MODELING HYDROCARBON PIPELINE LEAK DETECTION USING SYNTHETIC APERTURE RADAR (SAR)

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ABSTRACT

Leaks are catastrophic incidents that occur during pipeline operations, thus finding ways to prevent them is of importance on a worldwide scale. This paper model adopted Hermitize wave equation with maxwells equation into one unified electromagnetic theory and leverage on Synthetic aperture radar model using target radar cross section and digital image processing characteristics of a smart antenna to provides better spatial resolution than traditional radars by using the relative motion of the radar antenna across a target location. The synthetic aperture radars adopt the leaks pressure sound scattering to detect the leaks. The bottle neck of the SAR is how to differentiate the leak signal from the noise. Perhaps, the synthetic aperture radars technique in accurate leak detection handles the bottle neck, using the principle of successive pules coherent combination of real apertures for high angular resolution through acoustic scattering.

The model simulated in MATLAB display high accuracy by reducing the real aperture radar leak time-period drastically from 900s to 8 seconds and give a better resolution image as the array element N, increases from 1, 8, 16, 32, 128 and the noise level of SAR shows a better performance as compared with RAR. The model is recommended for pipeline actual time leak detection estimate with a high spatial image resolution.

Keyword: Pipeline, target, leak detection, Antenna, and aperture

INTRODUCTION

Synthetic aperture radar (SAR) is a type of radar used to take two- or three-dimensional pictures of things like landscapes. SAR provides better spatial resolution than traditional radars (RAR) by moving the radar antenna over the target area. A large "synthetic" antenna aperture (the "size" of the antenna) is produced by the distance the SAR device travels over a target in the time it takes for the radar pulses to return to the antenna. (Asterra, 2021).

Vollmer and Möllmann, (2017) worked on SAR as techniques of pipeline leak detection using thermal imaging detection technology of synthetic aperture radar to analyze the thermal radiation changes around the pipeline to detect leaks. They said that when the natural gas pipeline leaks, the temperature of the soil around the pipeline will decrease depending on the throttling effect. For a crude oil pipeline that is heated and transported, when the pipeline leaks, the temperature of the surrounding soil will increase , at the comparison the result obtained meet up the target size of leaks expected, perhaps the work was limited to the thermal radiation and temperature of the soil around the pipeline ,without considering the pressure , the ability of the SAR to process raw data into real image, the visualization of the vegetation at the pipeline surrounding while looking at the target cross section that relies on target reflection or scattering to detect and identify targets. The more strongly a target reflects, the greater the returned echo at the radar receiver, resulting in a higher signal-to-noise ratio (SNR) and likelier detection.

Argonne National Laboratory, (2018) worked on natural gas pipeline leak detection and said that because natural gas is lighter than the air, the radar signal for leak detection can be obtained over the natural gas pipeline leak by the use of millimeter wave radar system, and the leakage is judged according to the density difference between the natural gas and the air which mainly composed of depth camera, high-resolution camera, video tracking, and identification and millimeter-wave sensor. The result obtained was limited to density difference between the natural gas and the air without considering other parameters of leak detection (pattern recognition, temperature difference, landslide, obtaining obstacle images etc.) that could be explore by the SAR which call for its versatility as a state of art technology in detection of leak in hydrocarbon pipeline considering the key advantage being an active sensor system and Its all-weather actor, Free of atmospheric conditions (day, night ,fog, rain etc.),well, the radar was quite under-utilized (Argonne National Laboratory)

Chhaya Sharma,(2021) presented work on Pipeline monitoring and surveillance using Geospatial of SAR Approach he said that Pipeline equipped with pumps, valves, and other devices to transfer liquids, gases, and slurries from one place to another. Pipeline monitoring systems and surveillance provide technique to monitor the condition of a pipeline such as evaluation of corrosion, preservation of environment, leakage detection, etc.in his techniques of geospatial, he explore High-resolution satellite imagery (30 cm), ultra-high-resolution imagery (15 cm HD) used to compile environmental maps (geological and technical features) to determine the effects and risk in construction, leakage, maintenance of pipelines on environmental components such as water bodies, plants, soil, etc. and pollution. The map which shows the possible ways of oil accumulation in case of an oil spill was also compiled; the remote sensing uses these compiled maps to monitor the condition of the pipeline. Perhaps the work has a drawback on SAR imagery which includes detection and feature extraction of all dark areas, where features are used as inputs for the classification of oil spills or look-like areas and can distinguish oil spills from other dark spots. Perhaps, the proposed used of SAR techniques

at this case will use time-series image analysis of Multispectral resolution imagery with SAR imagery data and Remote sensing change detection methods to identify potentially unauthorized intrusion environmental risk and security issues, at after, before change detection will be identified and analyzed.

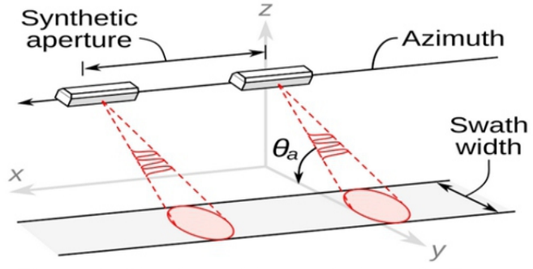


Figure 1: Simple Architectural view of a Target Radar Cross Session (Wikipedia)

The figure 1 shows the application of RADAR system to generate a 'Synthetic Aperture' by generating high resolution images out of Radar data, it exploit the capabilities of Radar Ranging, by moving the platform orthogonal to antenna radiation direction, perhaps radio-waves transmitted by the antenna are scattered, received back, recorded, and processed to generate images of the ground terrain-objects that collects two-dimensional data by using such geometry , the system process data in two direction “Range (Fast-time direction) and Azimuth (slow-time direction).' Azimuth direction data arises out of inter-pulse Doppler (phase history) generated due to platform motion with respect to ground target. Range and azimuth data are processed to generate the hydrocarbon pipeline leak detection monitoring process done by Synthetic Aperture Radar (SAR) utilizes the following key advantage to maintain pipeline integrity:

a. Key advantage being an active sensor system.
b. Its all-weather actor, Free of atmospheric conditions (day, night, fog, rain etc.).
c. Vegetation Penetration for certain operating Frequencies.
d. Long range operation (~20000 meters upto so many hundred kilometers).
e. High resolution imaging (1 meter at orbital altitude of ~ 500Kms)

SAR Imaging Process communal of 2D reflections, each being a reflection from individual scatters the scene, small antenna illustrates large swaths on ground (hydrocarbon pipelines), perhaps Phase encoded pulses are transmitted and echoes received. SAR algorithm processes raw data into an image by synthesizing an aperture as large as the hydrocarbon pipeline path and narrow synthesized beam width, high resolution, and high gain.

The best algorithm for each application depends on; geometry and radar parameters, accuracy required, and efficiency required on the target radar cross section system that relies on target reflection or scattering to detect and identify targets. The more strongly a target reflects, the greater the returned echo at the radar receiver, resulting in a higher signal-to-noise ratio (SNR) and likelier detection which the research leverage on in the near zero false alarm. More so, the real time pipeline leak detection leverage on the better results of Synthetic aperture radar using target radar cross section and digital image processing characteristics of a smart antenna. Synthetic-aperture radar is imaging radar mounted on an instant moving platform. Electromagnetic waves are transmitted sequentially, the echoes are collected, and the system electronics digitizes and stores the data for subsequent processing. As transmission and reception occur at different times, they map to different small positions. The well-ordered combination of the received signals builds a virtual aperture that is much longer than the physical antenna width. That is the source of the term "synthetic aperture," giving it the property of imaging and data collection radar. The range direction is perpendicular to the pipeline track and perpendicular to the azimuth

direction, which is also known as the along-track direction because it is in line with the position of the object within the antenna's field of view. (Ekikere *e t al*,(2023))

2.0 METHODOLOGY

The model adopted Hermitize wave equation with maxwells equation into one unified electromagnetic theory, it describes that when an electromagnetic radar wave is incidental upon targets, the scattering and the propagation take place at the boundary between the two media at free space.

Synthetic Aperture Radar (SAR) Models

Due to the active data collection characteristics of synthetic aperture radar, a sensor generates its own energy and then measures how much of that energy is reflected after coming in contact with the hydrocarbon pipeline and its surroundings (leaks, moving objects, third-party interference).

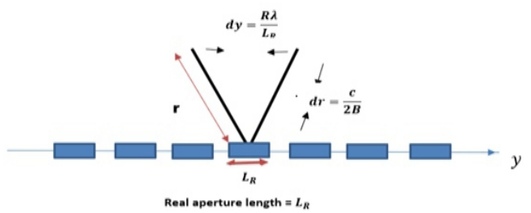


Figure 2: The Architecture of a Real Aperture Radar.

The figure 2 shows the operational mode of a traditional monostatic radar (RAR), where*dy* is the along track resolution in the range *r* proportional to wavelength (λ) and inversely proportional to the L_R The deduction implies that, by increasing frequency and aperture length, the resolution is improved. Conversely at across track resolution in range, the change of range is proportional to the speed of sound in air and inversely proportional to twice the bandwidth.

Thus,

dr is across track resolutions range.

C is the speed of sound in the air.

B is the bandwidth of the real aperture array.

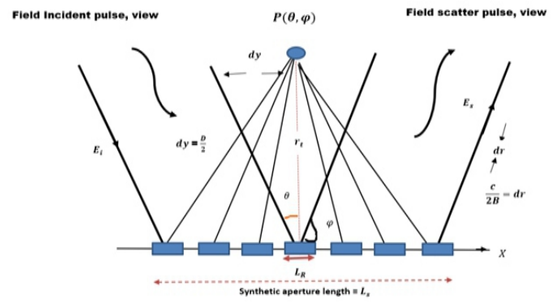


Figure 3: The Synthetic Aperture Radar Operational Mode Geometry.

The figure 3 shows a synthetic aperture moving along the x-axis transmits coherently multiple successive pules, at the target location, the synthetic aperture size along track resolution *dy* in the range *r* with the antenna element size D alone.

Thus,

dr is the across track resolution.

C is the pressure sound speed in the air

B is the frequency change or bandwidth operation.

$E_i E_s$ are the electromagnetic wave incident and scattering fields

P, is the point source.

In using one of the aperture elements as shown in figure 2 (RAR), it focuses on separating collected data and processing the echo of one element, while the SAR system geometry in figure 3 focuses on data arrangement at a successive coherent manner, using the multiple transducer element combination in making the antenna smart.

These multiple synthetic aperture element in radar concept, has the capability in directing narrow beams towards the user's interest, while nulling other users that is not of interest. This allows for higher signal to interference ratios, lower power levels and permit greater frequency reuse within the same synthetic aperture cells, which offer solution to space division multiple access. This system of antenna enhances direction finding techniques to obtain angle of arrival

(AOA), instantaneous tracking of moving objects (vandals and leaks), reduce fleck in radar imaging, cluster suppression, increased degree of freedom, improve the array resolution of pressure sound scattering from the hydrocarbon pipeline as leaks occurs.

The Scattering Field of the Reverberation Signal Model

The model utilizes acoustic scattering spatial beam array at different angles orthogonally along synthetic apertures is used for the leak detection monitoring, by observing a moving target over a substantial time with a stational antenna, the more strongly a target reflects, the greater the returned echo at the radar receiver, resulting in a higher signal-to-noise ratio (SNR) and likelier detection as shown in figure 4.

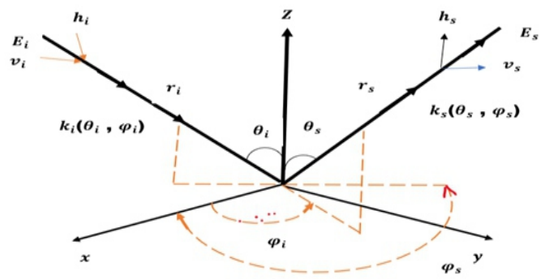


Figure 4: The Scattering geometry of electromagnetic radar wave.

This figure 4 describes the total electric field in relation to the surface current according to maxwells equation.

The scattering geometry parameter definition

E_i is the incident electric field intensity vector

E_S is the scattered electric field intensity vector

r_i, r_s is the incident and scatter radius relative to the earth or object

θ_i, θ_s are the angles of incident and scattering along-track

φ_i, φ_s are the angle of incident and scattering along-track

Thus, at free space, where the electric and magnetic fields intensity vectors are expressed as the phasors E_s and H_s respectively, the maxwells equation becomes

$$\nabla X E_S = -J\omega\mu H_S \quad 1$$

$$\nabla X H_S = (\sigma + J\omega\mu)E_S \quad 2$$

$$\nabla X E_S = 0 \quad 3$$

$$\nabla X H_S = 0 \quad 4$$

Expressing the phasor as sinusoid in a complex form, that's

$$E = E_s e^{j\omega t} \quad 5$$

$$H = H_s e^{j\omega t} \quad 6$$

Hence the combination of equation 1 and 3 becomes Helmholtz wave equation that host the proposed model as,

$$\nabla X \nabla X E_S = -J\omega\mu(\sigma + j\omega\varepsilon)E_S \quad 7$$

Using the vector identity where, $\nabla X \nabla X E_S = \nabla(\nabla . E_S) - \nabla^2 E_S$ Since we are in free space, where no source exists, the divergence of E_S equals zero as given by equation 3 and 7 can be rewritten as

$$\nabla^2 E_S - k^2 E_S = 0 \quad 8$$

$$k^2 = J\omega\mu(\sigma + j\omega\varepsilon) \quad 9$$

Hence, equation 8 is called the vector Helmholtz equation and k is the known as the propagation constant in both incident and scattering field, since it is obviously a complex quantity it can be expressed as,

$$k^2 = \tau + J\beta \quad 10$$

Where τ *and* β are the distortion (np/m) and phase (rad/m) constant respectively, hence the real part and the magnitude of k^2 can be under careful manipulations will be separated to becomes

$$\tau = \omega\sqrt{\frac{\mu\omega}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^1} - 1\right]} \quad 11$$

$$\beta = \omega\sqrt{\frac{\mu\omega}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^1} + 1\right]} \quad 12$$

Wave propagation of spherical coordinates in relation to hydrocarbon pipeline: We can propagate the incident and scattering wave from the successive coherently combine synthetic aperture length as a smart antenna from point source in a spherical coordinate as shown in figure 5. The noise and phase constant are functions of the radian frequency ω, fundamental parameters μ and ε , where σ are the conductivity of the medium. As $\frac{\sigma}{\omega\varepsilon}$ is referred to as the loss tangent.

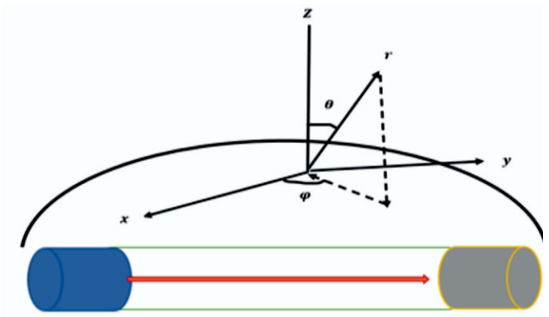


Figure 5: The antenna propagation of spherical coordinates system relative to the earth with hydrocarbon pipeline.

In the derivation we assume the following, The point source P of antenna such that the electric field solution is not a function of (θ, φ),

The electric field is polarized in the θ −direction and it's only a function of r

Thus, we can rewrite equation 8 as a Helmholtz wave equation spherically as,

$$\frac{d}{dr}\left(r^2\frac{dE_{\theta s}}{dr}\right) - k^2 r^2 E_{\theta S} \quad 13$$

Hence at infinite fields, the solution can be written as

$$E_{\theta s}(r) = \frac{E_0 e^{-rk}}{r} \quad 14$$

We can express the phasor of equation 14 in time domain to get

$$\tilde{E}(r,t) = \frac{E_0 e^{-rk}}{r} cos\ cos(\omega t - \beta r)\ \theta 15$$

The spherical coordinate used in this model formulation is due to its unique nature of a point source producing the propagating wave that give inverse r dependency factor called spherical scattering, conversely it implies that since the radiation emanates from a point source, the field scatters out to the surface of the sphere whose radius is r. Hence since all the element of the SAR are used to generate radio waves, perhaps all the propagating electric far-field undergo a spherical spreading loss as well as attenuation loss.

The boundary condition of a propagating wave was established to determine the nature of reflection, transmission, or refraction between dielectric materials as scattering or diffractions are encountered in different mechanism.

Hence equation 16 and 17 are the respective boundary condition of the electric field phasor tangential and normal components relative to the boundary.

Hydrocarbon Leaks and Sound Pressure Scattering Model: The model of a target sound pressure scattering in synthetic aperture radar (SAR) is the most important with the parameter of accurate target strength calculation. The target scattering signal is achieved from the interaction of the sent and received signals between active SAR and the hydrocarbon pipeline leaks (target object). The sound pressure θ −direction, the equation becomes,

$$\nabla^2 P(\theta) - k^2 P(\theta) = 0 \quad 18$$

$$P(\theta) = P_{in}(\theta) + P_{scat}(\theta) \quad 19$$

$$w_n = \frac{360}{\lambda} \quad 20$$

Where, $w_n$is the wave number contain in P (θ) under propagation and λ is the wavelength

P (θ) is the acoustic pressure of the model

$P_{in}(\theta)$ is the incident sound pressure

$P_{scat}(\theta)$ is the diverged incident sound pressure that scatter (scattering sound pressure)

Let's consider a spherical scattering in a free space using figure 3.15, the P_{in} and the wavelength with spherical Hankel function becomes

$$P_{scat}(r,\theta) = P_{in}\sum_{n-1}^{\infty} \varphi^{\frown}(2n + 1)h_n(w_n r)P_n(cos\, cos\, \theta)$$

Perhaps, Equation 21 is the accurate solution for calculating sphere sound pressure scattering from hydrocarbon pipeline leaks using Synthetic Aperture Radar in hydrocarbon pipeline modelling.

Thus

r is the radar range

θ is the scattering angle

h_n is the spherical Hankel function

p_n is the Legendre polynomial in n order?

$\varphi^{\frown} = h_p$is the boundary condition coefficient at normal, which can be define as the sum of the incident and scattering sound pressure is equal to the hydrocarbon pressure (h_p) inside the pipeline

Thus, the boundary condition equation becomes,

$$h_p = P_{in} + P_{scat} \quad 22$$

$$P_{scat}(r,\theta) = P_{in}\sum_{n-1}^{\infty} i^n(2n + 1)\frac{\rho j_n(w_n a)j_n(w_h a) - Bj_n(w_h a)j_n(w_n a)}{Bj_n(w_h a)h_n(w_n a) - \rho h_n(w_n a)j_n(w_h a)} h_n(w_n r)P_n(cos\, cos\, \theta)\ 3.145$$

Where the density relationship between hydrocarbon gas and air space becomes,

$$\rho = \frac{\rho_{air}}{\rho_h} \quad 23$$

The sound speed relationship between the air space and hydrocarbon filed sphere becomes,

$$B = \frac{c_{air}}{c_h} \quad 24$$

Where, the j_n, h_n in equation 23 are the respective derivatives of the spherical Bessel and Hankel function of the first kind. Thus c_h, c_{air} are the respective sound speed of hydrocarbon filed pipeline (sphere) and space as shown in figure 6

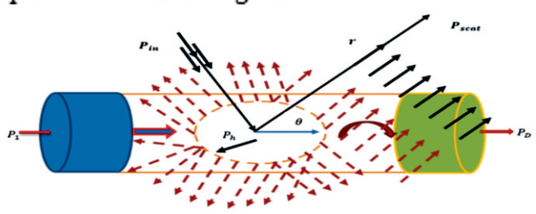


Figure 6: The geometry of Hydrocarbon Leaks scattering from the pipeline.

Considering the leak hole sphere with a radius in pipeline finite domain affected by an incident sound pressure plane wave (P_{in}) with wave length λ . The hydrocarbon leak re-generates scattered field with red dashed arrow into the air space in all direction with different intensities. the scattering pressure along the range r and angle θ is simulated using equation 21

The Synthetic Aperture Radars (SAR) Data Collection Architecture Model

A horizontal hydrocarbon pipeline laid at the right of way, leaks produce a sound wave, the smaller the leak the higher the resonance produced as shown in figure 7 for data collection architecture. The architecture is a monostatic with element length (L_e)

moving along track, the platform has equal distance that ends at N-position, at each end, a wave will be propagated to the target section of range movement (R_m) between one target and aperture sequential position and the sound is obtained at received time series (t_m). The sounds are sequentially repeated at N times of sending and receiving until the target finds the synthetic aperture field of view as shown in figure 7 the time series of the received pules in the synthetic aperture at different range movement (R_m) is written as,

$$R_m = r_t + \frac{(y_n - y_t)^2}{2r_t}, n = 1, \ldots\ldots\ldots\ldots, N \quad 25$$

$$t_m = \frac{2R_m}{c_{air}}, n, \ldots\ldots\ldots\ldots, N \quad 26$$

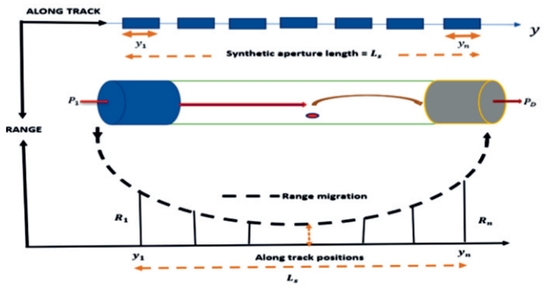
Where

y_n are the coordinates of different synthetic aperture position?

y_t is the target position

r_t is the target range of the broadside

R_m is the range movement between one target and aperture sequential position.



The figure 7 shows the SAR target passes through the incident field of view moving along-track direction and stops at position $y_n, n =, \ldots, N$. Conversely, when a leak sound is made on the occurrence of leaks in the hydrocarbon pipeline synthetic aperture field of view, the pressure sound scattering in the SAR receiver at direction θ, is obtained using equation 21. Hence, the hydrocarbon leaks sound in SAR field of view at different position N corresponds with the acoustic pressure scattering P_{scat} at SAR position N with the migration range R_m and scattering angle of N position θ_n , in a time function t_n is obtained as.

ב

$$= \frac{\rho j_n(w_n a)j_n(w_h a) - Bj_n(w_h a)j_n(w_n a)}{Bj_n(w_h a)h_n(w_n a) - \rho h_n(w_n a)j_n(w_h a)} 26$$

$$P_{scat}(R_m, \theta_n, t_n) = P_{in}\sum_{n-1}^{\infty} p\, i^n(2n + 1)\, ב h_n(w_n R_m)P_n(cos\, cos\theta_n), n = 1, \ldots\ldots\ldots, N \quad 27$$

Equation 27 simulates the pressure sound scattering fields obtained from the transmitted pings at N different positions in the synthetic aperture moving path, the leaks scattering fields are saved as a function of scattering angles (θ_n), range migration (R_m), and time series of occurrence (t_n), hence the side lobe is reduced by performing pulses compression operation on the scatter signal in each time series. Conversely the combination of the scattering field at different scattering angles along track can differentiate the noise from the leak sound signal which cannot be achieved by a real aperture that detect leak signal in just one pass.

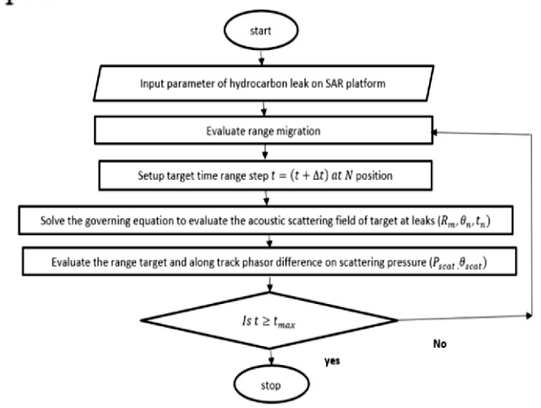


Figure 8: The algorithm of SAR at leak pressure sound scattering on coherence processing.

RESULT AND CONCLUSION

Table 1: The simulation parameters of SAR platform and hydrocarbon pipeline

Synthetic Aperture Radar platform Parameter	Values
SAR Centre frequency is given by C-band (F)	5.3GHz
Sound speed in air (c_{air})	3 *e* 8 m/s,
Sound speed in solid containing hydrocarbon (C_h)	5960 m/s
Air density at (STP)	1.29 kg/m^3
Backward scattering angle (θ_n)	$(-\pi,\pi)$
Hydrocarbon gas liquid density (ρ_{HGL})	71 kg/m^3
The gasoline density	755 kg/m^3
The black oil density	881 kg/m^3
Antenna dimension (height by width)	10m x 1m
Bandwidth, (B	15.5MHz
Pulse duration, τ	31.1 µs
SAR sampling frequency, f_s	19$Msample/sec$
Acoustic pressure incidence (P_{in})	3dB
Look angle, (γ)	23°
Ground swath width, (W_G)	100km
Data rate, (D_R)	105Mb/s

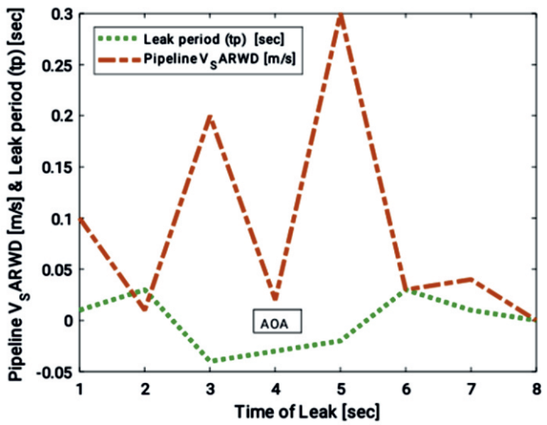
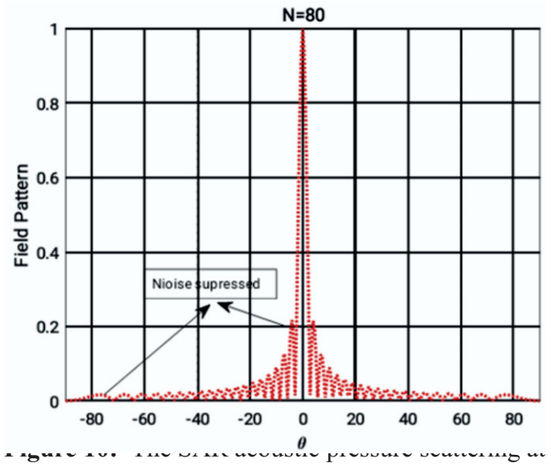


Figure 9: The model result of pipeline velocity Synthetic Aperture Radar Wave Difference (Pipeline V_{SARWD})(m/s) and leak period *(tp)*.

