people. The Nigeria's natural and cultural resources are unique and it provides the country with beautiful historical significance that is link to the national identity and the pride of the country and her people. (James, 2000). Nigeria is endowed with abundant natural resources at different ecological zones in the country. There are eight national parks, over 36 games reserves, cultural attraction, museums and monument, zoological and botanical gardens, conference and business tourism, sports tourism and other attractions, All these establishments potential centers of tourism which should be developed "National parks, game reserves, and zoological gardens are sources of tourism from which huge amount of revenue are obtained in countries like Kenya, Tanzania, south Africa and Zimbabwe. Although tourism and landscape occupies an important position in the economy of some countries, in Africa, it is still at its infancy in Nigeria. One of the major

causes of the economic crisis in Nigeria is the sole dependence on crude oil (Adeyemo, 2005).

Butler (2002) explained that some of in the purposes of tourism development are to avoid a confrontation between tourist and community residents and to provide residents with a reasonable chance of being involved in the industry. In recent years, the concept community participation as tool for both conservation and tourism development has been increasable recognized by government, business, private and community sectors. The emergence of community participation in tourism can be placed in the context of two developments which are recent worldwide activities that promote sustainable and responsible forms of tourism and, the emergence of alternatives approaches to protected area management and conservation effort that link biodiversity conservation with local community development (Adeleke, 2004). According to Hiwasaki (2003), community participation tourism can be explain by four objectives these are, Empowerment and ownership, conservation of resources, social and economic development, and quality visitors' experience.

Tourism is one of the main drivers for metropolitan economics. Such as Millennium Park Abuja are visited by thousands of international and domestic tourist annually. Also tourist has been regarded as an economic development tool for Nigeria. Many small towns and rural communities are trying to acquire their share of growing tourism industry. In order to attract more business and tourism sites, cities is increase looking for ways to beautify their living places and make them more attractive for tourist. A beautiful image of a city is one of the most important requirements for tourism. Trees and green space national parks can create a positive image and provide an aesthetically pleasing experience for both residents and tourists. Thus trees/forest and green areas play a critical part in enhancing city's image, attracting tourist and increasing their tourism experiences. It is evident that linking urban forest and tourism is a very important topic gaining national recognition. The Millennium Park is the largest public park of Abuja, the capital of Nigeria and is located at Maitama District of the city. Her Majesty Queen Elizabeth II of the United Kingdom inaugurated the Millennium Park on the 4th December 2003. It's located near to the former presidential palace close to the nucleus of presidential and administrative buildings of the city. A river crosses the park in its main rectilinear axis, dividing into two parts.

Overview

This study is to identify the perception of tourist/visitors on the impact of landscape in tourism by carrying out a review of key concepts in landscape tourism development and also to identify key landscape features that contributes to tourism in Nigeria. Abuja is located within the mountainous regions of the country with a unique and impressive climate and a rich culture provides an impressive investment opportunity for tourism and recreation in the nation. This research is in line with the desire of the federal government to expand its economy by promoting tourism to create a social and recreational arena and to encourage tourist and visitors to come to the country. The Millennium Park Abuja is one out of numerous tourist sites in which the owner intends to equip with necessary infrastructures in which several proposals have been made to develop such a Parks to an international standard. This will thereby further create direct employment and serve as source of revenue generation to the capital authority and the nation at large.

Landscape is about the relationship between people and places it provides the settings for our day-to-day lives (Uji 2000). The term does not mean just special or designated landscapes and it does not only apply to the country side Landscape can mean a small patch of urban waste land as much as mountain range and an urban park as much as an expanse of lowland plan. It results from the way that different components of our environment both natural (the influences of geology, soils, climates, flora and fauna) and cultural (the historical and current impact of land use, settlements, enclosure and other human intervention) interact together and are perceived by us. (Redmond 2009).

Landscape comprises the visible features of an area of land, including the physical elements of landforms such as (ice-capped) mountains, hills, water bunches such as rivers, lakes, ponds and the sea, living elements of land cover including indigenous vegetation, human elements including different forms of land use, building and structures and transitory elements such as lighting and weather conditions (Adamson and Aberg 2003).
There are many different interpretations of the terms landscape "the dispute in definition makes it difficult to communicate clearly and even more difficult to establish consistent management policies. According to James, (2001) Landscape is define as an area perceived by people, whose character the result of the actions and interaction or natural and human factors. Godrom (2005) also Defines Landscape as an invariable include an area of land containing a mosaic of patches or landscape elements. Forman and Godrom (2005) defined Landscape as a heterogeneous land area composed of a cluster of interacting ecosystem that is repeated in similar form throughout.

The term landscape has several connotations and interpretations. Knudsen et al (1995), clarify that landscape cannot be the same for two individuals because each of them has a different interaction with the landscape and their knowledge of landscape differs. Nevertheless, some definition of landscape can be found in the interactive and documents.

The perception of landscape has changed during the time. In general, there must be distinguished two basic perception of landscape. The first one is the classical perceptive in which the view is taken that the creation of livable and usable space, such as urban areas, is the mark of civilization and progress. The second approach is the romanticism, in which untouched space has a greatest value, and wilderness assumes a deep spiritual significance (Holden 2008) Healy (1994) determines that the ability to view natural man made scenes that are interesting is an important part of the tourism experiences and it is probably the principal motivation for many visitors Macagno et al. (2010) have similar opinion and published that it is widely acknowledged that landscape features can play a major role in determining the tourist destination choice. Knudsen et al (1995) conclude that the focus of the study of tourism is and should be landscape. They agree with Minca and Dakes (2006), in whose point of view of tourism landscape is a result of several processes made by the state, regional offices, tourist agencies, tourist and others.

The term used for tourism which respects and protects nature is green tourism. Ryglova (2007a) characterize green tourism as a desire of tourist to connect nature and human environment. Human environment, especially cultural heritage, is dealt by authors. Hudeckova and Sercikora (2007) in their work they focus on cultural heritage as part of infrastructure for certain forms of tourism. Ryglova. (2007b) added that with growing importance of tourism for the economies, the topic of sustainable tourism is and should be discussed more often. Since the beginning of time humans have travelled. Food, water, safety or acquisitions of resources (trade) wevices re early travel motivations. However,

the idea to travel for pleasure or exploration soon emerged. Travel has always depended upon technology to provide the means or mode of travel. The earliest travelers walked or domesticated animals. The invention of the wheel and the sail provided new mode of transportation. Each improvement in technology increased the individual's opportunities to travel.

Tourism is collection of activities, services and industries that delivers travel experience, including transportations, accommodations, eating and drinking establishments, retail shops, entertainment business, activity facilities and other hospitability services provided for individuals or group of travelling away from home. The world tourism organization (WTO) claims that tourism is currently the world largest industry with annual revenues.

Mathieson and Wall (2002) created good working definition of tourism as the temporary movement of people to destination outside their normal places of works and residence, the activities undertaken during their stay in those destinations, and the facilities created to cater their needs. According to Macintosh and Goeldner (2006) Tourism is the sum of the phenomena and relationship arising from the interaction of tourist, Business suppliers, host Government and host communities in the process of attracting and hosting these tourist and other visitors.

The IMPACT OF TOURISM are Damage to the landscape: litter, erosion, fires, disturbance to livestock, vandalism**,** Traffic congestion and pollution**,** Local goods can be expensive because tourist will pay more **and** Demand for development of more shops and hotels **POSITIVE IMPACTS OF TOURISM are** Jobs for local people**,** Income for local economy**,** increased demand for local food and craft

METHODOLOGY

3.1 INTRODUCTION

This chapter deals with one of the fundamental area in any research work. It elaborates on the ways in which data were collected, the methods used, the sampling frame selected and the methods used for analyzing data. It also gives an indication about limitation of the study.

3.2 METHODOLOGY

The methodology of this research is Case Study, Basically qualitative research method will be used in the case study, which includes the following methods:

Visual Survey: Take a visit of the parks and careful observation of its features.

Structured interview: To interview of administrative and technical staff on several aspects of the parks to get detailed and precise information on the functionality of such parks.

ii. Analytical and comparative study:

Comparative analysis of parks landscape using the following independent variables:

i. Major facilities
ii. Primary means of circulation
iii. Landscape style and the concept

3.3 DATA COLLECTION

Case studies in landscape begin with a documentation of the case, and for theoretical research they may require the use of general methods of data collection (Oluigbo 2010). However, the methods of data collection adopted for this study is observations, visual survey, analytical and comparative study, and structured interview.

3.4 INSTRUMENTS FOR DATA COLLECTION.

Case studies in landscape architecture begin with documentation of the physical characteristics the cases studied (Oluigbo, 2010). For the purpose of this study, the instrument used for the collection and documentation of data was questionnaire.

3.5 PROCEDURES FOR DATA COLLECTION.

The procedures for data collection for the local case study involved visits to the case study sites, and taking visual analysis of their landscape elements, as the reflects harmony with nature.

Research design refers to the outline or strategies used in answering research question. Research design also shows the approach and amount of secondary and primary research based undertake as well as the analysis.

3.8 STUDY AREA

The sampling frame focused on tourism areas where tourism development is expanding. As such the study areas for the survey were the millennium park Abuja which attracts large number of tourist. Therefore, strategic areas were identified within the National parks. Some of these areas include the administrative block, lodge and the tourist/visitors.

3.9 DATA COLLECTION DESIGN

For this study, the survey instrument used was a structured questionnaire this method was chosen because it has better responses rates than other methods in previous studies, (Andereck and Nickerson, 1997). The questionnaire was designed in a simple way and in a simple language so as to facilitate the respondent in answering it. The survey questionnaire designed for the tourist consisted of the parts. Covering note was included to the questionnaire explaining the purpose of the study. Part A contained questions relating to the demographic characteristics of the respondents but no names were collected, to retain the privacy of the respondents. The demographic characteristics included: respondents age, gender, level of educations, occupation and length of residency. Part B has 26 items to capture the tourist perception of the impact of landscape in tourisms development. These items relate to the positive and negative aspect of the environment, thus, the respondent were asked to indicate their level of agreement on a five – point likert scale (strongly disagree to strongly agree). Maddox (2005) recommended the use of a likert – scale in tourism impact research because of its superior validity. Furthermore, the part consisted of 4 close ended questionnaires. Closed – ended questionnaires were mainly used since it is easier to collect, analyze and interpret data.

4.0 RESULT

The results analyzed based on the questionnaires distributed to liable tourist in the millennium park Abuja. It provides analysis to assess the tourist perception of the impacts of landscape in tourism development.

The data was organized and evaluated with the evaluation, descriptive statistic (frequency distribution, percentages means and standard deviation).

4.1 POPULATION AND RESPONSE RATE

Punch (2003) stated that a low response rate can raise question according to whether the response received were representative of the sample or were in some way biased. However the researcher should strive for a response rate of at least 60%. Therefore, as regards to this study, 100 questionnaires were distributed to the liable tourist and 84 questionnaires were collected one week later. All the collected questionnaires were deemed good to be analyzed. Hence, a feedback of 84% in this research is therefore taken to be acceptable.

4.2 DEMOGRAPHIC CHARACTERISTIC OF RESPONDENTS

The following sections describes the demographics features of the sample being studied and the participants were asked to provide information about gender, age group, level of education, occupation, length of residency and salary, these variables were analyzed as follows:

4.3 GENDER

Table 4:2;1 show the composition of respondents by gender and the sample was distributed between the male (59.9%) and female (40.1%) tourist.

4.4 AGE GROUP DISTRIBUTION

The result from figure 4.2.2 indicates that 4.4% of respondents were more than 55 years of age, 16.8% of respondents were from 46 to 55 years old, 13.9% were from 36 to 45, 34.3% were from 26 to 36 and 30.7% of the sample was between 18 and 25 years of age. This statistical figure shows that most of the employees in the sample were of 18 to 35 years of age.

4.5 OCCUPATION

Regarding occupation of respondents in this study, the result in (figure 4.2.3) show that 32.1% of the respondents were from the professional grade, 8.8% of respondents were self employed, 6.9% of respondents were students, 4.7% were retired respondents and 4.4% of the sample was unemployed.