The figure 9 shows the angle wave difference of a Synthetic Aperture Radar steered on a pipeline right of way at along track range resolution, with the function function (t_p) of the leak period, identified by the Acoustic pressure incidence (P_{in}) at 2sec between 0 and 0.1m/s velocity wave difference satellites cameras of the SAR at the angle of arrival (AoA) observed at 4sec of the leak period along the pipeline length as leak occurs at the point the time period and AoA intercept.



N=80 on rectangular form.This figure 10 uses the array factor of the field pattern against the Θ of the radar viewing angle through 80 Synthetic aperture element , that coherently combine the propagated echo along- tract range resolution, to pinpoint the direction of the acoustic scattering from its different angle of incidence, several noise were suppressed within 0.2 meter radius, these noise (lobe) were suppressed and separated from the desired angle of scatter as indicated with red dash parabolic profile at Θ = 0 degrees.

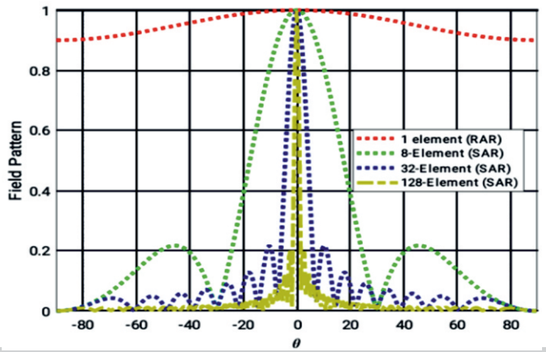


Figure 11: The Comparison of real aperture radar (RAR) and synthetic aperture radar (SAR) acoustic pressure scattering (leak) direction pinpoint characteristics at different Elements.

The figure 11 shows the plot of scattered field pattern and the Θ of the radar viewing angle with N=1 Real aperture elements on a red dotted line, 8-SAR element, 32-SAR element and 128-SAR element, the plot shows high resolution of 128-SAR element to pinpoint leaks, using increases number of successive coherent summation of echoes, reflected as the monostatic radar elements are beamed at the along-track and cross-track of the monitoring object. It also shows several noise suppressions to near zero radius, leaving the desired angle of scatter to identify the pressure acoustic scattering (leak) and the moving object within the range migration.

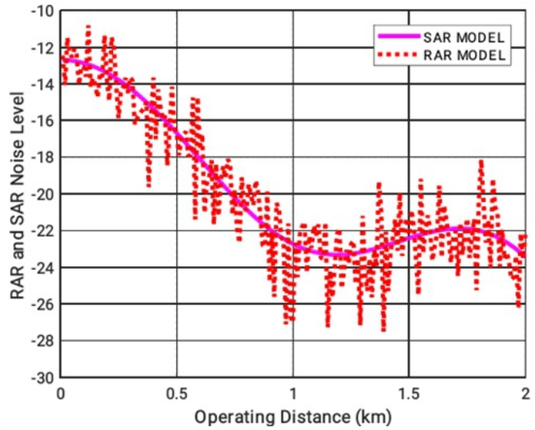


Figure 12: The Profile of the RAR and SAR Noise Level with the operating distance.

The figure 12 shows the models noise levels between the RAR and the SAR model, it is deduced that the noise produced by the real aperture radar on operation to maintain resolution with the desired area of interest is quite alarming, which makes it difficult to identify the targeted pressure scattering of the object under monitor , conversely the successive coherent summation nature of synthetic aperture element of high array element maintain high resolution of image along and across tract range with near zero received power noise.

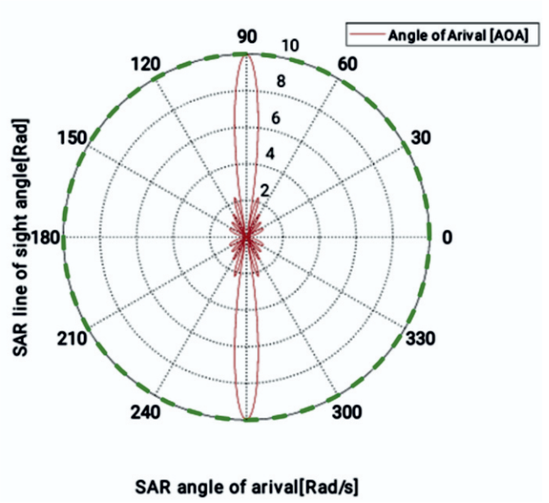


Figure 13: The SAR Line of sight and angle of arrival (AoA) along and across track profile.

The figure 13 shows the angle of arrival at the exact point of the leak angle by reducing the lobes formed, by the jammers angle at the quest of coming against the high resolution in angle of arrival that measures the individual element array time difference of arrival along and across track of line under monitor using the successive coherent summation of 10-meter array element of the synthetic aperture radar with the angle of arrival identified at 90 degrees, where the lobes inform of noise is reduce to near zero degrees.

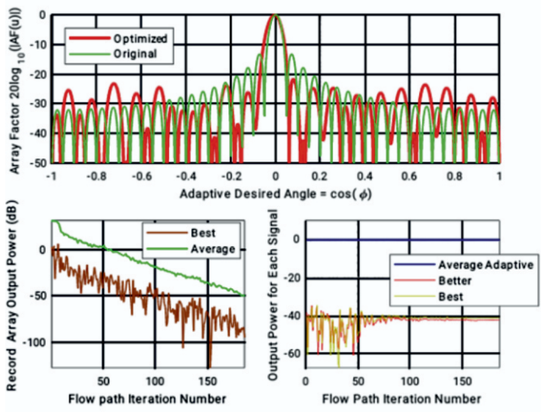


Figure 14: The SAR thinned beam array for high resolution signal.

The figures 14 represent a single output thinned power beam array and flow path iteration to obtain average adaptive null power at better and best category, at the same vein the best and the average recorded arrays output power were matched to produce a high satellite antenna gain, obtained at every narrow beam that will hit the targeted entry and exit sound wave signal of the leaks along and across the track of the flow path element. The generic output result is shown by plotting the array factor against the power factor, which is the adaptive desired angle, the narrow beam was realized in the form of original array beam power and the optimized beam power. The inference drawn holds that, the high satellite array gain resolution in SAR pipeline monitoring is increased by reusing the frequency band allocated to the system many times, as it occurs in flow path iteration number element, perhaps the system is not a good candidate for long area distance coverage.

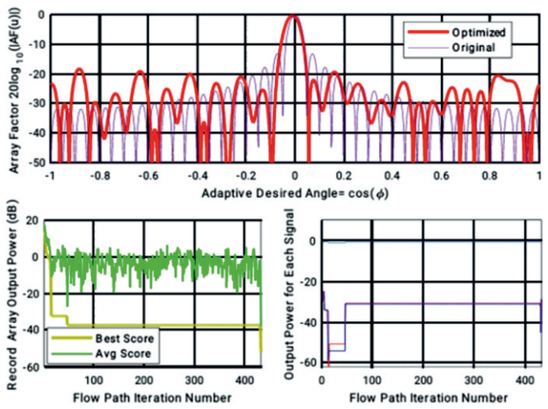


Figure 15: The SAR multiple beam array for high resolution signal.

The figures 15 represent several output power array and flow path iteration to obtain average adaptive power at different lines category, at the same vein the best and the average score arrays output power were matched to produce a high satellite antenna gain obtained at every narrow beam that will hit the targeted entry and exit sound wave signal of the leaks along and across the track of the flow path element. The generic output result is shown by plotting the array factor against the power factor, which is the adaptive desired angle, the narrow beam was realized in the form of original array beam power and the optimized beam power. The inference drawn holds that, the high satellite array gain resolution in SAR pipeline watching is increased by reusing the frequency band allocated to the system many times as it occurs in flow path iteration number element, perhaps, the system is bad in nulling resolutions of signals but perfectly good at long distance area coverage.

CONCLUSION

The proposed model was investigated using a horizontal pipeline of a hydrocarbon with a Synthetic Aperture Radar platform at Orbit altitude (h) to the hydrocarbon pipeline. Table 1 contain the simulation parameters used in the result validation. We assumed that the Synthetic Aperture Radar platform with common transmitter and receiver antenna length (L) moves along-track above the hydrocarbon pipeline, at a constant speed and transmitting pressure sound echoes in N different positions along track, with equal distances in different ranges of migration (R_n) illuminate a target section of the hydrocarbon pipeline. Conversely the scattering fields data are collected and stored in the backward direction at different scattering angle of N position Θ_n in a time function function t. The SAR mimic pendulum-controlled stop and go system in data collection, to enable platform movement to be neglected during pulses transmission and echo reception.

The hydrocarbon leak detection in a pipeline was achieved by identifying the range movement and successive coherent summing of the received echoes at range movement in different scattering directions. To test the SAR accuracy, the pipeline velocity wave difference at the leak period of the hydrocarbon leak pressure sound scattering is compared with the real aperture radar technique of pressure sound scattering. Comparison of the different hydrocarbon leak size for both using the scattering field obtain from pressure acoustic scattering coherent combination p_{sar} of SAR method and non-coherent pressure acoustic scattering p_{sar} of RAR method and the presence of background noise variance of the hydrocarbon pipeline scattering in both RAR and SAR method.

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ON SIGNED SUB-SEMIGROUPS IN FINITE FULL TRANSFORMATIONS

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ABSTRACT:

Signed (partial) transformation semigroup (ST_n) is the set of all mapping from a set α:[n] →[n$^{\square}$] such that α:dom(α)⊆[n]→[n$^{\square}$] is called full or total transformation if Dom(α) = [n] and Im(α) ⊂ [n$^{\square}$]. Let SC_n be an order-preserving and order-decreasing signed full transformation semigroups. This study obtained the number of all idempotent elements in SC_n. along the lines of Howie (1996).

Keywords: Semigroup, Order-decreasing, Order-preserving, Cardinality, Signed full transformation semigroup.

INTRODUCTION

The full transformation semigroup on [n] = {1, 2, 3, ..., n}, under natural order is denoted as T_n. More than one enumerative or different challenges of an essentially combinatorial nature are carefully thought out (considered) for some specific classes of semigroups of transformations. For instance, Howie (1971) presented that, the order and number of idempotents of order-preserving full transformations (O_n) are

$$|O_n| = \binom{2n-1}{n-1} \text{ and } |E(O_n)| = F_{2n} \quad (1)$$

where F_{2n} is the alternating Fibonacci number given by $F_1 = F_2 = 1$. Higgins (1993) showed that, the order-preserving and order-decreasing full transformation semigroup (C_n) is the n-th Catalan number given by

$$|(C_n)| = \frac{1}{n+1}\binom{2n}{n} \text{ and } |E(C_n)| = 2^{n-1} \quad (2)$$

Respectively. See Higgins (1992), Howie (1976) and Howie (1995) for standard terms and concepts in transformation semigroup.

We shall present some definitions and notation to be used in the paper. Consider [n] = {1, 2, 3, ..., n} and [n$^{\square}$] = {−n, ... − 2, −1, 0, 1, 2, 3, ..., n}. Then, Signed (partial) transformation semigroup (ST_n) is the set of all mapping from a set α:[n] →[n$^{\square}$] such that α:dom(α)⊆[n]→[n$^{\square}$] is called full or total transformation if Dom(α) = [n] and Im(α) ⊂ [n$^{\square}$]. The signed full transformations semigroup consist of two important subsemigroups which some authors have researched on recently, they are SO_n and SD_n the signed semigroups of order-preserving and order-decreasing full transformations, (Mogbonju and Azzez, 2018, Alaku and Mbah, 2021).

An element e ∈ST_n is called an idempotent if $e^2 = e$. We write E(T_n) to denote the set of all idempotents in ST_n. A signed transformation α in ST_n that is α:

dom(α) ⊆ [n] → im(α) ⊆ [n$^{\square}$] is order-preserving if;

$|a| \le |b| \rightarrow |a\alpha| \le |b\alpha|$ ∀ a,b ∈ dom(α) and is order-decreasing if $|a| \le |b| \rightarrow |a\alpha| \le$

$|a|$ ∀ a ∈ dom(α). The signed semigroup of all order-preserving and order-decreasing full transformation will be denoted as $SC_n = SO_n \cap SD_n$.

Several results on idempotent numbers of different classes of semigroups of transformations were established, see Howie and M$_c$fadde(1990), Laradji and Umar(2004),Tainiter(1968) Umar(1992) and Umar(1998). Our main concern in this paper is compute the number of all idempotents elements in signed full transformation (SC_n) along the lines of Howie (1966).

PRELIMINARY

Several relevant papers on transformation semigroupg theory were reviewed thoroughly before bringing out our research method, in order to cover major parts of work done by idempotents as well as order of transformation semigroups.

Matrix Notation: The following notations will be used in representing elements in transformation semigroups.

Let $\alpha \in T_n$. This elements can be represented by α(b) = a by placing ± in (a,b) entry of an n × n matrix.

We shall study the following matrices for order-decreasing and order-preserving transformation.

$$\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ -3 & -2 & 2 & 4 & 5 \end{pmatrix} \in SC_5 \quad (3)$$

Which can be written in matrix notation as;

$$\alpha = \begin{pmatrix} 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \quad (4)$$

0.1. Idempotent elements in SC_n for each n.

$E(SC_1)$

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

$E(SC_2)$

$$\begin{pmatrix} 1 & 2 \\ 1 & 1 \end{pmatrix} \quad \begin{pmatrix} 1 & 2 \\ 1 & 2 \end{pmatrix} \quad \begin{pmatrix} 1 & 2 \\ -2 & 2 \end{pmatrix}$$

Some known results of idempotent and nilpotent on signed transformation semigroup are presented below:

Let $\alpha \in ST_n$. Then $|E(ST_n)| = 5^{n-1}$

Let $\alpha \in SPT_n$. Then $|N(SPT_n)| = 5^{n-1}$

Let $\alpha \in SI_n$. Then $|E(SPT_n)| = 2^n$

Let $\alpha \in SSing_n$. Then $|E(SPT_n)| = \frac{n^2(2^2-1)}{3}$

Let $\alpha \in SPT_n SS_n$. Then $|N(SPT_n)| = 5^{n-1}$

Let $\alpha \in SO_n$. Then $|E(SO_n)| = \frac{1}{3n+1}\binom{4n}{n}$

Let $\alpha \in SIO_n$. Then $|E(SPT_n)| = 2^n$

RESULTS

In this section we presented some results of idempotent on order-decreasing (SD_n) and order-preserving signed full transformation semigroups(SC_n) with their proofs combinatorially.

TABLE 1. Values of elements in SC_n and E(SC_n) for each n.

n	SC_n	E(SC_n)
1	2	1
2	9	3
3	48	8
4	280	15
5	1966	32

Theorem 4.1: Let $\alpha \in SC_n$. Then

$$\begin{cases} 1 & \text{for n = 1} \\ 2^n & \text{for n is odd} \\ 2^n - 1 & \text{for n is even} \end{cases}$$

Proof:

case 1.

$|E(SC_n)| = 1$, when n = 1.

when n = 1 it is obvious

case 2.

$|E(SC_n)| = 2^n$, when is odd.

Let SC_n be the Subsemigroups of SOD_n. Thus $E(SC_n) \subseteq SC_n$. An $e \in SC_n$ is idempotent if $e^2 = e$ and e is idempotent element if $|im(\alpha)| = |f(\alpha)| = 1$. Hence from the sequence 2,8,32,... generated when n is odd for $E(SC_n)$ which likened to the power set which are number of subsets of a set, and of which they are special case of binomial theorem i.e

$$\sum_{i=0}^{n}\binom{n}{i}x^i y^{n-i} = (a+b)^n \text{ if } a = b = 1 \text{ i.e } \sum_{i=0}^{n}\binom{n}{i} = 2^n$$

We could observed also that this situation is same as most of idempotent elements of some subsemigroups. Thus $|E(SC_n)| = 2^n$ when n is odd.

case 3.

$|E(SC_n)| = 2^n - 1$, when n is even.

$2^n - 1$, for n = even.

Let [n] = {1, 2, 3, ..., n} and [n$^{\square}$] = {$-n$, ... -3, -2, -1, 0, 1, 2, 3, ..., n}. Then an $e \in SC_n \subseteq SOD_n$ is an idempotent if $e^2 = e$. We observed that, from the sequence generated when n is even for $E(SC_n)$ the order is one less than the power set. Hence from when n is odd we have $|E(SC_n)| = 2^n - 1$ as required.

SUMMARY OF THE RESULTS

In this research work we paid attention to the idempotent in signed semigroup of order-decreasing and order-preserving (SC_n) full transformation and the following results were established.

Let $\alpha \in SC_n$. Then

$$|E(SC_n)| = \begin{cases} 1 & \text{for n = 1} \\ 2^n & \text{for n is odd} \\ 2^n - 1 & \text{for n is even} \end{cases}$$

Which generate sequence 1,3,8,15,32,....

CONCLUSION

In this work, we generate sequence and find the n^{th} order formula for idempotent on order-decreasing and order-preserving signed full transformation semigroups and those sequences have application on coding theory, combinatorial algebra and computational theory. The total number of nilpotent elements of SC_n has not been known.

FURTHER RESEARCH

Further study on signed transformation semigroup can be carried out for nilpotent on signed transformation semigroups.

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PARTY SUPREMACY AND MEMBERS PARTICIPATION IN PARTY PRIMARIES

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ABSTRACT

Democratic politics requires participation of political parties and primaries that involve members. This paper briefly discusses these two key factors in political party dynamics: party supremacy and members participation. Party supremacy refers to how the leadership of political parties dominate their internal processes and candidate selection. Party leadership sometimes control primary elections by influencing or even choosing the official candidate. Party leadership domination can conflict with members involvement. Political parties depend on their members, and a healthy democracy requires their participation. Members can voice their opinions and influence candidate selection in party primaries. Party leadership that overreaches might hinder democratic ambitions and cause unrest. Political organisations struggle to balance party supremacy and members engagement. Transparent and fair primary processes that encourage members input are needed to strike the correct balance. Open primaries, where registered members of any party can vote, can boost members engagement. Parties can also implement internal reforms to balance power between the leaders and members. In conclusion, a functioning democracy requires a competitive party system and members engagement in party primaries. Parties must adapt to shifting political landscapes and public expectations while retaining their basic ideals to strike the correct balance between these two factors. Political parties should hold transparent and inclusive party primaries to reinforce party supremacy and encourage members engagement. Parties should set clear primary guidelines and timetables to ensure an open, fair, and uninfluenced process.

KEYWORDS: Party Supremacy, Members' Participation, Party Primaries politics, elections

Introduction

Political parties are the cornerstones of representative democracies, serving as vital mechanisms for citizen engagement and the organization of political activities. Within the parties, the balance between party supremacy and member participation plays a critical role in shaping the democratic process. Party supremacy refers to the authority and control exerted by party elites and leadership over key decisions, while member participation pertains to the involvement of party members in various party activities, including the selection of candidates in primary elections. Striking a balance between these two factors is essential for the health and vitality of democratic systems. Party supremacy has long been a subject of scrutiny in the realm of political science. In the seminal work of Bryce (2014) he underscored the significance of party organization and discipline in maintaining effective party supremacy. This supremacy often finds expression in the party's capacity to exercise control over the selection of candidates for elected offices, especially in primary elections. However, the imposition of party candidate will can run counter to the principles of democratic participation and member involvement.

The clash of interests between party supremacy and member participation is particularly evident in the contests of primary elections, which serve as a gateway for individuals to vie for public office. Primaries are the initial stage of candidate selection in many democratic systems, and the level of member involvement in these contests can significantly impact the overall health of the political process. A key factor in determining the nature of primaries is the extent to which party elites exert their influence over the nomination process. Party elites, often consisting of party leadership, long-serving politicians, and influential donors, can either enhance or hinder member participation in primaries. They can influence the primary system through various means, including endorsements, financial backing, and by controlling the party apparatus. The extent to which this influence is exercised can shape the primary process and, consequently, impact the broader democratic landscape. In a recent research, Petrocik (2018) demonstrated that party elites' involvement in candidate selection is a significant factor that can limit member participation.

The study found that the more party elites support a candidate, the less likely it is that the primary will be competitive, and this often discourages members from participating. On the other hand, encouraging member participation in primaries can foster a more robust and democratic political environment. A study by Gerber and Green (2019) suggested that members participation in primary elections can lead to more diverse candidate pools and increased accountability of elected officials. This not only reflects the democratic ideals of representative democracy but also enhances the legitimacy of the entire political process.

In order to strike a balance between party supremacy and members participation in primaries, it is crucial for political parties to adopt reforms that promote inclusivity and fairness. One such reform is open primaries, where non-party members can also participate in the selection of candidates. This approach can broaden the primary electorate, reduce the dominance of party elites, and encourage a wider range of candidates to run for office. Research by Niven and Womack (2016) highlighted the benefits of open primaries in fostering greater members participation and reducing the influence of party elites in candidate selection.

Furthermore, primary elections should be designed to ensure that they are not overly susceptible to manipulation by party leaders. Blais et al. (2020) demonstrated that the effectiveness of adopting ranked-choice voting systems in primary elections can promote a more inclusive and participatory primary process. Such reforms can enhance the competitive nature of primaries, encourage more candidates to participate and members to engage in the selection process. However, recent developments in technology have had a profound impact on party primaries. Social media and digital platforms have empowered party members to mobilize and organize like never before. This technological shift has encouraged a more direct form of member participation and, at times, challenged party supremacy. It allows members to circumvent traditional party hierarchies by raising awareness and rallying support for candidates independently.

Party Supremacy

Party supremacy is a fundamental concept in political science and governance. It refers to the dominance and control that political parties exercise over the government, and it has significant implications for the functioning of democratic systems. The concept of party supremacy has its roots in the development of modern political parties. In the early years of democratic governance, parties were less organized, and individual politicians held more influence. Party supremacy can be traced back to the early development of political parties in democratic societies. In the United States, for example, the emergence of the Federalist and Democratic-Republican parties in the late 18th century marked the beginning of a party-driven political system. Alexander Hamilton, a prominent Federalist, argued in the Federalist Papers (1787-1788) for the central role of political parties in ensuring stability and unity. Similarly, Thomas Jefferson, a leading Democratic-Republican, believed that political parties were essential for representing diverse interests and fostering democratic engagement. These early arguments laid the foundation for the concept of party supremacy (Hall, 2016).

However, the 19th century saw the emergence of structured political parties in Europe and North America. Scholars like Duverger (2014) have highlighted how these parties gained control over the political system, leading to the gradual development of party supremacy. One significant milestone in the historical development of party supremacy is the emergence of the Whig and Tory parties in the United Kingdom. As highlighted in Bagehot's (1867) work cited inOdubajo and Ologbenla (2019), these parties came to dominate the political landscape and played a pivotal role in shaping the British political system. A similar trend was observed in the United States with the rise of the Democratic and Republican parties. In the 20th century, the concept gained prominence as parties became increasingly institutionalized and influential in shaping government policies. Throughout history, party supremacy has been employed in various forms. One prominent example is the Westminster system in the United Kingdom, where the political party that commands a majority in the House of Commons forms the government, and its leader becomes the Prime Minister. The executive, legislative, and even judicial branches are deeply intertwined with party politics, reflecting the dominance of the ruling party (Hardt, 2013). The concept of party supremacy is not exclusive to democracies; it can also be found in single-party systems, where one party maintains control over all aspects of government.

Party supremacy can have both positive and negative implications for governance. Proponents argue that it enhances stability and accountability. Parties, by offering coherent policy platforms and electoral manifestos, provide voters with a clear choice.

The study found that the more party elites support a candidate, the less likely it is that the primary will be competitive, and this often discourages members from participating. On the other hand, encouraging member participation in primaries can foster a more robust and democratic political environment. A study by Gerber and Green (2019) suggested that members participation in primary elections can lead to more diverse candidate pools and increased accountability of elected officials. This not only reflects the democratic ideals of representative democracy but also enhances the legitimacy of the entire political process.

In order to strike a balance between party supremacy and members participation in primaries, it is crucial for political parties to adopt reforms that promote inclusivity and fairness. One such reform is open primaries, where non-party members can also participate in the selection of candidates. This approach can broaden the primary electorate, reduce the dominance of party elites, and encourage a wider range of candidates to run for office. Research by Niven and Womack (2016) highlighted the benefits of open primaries in fostering greater members participation and reducing the influence of party elites in candidate selection.

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Party supremacy can have both positive and negative implications for governance. Proponents argue that it enhances stability and accountability. Parties, by offering coherent policy platforms and electoral manifestos, provide voters with a clear choice.

This, in turn, allows for greater accountability since voters can hold parties responsible for their actions. Moreover, party supremacy often leads to the efficient passage of legislation and the implementation of the party's agenda as well as reducing gridlock in government. Scholars such as Giovanni Sartori (2016) have emphasized the role of political parties in aggregating and representing diverse interests, thus promoting pluralism and democracy. In this view, party supremacy is an essential component of democratic governance. It is argued that strong parties can better negotiate and compromise, ultimately leading to more effective policymaking.

On the contrary, critics of party supremacy highlight several significant drawbacks. One of the main concerns is the potential for abuse of power. When a single party or coalition enjoys supremacy, it can concentrate power in the hands of a few, leading to authoritarian tendencies. This was notably seen in countries like Nazi Germany and the Soviet Union, where single-party rule resulted in oppressive regimes. Another criticism revolves around the stifling of individual voices within the party. In party-supremacist systems, elected representatives are often expected to toe the party line, which can limit their ability to represent the diverse interests of their constituents. Furthermore, party supremacy can lead to adversarial politics, polarization, and a lack of cooperation between parties. In 2012, Mickey Edwards argues that party supremacy can undermine the democratic process by prioritizing party interests over the public good. This can result in a highly polarized political environment, making it difficult for parties to find common ground and work together to address pressing issues (Edwards, 2012).

Party supremacy is a dynamic concept that takes on various forms and can be viewed differently depending on the political context. In parliamentary systems, it may result in a strong executive branch under party control, while in presidential systems, it can lead to divided government and partisan conflict. Furthermore, it is crucial to consider the role of political culture, party discipline, and constitutional design in shaping the degree of party supremacy in any given system.

Party Primaries

Party primaries are the cornerstones of modern democratic systems, serving as a crucial mechanism for political parties to select their candidates for various offices, from local city councils to the highest executive positions in a country. These contests are instrumental in shaping the political landscape, enabling citizens to participate actively in the candidate selection process and helping to ensure that the candidates presented in the general election represent the preferences and ideologies of their respective parties. According to Smith and Green (2016), the history of party primaries dates back to the 19th century in the United States, with the development of what is known as the "direct primary." The direct primary system emerged as a response to the growing dissatisfaction with the convention system, in which party leaders and insiders had significant control over candidate selection. The introduction of direct primaries aimed to make the candidate selection process more democratic, allowing rank-and-file party members and the broader public to participate in nominating candidates. Pildes, (2010) argues that the direct primary system was a significant development in American politics, introducing an element of popular participation and competition into the party nomination process. This transition transformed parties from exclusive, hierarchical organizations into more inclusive and democratic entities. Moreover, it ensured that the chosen candidates were not solely beholden to party elites but also had to appeal to a broader cross-section of voters.

Party primaries come in various forms, with the two most common being open and closed primaries. Open primaries allow voters, regardless of their party affiliation, to participate in the selection of candidates for a particular party. In contrast, closed primaries restrict participation to registered members of a specific political party, excluding those registered as independents or with other parties. Accordingly Sabato (2011) noted that open primaries tend to foster a more inclusive and centrist candidate selection process, as candidates must appeal to a broader ideological spectrum. Closed primaries, on the other hand, may result in more ideologically extreme candidates, as they are primarily influenced by the preferences of the party's core members. The choice between these systems has significant consequences for the ideological diversity of elected officials and the overall political landscape.

Party primaries play a pivotal role in the democratic process for several reasons. First and foremost, they enable parties to gauge the popularity and viability of potential candidates. Crotty (2011) highlight that primaries serve as a testing ground for candidates to build support, hone their messaging, and demonstrate their ability to mobilize voters. Secondly, party primaries allow for greater citizens engagement in the political process. Citizens have the opportunity to directly influence candidate selection, ensuring that the candidates who advance to the general election are more likely to align with the values and beliefs of their party members. This aspect of primary elections empowers voters and enhances the overall legitimacy of the democratic system. Thirdly, primaries contribute to a more competitive political landscape. When parties hold competitive primaries, it forces candidates to engage with one another on policy issues and campaign strategies, ultimately leading to better-qualified and more accountable candidates (Abramowitz, 2018)

Members' Participation in Party Primaries

Party primaries play a pivotal role in democratic systems, serving as a mechanism for selecting candidates who will represent political parties in general elections. The participation of party members in these primaries is crucial for shaping the future of the political landscape. Gerber and Morton (2018) noted that party primaries are a fundamental component of democratic governance, allowing citizens to have a direct say in the candidate selection process. Primaries democratize the candidate selection procedure, ensuring that candidates represent the interests and values of party members. Primaries enhance democratic accountability by involving the grassroots in the decision-making process.Numerous motivations drive party members to participate in primaries. A common motivation is the desire to shape the party's ideology and policy agenda. Scholars such as Campbell et al. (2018) argue that party members who actively engage in primaries often have strong convictions about specific policy issues and seek to nominate candidates who align with their ideological preferences.Another motivation is the aspiration to have a voice in candidate selection. According to Aldrich (2016), party members view primaries as an opportunity to ensure that candidates reflect their values and beliefs, thereby increasing the likelihood of electoral success. In essence, they wish to influence the nomination process to optimize the party's chances in general elections. Participation in primaries can also be seen as an act of party loyalty. Gelman and King (2018) suggest that members participate to demonstrate their commitment to the party and its values, which may foster a sense of belonging and social identity. Such loyalty-driven motivations are often linked to strong party identification and long-term commitment to party activities.

Despite the motivations, party members face several challenges when participating in primaries. One significant barrier is the scheduling of primaries. Studies by Donovan et al. (2017) have shown that primary elections are often held at times that do not align with the availability and preferences of many party members. This can lead to lower participation rates, especially among those with work or family commitments. Access to information is another challenge. Doherty and Desposato (2019) argue that not all party members have the same access to information about primary candidates, which can result in an uneven playing field. The lack of information can make it difficult for voters to make informed choices, potentially leading to a disconnect between the party's ideological base and the candidates who advance through the primary process.

The level of member participation in party primaries has significant consequences for the democratic process. When party members actively engage in primaries, they contribute to a more representative candidate pool. Abramowitz (2018) emphasizes that high levels of member participation can lead to candidates who more closely mirror the party's ideological diversity and policy preferences. This can enhance the competitiveness of the party in general elections. Furthermore, member participation can foster a sense of party cohesion. Karp and Banducci (2018) have found that when members feel that their voices are heard in the primary process, they are more likely to be committed to the party and willing to work for its success. This, in turn, can lead to increased party unity and a stronger, more cohesive organization.

Balancing Act

Balancing party supremacy with members participation in primaries is a challenging but essential task for a functioning democracy. Striking the right balance ensures that party elites have the authority to make informed decisions while respecting the values of democracy and transparency. According to Cohen and Karol (2017), to foster a healthy democracy within political parties, internal party democracy mechanisms must be established. These mechanisms include clear rules and procedures for candidate selection,

transparency in decision-making, and mechanisms for member input and feedback. By adhering to these principles, parties can minimize the risk of elite manipulation while maintaining party unity. Norris (2014) also added that by establishing clear rules for candidate selection and decision-making, political parties can reduce the risks of elite manipulation. These rules should include open candidate selection processes, party constitutions that outline democratic procedures, and mechanisms for grassroots members to influence decision-making. Accountability is another and a critical element in balancing party supremacy and member participation. Party leaders must be accountable to their members and should regularly communicate their decisions and the reasons behind them (Bowler et al., 2019). Moreover, mechanisms for recall or internal challenges can be put in place to hold leaders accountable for their actions. Scarrow (2015) argued that political parties should embrace internal elections for leadership positions, which can provide members with a degree of control over the party's direction. Additionally, Scarrow suggests the establishment of regular channels of communication between party leaders and members to foster transparency and accountability.

However, Tranter (2019) stated that reforms in party primaries can help strike a balance. Open primaries, in which party members and unaffiliated voters participate, can bring new perspectives into the process. Additionally, implementing preferential voting systems, like ranked-choice voting, allows for more diverse candidate pools and reduces polarization within parties. Ansolabehere and Schaffner (2014) also underscores how preferential voting systems, like ranked-choice voting, can be an effective means of balancing party supremacy and member participation. Such systems allow for a more diverse range of candidates, reducing the risk of polarization within parties. Furthermore, political parties must prioritize educating their members and engaging them in the process. This includes providing training on how primaries work, how candidates are selected, and how members can participate effectively (Abdullah &Ramly, 2013). Engaged members are more likely to understand the importance of party unity while advocating for their own preferences. Norris (2016) emphasize that by educating members about the workings of party primaries and the broader political process, parties can empower their members to participate effectively. He also suggests that parties should invest in civic education programs and engage members in various party activities beyond voting in primaries.

Challenges of Balancing Party Supremacy and Member Participation

Intra-party Conflicts: One of the most significant challenges in balancing party supremacy and members participation is the potential for intra-party conflicts. When party leaders and members disagree on candidate selection, it can lead to internal divisions that weaken the party as a whole. Such conflicts can have lasting consequences, as well as impacting adversely on a electoral performance of the party.

Risk of Factionalism: Members participation can sometimes encourage factionalism within a party. Various party factions may vie for influence and control, potentially causing divisions that are detrimental to the party's unity. Factions can be driven by ideological differences or personal ambitions, which can harm the party's overall effectiveness.

Vulnerability to External Influence: Allowing broad members participation can make party primaries susceptible to external influence. Special interest groups, external donors, or even opposing political parties may seek to manipulate the process to promote their own agendas. This can undermine the integrity of the primaries and the democratic system.

Some Case Studies

Political parties are fundamental actors in any democratic system, serving as intermediaries between citizens and the government. The internal dynamics of political parties, particularly their approaches to candidate selection, are critical for understanding the health and vitality of a democracy. Case studies from different countries demonstrate various approaches to party supremacy and members' participation in party primaries:

United States

The United States serves as an interesting case study due to its two-party system, where the Democratic and Republican Parties dominate the political landscape. Party primaries play a crucial role in candidate selection at various levels, including presidential elections. In the United States, party primaries often vary in terms of rules and regulations depending on the state, as election laws are typically determined at the state level. However, the concept of party supremacy remains prevalent in both major parties. Party leadership, represented by the Democratic National Committee (DNC) and the Republican National Committee (RNC), plays a significant role in setting the rules and shaping the primaries. (Ware, 2019).While the U.S. primaries are relatively open, the influence of party elites and the primary process's control are evident.

Superdelegates in the Democratic Party, for instance, are party leaders and officials who have a say in selecting the nominee, which has raised questions about the inclusivity of the process. In contrast, the Republican Party has seen its share of controversies with some states implementing winner-takes-all rules, limiting the influence of members' votes in candidate selection (Caul &Debnam, 2019).

United Kingdom

The United Kingdom's political landscape consists of multiple parties, with the Conservative Party and the Labour Party being the two dominant ones. In the UK, party supremacy has historically been a significant aspect of party politics, with party leaders often having substantial control over candidate selection. The UK operates on a first-past-the-post electoral system, which impacts the role of party primaries. In recent years, there has been growing debate about democratizing candidate selection processes within political parties. Both the Conservative and Labour Parties have made efforts to involve more members in candidate selection, moving away from the exclusive role of party elites (Webb & Marsh, 2017). One notable example is the Labour Party's use of open primaries in some constituencies, allowing all eligible voters, regardless of party affiliation, to participate in the selection of their candidate. This demonstrates a shift towards a more inclusive and participatory approach (Hazell & Cowley, 2018).

Germany

Germany provides another case study where party supremacy and members' participation are balanced differently. In Germany, political parties have a significant degree of control over candidate selection, and party leaders play a prominent role in the process. However, German parties use a system of closed primaries, where party members and delegates participate in selecting candidates (Hough & Jeffery, 1998). The German Christian Democratic Union (CDU), for instance, holds a closed primary in which party members and delegates from local branches have the authority to choose the party's candidates. While this system maintains party supremacy, it also ensures that party members have a say in candidate selection, albeit through an indirect process. The balance between party leadership and members' involvement varies from party to party and plays a crucial role in candidate selection (Thibaut & Walker, 2015).

India

India, with its multi-party system, provides another insightful case. The Indian National Congress and the Bharatiya Janata Party (BJP) are two of the most prominent parties in the country. India's political landscape is characterized by a vast and diverse electorate, making party primaries or candidate selection processes crucial. According to Chhibber and Kollman (2018), in India party supremacy often takes the form of high command culture, where party leaders hold significant power and influence over candidate selection. This practice has faced criticism for limiting the participation of grassroots members. However, India also showcases examples of vibrant and competitive party primaries at the regional level. Some political parties, especially those with a strong regional base, have adopted more inclusive candidate selection processes, allowing members to have a say in nominating their candidates (Basu, 2019).

Japan

Japan provides a unique case where party supremacy is strong, and party leaders have significant influence over candidate selection, but member participation is limited. In Japan, the Liberal Democratic Party (LDP) has historically exercised tight control over candidate selection, often endorsing candidates through internal party mechanisms (Curtis, 2010). However, there has been a growing demand for increased member participation in candidate selection processes in Japan's political landscape. The rise of new parties and reforms aimed at increasing transparency and accountability have challenged the LDP's traditional party supremacy (Scheiner, 2016).

Nigeria

Nigeria's political landscape exhibits a high degree of party supremacy, with party leaders often handpicking candidates. The country's primary elections are typically influenced by a select few within political parties. Adedayo (2019) observes that the concentration of power within political parties often undermines members' participation and internal democracy. In the context where parties often serve as vehicles for the political ambitions of elites, research conducted by Mohammed and Barau (2018) shed light on the extent to which party members influence candidate selection within the All Progressives Congress (APC) and the People's Democratic Party (PDP).

The study shows that party supremacy remains a substantial factor in candidate selection, with party leaders exerting significant control. However, Nigeria is also witnessing efforts to increase member participation. The study highlights how some internal party mechanisms, such as direct primaries, aim to empower members in the candidate selection process and reducing party elites' influence. This case study demonstrates the evolving dynamics between party supremacy and member participation in a young and vibrant democracy.

The political parties in Nigeria, particularly the dormant ones: Peoples Democratic Party (PDP) and All Progressives Congress (APC) adopt a delegate system for the selection of party flag bearers. Their constitutions provide for both statutory and elected delegates for primary elections at the local government area, state and national levels. The statutory delegates includes some elected party officials former and incumbent elected local government chairman, former and incumbent members of both the state and national assemblies, incumbent and former governors and their deputies as well as current and former president and their vice. The elected delegates are nominated and chosen by members of the party through elections or consensus arrangements. From the foregoing, the statutory delegates who are always much in number are also the political and administration leaders of the party. This gives them overwhelming vantage position in determining who gets elected as party candidates. Ultimately this limits members' participation in the selection of party candidates or representatives.

The Influence of Technology

Technology has also played a significant role in shaping party primaries. Online voting and digital platforms have made it easier for members to participate in primary elections, potentially increasing their engagement. This shift has raised important questions about the security and integrity of the primary process, as well as how to maintain fairness and transparency.Traditionally, party primaries were often controlled by a select few party elites, giving rise to the concept of party supremacy. These elites wielded substantial influence in candidate selection, making it a closed process. However, the rise of technology has democratized party primaries. Online voting systems and social media platforms have allowed for a broader and more inclusive participation. A study by Aldrich and Sullivan (2018) discusses the impact of online voting in party primaries, highlighting how it has reduced the influence of party elites and increased the involvement of rank-and-file members. However, the digital age has democratized political communication and opened new avenues for member participation. Studies have shown that digital platforms allow for broader and more direct engagement with party members, thus reducing the influence of party elites (Norris, 2017).

One significant way technology has affected party primaries is by making information about candidates more accessible to the party members. Before the internet era, party members had limited sources to gather information about potential candidates. Today, websites, social media, and online forums provide platforms for candidates to present their platforms and interact with party members directly. A study conducted by Smith and Williams (2020) and published in the "Journal of Political Communication" emphasizes how the internet has become an essential tool for political campaigns to reach out to party members.Likewise, technology has made it easier for political parties to mobilize their members for primary elections. Online tools and platforms have provided parties with new ways to reach and engage voters. For instance, email campaigns, text messaging, and social media outreach have proven effective in encouraging voter turnout in primaries (Ansolabehere et al., 2020).Moreover, mobile apps developed by parties and third-party organizations have become essential tools for voter registration and information dissemination. These apps provide voters with convenient access to candidate profiles, polling locations, and up-to-date election information. The convenience offered by technology encourages greater participation in primaries, even among individuals who might not have otherwise been engaged in the process (Gerber et al., 2017).

Furthermore, social media platforms have emerged as powerful tools for political campaigns. Candidates and parties can connect with voters and party members on platforms like Facebook, Twitter, and Instagram. These platforms offer opportunities for real-time engagement, allowing members to ask questions, voice concerns, and share their opinions. They have enabled party members to mobilize independently of traditional party hierarchies. Candidates can directly appeal to voters and bypass party leadership, as seen in the rise of grassroots movements. For example, the Bernie Sanders campaign in the 2016 Democratic primaries made effective use of social media and online fundraising to challenge the party establishment (Shirky, 2016). This trend has forced parties to adapt to new realities, making party supremacy more fragile and susceptible to grassroots movements.

Moreover, technology has significantly increased the transparency of party primaries. The use of digital platforms for broadcasting debates, live streaming candidate events, and publishing real-time election results has made the process more open and accountable (Howard, 2017). This enhanced transparency helps prevent manipulation and fraud, which can undermine the legitimacy of primary elections. However, the widespread use of social media has empowered voters to scrutinize the actions of their parties and elected representatives. Scandals and unethical behavior are more likely to come to light, and members can hold their parties accountable for addressing such issues. This increased scrutiny places additional pressure on party elites to maintain the trust of their members, further challenging traditional party supremacy (Baumgartner et al., 2018).

Hersh, (2015) further added that the availability of voter data and sophisticated data analytics tools have revolutionized political campaigning. Parties can now customize their messaging and campaign strategies based on demographic, geographic, and behavioral information gathered from various sources, including social media. This level of personalization can significantly influence the outcome of primaries.Data-driven campaigns enable parties to better target their base, increase voter turnout, and sway undecided voters. While this can be advantageous for party elites, it can also empower candidates who excel in leveraging data analytics and digital strategies to gain an edge over establishment contenders (Kreiss, 2016).

Relationship between Party Supremacy and Members' Participation in Party Primaries

The relationship between party supremacy and members' participation in party primaries is a fundamental aspect of democratic politics. Party primaries are the cornerstone of candidate selection in many democracies, offering members and supporters of political parties the opportunity to have a say in who represents their party in elections. However, the degree to which party members can influence this process varies significantly. In some cases, party leaders exert a high level of control, while in others, there is a greater emphasis on grassroots participation.Party primaries serve as a key mechanism for selecting candidates who will represent a party in elections. Primaries can be open to all registered voters (open primaries) or restricted to party members (closed primaries). The relationship between party supremacy and primary participation is most evident in closed primaries, where only party members can vote (Fowler &Gronke, 2020).

In cases of strong party supremacy, party leaders and elites hold a significant influence over the primary process. They often play a key role in determining who the party's candidates will be, sometimes endorsing specific individuals or even selecting candidates behind closed doors.A study by Aldrich (2015) on the Democratic Party in the United States illustrates the impact of strong party supremacy. It found that the party's leadership had a substantial role in shaping candidate choices, with limited grassroots involvement in the selection process. Party leaders could endorse preferred candidates, allocate resources, and exert significant control over who could run in primary elections.This high level of control can limit the participation of rank-and-file party members in the primary process. When members perceive that party elites are pre-selecting candidates, they may become disengaged and feel that their input is not valued. As a result, voter turnout in primaries may be low, and members may be less likely to participate actively in the party's internal affairs (Aldrich, 2015).

The level of party supremacy in primary elections has far-reaching consequences for democratic politics. When party leaders exert strong control, the democratic nature of the process may be questioned, as party members have limited influence over candidate selection.Katz and Mair (2019) argued that the weakening of party members' influence can lead to the rise of candidate-centered politics, where candidates focus on building their personal brand rather than adhering to party platforms. This shift may undermine party cohesion and ideological consistency, potentially harming the party's long-term viability. Conversely, when party supremacy is weak, party primaries tend to be more inclusive and participatory. In such cases, primaries can serve as a means of enhancing political education and engagement among party members. This is exemplified by the case of the Pirate Party in Iceland, as studied by Vasilopoulou and Giannakou (2016). The party's open candidate selection process empowered members, leading to increased participation and a sense of ownership over party decisions.

The relationship between party supremacy and members' participation in primaries can also impact a party's electoral success. While strong party supremacy may result in more centralized and controlled candidate selection, it does not guarantee victory in general elections. A study by Blais et al. (2013) analyzed Canadian party primaries and found that a high degree of party control did not necessarily lead to better electoral outcomes.

Parties with weak party supremacy in the primary process performed just as well as those with strong party supremacy. The key factor in electoral success appeared to be the quality and appeal of the selected candidates rather than the level of party control. However, the way in which candidates are chosen can affect party unity and cohesion. When party members are excluded from the candidate selection process, it can lead to internal divisions and a lack of enthusiasm among the party base, potentially undermining electoral success.

Therefore, the relationship between party supremacy and members' participation in party primaries is a crucial element of democratic politics. Strong party supremacy can limit the influence of grassroots members and may lead to lower participation in primaries, potentially harming the party's internal democracy and long-term viability. In contrast, weak party supremacy can encourage active participation and contribute to a more engaged and committed party base.While party supremacy can shape the primary process, it does not guarantee electoral success. The quality and appeal of candidates chosen in primaries play a significant role in determining a party's performance in general elections. Ultimately, striking the right balance between party control and member participation is essential for the health of political parties and the vitality of democracy.

Conclusion

The delicate balance between party supremacy and member participation in party primaries remains a critical issue in democratic political systems worldwide. The tension between these two aspects of political engagement is emblematic of the larger struggle to ensure both effective party organization and the inclusion of diverse voices in the electoral process. Party supremacy, on one hand, is essential for maintaining ideological coherence and party discipline. It allows parties to present a unified front during general elections and offers a sense of stability and direction to the electorate. This centralized authority can help prevent fragmentation and maintain party identity. On the other hand, member participation in party primaries is crucial for fostering inclusivity and promoting democracy within political parties. Allowing party members to directly engage in candidate selection can provide a more diverse pool of candidates, encourage grassroots involvement, and make the party more responsive to the needs and aspirations of the electorate. The ideal approach lies in striking a balance between party supremacy and member participation. Parties should adopt transparent and fair primary processes that allow members to participate while ensuring mechanisms for accountability and discipline. This ensures that parties remain true to their core ideologies while embracing the voices of their members.

Recommendations

Striking the right balance between party control and member involvement is essential for a thriving political environment. The following recommendations were deemed necessary:

1. To strengthen party supremacy while promoting member participation, it is essential political parties to ensure transparent and inclusive party primaries. Parties should establish clear guidelines and timelines for primaries, ensuring that the process is open, fair, and free from undue influence.
2. Parties should actively engage their members through regular meetings, town halls, and online platforms. This helps in fostering a sense of belonging among members and keeps them informed about party activities.
3. Parties should invest in educating their members about the electoral process, the importance of primaries, and the party's values and ideology. Informed members are more likely to make meaningful contributions.
4. To prevent undue party influence, primaries should be overseen and well managed by independent election commissions. This ensures fairness and impartiality, fostering trust among members and the public.
5. Parties should be accountable to the public and should be open to scrutiny regarding their primary processes. Transparency builds trust, and it is essential to maintain the integrity of party primaries.

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PERFORMANCE EVALUATION OF A MECHANICALLY POWERED ROTARY LAWN MOWER

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ABSTRACT

This work presents the design, construction and performance evaluation of a mechanically powered lawn mower which is environmentally friendly, affordable, easy to maintain and user friendly using locally sourced materials. At the heart of the design are gear sets which convert the forward motion of the wheels to a rotational movement of blades at a higher speed. The blades rotate at 250rpm and move relative to a horizontal stationary blade, causing a scissoring action against the grass, thus enabling a clean cut. For a push of 407.33N, a sheering force of 46.58N is generated at the blades which are used for the scissoring action. The effectiveness of this designed machine, cutting grass at a good efficiency is the cutting blades assembly which uses the scissoring effect of the shearing blades to smoothly cut through grasses of certain area at the little force of push on the machine. The results from the test carried out showed that the scissoring effect of the shearing blades was 93 percent efficient, as they were able to cut through the grasses which they were subjected to.

Keywords: *Cutting Blades, Lawn Mower, grasses, Efficiency, Design*

INTRODUCTION

Moving the lawn is important as it keeps the surrounding tidy and helps prevent the breeding of mosquitoes, rodents and reptiles. Before the advent of lawn mower, traditional method of grass cutting was employed. As technology advances, techniques of grass cutting by lawn mowers were constantly improved. Most mowers can be obtained as push or self – propelled model. There are primarily two types of mowers namely; The Reel mowers and the Rotary mowers. The rotary mowers are often powered either by an internal combustion engine or an electric motor. The rotary mower engines spin the cutting blade at a very fast rate that ensure smooth cutting. The initials and operating cost of the rotary mower is high because of the energy usage. Again, the rotary mower is very noisy. The internal combustion engine employed also releases exhaust gas into the

atmosphere which is harmful to both humans and the environment.

The purpose of lawn mower design is to cut lawn around the home, industries building and buildings in other establishment. It can also be used to maintain lawn in sport ground and parks Apart from this rotary lawn mower, the other type is the reel lawn mower, the reel is made of blades on a revolving cylinder, they achieve clean cut by scissors action. As the mower forward, rotating blades meet a stationary blade by the shearing action of the reel blades against the stationary blade. The reel mower cut at a very slow rate, making it users unfriendly. Also, the reel mowers are usually expensive and difficult to maintain (Spangenberg, 2001). Sharpening reel mower is difficult and is best left to a professional mower repair service, (Wikipedia.org).
The lawn mower can be manually, mechanically or/and electrically operated. The design of this machine is based on the means by which the mechanism rotates the cutting blade to cut the grass. This project work was concerned with the design of a rotary lawn mower powered by a mechanical movement. The work puts into consideration affordability, ease of maintenance and repair of the grass cutting machine (rotary lawn mower) and ensured that it is environmentally and user friendly. The machine was also constructed from locally sourced materials.

SIGNIFICANCE OF THE STUDY

The significance of this research work was to show that with the application of the right methods in the design and construction of the manually operated lawn mower using locally available materials produces the great results in lawn grass cutting whilst maintain national standard and also contribute immensely to economic growth and development by creating employment.

SCOPE AND DELIMITATIONS

The project focuses on grass cutting while putting into consideration pollution to the immediate environment. The work involves the design and construction of a manually operated lawn mower while considering the properties required for efficiency.

LITERATURE REVIEW

In this chapter, the description of lawn mower and also study of the previous work on the design and construction of the lawn mower are presented. As stated in the previous chapter, the design and fabrication of this machine is based primarily on local raw materials. Thus, this manual rotary lawn mower is designed and constructed locally.

Basic Classification of the Lawn Mower
The lawn mower can be classified into three types namely:

The Reel Lawn Mower

This lawn mower was first invented in 1830 by an Englishman. Edwin Budding. This type of lawn mower cut like scissors. There are about six blades mounted on a cutting bar that holds all the blades together enabling the different cutting height adjustment. This type of lawn mower can be powered by a fuel engine, an electric motor or manually propelled. It is mainly used on lawns in parks, golf courses, fields and on industrial ground where smooth and even cut is desired. The reel lawn mowers are of two kinds, the one that discharges the chippings to the rear and those that throw the chippings to the front. It has a lot of moving parts, hence requiring great maintenance at a high cost which makes the machine less attractive to low income earners.



Fig. 1: The real Lawn mower
Source: www.wikipedia.org/wikireal

The Rider Lawn Mower

This lawn mower exists in various kinds of shapes, sizes, power and designs. It is mostly used on lawns larger than a Half (1/2) acres. Unlike most lawn mowers, this machine has a riding system on which the operator rides during cutting operation. This type of lawn mower is smaller than the lawn tractor and it is easier to manoeuvre, but less capable on slopes, the operator sits on a short balanced surface like a mini chair with the moving deck out in front and the engine in the rear.