4.6 LEVEL OF EDUCATION

Figure 4.2.4 highlights the education level of the employees, in this study the highest level of education completed by the respondents was master degree (15.3%), 25.2 % of respondents in the sample completed bachelor degree, 10.2 % of the employees attended science school, 43.4% were respondents attended secondary school and 4.4% of respondents of respondents attended primary school. Hence this statistical figure shows that most of the respondents in the sample attended secondary school.

4.7 RELIABILITY OF DATA

Reliability in general means stability of response. This concern whether the same respondents would answer the same question in the same way if they were asked again. Reliability is the consistency or dependability of a measure, therefore one of the ways to

measure reliability is called internal consistency. This is the extent to which the questions were designed to measure the same attitude in other words how well the question correlate with one another. Hence, the result (table 2) reveals a value of 0.796 which is higher than 0.7 indicating a high reliability and internal consistency of data.

4.8 NEGATIVE ENVIRONMENTAL IMPACT OF LANDSCAPE

The next issue examined in this study concern the negative environmental impact of landscape on tourism development in millennium park Abuja. Serve statement regarding the tourist perception of the level of impact based on the five point likert scale of agreement level (where 1=strongly disagree to 5= strongly agree) have been measured and represented in a bar chart.

Figure 4.4 illustrate that 25.5% of respondents disagreed that landscape contributes toward traffic congestion and 39.8% of sample disapproved that overcrowding at beaches, pools are merely cause by tourist. 24.1% of respondents also disagreed that landscape has massively contributed to pollution and 18.2% of the sample disapproved that wetlands are destroyed by tourists.

PLATE 3: The must crowdie area in Millennium park

PLATE 4: The Bridge inside the Millennium Park Abuja

PLATE 5: Part of a Green Garden in the Millennium Park Abuja

Table 4.8: Preference of tourism type according to gender

TOURISM TYPE (%)				
GENDER	History and culture tourism	Sun, sand and sea tourism	Golf tourism	Total
Male	22	17	11	51
Female	13	16	4	33
Total	35	33	15	84

Table 4.9

Importance of Landscape Design (%)			
GENDER	Yes	No	Total
Male	28	16	44
Female	52	4	56
Total	80	20	84

According to the survey conducted at the millennium park Abuja, the tourist surveyed described the landscape design differently from each other when asked; most deserts the parks as an oriental style, while others described it as tropical. Another question was directed to tourist to see if they perceive a relation with the landscape design of the parks and the local landscape while 20% state that there is no relationship with the local landscape, 37% link it with a tropical landscape and 35% with the Mediterranean landscape.

PLATE 6: Part of a Rock Garden in the Millennium Park Abuja

PLATE 7: Part of a Pool in the Millennium Park Abuja

Table 4.10: The most Impressive Elements in Landscape

Impressive Elements	Percentages %
Vegetation	9
Water element	59
Colorful surfaces	15
Other	2
Total	84

PLATE 8: part of a Water Element in the Millennium Parks Abuja

PLATE 9: Part of a Water Element in the Millennium Park Abuja

Table 4.11: The most Impressive Elements According Gender

Elements of Landscape Design (%)					
GENDER	Vegetation	Water Element	Colorful Surfaces	Other	Total
Male	5	31	10	5	51
Female	7	13	11	2	33
Total	12	44	21	7	84

Table 4.12: Preferred Locations in the Park.

Locations Shadow areas	Percentages % 7
Private areas	6
Closeness of water element	57
Colorful plants	9
Other	6
Total	84

PLATE 11: Some street and a part of water element in the park

PLATE 10: Bridge with some Part of a Garden in the Millennium park Abuja

Table 4.13: Preferred Locations in the Parks according to Gender

Locations						
GENDER	Shadow Areas	Private Space	Closeness to Water Elements	Colorful Plant	Other	Total
Male	7	2	37	6	1	52

Female	0	4	20	3	5	32
Total	7	6	57	9	6	84

PLATE 12: Recreational Area in the Millennium park Abuja

PLATE 13: Tourist Snapping Pictures with Student

CONCLUSSION/RECOMMENDATION

Conclusion

This study examines the perception of tourist on the impacts of landscape in tourism development and indicates clues for future landscape designs of similar sites. The survey conducted in the park shows that the natural and cultural features of the surrounding environment are found attractive by tourist, and leave a positive impression for a good holiday experience.

Recommendations

Upon carrying out all necessary research on the impact of Landscape on tourism development, the following recommendations are put forward:

Park in Abuja should take action to protect the environment from the negative impacts of mass tourism. Furthermore, tourist in general take into consideration the landscape design of the park and are particularly impressed by the water element design, and by prefer speeding most of their time around it. Therefore, pools site in the parks are densely populated and the places used the most. This finding shows similarly with many other research results conducted in landscape design (Saatc, 2009).

Landscape designer has used Mediterranean plant species in the design and have been careful about the interest of environmentally conscious tourist, who are less demanding and consume less when it comes to environmental resources.

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Impacts of Environmental Factors on Electrical and Electronics Equipment and Devices

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Abstract: *Varieties of climates prevail around the world in which electrical and electronic equipment and devices are expected to function. These equipment are often subjected to environmental shock, vibration and other factors during both normal use and testing. Such environmental factors can cause physical damage to parts that will result to total failure. Deterioration of system can vary considerably depending on environmental conditions encountered. These factors invariably influence the quality, reliability and lifespan of systems. This paper discusses various negative impacts experienced due to environmental factors on electronic and electrical systems in the North-Eastern part of Nigeria. Factors such as high temperature, relative humidity, solar radiation, sand dust, wind, rain and magnetic fields have adverse effects on EEE. Each environmental factor that is present requires a determination of its impact on the operational and reliability characteristics of the materials and parts comprising the equipment being designed. Possible solutions that can extend the lifespan and prevent untimely failure of these equipments and devices have been proffered.*

Key words: *Environmental factors, Negative impacts, Deterioration, Reliability, EEE*

1.0 Introduction

Electrical and Electronics Equipments (EEE) and Devices play an important role in the world today. The use of these Equipments and Devices in various spheres of human activity in such places like home, farms, gardens, recreations, workshops and laboratories (etc.) contributes largely to the development of complex scientific and technical know-how, increased productivity, improvements in communication and control systems, computer and instrument engineering, as well as wireless technology. Equipments and Devices are experiencing rapid development as a result of the emergence of the demand for sophisticated machines and global technological advancement. Their urgent need has

become essential in the present - day complex electronic and electrical systems which are used in transport, communication, industrial operation, military, medical, entertainment, research etc.

Electronic and electrical equipments and devices are expected to function in a variety of climates like tropical/arctic/desert conditions, high altitude, radiation, including transport hazards and mechanical shocks. These factors invariably influence the quality, reliability and life of electronic and electrical systems (Rao, 1998). A sustainable future for electrical and electronic equipment (EEE) is uncertain with rapid acceleration in technological advancements and resource consumption (O'Connel, 2013). In this paper, the general effects of various environmental factors on electrical and electronic systems in the North-Eastern part of Nigeria have been discussed. It covers various effects due to anyone or a combination of climatic factors may have on electronic/electrical equipments and materials.

2.0 CLIMATIC CONDITIONS AND THEIR EFFECTS ON ELECTRICAL AND ELECTRONIC EQUIPMENT

a. High Temperature

The prevailing climate in the North-Eastern part of Nigeria is known as the Local Steppe climate and semi-arid with an average temperature of 30◦c across the year (Accuweather, 2018). These high temperatures will result into the following negative impacts on EEE.

i. **Thermal ageing and oxidation:** This results in the loss of electrical quality and/or change of electrical properties like increase in power factor, decrease of dielectric strength and insulation failure.

ii. **Physical expansion:** Noticeable effects in form of Structural failure and differential expansion of different materials can cause distortion of assemblies, rupturing of seals and wear or binding on moving parts.

iii. **Loss or change of viscosity and evaporation:** This causes loss of lubrication properties, structural and/or mechanical failure (breakage or fracture, seizure).

iv. **Softening and melting of joined parts:** The internal temperature of equipment may approach a value where low melting point materials such as greases, protective compounds and waxes become soft or even begin to flow. This may lead to structural failure, physical breakdown or penetration of sealing may lead to internal electrical breakdown.

v. **Chemical decomposition:** With high temperatures, decomposition of organic material increases and rubber materials hardens. This may change the initial physical or electrical constants (Rao, 1998).

These factors results in physical or chemical change in the materials used and hence variation in characteristics of component. High temperature is considered the most destructive environmental factor associated with electronic/electrical equipments. Proper ventilation and air conditioning will go a long way in preventing the damages to be caused, thereby extending the lifetime of EEE.

b. Relative Humidity (Moisture Content)

Relative humidity RH is a measure of water vapour held in the atmosphere. Water vapour is intimately involved in the greenhouse because its concentration is linked with those of

other gases brought about by greenhouse gases. Changes and variations in RH in the lower levels of the atmosphere are critical to understanding changes in the hydrological cycle, including moisture content and precipitation (Dammo, 2016). With the RH and corresponding moisture content, EEE are affected negatively in the following ways:

i. **Moisture absorption and the deposition of damp layers:** Swelling, rupture of container and physical breakdown. Water is a good conductor and can act as a low resistance path on the insulation of electronic circuits. It has been observed that an ionized conducting film of water will form on the surface of a dielectric within a few seconds if the RH is 100%. This will lead to insulation break-down, change of dielectric properties and external electrical failure like tracking, insulation flashover etc. Only a few materials such as silicones, polystyrene and some polymers can stop the formation of a continuous moisture film but have poor resistance to fungal growths.

ii. **Corrosion:** This causes structural and/or mechanical failure that interfere with function, internal electrical failure and change of physical or electrical constants.

iii. **Electrolysis:** It causes loss of electrical properties and subsequent increase in the conductivity of insulators.

iv. **Loss of seals and the penetration of sealing:** Physical breakdown of sealing will lead to loss of electrical quality. A pressure seal must be incorporated in any component which has to be protected from high humidity. Edges of glass fibre material must be sealed to prevent moisture absorption by capillary attraction.

Relative Humidity of the environments can cause degradation of equipment performance since they promote corrosion effects in metallic components, the formation of surface films on nonmetallic parts that causes cause leakage paths and degrade the insulation and dielectric properties of these materials. Moisture absorption by insulating materials also can cause a significant increase in volume conductivity and the dissipation factor of these materials (NASA, 2000). Methods of averting these effects include use of hermetic sealing, moisture-resistant material, dehumidifiers, protective coatings and covering whenever not in use.

c. Altitude-high or low air pressure

(a) High Air Pressure: this will result in breakage or fracture of equipment, not only this but also external electrical failure like tracking, insulation flashover will occur.

Physical breakdown of sealing: this will result in Loss of electrical quality such as insulation and electrical breakdown.

(b) Low Air Pressure: conditions such as Low dielectric strength, insulations breakdown and flashover, corona and ozone formation, and overheating and fire risk will occur.

d. Solar Radiation

The sun is constantly giving off electromagnetic radiation (EMR) in all directions. When there is solar flare (high concentration of EMF pointed toward the earth), EEE are adversely affected in the following ways:

i. **Surface deterioration:** The EMR from the sun combined with heat dissipated by the components in the system can develop internal temperature well over 110°C. The Ultra-Violet solar radiation is of a much greater intensity in the region (Rao, 1998).

ii. **Change of initial physical/electrical properties:** The degradation of cable insulation will be considerably accelerated. The use of low melting point waxes should be avoided.

Appropriate shielding, the use of protective covers and solar refractors will go a long way in protecting EEE from the possible damage of solar flares.

c. Sand Dust and Wind

Dust is capable of hiding and accumulating inside the sockets, ports and other in-betweens of electronic product. If a barrier of dust is created, within those spaces, it may lead to the following:

i. **Clogging of parts:** This causes mechanical failure like seizure, wear or binding on moving parts.

ii. **Overheating:** The blockage of vents leads to overheating and subsequent leakage of dust through insulation.

iii. **Poor contacts in relays, switches and connectors:** This will result in loss of electrical quality and causing insulation flashover or breakdown of circuit

iv. **May cause arcing and carbon tracking in higher voltage appliances:** This will lead to insulation break-down, change of dielectric properties and external electrical failure like tracking, insulation flashover, open fire etc. (Dust Commander, 2018)

For most electronic appliances, constant cleaning of their parts and surfaces before use, covering while not in use and routine dusting will make them function well.

d. Rain

Pure water is a very poor conductor of electricity, but when it contains ions (sodium and chloride), it can act as a good conductor. When it comes in contact with active device, it makes several contacts that result in large current in the circuit. This will further result to:

i. **Corrosion:** Metals will corrode more rapidly and electrolyte action between dissimilar metals is considerably accelerated.

ii. **Distortion of materials:** An increase in the absorbed moisture leads to swelling of materials and both electrical and mechanical breakdowns can occur. Moisture absorbed by insulating material results in lowering of surface and volume resistivity.

iii. **Biological activity:** One of the end products of humidity/deposition of damp layer is growth of fungi. All organic materials are liable to deteriorate owing to the presence of moisture and nutrient causing fungous growths to form.

The presence of mould/fungi/insects can be destructive to electrical and electronic equipments. Such biological activity on the surface of materials will form a low resistance path resulting in loss of electrical quality and causing insulation flashover or breakdown of circuit (Rao, 1998). This can be overcome by keeping susceptible devices indoors with proper covering.

e. Magnetic Field

Electronic components like diodes, transistors, micro-controllers, microprocessors, wireless transceivers etc are affected in their function by the presence of magnetic fields (NASA, 2000). It results in induced magnetization with the following effects:

i. **Interference with function:** Active electronic components are affected in their function by the presence of magnetic fields.

ii. **Alteration of electrical properties:** It cause faults in electrical and electronic components. It can be responsible for loss of insulation resistance, warping of insulating materials, development of moulds, short circuits.

iii. **Induced heating of the contact:** This heating accelerates corrosion which increases the initial contact resistance and hence causes heating of the contact (NASA, 2000).

f. Desert condition

This can result in surface deterioration, the high ambient temperature combined with heat dissipated by the components in the system can develop internal temperature well over 110^{0}C. The solar radiation is of a much greater intensity in these regions. Change of initial physical and electrical properties coupled with degradation of cable insulation will be considerably accelerated (Rao. S, 1998).

g. Air - wind

Vibration; rocking and excessive movement: Structural failure like breakage or fracture. Physical breakdown of sealing may lead to electrical breakdown or loss of electrical quality (Rao. S, 1998)

g. Contamination

Contamination occupies an important place among the various chemical/physical mechanisms that cause faults in electrical and electronic components. It can be responsible for loss of insulation resistance, warping of insulating materials, short circuits, unwanted/poor or intermittent contacts etc. Electrolytic impurities derived from flux residues and impure supporting materials lead to corrosion in the base of ceramic resistors. Electrochemical and electrolytic corrosion of textile covered wires, connectors due to presence of acids and soluble salts in the coverings. Corrosion by hydrochloric acid released from overheated PVC coverings. Contact corrosion due to formation of black sulphide films on relay contacts in industrial area. Atmospheric pollution produces a tarnish film on the contact surface which increases the initial contact resistance and hence causes heating of the contact, this heating accelerates corrosion (Rao. S,1998)

3.0 CONCLUSION

The working condition of equipment and component parts can deteriorate considerably in different regions of the world depending on climates. Temperate regions (particularly those area known as rain forests in which there are high temperature combined with high humidity), desert area (where the highest temperature occur with wide variation between day and night including airborne dust/sand and the atmosphere has a very low moisture content), the arctic conditions (where very low temperature prevails for long periods) etc. forms the various climatic conditions of the study area.

Therefore, it is of utmost importance that electrical and electronic equipment and systems are so designed and manufactured to withstand the natural environmental factors and perform reliably well over a wide range climatic conditions with a fairly long lifespan.

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Estimation of Outage Cost on Distribution Network

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Abstract: There is increasing attention on the estimation of the customer interruption costs. The existing studies adopt outages data available in the control center the study is based on Maiduguri distribution network and reliability data. Different reliability assessments are being used for the study of electric power system component using particular parameter of assessment to obtain certain indices. The study presents an approach that considers a wider range of outage parameters (duration, load interruption, cause of outage, and frequency) as input .while the outage cost assessment was used to analyse the economic implications of outages on the 33 kV feeders.

1.0 INTRODUCTION

The outage cost is the monetary value of the electrical power energy that is not served to the consumers due to power supply outages. The outages can be basically categorized into forced outages and emergency outages. While the forced outages are caused by automatic tripping of the feeders due to fault on the line, the emergency outages are due to manual opening of the feeders for load shedding or maintenance work. There various papers on the worth of electric power reliability and the interruption cost of a customer. The comprehensive review published in 2015 brings together the academic work done in the fields of worth of electric power reliability and customer interruption costs assessment techniques from the year 1990 to 2015 (Küfeoğlu, *et al*,2016). Tiedemann, (2015) reminds that the interruption costs vary by duration, time of the day or the season. And it indicates that the lowest cost for an interruption among United States (US) commercial sector customers would be 1.17 $/kWh. The forced outage cost and emergency outage cost are the monetary value of the electrical power energy that is not served to the consumers due to forced outages and emergency outages respectively. The occurrence of forced outages is mostly caused by lack of proper maintenance culture. Thus, the value of outage cost of a feeder gives an

insight to the relative amount worthy of allocating for the maintenance of the feeder (Billinton, 2011).

2.0 Causes of Feeder Outage

It is important for reasonable appreciation of the overall research objective to highlight the general causes of feeder failure. These include the following: (Leroy *et al,* 2011).

a) **Loading/increased activity**: Increased customer demands typically during peak periods increase the loading of the equipment. This may lead to tripping of the feeders on overload when the load current reaches the relay setting thus putting the affected areas in blackout. (Leroy *et al.,* 2011).
b) **Weather**: Adverse weather conditions during heavy rain along with strong winds, lightning or conditions like dusty and moist climates in general increase the tendency of the feeder to trip on fault. (Leroy *et al.,* 2011).
c) **Vegetation**: Vegetations ranging from trees to climber weeds and even moulds causes outages due to faults arising from part of the vegetation touching the lines or bridging phases of the line. This is the reason for utilities to maintain the "right of way" under the lines. (Leroy *et al.,* 2011).
d) **Animals and Pests**: The activities of animals like birds, ants and snakes result in outages when they get trapped or intertwined on the lines causing tripping on the lines to be detected as faults. Sometimes the faults may not be transient; it has to be cleared before the line closes back.
e) **Human Factors**: Even the most sophisticated power systems still involve human factor in operating them. For that failure may occur due to intentional or unintentional causes. The intentional ones are in the form of scheduled maintenance or manual load reduction to control system loading while the others are by accidents or errors and lead to outages or failure of the lines (Leroy *et al*., 2011).

2.1 Calculation of Outage Cost of A Feeder

The outage cost OC of a feeder for a study period is computed as follows:

$$OC = OE \; x \; IEAR \qquad (1)$$

Where OE is the outage energy in MWH (mega watt hour), lEAR is the interruption energy assessment rate (in Naira for this research). The OE is calculated as:

$$OE = T \; x \; L \qquad (2)$$

Where T is the length of time in hours that the load is interrupted on a feeder, and L is the interrupted load in MW (mega watts) (Illochi et al. 2010, Teoman et al, 2011 and William, 2011).

The calculation of the outage costs of the various feeders is useful for the following:

- Determining the monetary value of losses caused by the outage on each 33 kV feeder.
- Total energy lost in (mwH) by each feeder during outages.
- Monetary value of forced outages
- Monetary value of emergency outages.
- Determining the maintenance cost allocation to each 33 kV feeder
- Prioritizing of 33 kV feeders during load shedding activities.

The lEAR (Interruption Energy Assessment rate) is the cost of a unit of electrical energy in kwH fixed by National Electricity Regulatory Commission (NERC) act 2013.

3.0 Outage Cost Results and Analysis

The data used for the calculation of the outage cost of the 33 kV feeders are obtained from the same outage parameters data bank used in the analysis carried out in (Appendix I and III)

3.1 Calculation of Outage Cost of the 33 kV Feeder

a. **33 kV Bama Feeder**

From the outage data of the 33 kV Bama feeder already entered in Excel spread sheet format, the duration of time T, in hours that the load is interrupted on the feeder was extracted and placed on a separate column of the excel spread sheet. Also the corresponding load L, in megawatt (mw) interrupted during each outage was also extracted and placed on a separate column of the excel spread sheet. Using the values obtained for T and L, the outage energy OE in megawatt hour (mwH) for each outage was calculated using OE = T x L (equation 3.25), and the result placed on a separate column of the Excel spread sheet.

Then the outage cost OC was calculated using the formular

OC = OE x IEAR (3)

Where IEAR, Interruption Energy- Assessment rate is the cost of a unit of Electrical Energy in kwh fixed by the National Electricity Regulatory Commission Act, 2013.

This amount is currently fixed at N29.44 kwh for three-phase Residential customer excluding fixed charges (NERC Act 2013).

Therefore the OC for 33 kV Bama feeder is OC = OE x IEAR..

OE = 5213.9257mwh

IEAR = 29.44kwh

Therefore OC = 5213.9257 x 1000 x 29.44

= N153,497,972.60

b. 33 kV Benisheikh Feeder

OC = OE x IEAR

OE = 4094.8150 (from appendix I)

IEAR = 29.44kwH

OC = 494.8150 x 1000 x 29.44

= 120,551,353.60k

c. 33 kV Damasak Feeder

OC = OE x IEAR

OE = 3857.4150 x 1000 x 29.44

IEAR = 29.44kwH

OC = 3857.4150 x 1000 x 29.44

N113,562,297.60k

d. 33 kV Monguno Feeder

OC = OE x IEAR

OE = 7290.9167

IEAR = 29.44kwH

OC = 7290.9167 x 1000 x 29.44
N214,644,587.70k

e. 33 kV University Feeder

OC = OE x IEAR
OE = 842.2533mwH
IEAR = 29.44kwH
OC = 842.2533 x 1000 x 29.44
N24,795,937.15

3.2 Formulae and Results for the Calculation of Forced Outages and Emergency Outages Costs for the various 33 kV Feeders

Forced Outages Cost

I. 33 kV Bama Feeder

O/C = OE X IEAR
OUTAGE COST = OUTAGE ENERGY X IEAR
From Appendix III, which shows data on Total Energy lost in mwH due to force and emergency outages.
OE = 3649.7479mwH
IEAR = 29.44wH
OC = 3649.7479 x 1000 x 29.44
= ₦107,448,578.2k

II. 33 kV Benisheikh Feeder

O/C = OE X IEAR, from appendix III
OE = 2866.3705mwH
OC = 2866.3705 x 1000 x 29.44
= ₦84,385,947.52k

III. 33 kV Damasak Feeder

O/C = OE X IEAR
From Appendix III, OE = 2507.3198mwH
OC = 2507.3198 x 1000 x 29.44
= ₦73,815,494.91k

IV. 33 kV Monguno Feeder

O/C = OE X IEAR
From Appendix III, OE = 5468.1875mwH
OC = 5468.1875 x 1000 x 29.44
= ₦160,983,440.92k

V. 33 kV University Feeder

O/C = OE X IEAR, from appendix III
OE = 463.2393mwH
OC = 463.2393 x 1000 x 29.44
= ₦13,637,764.99k

Emergency Outages Cost

I. 33 kV Bama Feeder

OC = OE X IEAR
From Appendix III,
OE = 1564.1777mwH

OC = 1564.1777 x 1000 x 29.44
= ₦46,049,391.49k

II. 33 kV Benisheikh Feeder

OC = OE X IEAR,
from appendix III OE = 1228.4445mwH
OC = 1228.4445 x 1000 x 29.44
= ₦36,165,406.08K