Fig.2: The rider lawn mower
Source: www.wikipedia.org/wikirider_mower

The Rotary Lawn Mower

This is the most common type of lawn mower. Besides the engine, there are few moving parts in this type of lawn mower. It can be powered by two-stroke or four-stroke internal combustion engine running on petrol or other liquid fuel or by electrical means by using an electric motor. The engine (3.5 HP) as in the case of a fuel powered (i.e. the primary concern for this study) rotary mower whirls a straight sharpened blade (40cm by 60cm) are a speed of 3000 revolution per minutes (RPM) which provides a higher speed cutting action. Rotary mowers typically have an opening in the side of the housing where the cut grass is expelled. Some have a grass catcher attachment to that point to bag grass clippings.



Fig. 3: Rotary Lawn mower
Source: www.wikipedia.org/wikirotary_mower

Classification of Lawn Mowers Based On Blade.
The lawn mower can be classified based on the types of blades used. The various types include.

The Rotary Blade Type

This type of lawn mower is used in big establishments with large lawns or sometimes in homes. The blade is made up of a flat meter bar with central holes that connects it to the spindle which is driven by the prime mover. The frame is from the hood which carries the wheels, the pushing handles and the power source. The hood provides housing for the blade. This enables to gather and cut grass in a particular direction, this type of mower shreds, cuts, tears, chops, mows, pulverizes and munches leading to its

popularity on an African farm. The rotary blade mower was first produced commercially by the Australian Vicar Company in 1947. It can either be powered by petrol or a diesel engine, electric motor or air. The air type rotary blade mower depends on pressure variation within the inlet and the outlet of a centrifugal fan. The purpose of the fan is to move air continuously against modest pressure. As the fluid moves towards the outlet of the impeller, which acts as the diffuser, part of the kinetic energy is converted into pressure energy which now drives the blade.

The electrically powered lawn mower has the advantage of its easy starting over the other types of rotary blade mowers where force has to be exerted on its prime mover before it starts, it also does not emit gaseous effluents that might be harmful to the environment and it also produces less noise in comparison to the gasoline engine lawn mower. Its disadvantage over the other types of rotary mowers is that its usage is hindered in an environment with irregular power supply like ours. It is generally used in small lawns around the home, its use on large lawns is limited owing to the long cable required to supply power from where the electrical power source is situated.

The petrol or diesel powered lawn mower is the most common type in the market today. It is usually powered from a two stroke internal combustion engine and mechanically coupled to a shaft through a hub carrying the blade that does the actual cutting. The disadvantage of the lawn mower is its tendency to overheat, the pollution from its exhaust and its high maintenance cost during servicing. Asides from its disadvantage, this type of mower still offers more power ratings. It can be used on various sizes of lawns and isn't affected by power fluctuations.



Fig. 4: Rotary blade type
Source: www.wikipedia.org/wiki/rotary_mowerblade

The Spiral Blade Type

In this type of lawn mower, the power required to drive the prime mover varies from manual to electric, heavy duty petrol to diesel engine, the blade which is helical shaped is mounted on a rotating cylinder which is known as the blade wheel. The cutting principle is more efficient than any other type of blade as it starts to cut the lawn from the leading edge through the tail end. This results in the grass being cut properly.

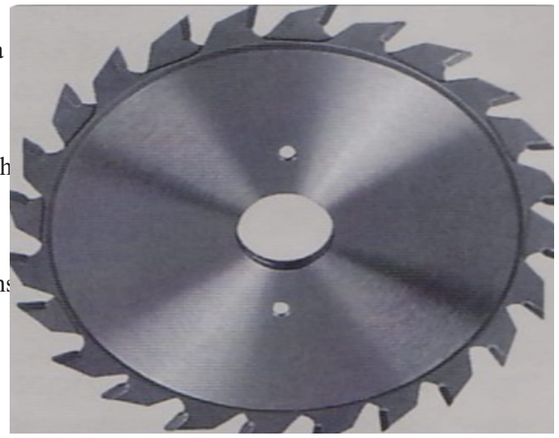


Fig. 5: The Spiral blade type
Source: www.wikipedia.org/wiki/spiral_mowerblade

The Reciprocating Blade Type

This type of lawn mower has a large power requirement. They are mainly used for agricultural purposes. They are usually on heavy duty diesel or petrol tractors. They are used for harvesting haystacks. The blades are mounted on a long stationary bar.



Fig. 6: The reciprocating blade type
Source: www.wikipedia,org/wiki/reciprocating_mower blade

Description of the Proposed Design

The proposed design incorporates the features of both the reel and rotary mowers. It receives its power from its rotating wheels when it is pushed by an operator. Built in are the powers transmitting mechanisms (the gear system) which are between the source of power and the blade. This makes it possible for the blade to receive mechanical power for the shearing action. It employs a rotating blade which rotates horizontally about an imaginary vertical axis (similar to the rotary mower).The transmission mechanism is made up of two mating bevel gears which change the forward motion of the rotating shaft via the wheels at an angle of 90 degrees into a horizontal rotation of the blade. The shearing mechanism (blade) comes in a pair, a stationary blade and a revolving blade. The revolving blade rotates about the stationary blade at an angle cut the grass with scissoring action.

Operating Principle

As the operator pushes the mower against its weight, the pushing force causes the wheels to rotate while moving on the ground. Torque is then generated from the wheels through the shaft. The torque is then transmitted through the beveled gear drive to a mating spur gear. The beveled gear drive is set up (with a speed ratio of 4:1) to increase the generated torque before transmitting it to the mating spur gear via the intermediate shaft. The spur gears with a speed ratio of 1:1.25 provide the blade with enough revolving speed and the needed torque to perform the shearing action. The shearing action is performed by two sets of blades: stationary and rotary blades. The blades rotate horizontally about an imaginary axis and slides over the stationary blades. As the rotary blades- move relative to the stationary blades, the grass is held by the shearing action between the two sets of blade, thus ensuring a clean cut by scissoring action

DESIGN ANALYSIS AND CALCULATION

The designs were computed on the power requirement, shear force, selection of bevels and spur gears, and driving shaft design.

3.1 Power Requirement

According to (Nkakimi & Yahefa, 2014), the minimum power required to operate the mower is given by,

$$p_r = p_{io} + p_{ct} \quad 1$$

Where,

p_r = Power required,

p_{io} = Power to overcome inertia of the mower and

p_{ct} = Power to overcome grass cutting resistance.

But $p_{io} = wv$

Where,

w = weight of the mower

= 337.46N,

v = operational speed of the mower

= 0.8m/s·

Also,

$$p_{ct} = F_{ct} R_b \left(\frac{2\pi N_b}{60}\right)$$

Where,

$F_{ct} = 11.54N$, the shearing force of the grass according to (Okafor, 2013),

$R_b = 0.185m$, radius of the blade,

$R_b = 250rpm$, angular speed of the blade

$\therefore p_r = 325.86W$

3.2 The Pushing Force Required

The pushing force required, F_r to generate the required power is given by,

$$F_r = \frac{P_r}{V}$$

Where,

P_r = power required,

V = Operational velocity of the mower,

P_r = pushing force required. By substitution into equation (4), we have that

$F_r = 407.33N$

3.3 The Blade Shearing Force and the Blade Power

According to (Khurmi and Gupta, 2005) assuming the power transmitting efficiency of the gear drive to be high, more than 80%, the minimum power transmitting to the blade (P_b) is given as,

$$P_b = \frac{2\pi N_b T_b}{60}$$

Where;

T_b= blade torque and is expressed mathematically as:

$T_b = F_t R_b$

And,

$F_t = 46.58N$(Simons el' al, 2017)

= blade shearing force.

$R_b = 0.185m$ (Radius of blade)

$\therefore T_b = 8.65Nm$ and $N_b = 250rpm$

Substituting into equation (5), we have that

$P_b = 225.69W$

3.4 The Transmission Shaft Design

According to Khurmi and Gupta (2005), the equivalent twisting moment, $T_e$is giving of a shaft is expressed as:

$$T_e = \sqrt{M^2 + T^2} = \frac{\pi d^3 \tau}{16} 7$$

Where,

M= maximum bending moment,

T = torque transmitted,

τ = allowable shear stress and

d = diameter of shaft

But, $\tau = \frac{\tau_u}{F_S}$ 8

Where, τ_u = ultimate tensile stress

F_s = factor of safety

$$\Rightarrow T_e = \sqrt{M^2 + T^2} = \frac{\pi d^3 \tau}{16} = \frac{\pi d^3 \tau_u}{16 F_s} 9$$

The torque, T transmitted was determined as,

$T = F_r \times R$ 10

Where,

F_r= 407· 33N,

R= the radius of the wheel = 0· 155M

Thus,

$T = 63.14Nm$

Since the gear is mounted at the middle of the shaft, the maximum bending moment at the centre according to (Khurmi and Gupta, 2005) is expressed as:

$$M_{max} = \frac{WL}{4}$$

Where,

L = length of the shaft between bearings

= 0.7m

W = normal load acting on the tooth of the gear

Where, $W = \frac{F_t}{cos\alpha}$

Where,

$\propto$ = the pressure angle of the gear = 20°

$F_t = \frac{2T}{D}$

Where,

F_t = tangential force on the gear,

T = torque transmitted and

D = pitch circle diameter of the gear = 0.12m.

By substituting values into equation (13), (12), (11) and (9), we have that F_t = 1052.33N, $W = 1119.87N$, $M_{max} = 195.98Nm$ and $T_e = 205.9KNmm$ Respectively.

Similarly, from equation (9), we have that the transmission shaft diameter can be expressed as: $d = \sqrt[3]{\frac{16T_e}{\pi\tau}}$

According to ASME, the allowable shear stress for shaft with keyway is$45MPa$. Substituting values into equation (14) we have that $d = 28.56mm$. Thus, the shaft was designed with a diameter of $30mm$.

The Design and Selection of Bearings for the Machine

According to (Khurmi and Gupta, 2005), due to the bearing high load carrying capacity and suitability for high running speeds, the single row deep groove ball bearing was chosen for this design.

Considering the average life of the bearing to be 8years at 10 hours per day and assuming 300 working days per year and a rotational speed of 50rpm, the life of the bearing in hours is, $L_h = 24000hrs$.

The life of the bearing in revolution is expressed as $L = 60NL_h$

Where,

$N = 50rpm$, thus, by substituting into equation (15),

$$L = 72 \times 10^6 rev$$

In other to select the most suitable ball bearing, we apply the equation for the design basic dynamic radial load capacity as given by

$$C = W\left(\frac{L}{10^6}\right)^{1/k}$$

Where,

C = design basic dynamic radial load capacity,

W = basic dynamic radial load

L = bearing life in revolutions,

k= 3 (for all bearings).

But, $W = XVF_r + YF_a$

Where,

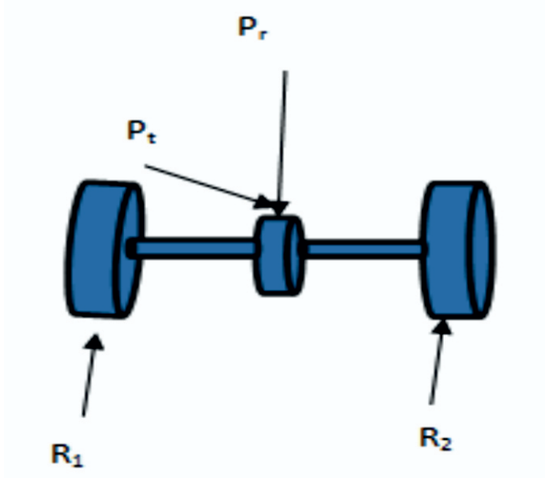
$F_r = the\ radial\ load$ F_a = the thrust load, X = Radial load factor,

Y = Axial load factor,

V = Rotational factor and has a value of 1 for most bearings. The values of X and Y are selected from the table of dynamically loaded bearings. This is based on the relationship given by (Hall et al, 2002) as:

$$\frac{F_a}{VF_r} > e \text{ or } \frac{F_a}{VF_r} \leq e \quad 18$$

To determine the basic dynamic radial load, the forces acting on the bevel and the reaction on the wheels are calculated as follows,



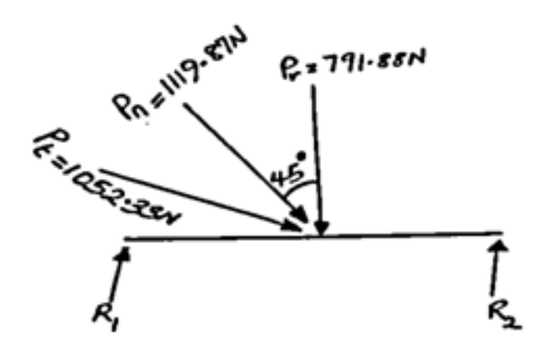


Fig. 7: Free body diagram

$$\sum upward\ forces = \sum downward\ forces$$

$$R_1 + R_2 = 791.88N$$

The radial force F_r acting on the bearing is $P_r = F_r = 791.88N$ and since there is no axial force acting on the bearings thus, the tangential force $P_t = F_a = 1052.33N$

For,

$$\frac{F_a}{F_r} = \frac{1052.53}{791.88} = 1.33$$

(Which is $> e = 0.44$)

From Factor X, V and Y table as recommended by (Hall et al, 2002), we have that

$X = 0.56, V = 1$ and $Y = 1$. Substituting these values into equation (17), we have that:

$$W = 1495.78N$$

According to (Khurmi and Gupta, 2005), the basic dynamic radial load capacity C is expressed as:

$$C = W\left(\frac{L}{10^6}\right)^{1/k} \times K_s \quad 18$$

Where,

$K_s = 2 = service\ factor\ for\ moderate\ shock\ load$

By substituting into equation (18), we have that $C = 12.45KN$

From table 27.6 (khurmi & Gupter, 2005), the bearing number 304 was selected. And it has the following basic capacities

$C_0 = 7.65KN$, $C = 12.5KN = 12500N$

$$\frac{F_a}{C_o} = \frac{1052.33}{7650} = 0.14$$

From the table 27.4, for $\frac{F_a}{C_o} = 0.14$, the values of X and Y are 0.56 and 1.14 respectively. By substituting into equation (17), we have that $W = 1916.71N$. Similarly, substituting into equation (18), we have that $C = 15.95KN$

From the table 27.6, for single row deep groove ball bearing, the bearing number 207 having C = 20 KN was selected for machine.

This in confirmation of table 27.1, for bearing number 207 has a bore of 35mm which fit in the 30mm shaft diameter designed for the machine.

General Assembly of the Machine

The machine is made up of separate parts namely:

The Hood (Frame), Handle, Blade, Wheels and gears. The gears, which are the back bone of this lawn mower, were mounted directly on the transmission shaft. Bearings where placed at both end of the shaft and mounted to the wheels. A suitable base was made and welded to the frame on which the bevel gear pinion was mounted onto the bevel gear. Suitable packing materials were used and an intermediate shaft connecting the bevel gear pinion was mounted with a bearing and its housing to allow for proper positioning and rotation. At the bottom of the intermediate shaft was also mounted a spur gear which has the same bore with the bevel gear pinion and rotate with the same rotational speed. Another intermediate shaft connecting the spur gear pinion and the blade at the bottom was then mounted in position with another bearing and housing. The rotating blade was given a proper clearance with the stationary blade to allow for rotation and scissors action cutting. Then the bolt and nuts were used to fasten all the components of the machine in position to prevent vibration.

COMPONENTS OF THE MACHINE	
S/N	**PARTS**
1	HOOD (FRAME)
2	HANDLE
3	BLADE
4	WHEEL
5	BEVEL GEAR
6	SPUR GEAR (PINION)
7	SHAFT
8	ROLLER
9	BALL BEARING
10	BLADE GUIDE
11	COVERING PLATE FRAME

Table 1: Components of the Machine

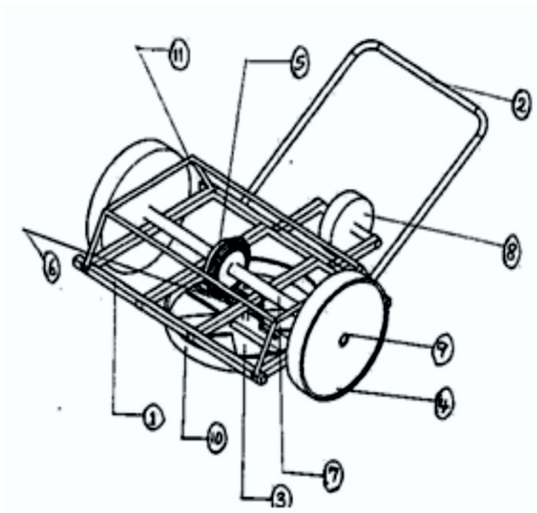


Fig.8: Isometric view of the machine

PERFORMANCE TESTING OF THE MACHINE

After the assembling process in the Welding and fabrication workshop of the school of Engineering, National Institute of Construction Technology and Management, an inspection to ensure proper assembly was conducted. The machine was pushed round to check if the components were properly positioned and to observe the rotation of the blade and its speed. Some little adjustments were made in tightening some of the bolts. The machine was certified good to carry out its work and was taken to the field for further testing. A land predominately covered with carpet grass (Axonopusaffinits) was mapped out into plots of 4m x 2m. Four of these plots were selected at random and mowed. It was found out that the mower gave a fine and clean cut at a reasonable little time. Based on this result, it can be inferred that the machine is satisfactory and can service Polytechnic effectively.

Efficiency of the Machine

The following capacities were computed to determine the efficiency of the machine. The theoretical field capacity

(□□□), Effective field capacity □□□ and the field efficiency (η). According to Nkakini and Yabefa, 2014,

$$□□□ = □□ \times □□$$

Where $□□ = 0.8□□^{-1}$ =forward speed, $□□ = 2□$ =theoretical width

$$□□□ = 0.8 \times 2 = 1.6□^{2}□^{-1}$$

$$□□□ = \frac{□□□□□□\ □□□□\ □□□□□□□□}{total\ □□□□\ □□□□□} = \frac{□}{□}$$

$$= \frac{4 \times 2}{6} = 1.333□^{2}□^{-1}$$

$$□□□□□\ □□□□□□□□□□□(\eta) = \frac{□□□}{□□□} = \frac{1.333}{1.6}$$

$$= 83.33\%$$

RESULTS AND DISCUSSION

The results of the performance test show that the machine performed excellently well with an efficiency of *83.33%* with a theoretical field capacity and effective field capacity of $1.6□^{2}□^{-1}$ and $1.333□^{2}□^{-1}$ respectively.

CONCLUSION

A manual rotary lawn mower has been designed with its blades rotating speed of 250 rpm which is capable of cutting the lawn with a shearing force of 46.58N. The mower requires a minimum push force of 407.33N. The machine is made up of simple components that can be easily assembled from locally sourced materials in order to minimize the cost of production. Local expects can operate and maintain the machine with little or no training/ it is anticipated that the machine when commercialized will meet the need of gardeners by providing an easier way of clearing lawns in our immediate environment. Jobs will also be created for those that will go into the production of the machine out of which they will elk out a living.

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Impact of Corruption on the Investment Volume of Public-Private Partnership in Abia State.

POLYTECHNIC EDUCATION AND SUSTAINABLE CAPACITY DEVELOPMENT OF PERSONS WITH SPECIAL NEEDS IN NIGERIA.

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ABSTRACT

Effective implementation of inclusive education in Nigeria has remained a matter of great concern especially at the tertiary level. In practice, the Nigerian education system is skewed towards the promotion of extreme theorization of ideas without much intentionality to improve skills and talents. This makes it quite discriminatory for people with special needs who may have limited cognition but endowed with much psycho-motor potentials that can be tapped using the right curriculum and programme design. Polytechnics in Nigeria are structured to provide technical and vocational education training in order to promote the production of skilled manpower from all categories of people for the overall development and sustenance of both the local and national economies. The paper reviewed Polytechnic education in Nigeria to assess its suitability for the attainment of sustainable capacity development of persons with special needs in Nigeria through inclusiveness.

Keywords: Polytechnic Education, Sustainable Development, Special Needs.

INTRODUCTION

Education is one of the fundamental human rights enshrined in Nigerian constitution. It is the compulsory right of every Nigerian irrespective of gender, social status, religion, colour, ethnicity or any peculiar individual challenge, designed to be an instrument for achieving National Development and social change as contained in the Nigerian National Policy on Education (Federal Republic of Nigeria-FRN, 2013).

The Nigerian Educational Research and Development Council-NERDC (2019) describes education as a social instrument through which the culture of a people is perpetuated, implemented and refined in such a way as to serve a wide range of different learning patterns irrespective of the abilities or inabilities of learners. This is in line with the national goals targeted to achieve a free and democratic society, a just and egalitarian society, a united, strong and self-reliant nation, a great and dynamic economy and a land full of opportunities for all citizens (Federal Republic of Nigeria-FRN, 2013). This implies that everyone must be allowed to explore educational opportunities that are not just age-appropriate but also suitable with his or her abilities, thus, the need for the development of a national policy on education in order to provide a blue-print through which, implementers will be guided in order to make education inclusive at all levels.

Effective implementation of inclusive education in Nigeria has remained a matter of great concern to experts as well as those affected as a result of the many challenges persons with special needs often encounter in their quests to acquire knowledge and skills at all levels (Oluka & Okorie, 2014). In practice, the Nigerian education system has been blamed for extreme theorization of ideas without much intentionality to improve skills and giftedness (talents). This makes it quite discriminatory for people with special needs who may have limited cognition but endowed with much psycho-motor potentials that can be tapped using the right curriculum and programme design.

Polytechnic education in Nigeria is structured to provide technical and vocational education training in order to promote the production of skilled manpower from all categories of people for the overall development and sustenance of both the local and national economies (Ikelegbe, 2020).

It is predicated against this backdrop that this study assessed Polytechnic Education in order to determine its suitability or otherwise for the attainment of sustainable capacity development of persons with special needs in Nigeria through inclusiveness.

CONCEPT OF SPECIAL EDUCATION

The National Policy on Education describes Special Education as a customized educational programme designed to meet the peculiar needs of persons with special needs that the general education programme cannot ordinarily cater for (Mukherjee & Samanta, 2015). This includes those with visual impairment (blind & partially sighted), hearing impairment (deaf & partially hearing), physical and health impairment, intellectual disability, emotional and behavioural disorder (hyperactive, hypoactive & the socially maladjusted), speech and language impairment, learning disabilities (psychological/neurological), multiple disabilities, the gifted and talented and the Albinos (FRN, 2013).

The policy also defined special education as the education of children and adults who have learning difficulty because of different categories of handicaps, such as blindness, deafness, hardness of hearing, social maladjustment, among others, due to circumstances of birth inheritance, social position, mental and physical health pattern, or accident in later life (FRN, 2013). It clearly stated that persons with special needs shall be provided with inclusive education services in schools which normal persons attend, in age appropriate general education classes directly supervised by general teachers (Rogers & Martin, 2010).

Thus, special needs are the segment of people with diverse disabilities, which set limitations in performing certain task in a given society. For instance, individuals with visual impairment are faced with the challenge of vision. Also, individuals with hearing impairment cannot understand the use of language except through some modes such as sign language, finger and spelling among others. Eze (2007) defined special needs persons as those who have some forms of disabilities that are capable of frustrating them in benefiting fully from the regular physical education program meant for those children without disabilities. Similarly, Ogbonna (2004) reported that individuals with disabilities are found in every community and school system and included are those with one or more of the following; learning disabilities, mental retardation, emotional imbalance and intellectual disorders among others.

The aims of special needs education are to provide access to education for all persons in an inclusive setting, equalize educational opportunities for all persons irrespective of their genetic composition, social, physical, sensory, mental, psychological or emotional disabilities, provide adequate education for all persons with special needs in order that they may fully contribute their own quota to the development of the nation, provide opportunities for exceptionally gifted and talented persons to develop their talents, natural endowments at their own pace in the interest of sustainable national development and design a diversified and appropriate curriculum for the different target groups (Ozoji, 2005).

The National Policy on Education further specified the training and retraining of all categories of teachers in the regular schools for effective implementation of the inclusive education for special needs persons such as Braille reading and writing, mobility training, use of regular typewriter for persons with visual impairment, total communication speech technique or sign language for the hearing impaired and daily living activities or skills for persons with intellectual disability (FRN, 2013 Mmatli, 2013). This includes special training and retraining of the personnel to develop capacity and keep abreast of latest teaching techniques for the various categories of disabilities, the gifted and talented. It recommended that schools' physical structures, designs and facilities shall take into account special needs of persons with physical disabilities such as ramps, steps, wider doors for wheel chairs and lower toilets among others.

CONCEPT OF INCLUSIVE EDUCATION

Inclusive education refers to the full time placement of persons with mild, moderate and severe disabilities in regular classrooms (Bryant, Smith, & Bryant, 2008). It is the practice of educating students with disabilities and their normal counterparts together in regular classrooms (Gwanshak & Milaham, 2015). According to Smith (2007), inclusion is the commitment to educate every student in the school and by moving essential resources that will facilitate learning for the student with a disability rather than placing that student in an isolated setting where services are located. It is an ongoing process aimed at offering quality education to all while respecting diversity and the different needs and abilities, characteristics and learning expectations of the learners and communities by eliminating all forms of discrimination (UNESCO, 2009).

The appropriateness of separate school systems has been challenged from a human rights point of view (Ainscow et al, 2016). In order to ensure education for all, including those children who have disabilities, it was increasingly asserted that modifying ordinary schools will be the most effective way of doing this

(Sebba & Sachdev, 1997). Thus, integrated programmes take the form of special classes within ordinary schools. A problem reported by many countries that have national policies regarding integration is that there is evidence of a significant increase in the proportions of persons being categorized as disabled as a way to earn additional resources for the schools (Booth & Ainscow, 1998).

POLYTECHNIC EDUCATION

Polytechnic education in Nigeria is structured to provide technical and vocational education training in order to promote the production of skilled manpower from all categories of people for the overall development and sustenance of both the local and national economies (Ikelegbe, 2020). Decree 33 of 1979, which gave legal power to the establishment of Polytechnics in

Nigeria stated among other things that the main purpose of polytechnic education is to produce middle-level manpower to manage the nation's economy. Thus, technical colleges were established in Nigeria such as Yaba Higher College of Arts, Science and Technology, which had branches in Enugu, Ibadan and Zaria in 1952. Other technical institutions were also established at Enugu and Kaduna in 1958, Ibadan in 1960 and Auchi in 1964 and all these metamorphosed to become full polytechnics in 1987 (Ukpai 2012).