III. 33 kV Damasak Feeder

O/C = OE X IEAR
From Appendix III, OE = 1320.0952mwH
OC = 1320.0952 x 1000 x 29.44
= ₦39,746,802.69k

IV. 33 kV Monguno Feeder

O/C = OE X IEAR
From Appendix III, OE = 1822.7292mwH
OC = 1822.7292 x 1000 x 29.44
= ₦53,661,147.65k

V. 33 kV University Feeder

O/C = OE X IEAR, from appendix III
OE = 379.0140mwH
OC = 379.0140 x 1000 x 29.44
= ₦11,158,172.16k

TABLE 1: OUTAGE COST OF THE 33kV FEEDERS

OUTAGE COST OF THE 33-kV FEEDERS				
FEEDER	*TOTAL ENERGY LOST (MWH)*	*FORCED OUTAGE COST (₦)*	*EMERGENCY OUTAGE COST (₦)*	*TOTAL OUTAGE COST(₦)*
BAMA	5213.9257	107,448,578.20	46,049,391.49	153,497,969.69
BENISHEIK	4094.8150	84,385,947.52	36,165,406.08	120,551,353.60
DAMASAK	3857.4156	73,815,494.91	39,746,802.69	113,562,297.60
MONGUNO	7290.9165	160,983,440.40	53,661,147.65	214,644,588.05

UNIVERSITY	842.2533	13,637,764.99	11,158,172.16	24,795,937.15

4.0 Result

The Bar charts in fig. 4.1, 4.2 and 4.3 show the results of the forced outage cost, emergency outage cost and total outage cost for all the 33 kV feeders connected to the Maiduguri 132/33 kV feeder substation.The 33 kV Monguno and Bama feeders have the highest forced outage costs of ₦160,983,440.92k and ₦107,448,578.2k respectively while the 33 kV University feeder has the lowest forced outage cost of ₦11,158,172.16k. This implies that the 33 kV Monguno and Bama feeders may be given preferential treatment for preventive maintenance cost allocation since spending money to reduce the forced outages on the feeder will help save a bigger percentage of loss due to its corresponding forced outages. Since forced outages are the ones that are caused by transient faults and can be reduced by effective preventive maintenance of the causes of the failure.The 33 kV University feeder with the lowest forced outage cost of ₦13,637,765,99k requires minimum preventive maintenance cost allocation. The 33 kV Monguno with the highest emergency outage cost of ₦53, 661,147.65k must be given highest priority during load shedding activities.

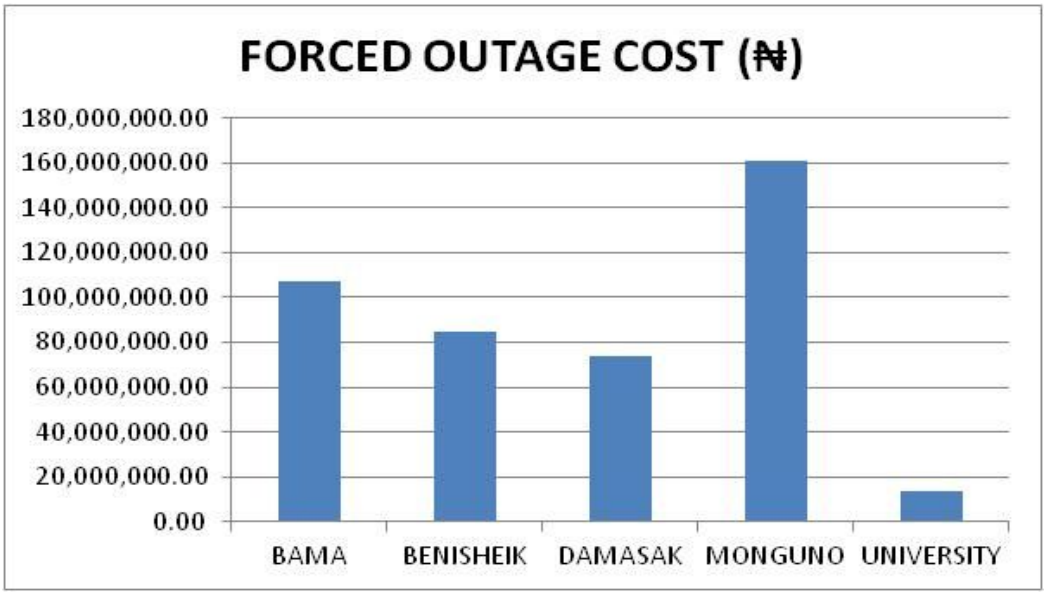

Fig 4.1: Bar chart of forced outage cost/ Feeders

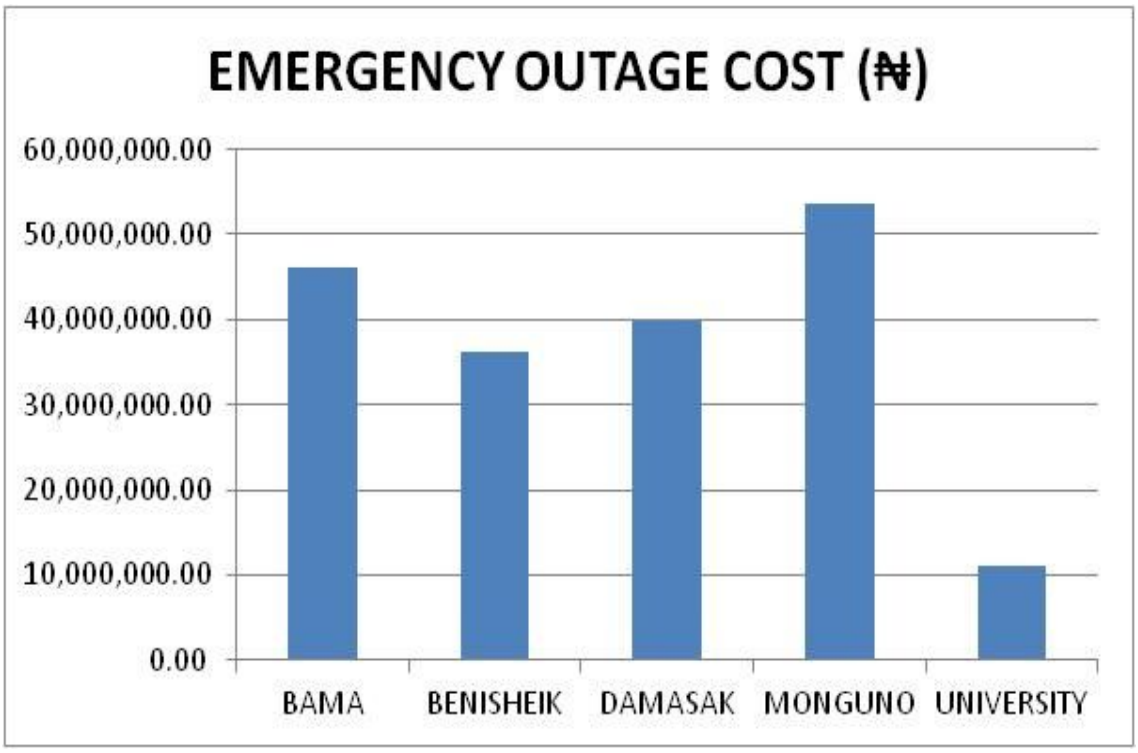

Fig 4.2: Bar chart of Emergency outage cost/ Feeders

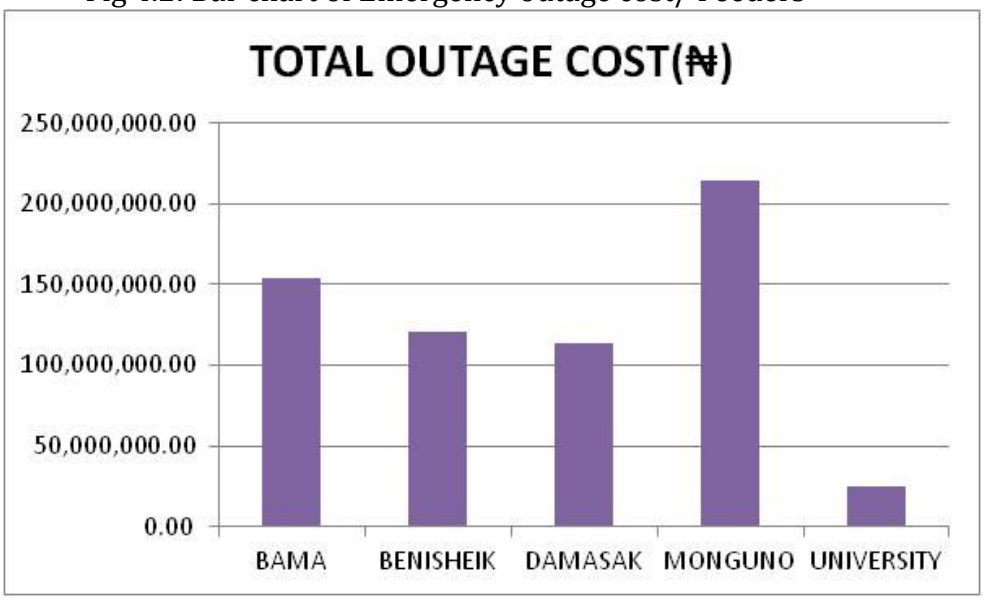

Fig 4.3: Bar chart of Total outage cost/ Feeders

5.0 Conclusions

It is quite essential to understand the costs of power interruption for planning purposes. Furthermore, protection of customers from long lasting blackouts is another driving factor behind the need of understating the impacts of power outages and their economic worth. Being a popular area of research, there have been numerous studies targeting this problem. However, in these work rely on outage record obtained from electricity Distribution Company.

The result obtained from the calculation of the forced outage cost of the 33 kV feeders indicates that 33 kV Monguno is having the highest outage cost value while 33 kV University feeder is having the lowest even though both feeders are having very close value of average duration of outage experienced by their respective customers (SAIDI). What this implies is that 33 kV Monguno feeder may be given first preference treatment for preventive maintenance cost allocation since spending money to reduce the forced outages on the feeder will help save a bigger percentage of loss due to its corresponding forced outages. Since forced outages are the ones that are caused by transient fault and can be reduced by effective preventive maintenance of the causes of the failure.

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Appendix i

Customers Population Data of the 33 kV Feeders in Maiduguri

33 kV FEEDER	NUMBER OF INTERRUPTION	CUSTOMER POPULATION	TOTAL ENERGY LOST (MWH)
BAMA	384	17,527	5213.9257
BENISHEIKH	338	12,961	4094.8150
DAMASAK	348	8007	3857.4150
UNIVERSITY	394	2410	842.2533
MONGUNO	534	12,573	7290.9167

Appendix ii
Data on outage Duration and Load Interrupted in MW for the 33 kV Feeders in Maiduguri

FEEDER	NUMBER OF INTERRUPTIONS	OUTAGE DURATION IN HRS	LOAD INTERRUPTED IN MW
33 kV BAMA	384	638.417	177.103
33 kV BENESHEIKH	338	441.670	139.690
33 kV DAMASAK	348	354.130	131.026
33 kV UNIVERSITY	394	559.467	28.609
33 kV MONGUNO	534	97.730	247.653

Appendix iii

Data on Total Energy lost in (mwh due to force outages and emergency otuages of the 33 kv feeders in Maiduguri

33 kV FEEDER	NUMBER OF INTERRUPTION	ENERGY LOST DUE TO FROCE OUTAGES (MWH)	ENERGY LOST DUE TO EMERGENCY OUTAGES (MWH)	TOTAL ENERGY LOST IN (MWH)
BAMA	384	3649.7479	1564.1777	5213.9257
BENESHEIKH	338	2866.3705	1228.4445	4094.8150
DAMASAK	348	2507.3198	1320.0952	3857.4150
UNIVERSITY	394	463.2393	379.0140	842.2533
MONGUNO	534	5468.1875	1822.7292	7290.9167

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Analysis of Tensile Strength of Fabrics Used in Production of Sportswear

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Abstract: *Sportswear fabric need to provide a comfortable wear for sport activities /game and consequently provide a good strength, woven fabric has greater tensile strength than the knitting fabric. Meanwhile, knitting fabric required less force for it to extend, which made it more advantage in manufacturing of sportswear than the woven fabric that required more force for it to extend. Fabric with less tensile strength have ability to handle moisture vapour and sweat produced by the body during strenuous activity in sports to feel good. In general, knitting fabric is best for manufacturing of sportswear than the woven fabric.*

Key words: *Sportswear, Comfort, Tensile Strength, Fabric.*

TRODUCTION

Background to the Study

Tensile strength is one of the most important mechanical properties for fabrics. To quantify the tensile strength of a piece of fabric, two testing methods are often used, namely the grab test and the strip test. Each testing method has its own advantages and disadvantages. Specimens in the grab test are easier to prepare, and the testing condition is closer to the load application on a fabric in practical use. However, the results of the grab test may not be as accurate and interpretable as those of the strip test, but the preparation of unraveled strip specimens usually takes up time. Both testing methods have been standardized as the ASTM standard D5034-95 for the grab test and D5035-95 for the strip test, respectively.

Given the wide application of both striping methods, it is desirable to establish the relationship between these two methods from both theoretical and experimental viewpoints. A few studies have been reported establishing the relationship between the grab and strip tests. These early investigations attempted to explore the relationship from empirical approaches. However, the tensile mechanisms and physical implications involved cannot be obtained from those studies. Recently, Pan (1984) conducted a theoretical investigation to relate the grab and strip tensile strengths of a fabric. In his model a grab

specimen is basically divided into two portions, the gripped part held by the machine grips, acting essentially like a strip specimen, and the ungripped parts on each side of a grip. A herringbone deformation mode was adopted for the ungripped portions caused by the tensile load during the test. According to continuum mechanics, the shear forces within the herringbone elements contribute to the generation of tensile stress in the ungripped portion. With the assumptions of roughly linear mechanical behavior of a fabric specimen as well as the negligence of the Poisson effect, the tensile stress in the ungripped portions can be expressed in terms of gauge length, ungripped specimen width, machine clamp width, and tensile and shear modulus of the specimen, among other variables. The overall tensile strength for a grab specimen can thus be calculated as the combination of the contributions from both ungripped and gripped parts. In other words, the tensile strength of the ungripped portions obviously determines the difference between the grab and the strip tensile strengths for a fabric specimen.

FABRIC

Fabric is a manufactured assembly of fibres and/or yarn that has substantial surface area in relation to its thickness and sufficient cohesion to give the assembly useful mechanical strength or tensile strength (Denton and Daniels, 2002). Also, there are many ways of making fabrics from textile fibers. The most common and most complex category comprises of fabrics made from interlaced yarns. These are the traditional methods of manufacturing textiles. The great scope lies in choosing fibers with particular properties, arranging fibers in the yarn in several ways and organizing in multiple ways, interlaced yarn within the fabric. This gives textile designer great freedom and variation for controlling and modifying the fabric. The most common form of interlacing is weaving, where two sets of threads cross and interweave with one another. The yarns are held in place due to the inter-yarn friction. Another form of interlacing where the thread in one set inters locks with the loops of neighboring thread by looping is called knitting. The interloping of yarns results in positive binding. Knitted fabrics are widely used in apparel, home furnishing and technical textiles. Lace, Crochet and different types of Net are other forms of interlaced yarn structures. Braiding is another way of thread interlacing for fabric formation. Braided fabric is formed by diagonal interlacing of yarns. Braided structures are mainly used for industrial composite materials. Other forms of fabric manufacture use fibers or filaments laid down, without interlacing, in a web and bonded together mechanically or by using adhesive.

The former are needle punched nonwovens and the later spun bonded. The resulting fabric after bonding normally produces a flexible and porous structure. These find use mostly in industrial and disposable applications. All these fabrics are broadly used in three major applications such as apparel, home furnishing and industrial. The traditional methods of weaving and hand weaving will remain supreme for high cost fabrics with a rich design content. Based on the nature of the yarn or fibre arrangements, fabrics are classified as woven, knitted, twisted and knotted, non-woven or compound fabric. Among them, woven fabric and knitted fabric are the major materials for apparel use (Dai, Choi and Li, 2006).

Woven fabrics

Woven fabrics are structures produced by interlacing two sets of threads: the warp which runs in a lengthways direction and the weft which runs in a width ways direction. There are three basic weaves used to produce woven fabrics: plain weave, twill weave and satin weave. Within the structure of these basic weaves are variations. Other weaves are variations and/or combinations of the basic weaves and are classified as complex or novelty weaves. By their very nature, woven fabrics are rigid or semi-rigid in the vertical and horizontal directions with only slightly more flexibility in the bias direction (Gioello, 1982).

Knitted fabrics

Fabric is produced by several parallel yarns that form one stitch for each yarn in each course. Each stitch in a course is made of different yarns (Gioello, 1982). Knitted fabric is structure that is formed by the intermeshing of loop yarn (Denton and Daniels, 2002). There are two types of knitted fabric structure: weft knitted and warp knitted. Weft knitted fabrics is produced by a system of interlocking loops in the weft direction. The loops are in horizontal courses with each course built on top of the other and all the stitches in the course are made by one yarn. Warp knitted fabrics are produced by a system of interlocking loops in the warp direction. Knitted fabric is the most common fabric structure for the base layer, as it possesses high stretch and recovery, providing greater freedom of movement, shape retention and tailored fit. Knitted fabrics also have relatively uneven surfaces, which make them feel more comfortable than smooth-surfaced woven fabrics of similar fibre compositions. Knitted fabrics are the most commonly used for functional sportswear garments due to their good handle and ability to provide greater freedom of movement. The types of fibers used play an important role in the heat and moisture management capabilities of knitted fabrics. For example, synthetic fibers (e.g. polyester) are often used preferably over natural fibers in sportswear fabrics because of their lower capacity for absorbing moisture and ability to transport water vapor. However, several fabric studies have shown that the yarn and structural aspects of the fabric, which determine variables such as fabric thickness and porosity, can play a greater role in the thermophysiological comfort properties than fiber type alone (Denton and Daniels, 2002) measured the moisture vapor transport behavior of polyester knit fabrics and found similar trends in both cotton and polyester knit fabrics on thermal comfort properties. Measures of thermal conductivity and thermal resistance increased with fabric thickness, while water vapor permeability was lower for thicker fabrics. A positive relationship between fabric thickness and thermal resistance was also seen in a study by (Denton and Daniels, 2002), evaluated heat and moisture transfer properties in a group of commercially produced underwear fabrics designed for sportswear applications.

This effect results from the fact that fabric that has uneven surfaces has less direct contact with the skin (Higgins and Anand, 2003). Knitted fabric can be structured as multi-layer knitted fabric. Multi-layered fabrics, produced by either warp or weft knitting, have been developed for use in sportswear and active wear. It is possible to knit a simple two-layer construction, which facilitates relatively fast removal of sweat from the skin and in which evaporation remains unhindered by multiple layers of fabric. Such a fabric might have a structure in which the inner layer is produced from a textured synthetic filament yarn which is hydrophobic and has good capillary action while the outer layer is made

hydrophilic yarn that absorbs the moisture and then allows it to evaporate (Higgins and Anand, 2003).

Research into the design of knitted fabric showed that the double layer fabrics are an ideal structure. For the doubled layer fabric, it is recommended that the inner layer, which touches the skin, is made from synthetic materials that have good moisture transfer properties such as polyester, acrylic, nylon or polypropylene. For the outer layer, materials that have good moisture absorption properties such as cotton, wool, viscose or their blends are recommended. The perspiration built up on the surface of the skin will be transferred to the outer layer of the fabric by way of the inner surface and consequently it will be absorbed by the outer surface. When absorptive material is used as inner layer, skin will have continuous contact with a wet layer and this feeling will irritate the wearer (Ceken, 2004).

Knitted fabric is the most suitable fabric structure for next-to-skin sportswear, as it possesses high stretch and recovery, providing greater freedom of movement, shape retention and tailored fit. Knitted fabrics also have relatively uneven surfaces, which make them feel more comfortable than smooth-surfaced woven fabrics of similar fibre compositions and have less direct contact with the skin. Multi-layer knitted fabrics made of different fibres with different water absorption will create base layer fabrics that have good moisture transfer properties and keep the skin dry.

SPORTSWEAR

Sportswear textiles belong to a category called sporttech, which is one of the mainstream technical textiles (Anand and Horrocks 2000). The consumption of textile fibres and fabrics in sportswear and sporting related goods has seen a significant increase in the last decade or so. The requirement of sportswear depends on the sport participants and the sport level activity. For instance in case of winter sports which are normally performed in the cold environmental conditions. In a condition of $0^{o}C$ without wind, humans can exercise at sufficient levels to adequately maintain core temperature while wearing one cold of thermal insulation .The cold unit is an index of clothing thermal resistance. One cold represents the clothing necessary to allow a resting individual to be in a comfortable state when the ambient temperature is $21^{o}C$. As the ambient temperature decreases, a significantly greater amount of clothing is required to maintain core temperature. In contrast to the small amount of clothing are commonly worn during exercise in warm or hot environments, also exercise in cold environments requires that selections of clothing insulation be made at appropriate levels (Crow and Osczevski 1998; Gavin, 2003).

In an analysis by Rigby (2002), it was stated that the worldwide consumption of textiles for sports increased from 841,000 tons in 1995 to 1,153,000 tons in 2005. The forecast made for 2010 was 1,382,000 tons. This reflects to a large extent the significant rise in interest of the population worldwide in active indoor and outdoor sports as well as in outdoor leisure pursuits (Shishoo, 2005)

Clothing selection for outdoor sports activities is a complex task. The ideal role of a clothing system is to maintain the thermal balance of the user in various environmental conditions despite the user's level of activity. The balance between heat production and heat dissipation is difficult to maintain. Too little clothing with low thermal insulation may

lead to hypothermia while an excessive amount may lead to discomfort due to significant increases in body temperature and excessive sweating and skin wetness.
This rising interest is due to a number of social factors that include increased leisure time, increased considerations of wellbeing and good health, growth of indoor and outdoor sports facilities and the ever-increasing pursuit of the adult population of activities outside the home or workplace. Textile materials in various shapes and forms are being used in a wide range of applications in sportswear and sporting equipment, and the manufacturers of these products are often at the forefront of textile manufacturing technologies for enhancing the properties of performance fabrics and sportswear in order to fulfil various types of consumer and market demands.

Sportswear as a technical textile

Technical textiles are textile materials and products manufactured primarily for their technical and performance properties rather than their aesthetic or decorative characteristics. Terms such as performance textiles, functional textiles, engineered textiles and high-tech textiles are also used in various contexts, sometimes with a relatively specific meaning (performance textiles are frequently used to describe the fabrics used in activity clothing), but more often with little or no precise significance (Anand and Horrocks, 2000).

TENSILE STRENGTH

Tensile strength is the ability of a material to withstand a pulling (tensile) force. It is customarily measured in units of force per cross-sectional area. This is an important concept in engineering, especially in the fields of material science, mechanical engineering and structural engineering. The ability to resist breaking under tensile stress is one of the most important and widely measured properties of materials used in structural applications. Tensile strength is important in the use of brittle materials more than ductile materials.

The tensile strength of a material is the maximum amount of tensile stress that it can take before failure, such as breaking or permanent deformation. Tensile strength specifies the point when a material goes from elastic to plastic deformation. It is expressed as the minimum tensile stress (force per unit area) needed to split the material apart. For example, if a metal rod one square inch in cross section can withstand a pulling force of 1,000 pounds but breaks if more force is applied, the metal has a tensile strength of 1,000 pounds per square inch. The tensile strength for structural steel is 400 megapascals (MPa) and for carbon steel is 841MPa. Tensile strength is different for different densities of steel.