It is therefore evident that the establishment of polytechnics in Nigeria was borne out of the need to provide citizens with the needed platform to acquire practical knowledge and technical skills which were hitherto organized by private companies in order to improve self-reliance which is a panacea for sustainable development of both the local and national economies (Idoko, 2005; Turner, 2014).

Apart from its ability to translate the ideas of highly cognitive students into visible and tangible technologies, Polytechnic education by design also had the capacity to tap from the neglected potentials of persons with special needs, most of whom, are highly gifted with skills and technical knowhow (World Health Organization-WHO, 2013). Agomoh (2012) had earlier noted that most children with physical and intellectual disabilities perform exceptionally when exposed to practical skills. For instance, we have a lot of proficient craftsmen with varying degrees of physical disabilities operating from their respective shops and as such, contributing massively to national economy.

Unlike most Nigerian Universities, the Polytechnic environment is designed to accommodate more of practical workshops and demonstration grounds. This is friendlier for persons with special needs who may find it extremely difficult to cope with exclusively cognitive tasks.

CONCEPT OF SUSTAINABLE DEVELOPMENT

The concept of development is very important to the advancement of any society. However, for any development to be meaningful, it should be able to cater for the needs of all classes of persons to the overall benefit of all and not also selective in anyway. Such developments should have the ability to satisfy the needs of the present generation without jeopardizing the chances of future generations to satisfy their own needs. In other words, it is that development that has the ability to sustain the chain of progress indefinitely by deliberately providing enabling conditions that will replace resources used to satisfy the needs of today with resources of equal or greater value for future generations to use without any form of discrimination.

Sustainable development therefore refers to that development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations-UN, 2015). Sustainable development is guided by the

principle of resource replacement. For instance, 'cut a tree and plant three' is in line with the principle of sustainable development because, it will not only prevent deforestation but will also ensure that the use of wood for furniture and other purposes today does not deny future generations the opportunity of using wood as the need arises. Sustainable development is one of the strategies adopted by the UN in order to bridge the widening gap of inequality existing between different classes of persons in the society especially; people with special needs by integrating some forms of balance using the inclusive and integrative approach (Shaker, 2015).

In order to achieve this, the United Nations General Assembly consisting of about 193 member countries formally adopted the 'universal integrated and transformative 2030 agenda for sustainable development' on September, 2015. This agenda contained a set of 17 Sustainable Development Goals (SDGs) projected to be implemented and achieved in every country from the year 2016 to the year 2030 (UN, 2015).

SUSTAINABLE DEVELOPMENT GOALS (1-17)

The SDGs capture the visions and expectations of the UN for all member countries. Although this discussion will concentrate more on SDG 04 which is concerned with inclusive and quality education for all, it is important to firstly state all the SDGs. According to the United Nations (2015), the SDGs can be stated and summarized as follows: By the year 2030, there should be;

1. No poverty (end extreme poverty in all forms)
2. Zero hunger (end hunger, achieve food security, improve nutrition & agriculture)
3. Good health and wellbeing (ensure healthy lives & promote wellbeing for all)
4. Quality education (ensure inclusive & equitable quality education for all)
5. Gender equality (achieve gender equality & empower all women & girls)
6. Clean water & sanitation (ensure availability & sustainability of quality water for all)
7. Affordable & clean energy (ensure affordable, reliable & sustainable energy for all)
8. Decent work & economic growth (productive employment & decent work for all)
9. Industry, innovation & infrastructure (inclusive & sustainable industrialization)
10. Reduced inequalities (ensure reduced inequality within & among countries)
11. Sustainable cities & communities (make all cities & houses inclusive & safe for all)
12. Responsible consumption & production (ensure sustainable consumption patterns)
13. Climate action (take urgent actions to combat climate change & its impacts)
14. Life below water (conserve & sustainably use oceans, seas & marine resources)
15. Life on land (protect, restore & promote sustainable use of the ecosystem)
16. Peace, justice & strong institutions (promote justice, peaceful & inclusive societies)
17. Partnerships for the goals (revitalize global partnership for sustainable development)

Education has a strong relationship with sustainable development. Education for sustainable development refers to that education that encourages changes in knowledge, skills, values and attitudes to enable for a more sustainable and equitable society where everyone is given an equal opportunity without any form of discrimination (Lynn, Kahle, Eda, Gurel-Atay, 2014). It is aimed at empowering and equipping present and future generations to meet their own needs using the inclusive and integrated approach. Sadly, one of the neglected classes in education is people with special needs.

CONCLUSION

Polytechnic education in Nigeria is by design the most suitable for enhancement of skills of persons with special needs for the sustainable development of both local and national economies and full realization of the objectives of the national policy on education.

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CONFERENCE LEAD PAPER

POLYTECHNIC EDUCATION AND SUSTAINABLE ECONOMIC DEVELOPMENT IN NIGERIA: INTERROGATING THE ISSUES, HARNESSING THE CONTRIBUTIONS

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ABSTRACT

The journey of polytechnic education in Nigeria has not been a very smooth one. Although, the functions of polytechnics are well articulated in the various Decrees and Acts of the National Assembly establishing polytechnics in Nigeria there are myriads of issues constituting serious setbacks for the system. This paper, therefore, seeks to present the journey of polytechnic education in Nigeria, highlights the contributions of polytechnic education, interrogates the impediments, and suggests strategies for harnessing the contributions of polytechnic education for sustainable economic development in Nigeria. Hinged on the triple helix theory, and using the secondary research approach, the paper revealed that even though the journey of polytechnic education has not been smooth, Nigerian polytechnics have made numerous contributions to Nigeria. The paper suggests among others, increased funding for polytechnics, commercialising researches and innovations from polytechnics, as well as establishment of National Polytechnics Commission.

Keywords: *Polytechnic education, economic development, sustainable economic development, contributions of polytechnic education.*

INTRODUCTION

Globally, technology education has assumed a prime of place, and Technical, Vocational Education and Training (TVET) has taken the centre stage. The world seems to suddenly realise the usefulness of technology and skill in bringing about the necessary innovations and sustainable development.

Nigeria appears to accord great importance to technological education as delivered through the polytechnics. This is evident in the National Policy on Education (2013). Specifically, Section 5, Paragraph 102 (a – c) clearly spells out the goals of Technology Education at the tertiary level to be:

a. Provide courses of instruction and training in engineering, other technologies, applied sciences, business and management, leading to the production of trained manpower;

b. Provide the technical knowledge and skills necessary for agricultural, industrial, commercial, and economic development of Nigeria;

c. Give training that imparts necessary skills for production of technicians, technologists and other skilled personnel who shall be enterprising and self-reliant;

d. Train people who can apply scientific knowledge to solve environmental problem for the convenience of man; and

e. Give exposure on professional studies in the technologies.

In recognition of the fact that merely setting goals cannot guarantee the accomplishments of such goals, paragraph 103 (a – c) of the policy states unequivocally that government shall adopt measure to develop and encourage the ideals of technology education by exposing students to practical work experience.

To further underscore the importance accorded technology education, paragraph 104of the National Education Policy (2013) takes a position that sounds very encouraging by declaring that efforts shall be made to inculcate an attitude of respect for and appreciation of the role of technology in society.

Also, in recognition of the relevance and importance of technological, technical and vocational education in national development, Nigeria established the then Yaba Higher College which underwent metamorphosis to become Yaba College of Technology in 1963 (Innocent, 2019; Decree No. 23 1963). The government went further to establish polytechnics in the different regions of the country as follows: Kaduna Polytechnic in 1968, the Polytechnic Ibadan in 1970, Auchi Polytechnic 1972 and Institute of Management and Technology in 1973 (Awodi, 2019, cited in Innocent, 2019). Presently, Nigeria has forty (40) Federal Polytechnics, forty-nine (49) State Polytechnics and eighty-four (84) Private Polytechnics spread across the country. All of these are approved and accredited. With these, the total number of Federal State and Private Polytechnics is one hundred and five (165). There are fifty-three (53) specialized institutions, thirty-four (34) Colleges of Agriculture, seventy (70) Colleges of Health Science and Technology which also have the status of Polytechnics. Thus, on the whole Nigeria has three hundred and forty-seven (347) technological institutions of Polytechnic status (NBTE, 2022). This number is a clear indication of the usefulness of polytechnic education.

Inadditiontotheaforementionedcategoriesoftechnological institutions,there are one hundred and eighty (180) Innovation Enterprise Institutions (IEIs), one hundred and twenty- seven (127) Technical Colleges and eighty (80) Vocational Enterprise Institutions (VEIs).

The recognition accorded polytechnic education by Nigeria flows from the global trend of emphasis being placed on technological, technical, vocational education as development drivers, and employment creators.

With this number of polytechnics, technical and

vocational institutions, it is not out of place to expect Nigeria to have gone a long way in technological and economic advancements. On the contrary, Nigeria is still depending heavily on China and other Asian countries for technology, technologists, technicians and artisans. This dependence comes with a heavy toll on Nigeria's economy.

Globally, technical vocational education and training is considered the way forward in achieving sustainable economic development. In today's global knowledge-based economy that requires, among other things, an educated and skilled population that can create knowledge and use it, polytechnic education remains a desideratum. However, the situation in Nigeria, regarding polytechnic education is that of stagnation or retrogression instead of moving with the global trend.

This paper is not making any pretension of breaking or delving into a new frontier in the issue of polytechnic education in Nigeria as this has been discussed at different for a and at different levels within Nigeria. The focus of this paper is to suggest how to harness the contributions of polytechnic education for sustainable economic development in Nigeria. Using the secondary research approach, some issues are interrogated and strategies for harnessing the contributions suggested.

OBJECTIVES

The specific objectives of this paper therefore are to:

- Present the journey of polytechnic education in Nigeria.
- Highlight the contributions of polytechnic education to Nigeria.
- Interrogate the issue impeding polytechnic education from contributing optimally to Nigeria's economic development.
- Recommend strategies for harnessing the contributions of polytechnic education for sustainable economic development in Nigeria.

Questions to Answer

- How has the journey of polytechnic education in Nigeria been?
- What are the contributions of polytechnic education to Nigeria's economic development?
- What are the issues impeding polytechnic education from contributing optimally to Nigeria's economic development?
- How can the contributions of polytechnic education be harnessed for sustainable economic development in Nigeria?

CONCEPTUAL REVIEW

Some concepts used in this paper need to be reviewed for clarification to aid the understanding of the subject matter of consideration. The concepts will be reviewed under the following sub-heads:

- Polytechnic education
- Contribution of polytechnic education
- Economic development
- Sustainable economic development

POLYTECHNIC EDUCATION

The word “polytechnic” has both Greek and French origins. The French word “polytechnique” which is spelt slightly differently from the current version with the last three letters changed from “que” to “c”, originated from the Greek word “polytechnos” which means “skilled in many arts” (Youssef and Hunter, 2016). This is indicative of the fact that polytechnic education is not a Nigerian creation, but a system of education adopted in many parts of the world, both developed and developing. In defining polytechnic education, Youssef and Hunter (2016, p.18) states as follows:

Polytechnic education is a multi disciplinary higher education model that engages students in an active, applied, lifelong learning and research process,

which also aims to foster innovation and entrepreneurship to leverage economically sustainable development on the local, provincial and national levels.

A few other definitions of polytechnic will suffice to adequately clarify the concept of polytechnic education. This definition by Doern (2008) cited in Oluwatusin and Daisi (2020, p.13) clearly captures the essence of polytechnic education as “a career focused applied education that spans trade through advanced degree, delivered in an environment where students receive hands-on training and enables them to more readily apply their skills. In the same vein, Sanni (2009) also cited in Oluwatusin and Diasi (2020, p.13) sees polytechnic education as “that type of education with great attention devoted to practical forestry etc.”

The myriads of definitions can be so many, but suffice it to define polytechnic education, as a system of higher education in which teaching and learning focus on the impartation and acquisition of advanced knowledge and skill in technology, science and humanities for application to the development of our societies in a sustainable manner.

Economic Development

“Economic development is the sustained increase in real per capita income, and measures of the distribution of income and wealth as well as increases in indicators of quality of life, ranging from life expectancy to crime statistics to environmental quality.” (Feldman, Hadjimichael, Kemeny & Lanahan, 2016, p.9)

After a careful analysis of the available or definitions of economic development, Feldman, Hadjimichael, Kenemy & Lanahan (2016, p.9) advance the following definition:

Economic development is defined as the expansion of capacities that contribute to the advancement of society through the realization of individuals', firms' and communities' potential. Economic Development is a sustained increase in prosperity and quality of life realized through innovation, lowered transaction costs, and the utilization of capabilities towards the responsible production and diffusion of goods and services. Economic development requires effective institutions grounded in norms of openness, tolerance for risk, appreciation of diversity, and confidence in the realization of mutual gain for public and the private sector. Economic development is essential to creating the conditions for economic and ensuring our economic future.

There are specific indices or indicators used in measuring economic development of any country. These indicators are used globally to determine how a developed country is. The indices indicate the levels of a country's development as a developed nation, transitional economics or less developed nation (Littel, 2008). The indicators of economic development include:

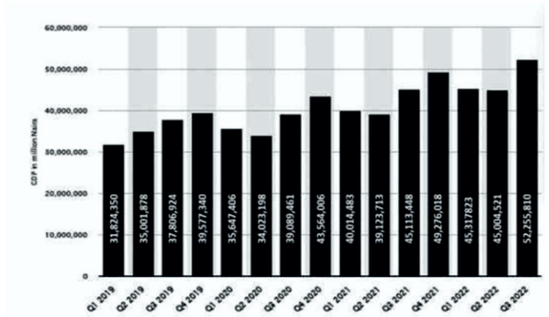
- Real GDP per capita
- Level of absolute poverty
- Malnutrition levels
- Access to safe water
- Literacy rate
- Average life expectancy
- Unemployment rate
- Inflation rate
- Quality of nation's infrastructure
- Share of agriculture in economy
- Political stability
- Openness of economy to international trade

African Development Bank (2022) published Nigeria's Economic Outlook highlighting recent macroeconomic and financial development which states as follows:

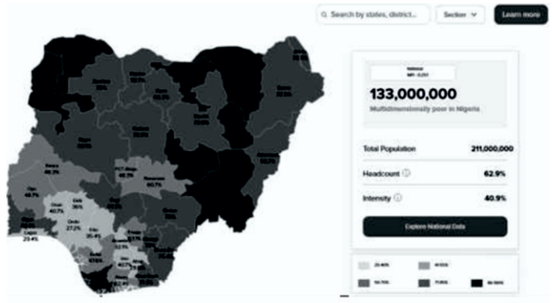
Growth will decelerate, averaging 3.2% during 2022 – 2023, due to persistent low oil production and rising insecurity. Inflation is projected to remain elevated at 16.9% in 2022 and to stay above pre-pandemic levels in 2023, fueled mainly by rising food, diesel, and gas prices and persistent supply disruption amplified by the Russia-Ukraine conflict. Capital inflows are projected to recovery, while oil export are projected to increase slightly. The benefits of a forecast positive oil price shock on exports may, however, be partly offset by a weak output effect due to lower oil production, stoked by infrastructure deficiencies and rising insecurity. The projected marginal current account surplus of0.1% of GDP in 2022 could turn into deficit of 0.2% is 2023. Improved revenue collection will help narrow the fiscal deficit to an average of 4.5% of GDP. Public debt targeted to reach 40% of GDP by 2024 on fresh borrowing. The head winds to the outlook may be exacerbated by rising insecurity and policy uncertainty underpinned by reversal of initially planned removal of subsidies on premium motor spirit a year before 2023 elections.

The foregoing is a description of Nigeria that fits perfectly into the frame of a less developed nation still gropping in search of economic development. Some indicators as captured by the National Bereau of Statistics show some indices of Nigeria's economic development as presented here:

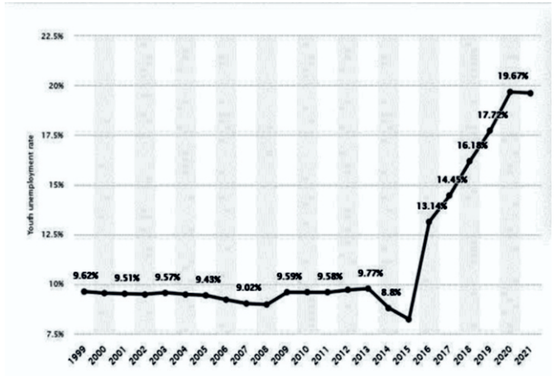
- Gross Domestic Product (GDP)
- Poverty rate
- Unemployment rate



Gross Domestic Product (GDP)of Nigeria from 1st quarter 2019 to 3rd quarter 2022 (in million naira) (Source: World Bank, July 2022)



Multi dimensional Poverty Index by State & Zones



Youth Unemployment Rate in Nigeria from 1999to 2021

Sustainable Economic Development

The International Institute for sustainable development (2015) defines sustainable development as the type of development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Mensah (2019) sees sustainability as the capacity to maintain some entity, outcome or process over time. Sustainable development in a very straight forward language is the development that can be maintained over time. In other words, it is the development that will last and the benefits can be sustained for a longtime. It is development with trans generational benefits that gives room for future harmless development.

What is known today as Sustainable Development Goals (SDGs) originated from the coming together of the international community in 2015 to adopt the seventeen (17) SDGs as the gold standard which would guide all developments, economic development inclusive, and by which all developments would be evaluated (Lawrence, Ihehuzor and Lawrence, 2020). Sustainable economic development, therefore, is the economic development that meets the standard of sustainability as set out in the Sustainable Development Goals (SDGs).

According to the United Nations Department of Economic and Social Affairs (2015), the 2030 agenda for sustainable development adopted by all United Nations member states in

2015, provide a shared blueprint for peace and prosperity for people and the planet, now and into the future. These development goals are seen as an urgent call for action by all countries in a global partnership. The goals are:

GOALS

1.No Poverty
2.Zero Hunger
3.GoodHealthandWell-being
4.QualityEducation
5.Gender Equality
6.CleanWaterandSanitation
7.AffordableandCleanEnergy
8.DecentWorkandEconomic Growth
9.Industry,Innovationand Infrastructure
10. Reduced Inequalities
11. Sustainable Cities & Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life below Water
15. Life on Land
16. Peace, Justice and Strong Institutions
17. Partnership for the Goal

Theoretical Framework

The theory adopted for this paper is the Triple Helix theory propounded by Etzkowitz and Leydesdroff (1995) cited in Ranga and Etzkowitz (2013). The theory explains the departure from the old model of the development paradigm in the grooming industrial society whereby the relationship was mainly between government and industry, to a new relationship framework involves educational institution, industry and government in a knowledge society and economy.

The thesis of the Triple Helixas explicated by Rangaand Etzkowitz (2013, p. 238) is that:

The potential for innovation and economic development in a knowledge society lies in a more prominent role for the university and in the hybridization of elements from university, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge.

For the purpose of this paper which focuses on polytechnic education, university is substituted with polytechnic in the Tipple Helix model. With this substitution we will then have the thesis of the theory angling for more prominent role for the polytechnic, and in the model, polytechnic, industry and government for the production, transfer and application of knowledge.

How has the Journey of Polytechnic Education in Nigeria been?

The journey of higher education in Nigeria started with the polytechnic. In the colonial era, the quest for higher education by Nigerians could only be satisfied by going outside the country to Britain and other parts of the world. The year 1932 remains very significant in Nigeria's educational history as the first higher education institution, Yaba Higher College, later

renamed Yaba College of Technology in 1963, was established by the colonial administration. This fact has been corroborated by many scholars including Innocent (2019), Bosedekirin and Abuh (2014) and Sanni (2009).

Apart from the numerical progression of polytechnics in Nigeria, the journey of polytechnic education can really be viewed through the binoculars of the Academic Staff Union of Polytechnics (ASUP) in terms of the agitations, demands and strike actions that the Unionhasembarkedupon.Thedemandsandindustriala ctionswillprovideacleartrackingof how polytechnic education has fared in Nigeria.

Since its establishment in 1990 ASUP has been working in line with its objectives which, apart from seeking the interest of its members, seeks to advance, promote and protect the technological, socio-economic and cultural interest of the Federal Republic of Nigeria as well as collaborate with the Federal and state governments in instituting a culture of good governance towards achieving the objectives of polytechnic/monotechnic education in Nigeria (ASUP 2023). From the various regimes of ASUP presidents: Comrade Mal. Hadi Mohammed Awwal (1993 – 1997), Comrade Yomi Oduwobi (1997 – 2001),Comrade Dr. Sylvester L. Mammah (2002 – 2005),Comrade Dr. Umar Muhammed Kibiya (2005 – 2007), Comrade Mohammed Alu Kabir (2007 – 2011), Comrade Dr. Chibuzo Asumugha (2011 – 2015),

Comrade Useman Dutse (2015 – 2019) and Comrade Anderson Ezeibe (2019 to date), the efforts of the Union have been towards the recurrent issues at the centre of ASUP strikes.

Year/Period of Strike Issues/Reasons for Strike

April 29, 2013, ASUP embarked on strike that lasted for three Hundred and thirty-one (331) days November 2017 Announcement of a nationwide strike. Strike suspended fifteen days later as the Federal Government agreed to implement the recommendations of the 2014 NEEDS assessment 12th December, 2018 ASUP strike began following failure by the Federal Government to Protesting government's refusal to honour a 13- point agreement made with the union in 2009.

Failure of the Federal Government to meet outstanding agreement on the recommendations of the 2014 NEEDS assessment into action. The agreement was on increased funding for polytechnics.

The demands of the outstanding agreement on the recommendations of the 2014 NEEDS

Meet ASUP's demands assessment. June 2021

ASUP declared a strike. It was suspended after sixty-five (65) days after reaching another agreement with the Federal Government on May 16, 2022.

ASUP embarked on a two-week warning strike For the Federal Government to meet the nine- point demand which include revitalization of polytechnic, the establishment of a National Commission for Polytechnic among others.

To protest Federal Government non-fulfillment of aspects of a memorandum of action it signed with the Union in 2021.

The Journey has not been a smooth one for polytechnics in Nigeria. Given the functions of the polytechnic as stipulated in the various Decrees and Acts of the National Assembly establishing polytechnics in Nigeria, as well as the provisions of the National Policy on Education, it would have been expected that the Nigerian government would ensure adequate provisions for the smooth operation of polytechnic education. On the contrary the situation has been as described by the Ezeibe leadership in the press release that suspended the last warming strike by ASUP: that the decision to embark on the warming strike was taken to protest the lethargic attitude of the government towards fulfilling some aspects of the

memorandum of action signed with the Union in 2021 (ASUP, 2022).

In spite of the rough roads that polytechnics in Nigeria have journeyed through, polytechnics education has remained resilient as polytechnic have increased in number within the last few years.

What are the Contributions of Polytechnic Education to Nigeria's Economic Development?

- Contributions of Polytechnic Education to Sustainable Economic Development in Nigeria.

In considering the contributions of polytechnic education, this paper recognizes the fact that no nation adopts a system, model or policy without considering and weighing what the nation stands to gain from such a system, model or policy. Based on the foregoing, contributions of polytechnic education are the advantages that can be gained from polytechnic education.

From the various Decrees and Acts establishing the Polytechnic as an educational institution in Nigeria, the functions prescribed for the polytechnic invariably constitute the contributions expected from polytechnic education. The Federal Polytechnic (Amendment) Act, 2019, Section 2, Subsection 1, paragraph a (i – ii) stipulates the functions of each polytechnic to be:

(a) To provide full-time or part-time courses of instruction and training to produce middle and high level manpower.

(i) In technology ,applied science, commerce and management; and

(ii) in such other fields of applied learning relevant to the needs of the development of Nigeria in the areas of industrial and agricultural production and distribution and for research in the development and adaptation of techniques as the council may determine.

If the provisions of the Polytechnic Acts are combined with the provisions of the National Policy on Education (2013), the contributions of polytechnic education can be extracted and summarized to include the following:

- Polytechnic education has full-time and part-time courses of instruction and training which have produced middle and high level manpower for Nigeria.
- It has also provided manpower in technology, applied sciences, commerce, communication, management and other fields geared towards the development of Nigeria.
- Polytechnic education has trained Nigerians in technological skills necessary for industrial development of Nigeria.
- Polytechnics have produced technicians, technologists and other skilled persons who have been self-reliant and enterprising.
- Polytechnic education has helped produced several self-employed Nigerians who are also employers of labour.
- Through polytechnic education many Nigerians have been trained to be able to apply scientific and technological knowledge to solve real life problems for the convenience of man within and outside Nigeria.
- Polytechnic education has helped in developing appropriate skills, mental, physical and social abilities and competencies to empower the individual to live in and contribute positively to the society.
- Polytechnic education has promoted functional education for skill acquisition, job creation and poverty reduction.
- Researches and innovations from Nigerian polytechnics are contributing enormously to sustainable economic development of Nigeria and the world at large.

The National Board for Technical Education has catalogued some of the researchers on development

and innovations done in its Technical and Vocational Education and Training (TVET) institutions across Nigeria in the recently published Research, Development and Innovation Exhibition Hall. The exhibition hall is to, among other things, "showcase, exchange and disseminate knowledge on all research works that can be commercialized as a tool or key driver of the nation's economy."

The contributions of academic staff in Nigerian Polytechnics as seen today, can go a long way in helping to close the gaps in economic development in Nigeria. This is feasible through the transition of research outcomes into real and tangible products and services that impact on people's life (Ogunkoya, Enyi and Aremu, 2020).