METHODOLOGY

In this chapter, the material and methods used for this research work will be discuss, in order to achieve the aims and objectives of the study, as it has be stated in chapter one. In general, the steps during which research data are collected, processed, analyzed, and presented manually or electronically will also be discuss. Fasakin (2006), defined research methodology as the different processes, measures, principles and methods by which data and information are sourced, specified, defined, collected, processed and analyzed.
There are two basic methods of testing Tensile Strength of fabric used in textile industries, namely:

i. Grap testing method/procedure and
ii. Strip testing method/procedure

In this study, strip-testing method was used in testing the Tensile Strength of fabric used in the manufacturing of sportswear. The raveled strip test in this test method is considered satisfactory for acceptance testing of commercial shipments of woven textile fabrics, since the method has been used extensively in the trade for acceptance testing.

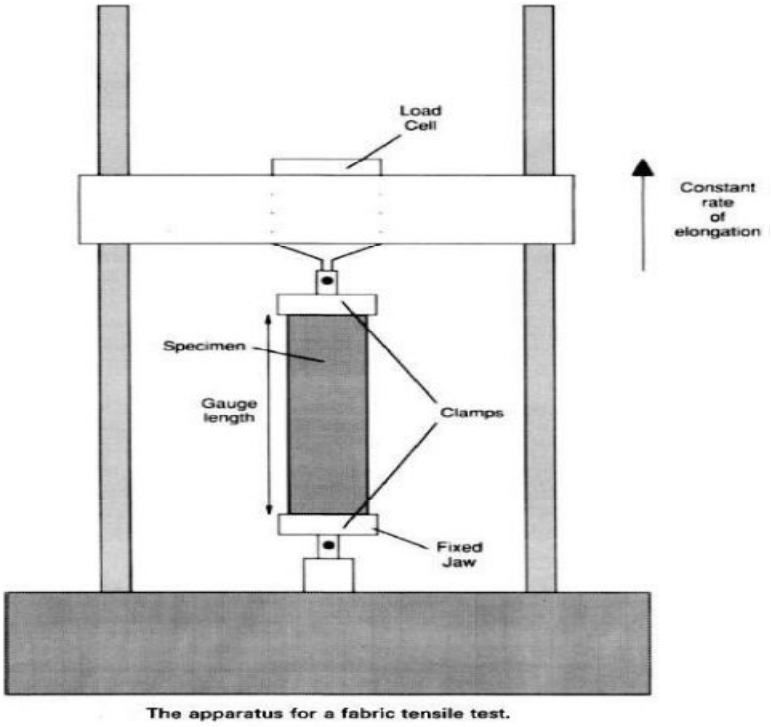

Figure 1: The Apparatus for Fabric Tensile Test.

REGRESSION ANALYSIS

Regression is a tools developed for parameter estimation and model verification, it is a very useful class of models encountered in science and engineering. A commonly occurring situation is one in which random quantity, *Y*, is a function of one or more independent (and deterministic) variables $X_1, X_2, \ldots, X_m$. Given a sample of *Y* values with their associated values of X_i, for *i*= 1, 2, . . . , *n*, we are interested in estimating on the basis of this sample the relationship between *Y* and the independent variables $X_1, X_2, \ldots, X_m$.

In general the model for regression can be written as:

$$y_i = \beta_0 + \beta_i X_i + \varepsilon_i \;;\; \text{for } i = 1, 2, \cdots n. \quad \cdots\cdots 3.1$$

Where;

β_0 = Slope

β_i = Intercept

x_i = Independent variable's

Y = Dependent variable

ε_i = Error term/component.

As one approach to point estimation of regression parameters α and β, the method of least squares suggests that their estimates can be chosen so that the sum of the squared differences between observed sample values y_i and the estimated expected value of Y, is minimized. Which can be written as;

$$\varepsilon_i = y_i - \left(\alpha - \beta_i x_i\right); \text{ for } i = 1, 2, \cdots n. \quad \cdots 3.2$$

The least-square estimates α and β_i, respectively, of and are found by minimizing

$$Q = \sum_{i=1}^{n} \varepsilon_i^{\,2} = \sum_{i=1}^{n} \left[y_i - \left(\alpha - \beta\right)\right]^2 \quad \cdots 3.3$$

In the above, the sample-value pairs are (x_1, y_1), (x_2, y_2), . . . , (x_n, y_n), and ε_i, i = 1, 2, . . . , n, are called the *residuals*. The estimates are easily found based on the least-square procedure.

$$\alpha = \bar{y} - \beta\bar{x} \quad \cdots 3.6$$

$$\beta = \frac{\left[\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})\right]}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \quad \cdots 3.5$$

Where;

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i, \quad \cdots 3.6$$

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i \quad \cdots 3.7$$

MULTIPLE LINEAR REGRESSION

Multiple regression is one in which the random quantity, Y, is a function of more than one independent (and deterministic) variables $X_1, X_2, \ldots, X_m$. For the case of this research multiple regression is used, because to the research involves more than one independent variables that is, in particular two independent variables (woven and knitting fabric) which are to be used to predict the dependent variable, i.e the product (sportswear).

In multiple linear regression, the model takes the form

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + \varepsilon_i \quad \cdots 3.8$$

Where;

β_0 = Slope

β_i = Intercept

$x_{m's}$ = Independent variable's

Y = Dependent variable

ε_i = Error term/component

Subscript i denotes the observational unit

Again, we assume that the variance of Y is σ^2 and is independent of $X_1, X_2, \ldots, X_m$. As in simple linear regression, we are interested in estimating (m +1) regression coefficients 0, 1,

. . . , and m, obtaining certain interval estimates, and testing hypotheses about these parameters on the basis of a sample of *Y* values with their associated values of (X_1, X_2, . . . , X_m). Let us note that our sample size *n* in this case takes the form of arrays $(x_{11}, x_{21}, \ldots x_{m1}, Y_1), (x_{12}, x_{22}, \ldots x_{m2}, Y_2), \ldots, (x_{1n}, x_{2n}, \ldots x_{mn}, Y_n)$. For each set of values, *k* = 1, 2, . . . *m*, of X_i, Y_i is an independent observation from population *Y* defined by

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + \varepsilon_i \quad \cdots\cdots 3.9$$

The least square equation used to (determine) fit the model for multiple regression is as follows:

$$\sum y = \beta_0 + \beta_1 \sum X_1 + \beta_2 \sum X_2 + \cdots + \beta_m \sum X_m + \varepsilon_i \quad \cdots\cdots 3.10$$

LEAST SQUARES METHOD OF ESTIMATION

To estimate the regression coefficients, the method of least squares will again be employed. Given observed sample-value sets $(x_{11}, x_{21}, \ldots x_{m1}, y_i)$, for; $i = 1, 2 \ldots . n$ the system of observed regression equations in this case takes the form;

$$y_i = \beta_0 + \beta_1 X_{11} + \beta_2 X_{12} + \cdots + \beta_m X_{1m} + \varepsilon_i \quad \cdots\cdots 3.11$$

Matrix form component of multiple regression can be written as:

$$c = \begin{pmatrix} a_{11} & a_{12} \cdots a_{1n} \\ a_{21} & a_{22} \cdots a_{2n} \\ \vdots & \vdots \ddots \vdots \\ a_{m1} & a_{m2} \cdots a_{mn} \end{pmatrix}, \quad y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix},$$

$$\beta = \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_n \end{pmatrix}, \qquad \varepsilon = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \beta_n \end{pmatrix}$$

As from the given matrices above, we can put the matrix into model as:

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} \cdots & a_{1n} \\ a_{21} & a_{22} \cdots & a_{2n} \\ \vdots & \vdots \ddots & \vdots \\ a_{m1} & a_{m2} \cdots & a_{mn} \end{pmatrix} \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_n \end{pmatrix} \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix} \quad \cdots\cdots 3.12$$

The element of a particular row of a , are the coefficients on the corresponding parameters. In β that gives E(y_i). Note that β_o has a constant multiplier of one for all observations. Hence, the column vector one is the first column of a multiplying the first row of a by β and adding the first element of ε contains that the model for the first observation as in equation 3.6.

NORMAL EQUATION FOR MULTIPLE REGRESSION

In matrix notation, the normal equation are written as:

$$X'X\beta = X'Y \quad \text{3.13}$$

The normal equations are always consistent and hence will always have a solution of the form.

$$\beta = (X'X)^{-1}(X'Y) \quad \text{3.14}$$

If $(X'X)$ has an inverse then the normal equation have a unique solution given as in equation 3.14.

The multiplication $(X'X)$ generates, $m^1 \times m^1$ matrix where the diagonal elements are the sums of equations of each of the independent variables and the off-diagonal elements are the sums of products between the independent variables. The general form of $(X'X)$ is,

$$\begin{pmatrix} n & \sum a_{11} & \sum a_{12} & \cdots & \sum a_{1n} \\ \sum a_{11} & \sum a^2_{11} & \sum a_{11}a_{12} & \cdots & \sum a_{11}a_{1n} \\ \sum a_{21} & \sum a_{11}a_{22} & \sum a^2_{21} & \cdots & \sum a_{21}a_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \sum a_{m1} & \sum a_{11}a_{m1} & \sum a_{12}a_{m1} & \cdots & \sum a^2_{mn} \end{pmatrix}$$

The elements of the matrix product XY are one the sums of product between each independent variables in turn and the dependent variable.

ANALYSIS OF VARIANCE (ANOVA)

Analysis of Variance (ANOVA) table is used to draw a valid conclusion using the p-valve on the table or student t- table, that is to say student t-table is determined by using statistical t-table. The value obtained is known as F-tabulate ($F_{tab.}$)

i. In the case of using p-value, if the p-value is less than level of significant (α) then we reject H_o. if otherwise, we fail to reject H_o.
ii. In the case of using student t-table, if $F_{calc.}$ is greater than $F_{tab.}$ then we reject Ho. Otherwise, we fail to reject H_o.

The summary of Analysis of Variance (ANOVA) table is show below:

Source	DF	SS	MS	F	P-valve
Regression	m-1	SS Regression.	$MS_{Reg.} = \frac{SS_{Reg}}{m-1}$	$\frac{MS_{Reg.}}{SS_{Reg.}}$	
Residual	n-m	SS Residual.	$MS_{Res.} = \frac{SS_{Res.}}{n-m}$	$\frac{MS_{Res.}}{SS_{Res.}}$	
Total	n	SS Total			

Where:

m= Number of parameter

n = Total number of observation/sample size.

HYPOTHESIS OF THE STUDY

H_o: The Tensile Strength of the fabric used in manufacturing of sportswear are not significant.

H_1: The Tensile Strength of the fabric used in manufacturing of sportswear are significant.

RESULTS AND DISCUSSION

Analytical Procedure

This chapter covers the analysis of data provided in table 4.1. The descriptive statistics and test for the relationship between the fabrics, and all other analysis used in this work were done with the use of computer using R-Package (R x648 3.1.2) and MINITAB, and results were presented in a meaningful and concise manner for an average reader to understand. The analysis was conducted in three stages. The first stage is the summary analysis, which deals with the use of descriptive statistics to explore the data. The second stage is ANOVA analysis which involved the investigation whether the data are related in manufacturing of sportswear and fit the model for the analysis. Third stage is the plot or graph to illustrate pertain of the data set. In other word chart are also used were necessary.

Table 4.1 Tensile strength of sportswear, woven fabric and knitting fabric.

Sportswear (y_i)	Woven fabric(x_1)	Knitting fabric (x_2)
94.18	89.60	63.20
83.43	72.20	62.20
96.56	88.80	76.33
77.35	69.60	56.70
57.91	52.00	36.60
95.12	88.71	70.56
62.19	50.84	53.66
70.27	64.22	59.17

Source: African Textile Manufacturing Industry (ATM), Sharada Kano State.

Regression Analysis: sportswear versus knitting, woven fabric.

The regression equation is

Sportswear = 8.24 + 0.246 knitting + 0.787 woven

Table 4.2 Summary of the Analysis

Estimate	Std. Error	t value	Pr(>|t|)	|t|
(Intercept)	8.23594	3.86029	2.134	0.086022.
Knitting	0.24648	0.11795	2.090	0.090942.
Woven	0.78685	0.08794	8.948	0.000291 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*'0.05 '.' 0.1 ' ' 1

S = 1.98962, R-Sq = 98.8% R-Sq(adj) = 98.3%

Table 4.2 Show that the standard Error of the tensile strength of knitting fabric is 0.24648, t value 0.11795 and p-valve of 0.090942, while the tensile strength of woven fabric have standard Error of 0.78685, t valve 0.08794 and p-valve 0.000291 more required in manufacturing of sportswear. Also: Residual standard error: 1.98962, Multiple R-squared: 98.8%, Adjusted R-squared: 98.3%.

Table 4.3 Analysis of Variance (ANOVA) for the parameter

Source	DF	SS	MS	F	P
Regression	2	1601.63	800.82	202.30	0.0001
Residual Error	5	19.79	3.96		
Total	7	1621.43			

Table 4.3 shows that the computed Analysis of variance (ANOVA) with variance equal to 3.96 with a p-value equal to 0.001, since the p-value is less than 0.05 (the level of significance) we therefore reject H_0 and conclude that the tensile strength of woven fabric and knitting fabric are not the same in manufacturing of sportswear.

Table 4.4 Analysis of Variance (ANOVA) for the fabrics.

Response: sportswear

Source	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Knitting	1	1284.70	1284.70	324.536	9.681e-06 ***
Woven	1	316.93	316.93	80.062	0.0002906 ***
Residuals	5	19.79	3.96		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 4.4 show that knitting fabric has Mean Square of 1284.70, F-value 324.536, and woven fabric has Mean Square of 316.93, F-value 80.062 with equal degree of freedom and variance (δ^2) 3.96.

Table 4.5 Table of Residual

(Intercept)	knitting	woven
8.2359	0.2465	0.7868

Sportswear	Residuals
1.	-0.1352
2.	3.0525
3.	-0.3620
4.	0.3739
5.	-0.2633
6.	-0.3090
7.	0.7245
8.	-3.0816

Source: Author, 2016

Table 4.5 shows the residual of the analysis or relationship in each case of the variables. Also the residuals are used for plot and graph, in order to determine the relationship if there exist.

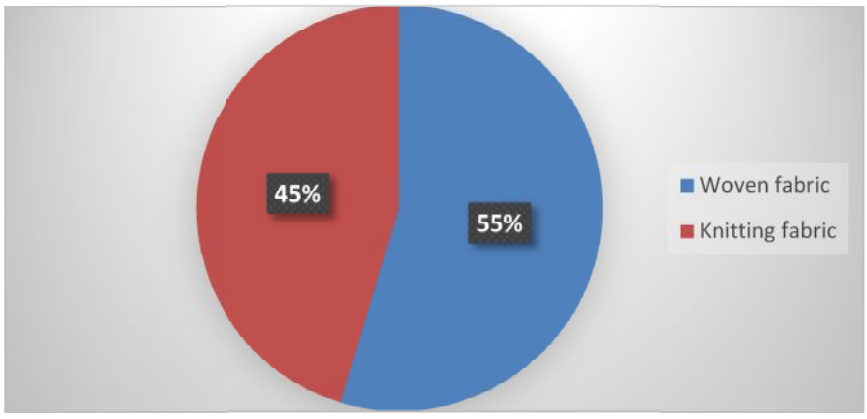

Figure 2. Pie chart showing the percentage tensile strength of the fabrics. From the chart it shows that the tensile strength of woven fabric is greater than the Knitting fabric.

CONCLUSION

Based on the statistical analysis carried out, evidence shows that knitting fabric is the best for the manufacturing of sportswear than the woven fabric, even as woven fabric has higher tensile strength than Knitting Fabric, at α equal to 0.5 level of significant, that is to say p-value is greater than 0.05 level of significant. Also, Table 4.3 shows that there is no

relationship between the tensile strength of fabric used in manufacturing sportswear at alpha (α) 0.05 level of significant. That is, to say P-value for the relationship is less than 0.05 level of significant. In general, we reject Null Hypothesis (Ho) for the relationship between the tensile strength of the fabric, and we fail to reject Null Hypothesis for the Knitting Fabric, and we reject Null Hypothesis for the woven Fabric in regard to the significant in the manufacturing of sportswear. Therefore, woven fabric has the higher tensile strength than the knitting fabric, but knitting fabric is more significant in manufacturing of sportswear compare to woven fabric, that is to say, p-value for woven fabric less than 0.05 level of significant (0.000291 is less than 0.05) and p-value for knitting fabric is greater than 0.05 level of significant (0.090942 is greater than 0.05). In general, the relationship between woven fabric and knitting fabric are also not significant in manufacturing of sportswear for p-value less than 0.05 level of significant, (0.0001 is less than 0.05).

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Estimation of Crop Evapotranspiration of Waterleaf (*Talinumtriangulare Jacq*) Using Lysimeter and Predicted Models

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Abstract: *The knowledge of crop evapotranspiration (ETc), the combined process of evaporation and plant transpiration, is important in agriculture for scheduling farm operations and designing and managing irrigation and drainage systems. Development of crop coefficient (Kc) can enhance crop evapotranspiration (ETc) estimates in specific crop growth stages. However, locally determined Kc information is not available for many important crops in Nigeria. This research was, therefore, conducted to determine the growth parameter stage, specific Kc and crop water use for waterleaf at the Ramat Polytechnic Agricultural Research Farm which is located in a semi-arid climatic zone in Maiduguri. Drainage type lysimeter was used to measure crop water use under water balance system and local weather data were used to determine the reference evapotranspiration (ETo). A lysimeter was used to measure the daily evapotranspiration of waterleaf on a sandy loam soil. Crop coefficient was developed from measured ETc and ETo calculated using weather data. Crop evapotranspiration observed from the field using the lysimeter and those estimated using models were compared using Nash- Sutcliffe efficiency (NSE). The outcome of the experiment revealed that, correlation analysis among the growth parameters showed that, there is strong positive relationship of about (82% to 90%).Similarly, crop evapotranspiration values of waterleaf in Maiduguri semi-arid region was found to be averagely 3.65, 4.88, 5.48 and 5.34 mm at each growth stages, respectively, with seasonal total ETc of 177.44 mm. The crop coefficient values of waterleaf were found to be 0.62, 0.82, 0.86 and 0.76 at each growth stages respectively. The values of ETc determined from the lysimeter were validated by Blaney-Morin Nigeria (BMN), Blaney-Criddle (BC) and Hargreaves models and better agreement was recorded between the ETc calculate from empirical model for the waterleaf using Nash- Sutcliffe efficiency (NSE) and T-test software. Therefore, the study revealed that, drainage lysimeter can be said to be functional and efficient to use in the region.*

Key words: *Waterleaf; Evapotranspiration; Lysimeter; and Crop Coefficient*

1.0 INTRODUCTION

1.1 Background of the Study

Irrigation plays an important role in food production globally. Irrigation is the supply of water to crops by artificial means, designed to permit farming in arid region and to offset the effect of drought in semi-arid region and even in areas where total seasonal rainfall is adequate or average (Vaughan *et al.,* 2007). Accurate evapotranspiration estimates are essential to identify the time variations on irrigation needs, to improve the allocation of water resources, and to evaluate the effect of the use of the land and changes in the management of the water balance (Ortega – Farias *et al.,* 2009). Evapotranspiration can be obtained by direct or estimate measures of climatic elements, using empirical methods. The direct method is represented by several types of lysimeters, being the most accurate method, and considered standard – tool for the determination of evapotranspiration (Bernardo *et al.,* 2006; Amorim, 1998). There are several empirical methods in literature that use meteorological elements data to estimate the evapotranspiration. These methods are based on observations and statistical analysis, and are generally adequate for a specific climatic or region condition (Gravilan *et al.,* 2006). Vegetables contain 80 to 95 percent water, because they contain so much water, their yield and quality suffers very quickly from drought. When vegetables are sold, a "sack of water" with a small amount of flavoring and some vitamins is being sold. Thus, for good yields and high quality, irrigation is essential to the production of most vegetables. Most vegetables are rather shallow rooted and even short periods of two to three days of stress can hurt marketable yield. Waterleaf (*Talinumtriangulare Jacq.*) is a plant to the family Taliniaceae and commonly found in humid tropics. It has been recognized in many countries of Africa; it is claimed to have South American origin but an African origin may not be doubted (Schippers,.2000). Waterleaf is an erect glabrous perennial herb (80-100cm tall), usually strongly branched; roots are swollen and fleshy. The leaves are alternate, simple, almost sessile and succulent (Oluwole *et al.,* 2018) Waterleaf cultivation like other leafy vegetables cultivation in home gardens improves nutritional quality for the family and may provide additional income for female farmers. As a result of its high nutritional value that provide good source of crude protein (22.1%), and vitamins, waterleaf is playing a major role in efforts to eradicate malnutrition in Africa (Tata *et al.,* 2016). Evapotranspiration (ET) It is the combination of two separate processes through which, water is lost from the soil surface via evaporation process and from the crop by transpiration. (Allen, 1998). Similarly, Konukcu (2007) classified evapotranspiration as actual evapotranspiration ETa, Crop evapotranspiration ETc, reference evapotranspiration ETo or potential evapotranspiration ETp. Crop Evapotranspiration is the evapotranspiration from disease-free, well-fertilized crops, grown in large fields, under optimum soil water conditions and achieving full production potential under the given climatic conditions. Crop coefficient (Kc) is defined as the ratio of the crop evapotranspiration to the reference evapotranspiration and can be calculated by different methods (e.g. single crop coefficient method and dual crop coefficient method) (Jensen et al., 1990; Allen et al., 1998). Crop coefficient Kc is the ratio of potential evapotranspiration for a given crop to the evapotranspiration of a reference crop. It represents an integration of effects of four primary characteristics that adjusts the crop from reference grass (i) Crop height, (ii) Albedo, (iii) Canopy resistance, (iv) Evaporation from soil; especially exposed soil. The factors determining the crop coefficients are crop type, climate, soil moisture evaporation, crop growth stage (Vaughan et al., 2007).

Therefore, the current study is undertaken to determine the growth parameters, crop evapotranspiration (ETc) and crop coefficient (Kc) of waterleaf using drainage in semi-arid region of Maiduguri North-Eastern Nigeria.

2.0 MATERIALS AND METHOD

2.1 Experimental Site

Field experiment was conducted at the Teaching and Research Farm, of the Ramat Polytechnic, Maiduguri, in the Sudano-Sahelian region of northern Nigeria. The site lies between latitude $11^0 5$ N and longitude 13^0 09E (Kyari *et al.,* 2014).

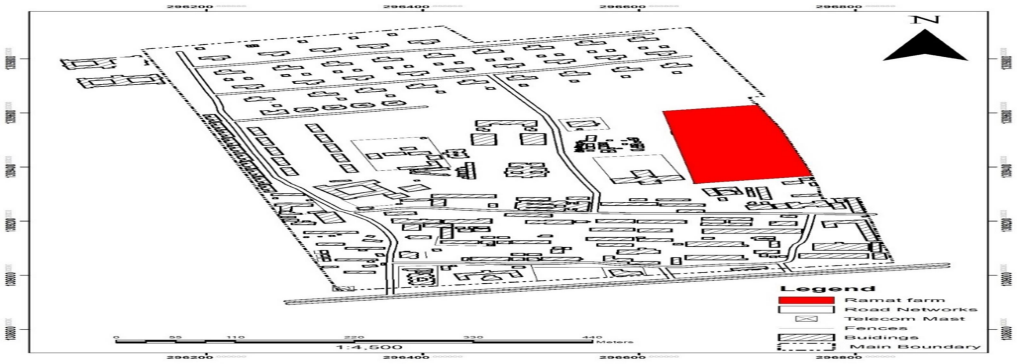

Figure 1: Digitize Map of the Study Area.