Generally, the contributions of polytechnic education are of tremendous benefits to the individual, employers, society and the economy. The individual benefits from training that translates into good income and financial independence; the employers benefit from the skilled workers they have from polytechnic who add productive value to the companies; the society benefits by having individuals who play active role in social development by virtue of technological and vocational trainings gained from polytechnic, and who practically help in reducing social inequality; and the economy benefits from the skilled workforce, which is key to overall development, produced by the polytechnics (Schneider & Pilz, 2019).s

Research and Innovations Hall

S/N	LEAD INVENTOR	INSTITUTION	INVENTION(S)
1.	Segun Babalola	Kaduna Polytechnic	The3DPrinter.
2.	Dr. (Mrs) Olafimihan C. A.	The Federal Polytechnic, Offa, Kwara State	1. Solar powered fumigator. 2.Hand-clap switch Solar powered handrub UV wave sanitizer. 3. Solar-powered sound wave actuated hand washing system.
3.	Idris Muhammad	Kaduna Polytechnic	E-Scooter
4.	Dr. O .D. Ayokunnu	The Polytechnic, Ibadan	Design and Construction of FM Transmitter
5.	Engr. Kamal-Deen Kassim	Kaduna Polytechnic	Hinata Energy.
6.	Engr. Anifowose Mukaila A.	The Federal Polytechnic, Offa, Kwara State.	Palm Kernel Fibre for Reinforced Mortar Tiles.
7.	Engr. Oladosu, Dauda A.	The Polytechnic, Ibadan	Automated System for Irrigation and Test of Soil Moisture.
8.	Abdul Nurudeen	Kaduna Polytechnic	Data Acquisition Graphical Time Value and Imaging-machine Processing System.
9.	Engr. Mrs. Komolafe T. F.	The Federal Polytechnic, Offa, Kwara State.	Recycled Waste Nylon/Plastic Bottle for Interlocking Stone.
10.	Engr. Dr. Gideon Ayuba Duvuna	The Federal Polytechnic, Mubi	Serpentine Solar Water Heater.
11.	Dr (Engr) L. A. O. Oyinkanola	The Polytechnic, Ibadan	Construction of Hydrogen Generator for Fuel Cell.
12.	Engr. Abu Afealiokha Lukman	Delta State Polytechnic, Ogwashi-Uku	Chicken De-Feathering Machine.
13.	YusufIdowu Moshood	The Federal Polytechnic, Offa, Kwara State.	1. Solar Powered Sound Wave Actuated Male Pee Toilet System. 2. Solar Powered Sound Wave Actuated Hand Washing System.
14.	Dr. Amoko, Oluwole	Auchi Polytechnic, Auchi	Bio-ceramic Bone Substitute Using Locally Sourced Ceramic Raw Materials.
15.	Dr. Ohimai, John O.	Auchi Polytechnic, Auchi	Lightweight Micro-porous Ceramic Bricks
16.	Andrew Kwaji Musa	The Federal Polytechnic, Mubi	Rice Husk Gasifier Stove
17.	Dr. Zakari Abdullahi	Kaduna Polytechnic	Fabrication of Protective Helmet From Waste Cow Horn Fibre

What are the Issues Impeding Polytechnic Education from Contributing Optimally to Nigeria's Economic Development?

Although polytechnic education in Nigeria is contributing enormously to the nation's economic development as seen today through the researches and innovations plus other key areas of the mandates of polytechnics, there are some issues or factors impeding the optimal contributions by the polytechnics in Nigeria. These hindrances can be gleaned from the records of industrial actions embarked upon by the Academic Staff Union of Polytechnics (ASUP) since the inception of the Union in 1990. The issues have been recurrent and the governments at the national and sub-national levels have been very reluctant about resolving these issues of national importance and interest.

A review of the reasons for strikes embarked upon by polytechnic lecturers under the umbrella of the ASUP in recent times show a recurrence of some of the demands spanning over a decade. For instance, in the last strike in May 2022 some of the demands were:

- The need for a re-constitution of the Governing Councils of Federal Polytechnics which were dissolved since 2010.
- The migration of the lower cadres on the CONTISS 15 as approved by Government since 2009.
- The need for the commencement of the implementation of the NEEDS Assessment of 2014 which stressed the importance of increased funding.
- The non-commencement of the re-negotiation of FGN/ASUP agreement signed since February, 2012.
- The reluctance of the office of the Head of Service of the Federation to approve the Revised Scheme of Service for Polytechnics since 2017.
- The dichotomy between university and polytechnic graduates in job placements and career progression.
- The continued refusal by the Federal Government to establish the National Polytechnics Commission.
- The worrisome state of some state-owned polytechnics.
- The continued appointment of unqualified persons as Rectors and Provosts of Polytechnics, Monotechnics and Colleges of Technologies by some state government.

- The refusal of most state governments to implement the approved salary packages (CONPCASS) and 65-year retirement age for their Polytechnic, Mototechnics and Colleges of Technologies even when both state and Federal Polytechnics are regulated by the National Board for Technical Education (NBTE) and they operate the same scheme of service.

Summarizing the challenges, Innocent (2019) indentifies underfunding, infrastructure deficit, understaffing and needless discrimination against the polytechnics and their products by the Nigerian government and the Nigerian society as fundamental issues and impediments.

Harnessing the Contributions of Polytechnic Education for Sustainable Economic Development in Nigeria: My Suggestions

Polytechnic education in Nigeria has contributed so much in different areas to the economic and overall development of Nigeria. These contributions have not been adequately harnessed for maximum impact on Nigeria's economic development. This failure to harness has resulted in Nigeria not identifying with the contributions that would have helped in shoring up the economy and earning the country a place among the nations with strong technological education institutions.

Harnessing the contributions of polytechnic education for sustainable economic development entails bringing together the researches, innovations, trainings and skills abounding in and emanating from the polytechnics and putting them to use for the sustainable economic development of Nigeria. It is similar to collecting the energy from the sun and using it to provide electricity. The energy from the sun (solar energy) is harnessed to produce electricity that is used to light homes, power equipment and home appliances for the benefit of man. In the same vein, water from the river or falls is collected through dams to produce hydroelectric power also used for lighting, powering of machines and appliances used in production of goods which boost economy. If the solar and hydro sources are not brought together, channeled and put to specific uses the various benefits we derive from these sources will not be feasible.

The implication of the foregoing analogies is that for sustainable economic development to be achieved in Nigeria, the contributions of Polytechnic education have to be harnessed. In other words, the contributions of polytechnic education are highly needed for Nigeria's sustainable economic and overall development. This is because no nation can do without technological education in this era of knowledge economy. Harnessing the contributions of polytechnic education in Nigeria requires deliberate, intentional and focused measures as other countries have done. Some peculiar measures can also be adopted based on Nigeria's needs as a nation.

The following measure should be adopted and applied by the Federal and state governments as well as other stakeholders to harness the contributions of polytechnic education in Nigeria for sustainable economic and overall development of the country.

Increase in the Funding of Polytechnics

The issues of increased funding for polytechnics have been a recurrent issue in all industrial actions embarked upon by the Academic Staff Union of Polytechnics (ASUP). Technological education by nature is capital intensive because it involves the application of knowledge in very practical terms for tangible results. It is not just theorizing and adding to the body of knowledge theoretically, but going steps further to create, produce and bring to reality whatever is created through knowledge.

Funding is very crucial in driving skills development. The imperative of funding is underscored by the recent call by the Executive Secretary of National

Board for Technical Education (NBTE), Professor Idris Bugaje for funding to drive skills development (The Guardian, 2023). According to the Guardian, 2023 report, the funding is expected through the National Skills Qualification Framework (NSQF) Acts, which has been submitted to the presidency, and hopefully, the Act would be accepted by 2023.

The National Association of Polytechnics Students (NAPS) also lent it voice to funding of polytechnics when its president, Asiegbu Chinonso blamed poor funding for polytechnic education in Nigeria as the bane of Nigeria's rising unemployment and underdevelopment (Vanguard, 2022).

In June, 2022 the Association of Heads of Polytechnics and Colleges of Technology (COHEADS) pointed out that, polytechnic are more capital intensive than other institutions. This, according to the Association, is why the Tertiary Education Trust Fund (TETFund) should reconsider the sharing formular for the normal intervention to tertiary institutions in favour of polytechnics (Vanguard 2022). The TETFund Act (2011) stipulates a 2:1:1 ratio sharing formula for the universities, polytechnics and colleges of education, tilting it in favour of Universities.

From the foregoing, the primary measure to take in harnessing the contributions of Polytechnic education is to increase the funding of polytechnics in Nigeria.

Removal of All Forms of Discrimination and Dichotomy against Polytechnic Education and Holders of Higher National Diploma (HND)

Higher National Diploma (HND) holders in Nigeria have faced very baseless and unwarranted discrimination in job employment and placement to the extent of being subjugated under bachelor degrees holders from the university. The Federal Polytechnic (Amendment) Act, 2019 Section 2(1) paragraph (a) clearly stipulates that polytechnics are "to provide full time or part-time courses of instruction and training to provide middle and high level manpower."

Presently, the situation in employment into the Federal and state civil services is that in the administrative cadre, degree holders are employed as Administrative Officers, while (HND) are employed as Executive Officers, a rank lower than that of the degree holders. The dichotomy continues as the officer's progress and limits the HND holders to salary grade level 14 in the State and Federal Civil Services. They are made to remain in perpetual subjugation to the bachelor degree holders.

The discrimination is also extended to other frontiers such as funding where the sharing ratio of 2:1:1 is applied by TETFund to the disadvantage of polytechnics and in favour of Universities. The same discrimination is found in budgetary allocations in which on annual basis funds allocated to Universities are higher than for polytechnics even when polytechnics require larger and more capital intensive facilities (Njoku, 2021).

These discriminations have instilled senses of superiority and inferiority among university and polytechnic graduates resulting in demoralized and discouraged polytechnic graduates. The discrimination and superiority mentality are also directed against polytechnic lecturers as those in the Universities regard polytechnic lecturers as second class and lower category academics. This level of discrimination has gone to the extent that papers presented by university lecturers at conferences organized by polytechnics do not count in the university lectures academic productivity assessment and appraisal. Universities do not invite polytechnic lectures as keynote lead paper presenters. Universities do not invite polytechnic lecturers as external examiners even though there are many lecturers in the polytechnic with doctorate degrees.

The consequences of these facets of discrimination

are low self-esteem, manpower migration from polytechnics to universities as well as low productivity and contribution to nation's economy by polytechnic graduates and lecturers (Njoku, 2021).

Given this situation, Nigeria has skills and manpower within the polytechnic section in disarray and in a state of flux and confusion. Therefore, to bring the contributions of polytechnics to bear on sustainable economic development, government and policy implementers must ensure that all forms of discrimination and dichotomy against polytechnic education, it graduates and members of the academic staff are completely removed.

Government at the national and sub-national levels should not continue to flout the Federal Government directives and policies given through the National Council on Establishment as far back as 2016. The national Board for Technical Education has shone the light in this direction by working to ensure that holders of HND get employed as assistant lecturers in polytechnics and monotechnics (NAN, 2022, November 28).

Making Polytechnic Education Attractive to Nigerians

Presently, most polytechnic students do so as a second option if they cannot secure admission into a University and not because they really desired to acquire polytechnic education. Some of the students and their parents only consider polytechnic as a choice if the universities are on strike, and they consider the polytechnic option instead of not gaining admission into a higher institution.

This disposition of Nigerians and perspective students is a consequence of the discriminatory and dichotomous treatment meted out against holders of Higher National Diploma (HND) in Nigeria

Recently the alarm was raised that only one percent (1%) of UTME candidates applied for admission to polytechnics while more than 90 percent of Nigerian youth prefer to go for bachelor degrees in the universities. This situation, according to Ezeibe (2021), arises due to various policies of successive governments, especially at the national level on polytechnic education which makes the system less attractive to many who seek skills and knowledge. Such government policies as not allowing HND holders to be promoted beyond level 14 in the civil service while their counterparts from the university get to the highest level portrays polytechnic education as inferior to that of the University.

To help in harnessing the contributions of polytechnic education, there should be incentives for polytechnic students such as abolishing obnoxious work placement and progression policies, and allowing HND graduates with good grades to pursue masters degrees at the universities instead of post graduate diplomas in the same course studied at the polytechnics. These measures will make polytechnic attractive to Nigerians and will in turn help in harnessing the contributions of polytechnic education for sustainable economic development and security.

Nigeria should follow the examples of many developed countries of the world such as Britain, the United States of America, Canada, New Zealand, China, Germany, Malaysia that have systematically guided the evolution of their polytechnics into polytechnic universities or technical universities.

Commercializing Researches and Innovations from Polytechnics

Researchers and innovations emanating from the polytechnics should be commercialized for the benefits of the researchers, innovators and economy of Nigeria. All products of researchers and innovations from the polytechnics should be patented, mass produced, sold to end-users within the domestic market and exported to other countries. By so doing, the researchers and innovators would have succeeded in creating jobs and contributing to developing the economy of Nigeria sustainably.

The commercialization can be a joint project involving the innovators, the institution where the innovators work, interested business partners and the relevant government agencies such as NBTE and TETFund.

Making Technical and Vocational Jobs Attractive to Nigerians

To harness the contributions of polytechnic education for sustainable economic development and security, i.e. is pertinent to make technical and vocational jobs attractive to Nigerians by paying special allowances and placing holders of HND properly in service and not in subjugation to bachelor degrees holders.

Resuscitating the Industrial Sector in Nigeria

The industrial sector is naturally the major up taker of technical education output. In a situation where the industrial sector in Nigeria is not vibrant and expanding to accommodate skilled manpower from the polytechnic system, research and innovation outputs from the polytechnic cannot be adequately put to use. Therefore, it is very necessary that the industrial sector in Nigeria be resuscitated to harness the contributions of the polytechnic sector.

Application of Development Communication Approach

Polytechnics, National Board for Technical Education (NBTE), Tertiary Education TrustFund (TETFund) and other relevant agencies should apply development communication techniques to communicating research and innovation outputs to the larger Nigerian society and the international community. Using this approach will engender awareness, understanding and better appreciation of the contributions of polytechnics to Nigeria's sustainable economic development and security pursuit.

Development communication makes use of integrated communication strategies of mass media and interpersonal communication to communicate development information to the public (Ashong 2021, Asemah, 2011). Conferences and journal publications are not enough in communicating the researches and innovations from the polytechnic and monotechnics in Nigeria. The mass media, including the new media, and exhibitions, should be extensively used to harness the contributions of polytechnic education for sustainable economic development and security in Nigeria.

Sensitization and Mobilization of ASUP members by ASUP for more Researches and Innovations

ASUP has a task at hand. That is the task of sensitizing and mobilizing its members to lookbeyondthediscriminatorypoliciesworkingagainstpolytechniceducationandembarkon more researches and innovations. Migrating to the universities by polytechnic lecturers will not help in harnessing the contributions of the polytechnic system, rather we have to make our marks and leave our footprints on Nigeria the like many great scientists and technologists of the world.

Establishment of National Polytechnics Commission

Currently the National Board for Technical Education (NBTE), the body charged with the responsibilities of overseeing technological education in Nigeria has the under listed number of institutions as at January 2023 to regulate:

Federal Polytechnics- - - -	40
State Polytechnics - - - -	49
Private Polytechnics- - - -	84
Specialized Institutions - - -	55
Colleges of Agriculture - - -	35
Public Colleges of Health - - -	68
Private Colleges of Health - - -	21
Technical Colleges - - -	127
Innovation Enterprise Institutions (IEIs) -	180
Vocational Enterprise Institutions (VEIs) -	80
Total - - - - - - - - - -	739

Source: *NBTE, 2023*

Aside regulating 739 institutions, NBTE is also saddled with the responsibility of supervising several skills development programmes under Nigerian Skills Qualification Framework (NSQF) which include National Skills Qualification (NSQ) and National Occupational Standards (NOS).

From the foregoing, it is very evident the NBTE is overloaded with responsibilities, unlike the National Universities Commission that oversees 220 Universities as listed below:

Federal Universities - -	-50
State Universities - -	-59
Private Universities - -	-111
Total - - - -	**-220**

Source: *NUC, 2023*

The National Commission for Colleges of Education oversees a total of 218 Colleges of Education comprising Federal, States and Private Colleges of Education as well as other NCE awarding institutions. The National Universities Commission and National Commission for Colleges of Education are more streamlined and focused to effectively regulate the relevant institutions. The establishment of National Polytechnics Commission (NPC) will go along way in streamlining and focusing on fewer institutions thereby making it more positioned to harness the contributions of polytechnic education in Nigeria.

Appointment of Polytechnic Lecturers into Key Positions in Government

Appointment of polytechnic lecturers on national assignment into positions of authority in government at national and sub-national levels is one way of bringing the expertise and wealth of experience possessed by the lecturers to bear in governments' policy formulation and implementation. There are many polytechnic lecturers with masters and doctorate degrees that, if properly integrated and harnessed into government as ministers, Chairmen of commissions, boards and agencies, can contribute effectively to Nigeria's sustainable development drive.

CONCLUSION

Nigeria, like other parts of the world, has recognized the importance of polytechnic education. The global trend in Technical and Vocational Education and Training (TVET) for skilled manpower development is embraced by Nigeria. There are laws and policies on ground to guarantee that technological education contribute to the economic development of Nigeria.

Despite the laws and policies, polytechnic education is still grappling with several issues that have consistently caused setbacks for the polytechnic system in Nigeria. These issues have been discussed in this paper, and several strategies that can help in salvaging polytechnic education discussed extensively.

If the measures recommended in this paper are adopted by the Federal government and other state holders in the polytechnic education sector, Nigeria will achieve the desired sustainable economic and overall development. The security challenges bedeviling the country will fissile out because

insecurity is partly a product of unemployment, poverty and illiteracy.

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PREVALENCE OF GASTRO-INTESTINAL PARASITES AMONG PRIMARY SCHOOL CHILDREN IN ABA NORTH L.G.A., ABIA STATE.

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ABSTRACT

Intestinal parasitosis is a major public health problem that significantly contribute to morbidity among School children in Nigeria. A study in the prevalence of gastro-intestinal tract parasites was conducted in four primary schools in Aba North Local Government Area of Abia State. Fecal samples from a total number of 500 pupils aged 5-13 years, (250 males and 250 females) were collected and examined by direct smear technique and result correlated with their socioeconomic behavior. The chi-square test was used for analytical assessment. The prevalence rate was 30%, girls being highly infected (31.2%) than boys (28.8%) but their difference were not significant (P>0.05). The following parasites were isolated: Ascaris lumbricoides (47.1%), Entamoeba coli (42.1%), Hookworm (36.1%) Entamoeba histolytica (33.7%), Trichuris Trichiura, (15.7%) and Giardia lamblia (4.8%). Multiple parasitism were also encountered during the study. The age groups 5-7, 8-10 and 11-13 years old recorded high prevalence rate of 20.7%, 32.5% and 35.3% respectively (P>0.05). The following parasites were isolated as follows, Ascaris lumbricoides (47.1%), Entamoeba coli (42.1%), Hookworm (36.11), Entamoeba histolytica (33.7%), Trichuris trichiura (15.7%) and Giardia lamblia (4.8%) (P<0.05). The result showed that the average school pupil in the four schools carry intestinal parasites burden. Awareness of infectious diseases, improving hygiene, and application of supportive programs for parents to elevate the socioeconomic conditions may reduce the burden of infection. It is also recommended that deworming programs should be introduced in primary schools to decrease the rate of intestinal parasitosis.

Keyword: Gastro-Intestinal parasites, Aba North.

INTRODUCTION

Children of all ages can develop parasitic diseases such as *Gardia Lumblia*, *Ascaris Lumbricoides* and *Entamoeba coli* from swallowing contaminated water during swimming, playing and other activities in contaminated recreational water., despite major efforts that have been made over recent years to clean up the environment, pollution remains a major problem and poses continuing risk to health. The problems are industrial emissions, poor sanitation, inadequate waste management, contaminated water supplies and exposures to such contaminated water resources (Samet et al., 2000: sexton and Adgate, 2000, Ajayi and Akinyinka, 1999).

Infections by intestinal parasites are major public health problem worldwide especially among children. WHO (2001) estimated that 3.5 million ill by them. Parasitic infection is associated with intestinal bleeding, nutritional deficiency, cell and tissue damage, anemia and delayed physical and

mental development. This leads to absenteeism and poor academic performance. Children are at poor risk of infection due to their little awareness, imamature immune system, and high nutritional system (Haque, 2007-El-Sherbini, and Abosdera, 2013).

Gastroenteritis can arise in two ways, the microorganisms may actually produce food borne infection that is they may first colonize the gastrointestinal tract and grow within it, then either invade host tissue or secrete exo-toxins. Alternatively the pathogens may secrete an the exo-toxins that contaminates the food and is ingested by the host. This is sometimes reffered to as toxification because the toxins ingested and the food and is ingested by the host. This is sometimes referred to as food intoxication because the toxins ingested and the presence of the living microorganisms is not required (Damen et al., 2007, Abah and Arene 2006).

The present study therefore sought to ascertain the prevalence of Gastro-Intestinal parasites among primary school children in Aba North L.G.A, Abia State.

MATERIALS AND METHOD

STUDY AREA

Aba, a city in the Southeast of Nigeria and the commercial center of Abia State is located between the latitude 5^0 07' N, Longitude 7^0 22'E and at 205m (673H) sea level upon the creation of Abia State in 1991, Aba was divided into two local government areas: Aba South and Aba North. Aba has on estimated population 534,265 people according to the 2006 national census and landmass of 7,400km^2, located geographically at the eastern part of Nigeria completely inhibited by the Igbos.

The study area was centered in Aba North Local Government Area.

STUDY POPULATION

The study population consists of four (4) primary schools with a sample population of 500 (250 males and 250 females) pupils.

ETHICAL CONSIDERATION

Informed consent of each participant was obtained prior to collection of samples. Ethical approval/permission was sought and obtained from the authorities in charge of schools used. Information sought includes name, age and sex of each pupil. The 500 selected were each given a clean dry and well labelled sample bottle and applicator stick for collection of fecal samples. They were instructed to collect their stool into the container.

EXAMINATION OF SPECIMENS

The processing of the stool analysis was done using two parasitological techniques which include direct wet preparation and concentration techniques. (Cheesbrough, 2005).

RESULTS

A total number of 500 primary school children participated in this study, 72 (28.8%) are male and 78 (31.2%) were females. Overall 150 (30%) were infected with gastrointestinal parasites. The prevalence of intestinal parasites among the age group 5-7, 8-10 and 11-13 years old recorded high prevalence rate of 20.7%, 32.5% and 35.3% respectively. The prevalence rate of the parasitic infection in the study were *Ascaris Lumbricoides (47.1%), Entamoeba coli (42.1%), Hookworm (36.1%), Entamoeba Coli (42.1%), Hookworm (36.1%), Entamoeba histolytica (33.7%), Trichuris trichiura (15.7%)* and *Giardia lamblia (4.8%)*. The prevalence of co-operative infections in the study showed AL + Hw (21.4%), AL + EC (9.0%) and AL + EH (7.8%).

Schools	No Examined	No Infected	% Infected	P-value
Private I	125	30	24	P>0.05
Private II	125	32	25.6	
Public I	125	42	33.6	
Public II	125	46	36.3	

In Table 1, the prevalence of intestinal parasites among school children in private and public schools are not significantly (P>0.05) different, or are statistically the same.

Table 2: Prevalence of intestinal parasites among the sex group sampled

Sex	No Examined	No Infected	% Infected	P-value
Male	250	72	28.8	P>0.05
Female	250	78	31.2	

In Table 2, the prevalence of intestinal parasites among school children, male and female are not significantly (P>0.05) different, or are statistically the same.

Table 3: Prevalence of Parasites in the study area.

Parasites	No Examined	No Infected	% Infected	P-value
Ascaris lumbricoides	85	40	47.1	p<0.05
Entamoeba coli	83	35	42.1	
Hookworm	83	30	36.1	
Entamoeba histolytica	83	28	33.7	
Trichuris trichiura	83	13	15.7	
Giardia lumblia	83	4	4.8	

In Table 3, the levels of parasitic infections are significantly different (P<0.05). This implies that there were evidence of students being more infected with *Ascaris Lumbricoides, Entamoeba coli, Hookworm, Entamoeba histolytica,* than they were infected with *Trichuris trichiura* and *Giardia lumblia.*

Table 4: Prevalence of parasitic infection in the study area

Parasites	No Examined	No Infected	% Infected	P-value
AL + HW	168	36	21.4	P<0.05
AL + EC	166	15	9	
AL + EH	166	13	7.8	

In Table 4, the levels of parasitic infections among students were significantly different (P<0.05). This implies that, among students, there were significantly (p<0.05) higher infections of AL + HW, than in AL + EC, and AL + EH.

ANALYSED TABLES HERE.

For journal publication, you may just use the tables above and ignore the ones below.

Table 1: Prevalence of intestinal parasites among children in private and public schools

Category	Hypothesized Proportion	Observed	Expected	p-value
Private School II	0.25	30	37.5	0.19
Private School II	0.25	32	37.5	P>0.05
Public School I	0.25	42	37.5	
Public School II	0.25	46	37.5	
Total		150		

Table 2: Prevalence of intestinal parasites among the sex group sampled

Sex	Hypothesized Proportion	Observed	Expected	p-value
Male	0.5	72	75	0.62
Female	0.5	78	75	P>0.05
Total		150		

Table 3: Prevalence of Parasites in the study area.

Parasites	Hypothesized Proportion	Observed	Expected	p-value
Ascaris lumbricoides	0.1667	40	25.005	0.0000004
Entamoeba coli	0.1667	35	25.005	P<0.05
Hookworm	0.1667	30	25.005	
Entamoeba histolytica	0.1667	28	25.005	
Trichuris trichiura	0.1667	13	25.005	
Giardia lumblia	0.1667	4	25.005	
Total		150		

Table 4: Prevalence of parasitic infection in the study area

Parasites	Hypothesized Proportion	Observed	Expected	P-value
AL + HW	33.33	36	2133.12	0.000014
AL + EC	33.33	15	2133.12	
AL + EH	33.33	13	2133.12	
Total		64		

DISCUSSION

It was discovered that the overall prevalence of gastrointestinal parasites among the study area was 30% and the presence of these parasites found supports the earlier observation that parasitic infection constitute a major problem in the country (Ukpai & Ugwa 2007, Iwunze 2014). The prevalence of intestinal parasites among sex group (Table 2) showed that females (31.2%) have a higher prevalence rate than males (28.8), the findings agrees with the work of Aw,-waadu (2005) but disagree with the work of Iwunze (2014).

The prevalence of parasitic infection in the study area (table 3) showed that six (6) parasitic infections were found *36.1%), Entamoeba Coli (42.1%), Hookworm (36.1%), Entamoeba histolytica (33.7%), Trichuris trichiura (15.7%)* and *Giardia lamblia (4.8%).*

The prevalence of co-parasitic infections (table 4) showed that there waere multiple parasitic infections in some of the pupils which may be due to opportunistic infection.

Conclusively, this study showed that the average school pupil in the four schools carry intestinal parasites burden. It is recommended that sanitary measures and deworming programs should be introduced in primary schools to decrease the rate or intestinal parasite infection.