Table 1: Mean Soil Characteristics of the Experimental Site (0-30 cm)

Soil type (USDA soil classification)	Sand loamy
Clay (%)	8.0
Silt (%)	11.8
Sand (%)	80.2
P H	6.8
Field capacity (vol. %)	16.2
Wilting point (vol. %)	3.2
Available water content (vol. %)	13.0
Bulk Density (g/cm^3	1.70
Organic matter (%)	3.99

Source : Agricultural Research Farm Rampoly

3.2 Agronomic practices

The location for excavation was marked after clearing the site from its previous vegetation in preparation for installation of the non -weighing lysimeter. To effect installation, the soil was excavated in layers, with soil from each layer placed in a separate pile. When the proper depth was reached; the bottom of the hole was leveled. The surface area of the excavation – 3.58m2 by 1.6m deep was done manually. This was done to provide some space to allow for the installation of the lysimeter manually. The field layout for the experiment consists of the developed lysimeter planted up with waterleaf stands transplanted from the nursery. The vegetable under study was transplanted on a spacing of 20cm by 15cm. The lysimeter installation was accomplished by six people with the use of shovels, and a few hand tools. The tank was lowered into and centered in the hole upon a stable concrete foundation. The tank was checked to ensure that it sat level on the bottom

of the hole. Soil was backfilled around the outer tank to stabilize the tank as can be seen in figure 3.2. In other words, the outside lysimeter was first filled with soil to provide a firm support to the lysimeter. In other to prevent transport of materials from the soil into the drain pipe, a wire mesh of about 0.20mm was placed at the bottom of the lysimeter, upon the hole drilled, to act as a filtering mechanism. The formation of the filter was achieved first by placing a screen over the hole, then gravel and finally sand. Then the inner tank was backfilled with soil, restoring the soil to the depth from which it was excavated.The soil was packed periodically in an attempt to return it to its original bulk density. In the installation, a freeboard of about 10cm from the ground surface was allowed and the process of irrigation was carried out with its attendant drainage. But before the transplanting, the lysimeter has stopped draining from the drainage pipe after saturation and the initial soil moisture data taken. The receiving vessel being a discarded plastic 20-litre emulsion paint container was placed in an adjacent pit for the collection of the percolated water. The field layout for the experiment consists of the developed lysimeter planted up with waterleaf stands transplanted from the nursery. The vegetable under study was transplanted on a spacing of 20cm by 15cm. weeding was done almost on daily basis during the course of this study, this is because weeds do not only compete with the crops for space and nutrients but also, transpire at a rate which affect, negatively the result of the evapotranspiration studies. Farm yard manure (Poultry) was applied to the Research lysimeter at 500g, the first dosage of fertilizer was applied after the first week of transplanting at a depth of 5-8cm, while the second dosage was also applied four weeks after planting.

Plate 1:Installation of a Lysimeter

Plate 2: lysimeter showing Waterleaf Crop

3.0 RESULTS AND DISCUSSION

Table 1 shows the correlation results as among the growth parameter in the study area. The parameters considered were number of leaves per plant, stem diameter, plant height, longest leaf length and longest leaf width of the waterleaf crop experimented using lysimeter was analyzed at ($p<0.05$).

Table 1: Correlation coefficients among growth parameter of waterleaf

WL	NLPP	SD	PH	LLL	LLW
NLPP	1				
SD	0.8386**	1			
PH	0.6639*	0.8120**	1		
LLL	0.3811*	0.8228**	0.9997**	1	
LLW	0.4161	0.7814*	0.9986**	0.9975*	1

NLPP= Number of leaf per plant, SD=Stem diameter, PH= plant height, LLL= Longest leaf length, LLW= Longest leaf width, WL = Waterleaf **=highly significant and *=significant.

As shown in Table 1 number of leave per plant showed a significant positive association with stem diameter (0.8386**), followed by plant height (0.6639**), and the longest leaf length and longest leaf width exhibited not significantassociation of (0.3811 and 0.4161) respectively. Correspondingly, the stem diameter, showed a highly significant positive association with plant height, longest leaf length and longest leaf with corresponding values (0.8120**, 0.8228**and 0.7814**) respectively. Conversely, plant height exhibited extremely significant positive association values of (0.9907** and 0.9986) with longest leaf length and longest leaf respectively. Likewise, positive significant association (0.9975**) was observed between longest leaf length and longest leaf width. The results are in line with the finding (Egharevba 1999).

3.2 Estimated stage –wise crop coefficients (Kc) of the waterleaf crops at different stages of growth

Table 2 shows the estimated crop coefficients of waterleaf at different stages of growth in the experiment farm were presented in an internationally recognized growth stages

Table 2: Estimated stage –wise crop coefficient (Kc) of the waterleaf

Day after Planting	ETc lysimeter (mm/day)	ETo reference (mm/day)	Kc (-)
Initial 1-7DAP	3.65	5.9	0.62
Dev 8-17DAP	4.88	5.95	0.82
Mid 18-29DAP	5.46	6.36	0.86
Late 30-36DAP	5.34	6.99	0.76

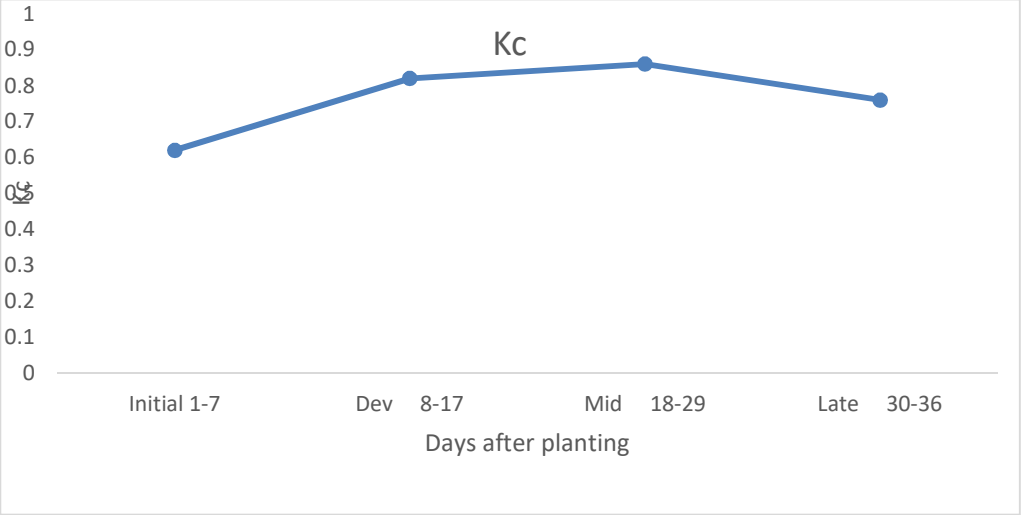

Figure2: Plot of stage –wise crop coefficient (Kc)

The curve presented in Figure 4 represents the changes in the Kc of waterleaf crop over the length of the growing season. The shape of the curve represents the changes in the vegetation and ground cover during plant development and maturation that affect the ratio of ETc to ETo. The Kc increased from the initial to development stages while reached its highest and relatively remained constant at the mid-season stage (Figure 4). The Kc declined rapidly during the late season stage. Higher Kc values were recorded from 18 - 29 days after planting as compared to the values in the initial and late of the crop life cycle. The maximum Kc value was 0.86 at 12 days after planting for the reason that changed in Kc could be attributed to the seasonal variation of leaf size which is in line with the findings of Zhang *et al* (2005).

3.3 Performance evaluation comparison between ETc observed using Lysimeter and other three empirical models for water leaf crop.

Table 3, shows the observed and predicted waterleaf evapotranspiration at different stages of growth respectively. Similarly, Table 4.4 shows the model performance comparison, which resulted in very good agreement. Etc predicted using the three models selected and ETc observed from the field using lysimeter for the waterleaf crop exhibited a high degree of agreement.

Table 3: Performance evaluation comparison between crop evapotranspiration observed from (lysimeter) versus predicted from (BMN, BC and HG models) for waterleaf crop at different growth stages.

Stages of growth (DAP)	Lysimeter Method (mm/day)	Blaney–Morin Nigeria (BMN) (mm/day)	Blaney – Criddle (BC) (mm/day)	Hargreaves (HG) (mm/day)
Initial 17	3.65	5.25	4.16	4.76
Dev8-17	4.88	5.24	4.51	4.54
Mid 18-29	5.48	5.4	5.31	5.42
Late 30-36	5.34	5.96	5.4	5.14

Table 4: Performance evaluation comparison between ETc observed using Lysimeter and other three empirical models for three crops.

Models	RMSE	NSE	RSR	Performance Rating
Blaney-Morin Nigeria	3.12	0.68	0.51	Good
Blaney-Criddle	2.81	0.94	0.04	Very Good
Hargreaves	0.87	0.96	0.02	Very Good

The output of the validation revealed NSE values of (0.68, 0.94, and 0.96) and RSR values of (0.51, 0.04, and 0.02) for Blaney –Morin Nigeria, Blaney-Criddle and Hargreaves respectively, which indicated that their performance was very good for predicting evapotranspiration of water leaf in the region and performance output of the models were rated " Good, Very Good' and Very Good" for the corresponded BMN, BC and HG model respectively. Similarly, the observed and predicted water leaf evapotranspiration were also analyzed using z-test as shown in Table 5-.7 which indicating that there was no significance difference between the predicted and observed crop evapotranspiration at ($P<0.05$) since the value of z-cal is less than Z critical. Thus, the applicability of BMN, BC and HG models is a good representation of calculating evapotranspiration for semi-arid region with sandy loam in the study area.

Table 5: Calculated z-test for ETc Lysimeter and Blaney-Morin Nigeria (BMN) for four stages of growth

z-test	ETc Lysimeter	ET BMN
Mean	5.030119	5.475191
Variance	0.526241	0.33857
Stage of growth	4	
level of significance 5%		
z-cal	-0.76478	
Z critical two-tail	1.9634	

Table 6: Calculated z-test for ETc Lysimeter and Blaney-Criddle (BC) for four stages of growth

z-test	ETc Lysimeter	ETBC
Mean	5.030319	4.945594
Variance	0.526341	0.36157
Stage of growth	4	
level of significance 5%		
z-cal	0.140969	
Z critical two-tail	2.4732	

Table 7: Calculated z-test for ETc Lysimeter and Hargreaves (HG) for four stages of growth

z-test	ETc Lysimeter	ETHG
Mean	5.030319	4.855535
Variance	0.526351	0.631574
Stage of growth	4	
level of significance 5%		
z-cal	0.218876	
Z critical two-tail	1.32634	

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

An experiment was conducted to determine the values of the growth parameters and crop evapotranspiration at stages of growth of waterleaf crop. The study was conducted at the research farm in Ramat Polytechnic, Maiduguri, Nigeria, from 16th February to 23rd March 2020. The observed crop evapotranspiration and predicted was analysed using Nash-Sutcliffe efficiency (NSE) and statistical analyses (z-test) as follows; Correlation analysis among the growth parameters showed that, there is strong positive relationship of about (82% to 90%).The crop evapotranspiration values of waterleaf in Maiduguri semi-arid climate and sandy loam soil is averagely 3.65, 4.88, 5.48 and 5.34 mm at each growth stage, respectively, with seasonal total ETc of 177.44 mm. The crop coefficient values of this crop for in region and soil is found to be 0.62,0.82, 0.86 and 0.76 at each growth stage, respectively. The values of ETc determined from the lysimeter were validated by Blaney-Morin Nigeria (BMN), Blaney-Criddle (BC) and Hargreaves models, better agreement was recorded between the ETc calculate from empirical model for the waterleaf using Nash-Sutcliffe efficiency (NSE) and T-test soft wire. Therefore, the study revealed that drainage lysimeter can be said to be functional and efficient to use in the region.

4.2 Recommendations

The results from this study have shown that a locally made, well designed and developed simple drainage lysimeter can be used to generate ET data for waterleaf crop and other similar crops where standard climatic data measurements are not available. Therefore, the following recommendations are onward:

(i) Since this experiment is season study in a single environment, further research over seasons are required so as to develop reliable values.

(ii) The experiment should be repeated in similar agro-climatic condition in order to confirm the findings.

(iii) Similar experiment are needed to be conducted at different agro-ecological zone of Nigeria.

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