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PRODUCTION, PROXIMATE AND SENSORY EVALUATION OF AN INFANT WEANING FOOD BASED BAMBARA GROUNDNUT (*Vigna subterranea*) AND SORGHUM (*Sorghum bicolor*)

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ABSTRACT

The prevalence of malnutrition increases drastically from the age of six to eighteen months as a result of poor feeding practices and low purchasing power that characterized many homes. Some of the factors that may contribute to infant malnutrition includes: brands of foods that are beyond the economics of low-income families, protein-energy malnutrition, imbalance calories-dense supplementary foods and deficiency of essential micro and macro nutrient. The use of readily available under exploited crop to complement with legumes such as bambara groundnut in developing a simple household low cost weaning food hold promise in alleviation of infant malnutrition. The main objective of this study is to produce and evaluate an infant weaning food based bambara groundnut and sorghum; evaluate the sensory characteristics of this weaning food. Sorghum (Sorghum bicolor) and bambara groundnut (Vigna subterranea L. verdc) were processed into flour, mixed in ratios of 70:30, 60:40 and 50:50 respectively and chemical and sensory properties were evaluated. The protein contents of the formulated sample (RBS_1) (17.51 0.01g) was significantly higher when compared with RBS_2 (15.20 0.02g), RBS_3 (13.56 0.02g) and cerelac (control) (16.50 0.02g). Among the formulations, RBS_2 was significantly different ($p<0.05$) for all the sensory attributes and compared favorably with the control. The result suggested that RBS_1 hold a potential promise for the delivery of cheap nutrient and dense infant food for low income household. Human dietary interventions should be carried out with weaning children to assess its effect on growth in general since nutrients present in food may not give the expected effect it is known to have.

Keywords: Production, Proximate, Sensory Evaluation, Bambara groundnut and Sorghum.

INTRODUCTION

Childhood malnutrition is very common in developing countries (Plahar & Hoyle, 1991). This is because infants at this stage of development require higher energy and proteins in their diets so as to meet increasing demand for metabolism. The nutritional status of children less than five years of age is of particular concern, since the early years of life represents the period of optimal growth and development (Prechulek *et al*., 1999).

Scientific study has proved that breast milk, however, at the age of six months and above when the child is undergoing rapid growth, physiological maturation and development, is no longer sufficient to meet the nutritional needs of infants. During the first four to six months of life, all nutrients required by the infants can be provided by breast milk and so there is no dietary need for the introduction of solid food before then (Trussel, 2003). By the age of six months, most infant needs additional foods, the purpose of which is to complement the breast milk; these foods are prepared and fed to the infants under hygienic conditions and given in adequate proportion (Akaniwor & Okechukwu, 2004).

Nutritional complementary foods are therefore introduced, also known as weaning foods which typically cover the period of six months to twenty two months of age in most developing countries (WHO/OSM, 2000). Bambara groundnut (*Vigna subterranea* (L) verdc) is a pulse with subterranean fruit-set that is cultivated by small holders over much of semi arid Africa (Linnenann & Azam-Ali, 1993). The crop is a legume specie of a African origin (Borget, 1992). Food legumes have a major role to play in the fight against malnutrition. The protein of bambara groundnut is of good quality and has surplus lysine, which complements cereals in the diet (Ocran *et al.,* 1998). It is high in protein but unlike ordinary groundnuts contain very little oil (Tweneboah, 2000). The composition of the seeds from the view of human nutrition is very well balanced as they contain twenty percent soluble carbohydrates and eight percent fats (Messiaen, 1992).

Sorghum (*Sorghum bicolor*) has been for centuries, one of the most important staple foods for millions of poor rural people in the semi arid tropics of Asia and Africa. For some improvised regions of the world, sorghum remains a principal source of energy, protein, vitamins and minerals (FAO, 1995). It is the most abundant cereal crop grown in the world. The predominant use of sorghum is a fodder for poultry and cattle (Rajulapudi & Srinivas, 2014). It is an important food crop of the traditional weaning foods in West Africa. Therefore, the objective of this study is to produce and evaluate the proximate and sensory properties of an infant weaning food based bambara groundnut (*Vigna subterranea*) and sorghum (*Sorghum bicolor*).

MATERIALS AND METHODS

Sources of Materials

Bambara groundnut (*Vigna subterranea*) and sorghum (*Sorghum bicolor*) used for the production were obtained from a market in Aba, Abia State. The control food sample (cerelac) was obtained from a supermarket in Aba, Abia State.

METHOD OF PROCESSING

Processing of Samples

The bambara groundnut seeds were sorted, soaked for 24 hours in warm water, drained, dehulled and roasted in the oven at 180°C for 15 minutes. The roasted seeds were dry milled, sieved through 0.11 mm muslin cloth.

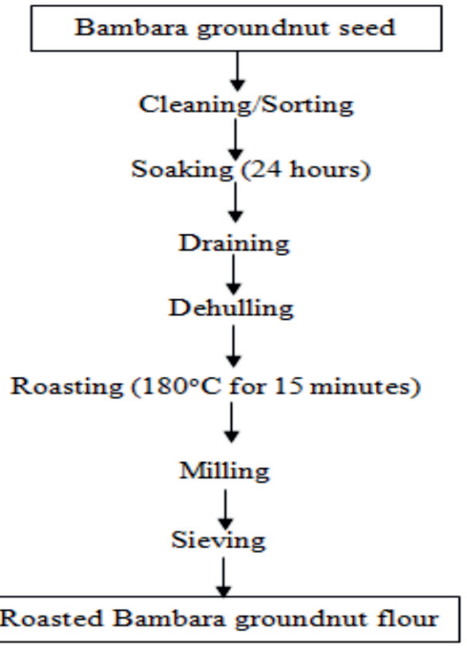


Fig. 1: Flowchart for preparation of roasted bambara groundnut flour.

The sorghum seeds were sorted, soaked for 24 hours in water, drained, dried in the oven at a temperature of 120°C for 15 minutes. The dried seeds were milled and sieved through 0.11 mm muslin cloth to produce sorghum flour.

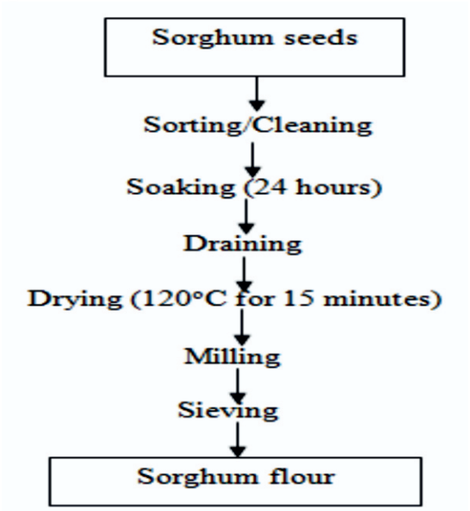


Fig. 2: Flowchart for the preparation of sorghum flour

Weaning Food Formulation

The roasted bambara groundnut flour and sorghum flour were mixed in ratios of 70:30, 60:40 and 50:50 respectively and the flour were then stored in an air tight container, prior to analysis.

Proximate Analysis of Samples

The proximate composition of the formulated weaning foods were determined. These were done in duplicate.

Determination of Moisture Content

The moisture content was determined according to the method of AOAC (1997). Two grammes (2 g) of the sample was accurately weighed into a moisture dish. The sample was dried for 5 hours at 105°C. After drying, the samples were removed from the oven and placed in a desiccator to cool to constant weight. The percentage moisture content was calculated as follows;

$$\%\text{Moisture} = \frac{(Y-Z) \times 100}{X}$$

Where; X and Y are the sample weight and the weight of dish + sample, respectively prior drying; Z is the weight of dish + sample after drying. Y-Z is the loss in weight of sample after drying.

Determination of Ash Content

The Ash content was determined according to the method of AOAC (1997). Two grammes (2 g) of the dried samples from the moisture determination was weighed into a previously dried and weighed porcelain dish. It was then placed in a muffle furnace, heated to 600°C and kept constant at that temperature for six hours. The samples were removed and were then cooled in dessicator and then weighed. The difference in weight of the residue and dish was recorded as the ash content and was expressed as a percentage of the total weight of the sample.

$$\%\text{Ash (dry basis)} = \frac{\text{MAsh}}{\text{MDry}} \times 100$$

Where; MAsh is mass of the ashed sample

MDry and MAsh is the original masses of the dried sample.

Determination of Crude Fat

Two grammes (2 g) of dried samples were weighed into porous thimble and its mouth plugged with cotton. The thimble was placed in an extraction chamber, which was suspended above weighed into receiving flask containing petroleum ether (B.P. 40 – 60°C) and below a condenser. The flask was heated on heating mantle for eight hours to extract the crude fat. After the extraction, the thimble was removed from the soxhlet and the apparatus reassembled and heated over water bath for the solvent recovery. The flask containing the crude fat was disconnected, cleaned with dry cloth, oven dried at 100°C for 30 minutes, cooled in a dessicator and weighed. The difference in weight is expressed as percentage crude fat content.

Determination of Crude Protein Content and Available Carbohydrate

Crude protein was estimated by multiplying the sample percentage nitrogen content by a factor 6.25. Available carbohydrate was calculated by difference by subtracting total sum of crude protein, crude fat, crude fibre and ash from 100% DW sample (AOAC, 1990).

Determination of Crude Fibre Content

Crude fibre was estimated by acid-base digestion with 1.25% H_2SO_4(w/v) and 1.25% NaOH (w/v) solutions residue after crude fat extraction was put into a 60cm^3 beaker and 200 cm^3 of boiling 1.25% H_2SO_4 added. The content was boiled for 30 minutes, cooled, filtered through a filter paper and residue washed with three 50cm^3 portions on boiling water. The drained residue was returned to the original beaker and 200 cm^3 of boiling 1.25% NaOH added. The content was boiled for 30 minutes, filtered, washed as above residue drained.

Sensory Evaluation of Formulated Diet

Ten (10) table spoonful of each sample was made into paste and poured into 1000 ml of boiling water. This was cooled for twenty minutes. The cooked samples were presented alongside with the control for sensory evaluation by twenty trained panelists. The attributes analyzed were: taste, aroma, colour, mouth feel and overall acceptability. The panelists were to assign score to their preference for various attributes using a nine (9) point hedonic scale with 1 being "dislike extremely" and 9 being "like extremely" (Iwe, 2002).

Statistical Analysis

Duplicate data obtained from the laboratory analysis were subjected to statistical analysis using Statistical Analytical System (SAS) software package. Mean values were determined, Analysis of Variance (ANOVA) was done and mean separation using Fisher LSD to determine significant difference (p at 5%).

Results

Table 1 shows the results of the proximate composition of bambara groundnut and sorghum formulated weaning diet.

Table 1: Proximate composition of bambara groundnut and sodium formulated weaning diet

Nutrients	RBS_1	RBS_2	RBS_3	Control
Fat (g)	7.60 ± 0.23	8.10 ± 0.04	8.60 ± 0.02	8.6 ± 0.03
Protein (g)	17.51 ± 0.01	15.20 ± 0.02	3.56 ± 0.02	16.50 ± 0.2
Ash (g)	3.01 ± 0.02	2.82 ± 0.01	2.51 ± 0.02	2.81 ± 0.02
Moisture (g)	4.90 ± 0.02	5.50 ± 0.03	6.20 ± 0.02	4.91 ± 0.02
Carbohydrate (g)	64.40 ± 0.2	65.80 ± 0.3	67.1 ± 0.01	65.00 ± 0.2
Fibre (g)	3.90 ± 0.01	4.20 ± 0.01	4.50 ± 0.02	4.60 ± 0.01
Energy (K/cal)	391.2 ± 0.1	398.10 ± 0.3	401.00 ± 1.5	3 97.11 ± 11.8

RBS_1 - Roasted bambara groundnut and sorghum (30:70)
RBS_2 - Roasted bambara groundnut and sorghum (40:60)
RBS_3 - Roasted bambara groundnut and sorghum (50:50)
Control - Cerelac

Table 2 shows the results of the sensory evaluation of bambara groundnut and sorghum formulated weaning diet.

Table 2: Sensory evaluation of bambara groundnut and sorghum formulated weaning diet

Attributes	RBS_1	RBS_2	RBS_3	Control
Taste	7.700 ± 0.9539^{b}	7.6500 ± 0.7263^{b}	7.6500 ± 0.6538^{b}	8.400 ± 0.8602^{a}
Aroma	7.65 ± 0.8529^{bc}	6.9500 ± 0.7399^{b}	7.2500 ± 0.9421^{bc}	7.800 ± 0.6000^{a}
Colour	7.2000 ± 1.0298^{a}	7.5000 ± 1.0724^{a}	7.3500 ± 0.9097^{a}	7.9500 ± 0.7399^{a}
Mouth feel	7.5000 ± 0.8660^{a}	7.1500 ± 0.7921^{a}	7.4500 ± 1.0712^{a}	7.7500 ± 0.8874^{a}
Overall acceptability	7.9000 ± 0.7000^{a}	7.7000 ± 0.7141^{a}	7.7500 ± 0.9937^{a}	8.0500 ± 0.4975^{a}

RBS_1 - Roasted bambara groundnut and sorghum (30:70)
RBS_2 - Roasted bambara groundnut and sorghum (40:60)
RBS_3 - Roasted bambara groundnut and sorghum (50:50)
Control - Cerelac

DISCUSSION

The proximate composition of the formulated weaning diet is shown in Table 1. The formulated diet containing 50% bambara groundnut and 50% sorghum (RBS_3) had the highest fat content (8.60 0.02g), while the sample containing 30% bambara groundnut and 70% sorghum (RBS_1) had the lowest fat content. The ash content of the control is comparable to that of RBS_2 (2.82 0.01). This could be as a result of high and good sources of mineral content of both bambara groundnut and sorghum. The formulations were also characteristically low in ash and fat for a food meal. There was a significant difference ($p < 0.05$) in the protein content of the control and processed sample. The protein content of RBS_1 (17.51 0.01g) was significantly higher when compared with RBS_2 (15.20 0.02g) and control (16.50 0.2g). A meal containing between 15 - 18% protein is considered adequate to offset any malnutrition. Jansen and Harper (1980), reported that weaning food used in supplementary feeding programs to contain 17 - 20% protein content. The carbohydrate levels were characteristically high ranging from 64.40 - 67.10 with RBS_3 having the highest value 67.10 0.01g, which can be considered as a good source of energy to meet the increasing demand for infants metabolism. These values were also higher than 61% recommended by the RTI (1987). The moisture content ranged from 4.90 0.02g to 6.20 0.02g, where RBS_3 had the highest moisture content and RBS_1 had the lowest moisture content. The result falls within the range of 5 - 10% as recommended by PAG (1975). The fibre contents of RBS_3 (4.50 0.02) was higher when compared with the other formulated food samples; RBS_2 (4.20 0.01) and RBS_1 (3.90 0.01). This is due to the high ratio of both samples. Dietary fibre is reported to have some beneficial effects on the muscles of the large and small intestine of infants. The energy value of RBS_3 was higher when compared with the control (397.11 1.8) and other samples; RBS_1 (391.20 0.1) and RBS_2 (398 0.3). The higher energy content of RBS_3 may be as a result of the higher fat and carbohydrate levels when compared to other samples. The high energy content revealed that the food is suitable to support growth and development in infants.

Table 2 showed the sensory evaluation of bambara groundnut and sorghum formulated weaning diet. The control (cerelac) exhibited higher sensory taste score of 8.40, followed by RBS_1 (30% bambara groundnut and 70% sorghum). The result of colour, mouth feel and overall acceptability indicated that there were no significant difference ($p < 0.05$) among the formulated samples. The mouth feel texture was due to the fact that the samples were subjected to the same processing methods and condition, therefore, they had the same mouth feel texture. However, there were significant difference ($p > 0.05$) in the taste and aroma parameters of the formulated samples. The overall acceptability variation in the weaning food formulations are statistically insignificant, as there are no significant difference ($p < 0.05$) in their mean scores. There was a significant difference ($p > 0.05$) between the taste parameter of the control and the formulated samples. However, there was no significant difference ($p < 0.05$) in the formulated samples. All the formulated samples are however, considered acceptable with sensory scores of 2 and above.

CONCLUSION

Bambara groundnut can effectively be used in traditional cereal based weaning foods as an acceptable protein supplement. The process parameters and formulation developed through this study successfully produced a high protein energy weaning food with acceptable sensory characteristics as well as an excellent nutritional quality. Underutilized bambara groundnut seeds could be exploited to produce adoptable household cheap weaning food with sorghum that can compare favourably with commercial brand (cerelac). This could be a sustainable way to curb malnutrition.

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REBUILDING DEMOCRACY IN NIGERIA THROUGH LANGUAGE: TOWARDS USING THE POWER OF LANGUAGE POSITIVELY

By

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ABSTRACT

Many Nigerians have lost trust in the government even though the country practices democracy. One of the factors that led to this lack of trust is the poor communication between the government and the people. This has caused voter apathy during elections and tax evasion. Furthermore, political propaganda, which is characterized as a tool for spreading false information, has further engineered lack of trust between the government and the populace. Nevertheless, since language is the primary means of communication, this study argues that language can be used to rebuild democracy in Nigeria. The study anchored its argument on the Sapir-Whorf Theory of Linguistic Relativity, which postulates that language can influence the mind and, by extension, social behaviour. Based on this ideology, the study postulates that if the government can communicate more effectively with the citizens as the tenets of democracy demand, it will succeed in building trust among the citizens. When the citizens trust the government, they will participate actively in activities that will rebuild democracy in the country. The study, therefore, concluded that language is a powerful tool for rebuilding democracy in Nigeria. It then recommended that the Nigerian government should use the Ministry of Information and Culture, the National Orientation Agency, and other state and federal MDAs to enlighten Nigerians on government activities, policies, and spending. The study also recommended that the government should enact laws that will discourage political propaganda, misinformation, and false promises from political leaders. Religious, social, and cultural leaders and other Nigerian stakeholders are also enjoined to open communication channels for interaction with the citizens and to prevent the spread of false information.

Keywords: Language, democracy, communication, linguistic relativity.

INTRODUCTION

Generally, democracy is perceived as a people's system of government. The term, 'people', as used here, refers to the masses, who are meant to participate actively in the government. Participation in the government requires the citizens to elect leaders that will represent them at the different levels of government and also present and project their needs and problems (Idada & Omoregie, 2017). Furthermore, when citizens participate actively in government activities, they will be able to provide information about issues that concern them to their elected leaders. This will give the leaders enough information they can utilise while creating policies, implementing projects, or enacting laws that can improve lives (Patarai, 2021; Munck, 2014). Nevertheless, citizens can only participate actively in a democratic government if a transparent and active communication channel is created between citizens and their leaders.

For democracy to be effective and sustainable in any country, citizens need to support their elected leaders, their administrations, and the country. They have to carry out their duties as citizens while enjoying the benefits of democracy (Adagbabiri & Okolie, 2019). Among the duties of citizens to their leaders and country include cooperating with the demands of the law, paying taxes, defending the country, assisting the law enforcement agents to flush out crimes, showing respect to the head of state, being loyal to the country, and respecting national symbols, such as the national anthem and the national flag (Adagbabiri & Okolie, 2019). However, for citizens to carry out their duties diligently and participate actively in a democratic government, they need to trust their leaders and the government.

One of the countries that is currently practising democracy in the world is Nigeria. The country practices representative democracy, whereby the citizens elect leaders to take up political offices at different levels. They elected these officials to represent and speak for them so that their voices will be heard. The leaders, in turn, need to interact with the citizens to know their demands, challenges, and expectations. The citizens are further given the opportunity to re-elect the leaders that represented them well while they sack those that failed to do their delegated duties.

Unfortunately, democracy in Nigeria is not working as it should. It is a common knowledge that citizens do not trust their elected leaders and the government (Ukpe, 2021; Adeyemi, 2023). This lack of trust affected the participation of Nigerians in the 2023 general election, where they had the opportunity of electing or re-electing their leaders. Data released by the Independent National Electoral Commission (INEC) showed that many eligible voters, who have registered and collected their Permanent Voter Cards (PVC) did not participate in the election (Suleiman, 2023). These data showed that out of 87 million eligible voters, only 25 million voted during the election (Suleiman, 2023). This amounts to only 28.63% of the eligible voters.

In addition, the increase in insecurity in the country and the disobedience of the citizens, in various forms, to the laws of the country has been attributed to poor governance, which resulted from ineffective democracy (Dahl, 2023; Idada & Omoregie, 2017; Nwogu, 2015). If this trend is allowed to continue, the country may witness anarchy, chaos, lawlessness, and other forms of crisis. This is the reason there is a need to discover ways democracy can be rebuilt in Nigeria before it becomes too late.

The aim of this study is to discover how language can be used to make democracy effective in Nigeria. It argues that since communication is one of the key components of good leadership, which should be utilised in democracy (Coffey International Development, 2007; Kapur, 2019), language can become a critical tool for rebuilding the trust of

Nigerians towards their leaders and encouraging them to participate actively in the democratic system. As a result, the overall research question of the study is, “How can language be used as an effective tool for rebuilding democracy in Nigeria?” It is our believe that this study will help Nigerian leaders and the citizens to discover how to create a synergy that will allow easy flow of information, opinions, ideas, demands, emotions, and challenges between the two parties. Hopefully, the findings of the research will help to restore the spirit of patriotism in Nigeria.

DEMOCRACY IN NIGERIA: AN OVERVIEW

Democracy is a system of government that encourages active participation of the citizens in the government's activities and decision-making. It is an old system of government, which existed even in ancient Greece (Nwogu, 2015; Mora, 2021; Adagbabiri & Okolie, 2019). Athens was said to be the first place democracy was practiced or brought to the limelight (Nwogu, 2015; Adagbabiri & Okolie, 2019). The Greeks were said to have perceived democracy as the government of the people by the people and for the people (Adagbabiri & Okolie, 2019), which indicates that democracy is the type of government that works towards serving every citizen in fairness, equity, and justice (Mora, 2020; Adeyemi, 2012; Dahl, 2023; Patarai, 2021). However, some scholars, such as Idada and Omoregie (2017), uphold that democracy started in the United States during the time of Abraham Lincoln. They also claim that the famous definition of democracy (that is, “government of the people by the people for the people”) was coined by Abraham Lincoln. Nevertheless, irrespective of where this system of government originated, it is spreading across the world as more countries continue to adopt and practice it.

Though democracy is generally referred to as the system of government that encourages active participation of citizens in government matters, activities, and decision-making, many scholars have suggested that the definition of the concept does not capture its elements and principles (Nwogu, 2015; Adagbabiri & Okolie, 2019; Munck, 2014). It is also discovered that modern democracy allows citizens to participate in government in proxy through their representatives (Patarai, 2021; Mora, 2020; Dahl, 2023). The elected representatives are empowered and delegated with the power to speak for the people that elected them into offices. However, these representatives must be elected by majority votes, meaning there are some individuals, who do not perceive them as capable enough to handle such positions. Nevertheless, for democracy to thrive, the elected officials must not impose their economic, political, social, and cultural ideas and practices on the masses (Idada & Omoregie, 2017; Dahl, 2023). They should also work towards ensuring the welfare of the people, including that of those that did not vote for them. State policies, decisions, and projects should reflect and capture the needs, demands, and wishes of the citizens and not that of the politicians (Patarai, 2021; Mora, 2020; Dahl, 2023). This simply means that there must be a synergy between political office holders and citizens for democracy to survive in any society.

In Nigeria, political leaders are elected into offices through elections that are conducted by an independent body – Independent National Electoral Commission (INEC). The elected leaders represent the decision of the majority voters, who elected them into office. They are also natives of Nigeria, which indicates that democracy in Nigeria is indeed the government by the people – since those leaders must be Nigerians and can only be elected into offices by eligible Nigerians (Adagbabiri & Okolie, 2019; Idada & Omoregie, 2017; Nwogu, 2015; Adeyemi, 2012). Furthermore, Nigerian democratic government promotes Nigerian culture, norms, and values, showing that it is indeed the government of the Nigerian people – and not that of foreigners (Adagbabiri & Okolie, 2019). However, it is unclear if the government can be described as the 'government of the people' since the elected leaders act in ways that question their loyalty to masses (Idada & Omoregie, 2017; Nwogu, 2015). Nigerian political leaders take state decisions and enact laws and policies that do not capture the interest of the masses (Adeyemi, 2012). The presence of corruption and insecurity has also further caused political leaders to adopt secrecy in carrying out state affairs (Idada & Omoregie, 2017; Adeyemi, 2012). The only time Nigerians seem to participate in democracy in the country is during election, which is characterised by violence, rigging, and other forms of manipulation that may deny people the rights to vote their preferred candidate (Idada & Omoregie, 2017; Nwogu, 2015). But then, after the election, Nigerians lose contact with the political leaders until the next election season, whereby the leaders adopt political propaganda and other forms of manipulative behaviours to win the votes of the electorates.

LANGUAGE AND THE MIND: THE SAPIR-WHORF HYPOTHESIS

Language is an arbitrary system of communication that is used by man. It is arbitrary because there is no logical relationship between what is stated and what is referred to (Syal& Jindal, 2016). For example, there is no logical relationship between the word 'tree' and the object it represents. However, the users of the English language understand what the word means each time it is used because they have learned the language (Mahadi & Jafari, 2012; de Villiers & de Villiers, 2014; Ebert, 2020). This, in extension, indicates that a language must be learned, consciously or unconsciously, before it can be used effectively and efficiently in communication.

Language is an uneasy concept to define. According to Syal and Jindal (2016), there is no existing definition of language that captures what the concept means. They observe that different authors define language to capture its characteristics or according to how they perceive the concept. They disclose that everyone understands what language is but may find it difficult to define it in order to capture all its characteristics. Nevertheless, according to them, the basic characteristics of human language include that language is a means of communication, arbitrary, organised and systematic, and a form of social behaviour.

The perception that language can influence thoughts is among the debates that have been taking place among linguists, psychologists, sociologists, philosophers, and other scholars. One of the scholars that engineered this debate was Edward Sapir, who propounded the theory of Linguistic Determinism (Hussein, 2012; Mahadi & Jafari, 2012; Caldwell-Harris, 2019). In this theory, Sapir argued that the language an individual speaks determines how he perceives the world (Mahadi & Jafari, 2012; Hussein, 2012). According to him, people, who speak different languages, have different realities because their languages limit the extent of the cognition (Hussein, 2012; Mahadi & Jafari, 2012; Caldwell-Harris, 2019). In other words, people only see and know what their language exposes them to.

Sapir projected the ideology of linguistic determinism because of the close relationship between language and culture, where culture and language are intermingled to the extent that one cannot exist without the other (Hussein, 2012; Shariatmadari, 2020; Mahadi & Jafari, 2012; Chen et al. 2013; Caldwell-Harris, 2019). For example, different aspects of culture are named and communicated with language while language is also perceived as an aspect of culture. The theory of linguistic determinism also posits that the knowledge of an individual is limited by the items within his

culture (Mahadi & Jafari, 2012). If an object does not exist in his culture, he will have no term or name for it. At the same time, he will have no knowledge of the object since he does not use any term that refers to it. That is to say that what a person says or hears about is what he knows and what he will know, respectively. This also occurs the other way around, when an individual has no knowledge of what he has not heard or said about.

Unfortunately, Sapir's ideology and theory of Linguistic Determinism was rejected by linguists, who believe that its postulation that language is the sole enforcer of people's worldview and reality is not true (Mahadi & Jafari, 2012; Hussein, 2012). They hold that language is not the only factor that shapes how people perceive because the experiences an individual had can influence his behaviour (Hussein, 2012). As a result, the theory is currently perceived as the strong form of the Sapir-Whorf Hypothesis, which is the famous theory that connects the relationship between language and the mind.

The controversy generated by Edward Sapir's Linguistic Determinism motivated one of his students, Benjamin Lee Whorf, to extend the theory into what is currently known as the theory of Linguistic Relativity or, in some cases, Whorfianism, Whorfian Hypothesis, or Whorfian Hypothesis of Language (Hussein, 2012; Chen et al., 2013; Mahadi & Jafari, 2012; Caldwell-Harris, 2019). This theory is what is generally referred to today as the Sapir-Whorf Hypothesis though linguists identify it as the weaker form of the hypothesis.

Whorf's Linguistic Relativity (Sapir-Whorf Hypothesis henceforth) postulates that the language an individual speaks can influence his thought and how he perceives life (Chen et al., 2013; Hussein, 2012). Whorf acknowledges that an individual's knowledge may be limited by his language. But, unlike his mentor, Edward Sapir, who failed to admit that there are other factors that may determine how an individual thinks, acts, or reacts to certain situations, Whorf upholds that language only plays a role in influencing a person's perception of life (Chen et al., 2012; Mahadi & Jafari, 2012; Caldwell-Harris, 2014; Hussein, 2012). He argues that the language an individual uses at any point of his life can provide him with the screen with which he views and describes the world (Hussein, 2012; Chen et al., 2012; Mahadi & Jafari, 2012). However, he postulates that when the individual changes his language or learns another one, his worldview changes or extends to accommodate the screen provided by the new language (Hussein, 2012). This, in other words, means that the language an individual is exposed to can provide him with certain information and knowledge about the world, which can influence how he thinks and what he thinks about.

Bringing the Sapir-Whorf Hypothesis into this study helps to explain how language can influence the mind and, in extension, behaviours. According to Zlatev and Blomberg (2016), human beings cannot think if language does not exist. They explain that the mental imagery, memories, perception of self, and anticipations, which take place as thoughts are done with a language. Chen et al. (2013) further disclose that people think within the domain of their culture. By this they mean that the mindset an individual has, the images he evokes in his mind, the actions he performs in his mind, and the emotions, norms, personality, and values he allows his mind to conjecture are all connected to his culture but they are objectified in his language. Scholars, such as Ebert (2020), Caldwell-Harris (2019), and de Villiers and de Villiers (2014), explain that when an individual learns a language, he will be able to understand the emotions, desires, complaints, knowledge, and beliefs of other users of the language. This will enable the individual to make sense of other people's behaviours and, in some cases, begin to adopt those identified items of the minds of other language users.

In other words, the language an individual knows and uses can determine what runs through his mind, which can, in turn, influence how he acts or reacts to certain issues and in certain circumstances.

The Sapir-Whorf Hypothesis further supports the argument of this study, which holds that language can be used to rebuild democracy in Nigeria. Based on this theory, the language (or expressions) Nigerians hear often can influence them to think positively about the government. When they do so, they may begin to trust the government and, hence, participate actively in government activities, decision making, and maintaining democracy in the country.

REBUILDING DEMOCRACY IN NIGERIA WITH LANGUAGE

Language, as described above, is a tool that can be used for communication, influencingthoughts, and restructuring social behaviour. Asa result, this section looks into how language can be used to rebuild democracy in Nigeria if it is positively used to communicate to Nigerians, influence their thoughts and encourage social behaviours that can help in sustaining democratic government. Thispaper argues, therefore, that these results can be achieved through positive propaganda and the provision of an active government-citizen communication channel.

POSITIVE PROPAGANDA FOR REBUILDING DEMOCRACY IN NIGERIA

Considering that language influences thoughts, it is necessary to discuss how propaganda can impact democracy when used positively. Propaganda, according to Busu et al. (2014), is usually given negative connotation as a result of the manner by which it is used.These scholars explain that since propaganda is usually used during wartimes and in politics, both of which are perceived negatively by the masses, it has always appeared as a deceptive communication strategy.Nevertheless, they argue that propaganda should not always be used in the negative sense if its meaning is understood. Propaganda, Busu et al.(2014) explain, is“a type of messaging that serves a particular purpose of spreading or implanting a particular culture, philosophy, point of view, or even a particular slogan”within a community (p. 82). Busu et al. further posit that messages spread through propaganda are meant to propagate a cause, a doctrine, or a piece of information that reflects the ideologies, interests, or concerns of a particular group. This description shows that propaganda is meant to spread messages of any kind and also encourage the audience to accept and adopt the ideology the message propagates. Inother words, if propaganda is used positively to spread positive messages, it will be a good medium for influencing the audience positively.

The assertion of Busu et al. (2014) aligns with the position of Wood (2016), who explains that propaganda, when used in the negative way, is a type of communication that can persuade and manipulate the audience instead of convincing or influencing them. Wood argues that there is a type of propaganda that can prevent the audience from seeing reasons but cause them to act irrationally. He further explains that though propaganda can be used for several purposes, the type of propaganda that is manipulative and deceptive is usually found in politics. This is so because, according to him,many politicians tend to use propaganda to persuade and manipulate the masses in order to win their supports. Wood states that this type of propaganda can be destructive if it is allowed to thrive.

Wood (2016) acknowledges that propaganda can be applied for good use as a result of its persuasive feature. He states that if the communicative strategy is used for persuasive purpose without any intention to manipulate the audience, it may be able to achieve good aims. However, he warns that if used without

restrictions or moderations, it may become destructive in the long run. Inother words, propaganda, no matter how good it may seem or how noble its purpose may appear, need to be used tactically to avoid its negative effects on the citizens. The description of propaganda byBusu et al. (2014) and Wood (2016) has given some revelations that may explain why Nigerians have lost trust in the government. As the scholars explain, politicians use propaganda to manipulate and deceive citizens. This is also the case in Nigerian, where Nigerian politicians adopt the use of propaganda to spread misinformation and engineer voter apathy among the citizens (Ukpe, 2021; Adeyemi, 2023). Politicians also use propaganda to cover their lies or to lie more to Nigerians, especially while making promises they cannot keep (Ukpe, 2021; Adeyemi, 2023). During the time of elections Nigerians are used to listening to manifestos that are never implemented. In other words when Nigerians hear politicians make promises, they assume that they (the politicians) are lying. Thisis one of the negative impacts of propaganda in Nigeria presently.

Though propaganda has negative connotations as a result of its negative uses by Nigerian politicians, it has the ability of serving positive purposes. This communication strategy can be employed as a tool for encouraging citizens to take active part in elections and other important state decision-making processes that may affect their lives. Considering the persuasive nature of propaganda, the approach can be used as an effective and efficient means of communication to instil positive ideology about the government and a culture of active participation in Nigerians (Wood 2016). With positive propaganda, Nigerians may be encouraged to support the government and help to rebuild democracy in the country. Nevertheless, politicians have to rebuild the citizens' trust in them and the government so that positive propaganda can work effectively and efficiently.

ESTABLISHING AN ACTIVE GOVERNMENT-CITIZEN COMMUNICATION CHANNEL

While propaganda is the medium, which Nigerian leaders can use to speak ***to*** the masses, there is need for a channel the masses can use to speak ***with*** them. Communication, which is the exchange of information, ideas, opinions, emotions, thoughts, and any other forms of message between two or more parties, can play a key role in rebuilding democracy in Nigeria. Since communication involves an 'exchange', messages should be allowed to flow freely between the parties involved (Akinbode, 2012; Sirbu, 2015). This means that for message sent, there must be feedback.

Communication performs several functions other than transferring messages. It can be used to establish and sustain relationships (Kapur, 2019; Sirbu, 2015), influence people's actions (Egbai & Nkanu, 2019), manage and resolve conflicts (Fernandez et al., 2016), eliminate misinformation and misunderstanding (Sirbu, 2015), reduce social ills and influence positive social behaviours (Jimoh & Idowu, 2021), change people's thoughts and perception of life (Banga & Suri, 2015), and, of course, persuade people to adopt certain culture, ideologies, and values (Jimoh & Idowu, 2021; Busu et al., 2014; Wood, 2016). These functions can show how communication can help in rebuilding democracy in Nigeria if a channel is opened for an exchange of messages between Nigerian leaders and the citizens.

CONCLUSION

Democracy as a system of government in Nigeria is facing challenges. The 2023 general election has disclosed that many Nigerians have lost trust in the government and are no longer interested in participating in government activities, including

electing their leaders. Several authors have also attributed the insecurity in the country to disobedience of the citizens as a result of bad governance. However, Nigerians should be encouraged to take active part in electing their leaders and participating in other government activities and decision-making that may impact their lives.

One of the ways Nigerians can be encouraged to participate in democratic activities in the country is through the use of language. Language, as a tool of communication, can be used to motivate the citizens through positive propaganda, which can persuade the masses to become active in government activities. If government opens a communication channel, through which it can interact with citizens, the citizens may find the avenue to relay their demands, complaints, and fears to the government. But for the citizens to begin to trust the government, political office holders need to become honest and keep to their promises. In other words, language can be used as an effective tool for rebuilding democracy in Nigeria if it is utilised positively.

RECOMMENDATIONS

The following recommendations are made as a result of observations made during the study:

Firstly, laws should be enacted and enforced to prevent negative propaganda, which can spread misinformation and prevent Nigerians from participating in government activities.

Secondly, the government should use the Ministry of Information and Culture, the National Orientation Agency, and other state and federal MDAs to enlighten Nigerians on government activities, policies, and spending.

Also, government agencies should utilise digital technologies, especially the social media, to reach out and communicate with Nigerians.

Finally, further studies should focus on the effects of negative propaganda on Nigerians.

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REMOTE SENSING AND GIS APPLICATIONS IN FLOOD MANAGEMENT

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ABSTRACT

India is one among the most natural disaster prone regions of the world and which causes losses of property, infrastructure and human life every year. Space and Air based observations of earth provide a unique vantage point for monitoring and assessing the floods and other disasters. Flood studies have been greatly improved with the geospatial technology mainly in three phases of floods. i.e., a) before floods (preparedness phase), b) during floods (monitoring phase) c) after floods (damage assessment and mitigation phase). The GIS data base created during preparedness phase contains agriculture, socio-economic, communication, population and infra structural data. This can be used, in conjunction with the flooding data to adopt an evacuation strategy, rehabilitation planning and damage assessment in case of a critical flood situation. During this phase integrated hydrologic-hydraulic modeling can be undertaken to reconstruct the flood event as well as generate the flood scenarios due to extreme precipitation, storm surge, cyclone, dam break or Glacial Lake Outburst Flood (GLOF). This work gives shows that how geospatial technology along with integrated hydrologic-hydraulic modeling can be used for making the flood risk maps, flood forecasting as well as flood evacuation routes identification. the gap areas in case of remote sensing, high resolution elevation data and urban floods is also discussed and future strategies to reduce these gap areas is also given. Finally integrated approach for Flood Management Information System (FMIS) is given.

Keyword: Floods, Remote sensing, GIS, Hydrologic-Hydraulic modeling, flood risk map.

INTRODUCTION

India is one among the most natural disaster prone regions of the world and which causes losses of more than Rs.1000 corer as a result of flood and cyclone damage annually. It is also the worst flood-affected country in the world after Bangladesh (Anil 1991, Anup et al 2006, Rao et al 1998) and accounts for one fifth of global death count due to floods. About 40 million hectares (mha) or nearly 1/8th of India's geographical area is flood prone (National Flood Control Commission Report) and the country's vast coastline of 7500 Kms is exposed to tropical cyclones arising in the Bay of Bengal and Arabian Sea. The most of the cities/agriculture lands are located near rivers and flood -plains as they are convenient and attractive locations for settlements and other agro-economic activities, which results in huge flood damages. The losses due to floods can be minimized by combination of structural and non- structural measures, short and long term predictions, prevention and warning system and real time monitoring and relief measures.

Flood studies with Geospatial Technology - Current status Nature of Floods in India

The major flood prone regions of India are the Ganges and the Brahmaputra flood plains. These rivers originate from the Himalayan mountains and cause heavy floods in plains of Uttar Pradesh, Bihar, West Bengal and Assam due to heavy high discharges concentration during monsoon months (June to September) and large volumes of sediment in flood plains. The heavy sediment load causes reduction in channel capacity, which results in extensive over-bank spilling and consequent inundation. The other flood prone areas of country are Mahanadi delta region, some portions of Mahi, Narmada and Sabarmati river in Gujarat and occasional heavy rainfall floods in Andhra Pradesh, Rajasthan and Maharashtra. The coastal floods are mainly due to Cyclone/Tsunami's along eastern/western ghats in Tamilnadu, Orissa, and Gujarat.

Role of Remote sensing and GIS in Floods

Space and Air based observations of earth provide a unique vantage point for monitoring and assessing the floods and other disasters. The traditional floods mapping and studies were based on conventional surveys and historical flood records. In this regard, space technology has made substantial contribution in every aspect of flood disaster management such as preparedness, prevention and relief (Rao 1994, Rao et al 1998). The Indian and other global remote sensing satellite are being used for obtaining the information about floods inundation areas and flood damage assessment. The major Indian remote sensing and foreign remote sensing satellites used for flood studies are given in table 1 and 2.

Table 1: Indian remote sensing satellites (IRS) in support of flood and disaster management

Satellite	Sensor	ial Resolution (Meters)	Revisit time (days)	Service period
Bhaskara 1/2	Television Camera	1000		June 1979 -1980 November 1981 -1983
IRS 1 A/1 B	(LISS-I & LISS-II)	36.5 and 72.5	22	March 1988-1992 August 1991 -1990
IRS 1 C/D	PAN, LISS 3, WIFS,	5.80, 23.5, 188.	22 22 5	December 1995 - 2001 September 1997 - 2005
IRS P 3	WiFS	188	5	March 1996 - 2002
IRS P 4	OCM	360	2	May 1999 - operating
IRS -P 6 (Resourcesat-1)	LISS 4, LISS 3, AWIFS.	5.8, 23.5, 56.0.	22 22 5	October 2003 - operating
IRS – P 5 (Cartosat – 1)	Stereo pan	2.5	5	June 2005 - operating
(Cartosat – 2)	Pan	1	5	Jan 2007 - operating

Table 2: Foreign remote sensing satellites in support of flood and disaster management

System	Status	Capabilities
AQUA/TERRA (MODIS)	Existing	Optical 36 bands in VIS, IR SWIR, TIR
DMSP	Existing	Optical, IR
ENVISAT	Existing	Radar, optical, IR
ERS 1 & 2	Existing	Radar, 5-500 km swath, 25 m resolution
IKONOS 1-2	Existing	Optical 1 and 4 m resolution
KVR-1000	Existing	Optical 150 km swath, 2 m
EO-1 ALI, Hyperion	Existing	Optical, VIS, IR, SWIR, TIR 10m to 30 m Multispectral (ALI) to hyper spectral (Hyperion)
LANDSAT 7	Existing	Optical, IR 185 km swath, 30 m, 80m
NOAA-GOES	Existing	Optical, AVHRR
NOAA-POES	Existing	In-situ visible and IR observation
Orb View	Existing	Optical 1, 2 and 4 m
Quick Bird	Existing	Optical 1 m resolution
RADARSAT 1	Existing	C-band Radar (SAR) 45-510 km, 9-63 m
TERRASAR-X	Existing	X-band Radar (SAR) 10-510 km, 1-50 m
ALOS (PALSAR)	Existing	L-band Radar (SAR) 40-350 km, 7-100 m
TRMM	Existing	Microwave radiometer, Rain radar, Thermal MI
Resurs-03	Existing	Optical 34-600 m
Sea WiFS	Existing	Optical, IR 1-4 m sea observations
SPOT 1-5	Existing	Optical 60 km swath, 10 m, 30 m

Flood studies have been greatly improved with the geospatial technology mainly in three phases of floods. i.e., a) before floods (preparedness phase), b) during floods (monitoring phase) c) after floods (damage assessment and mitigation phase). Table 3 and 4 list the major flood related themes, their utilization, spatial and temporal resolution requirements.

Table 3: Geospatial/other input(s)/deliverable(s) during disaster(s) (flood)

Theme(s) Required	Disaster (flood) Phase	End Product Utilization
Basin/flood plain nature	Before disaster	Disaster management org(s).
Digital elevation models	Before disaster	Disaster/ Flood management org(s). State WRD, CWC.
Natural resources map	Before disaster	Natural resources/Flood management org(s).
Flood inundation map Extent of inundation Crops area affected Villages inundated Damage to infrastructure	During disaster	Organizing relief operations, Near – real time assessment of damages, relief & rescue operations
Flood control works	Before/during/after disaster	State WRD, CWC, strengthening of existing flood control works, planning for future disaster control works.
River configuration	Before/after disaster	River engineering works
Riverbank erosion	After disaster	State WRD, planning anti
		erosion works
Rainfall estimation	Before during disaster	IMD, State WRD, CWC flood forecasting
Discharge measurements	During disaster	State WRD, CWC flood forecasting/simulation

Table 4: Spatial Resolution Requirements for Flood Studies

Theme	Phase	Threshold	Optimum
Land use (MSI)	Pre - flood Post - flood	30 m (MSI) -----do-----	4-5 meter
Infrastructure status (PAN-VIS)	Pre - flood Post - flood	5 m -----do-----	<=1 m
Vegetation (H/MSI)	Pre - flood Post - flood	250 m -----do-----	<= 30 m
Soil moisture	Pre - flood	250 m -1 km	100 m
Snow Pack	Pre - flood	250 m -1 km	100 m
DEM (vertical)	Pre – flood Post – flood	1-3 m (InSAR, Cartsat-1) -----do-----	0.1 – 0.3 m
Bathymetry/river X-sections	Pre – flood	<1 km (SAR/MSI)	90 m
Flood development andflood peak	During/postflood	30 m (MSI/SAR/VIS)	<= 5m
Damage assessment	Post – flood	2-5 m (MSI/SAR/VIS)	<= 1m

MSI = multi-spectral imagery (2 to 50 bands) HSI = hyper-spectral imagery (> 50 bands) pan-vis = panchromatic visible imagery SAR = synthetic aperture radar INSAR = interferometric SAR Source: (CEOS disaster report)

Flood studies with Geospatial Technology – Gap areas

Optical: The presence of cloud cover in the satellite images is one of the major limitations of optical images (A WiFS, LISS-3, and LANDSAT) in mapping and monitoring during the real time monsoonal/cyclonic floods. The only possibility of imaging is before and after the flood event has occurred. Therefore the active microwave images such as RADARSAT/ENVISAT are being used on global basis for near-real time flood mapping and monitoring. The revisit period of many satellites is 5 days and more, which causes delay in flood studies, and sometime no flood areas are mapped as flood recedes quickly especially in urban areas. It is suggested to use a constellation of low earth orbiting satellites (LEOs) at regular intervals with high spatial and temporal resolutions.

Microwave: Microwave sensors such as SAR, are very effective in flood studies due to their all weather capabilities, but due care must be given to areas with shadows, layover, and wind waves (Hess et al 1995). The rough water has much higher backscatter as compared to smooth – calm water surface. The use digital elevation model (DEMs) should be considered to mask out the high slope areas. The repeat pass of most of SAR system such as RADARSAT/ENVISAT is 23 to 35 days; therefore a given location is imaged at required time by using variable incidence angle images, which gives shorter revisit interval than the orbit repeat cycle. Even with variable incidence angle images it is difficult to get images of flood affected areas in different geographic locations with 1-2 satellites. Therefore, the optimal combination of multi SAR system such as RISAT/TERRASAR- X/PALSAR/RADARSAT-2/AIRSAR should be used for near real time flood monitoring.

Urban Floods: The urban hydrology and flooding is different than that of natural landscape. Urban areas have more impervious areas such as parking lots, roads, driveways, roofs, built-up areas etc which prevents the infiltration and halts the interflow, this results in >55 % rainfall as surface runoff . This produces multi peaked hydrograph for urban areas for different rainfall intensities. The high discharge further cause channel erosion and flooding. The SAR system are ineffective for the urban floods as they have multiple/corner reflection form urban buildings etc, therefore delineation/monitoring of flooded streets/parkways/grounds is difficult to detect satellite images.

Flood depth and duration: The current state of art in flood studies with geospatial techniques are limited to mapping, monitoring and modeling of floods. But still research is required to find the flood depth and duration of inundated area for more realistic flood management and simulation studies. The temporal SAR/cloud free optical images can give the rough estimates of duration of flooding and pre flood terrain information form DEMs and flood extent maps can be utilize for the calculations of flood water depth and duration. This requires multi satellite/sensors/altimeters/ground-truth approach for flood studies.

Flood studies with Geospatial Technology – Future advancements

Altimeters for Flood Discharges Measurements: Space based SAR systems have been extensively used for flood mapping (Hess el al 1995) and stream discharge measurements (Alsdorf et al 2001, Birkett 1998 and Smith et al 1995, 1996). The future sensors specific to flood discharge retrieval is **Wa**ter **E**levation **R**ecovery Mission (fig. 6). WatER is a swath based altimetry mission designed to acquire elevations of inland water surfaces (and hence the

capability to derive surface water storage and river discharge) at spatial and temporal scales necessary for answering key water cycle and water management questions of global importance. WatER is an international effort with participants from 14 countries (Rodriguez 2004). Maximum incidence angle is 4.3º, thus the instrument operates very near nadir where water surfaces are very bright. At Ka band, the interferometer will easily penetrate clouds and relies on subtle canopy openings to penetrate to any underlying water surfaces (openings of only 20% are sufficient). Spatial sampling resolutions are noted in the figure. Height accuracies will be ±50 cm for individual pixels" thus centimetric accuracies are achieved through polynomial averaging schemes. Such altimeters can provide the discharge/ water level fluctuation to the flood simulation/forecasting models for near-real time flood management.

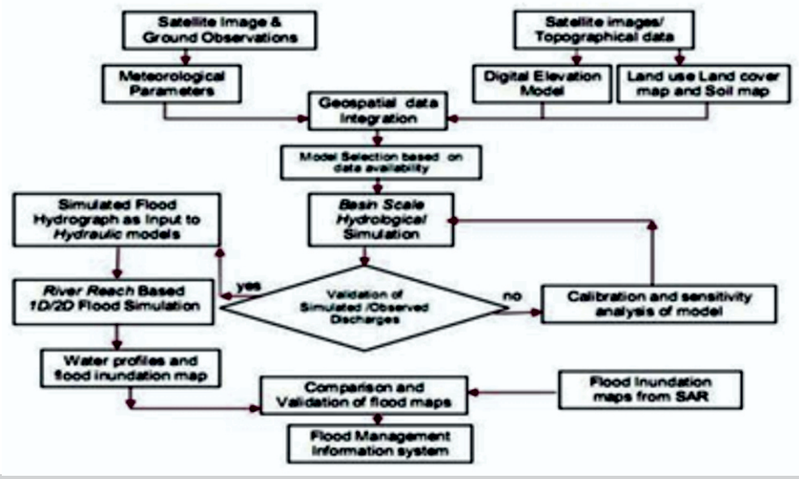
Lidar Based Flood Studies: The high resolution DTMs of floodplains and urban areas can be obtained from LIDARs and this becomes an input for flood hydraulic simulation models (Horrit and Bates, 2002; Alemseged and Rientjes 2005). This improves the prediction of flood waters more accurately in relatively flat urban/floodplains such as detla regions of Mahanadi and Ganges.

Urban Flood Studies: In this regard high resolution optical images (CARTOSAT, QUICKBIRD), high incidence/resolution SAR (TERRASAR-X/PALSAR/AIRSAR) and high resolution DEM from (CARTOSAT-1, LIDAR) should be used to find flood inundation areas and perform urban flood simulations.

Flood Management Information System

The inputs from remote sensing and conventional methods such as satellite/raingauge based precipitation, land use land cover, soil texture, DEM, etc can be integrated in geospatial environment to simulate the rainfall-runoff process, which becomes an input to the flood fore-casting models. The hydrologic-hydraulic and flood forecasting models can be used for the flood peak estimation and simulating the past/future flood scenarios. The simulated flood events can be used for the flood-plain delineation, flood hazard zonation and creation of flood risk map with different return period floods (Thakur and Rastogi 2006). The flood risk maps can than be used for flood prevention/mitigation purpose, fixing of flood insurance rates. The fig. 5 shows the general flow chart of FMIS.

Fig. 1; Flow chart for flood management information system (Thakur and Rastogi 2006)



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RESPONSE OF PLANTAIN (*MUSA PARADISIACA* AAB) SUCKERS UNDER DIFFERENT NURSERY SUBSTRATES IN UNWANA, EBONYI STATE, NIGERIA

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ABSTRACT

This field experiment was carried out at the experimental field of Horticulture and Landscape Technology Department in Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State to determine the Response of plantain (Musa paradisiaca AAB) suckers under different nursery substrate in Unwana, Ebonyi State. The treatment involved three nursery substrate (sawdust, poultry manure and topsoil) which were replicated four times in a Randomized Complete Block Design (RCBD) and data collected were subjected to Analysis of Variance (ANOVA) at P<0.05 and differences between treatments means were separated using Fisher's Least Significant Difference (F-LSD). The weight of each nursery substrate used was 30kg per plot. The results indicated that the substrate had significant effect on the number of leaves, plant height, leave length, leave width and pseudostem girth. The longest plant height, highest number of leaves, leave length, leave width and pseudostem girth at 7WAP and 14WAP were obtained on plants grown with poultry manure substrate while plants grown on the topsoil (control) consistently produced the least values in all the parameters measured. The result also showed that poultry manure substrate had significant effects on all the parameters accessed. Hence, poultry manure substrate proved to be the best growth medium and was recommended in order to maximize the multiplication of plantain suckers.

Keywords: Plantain, Nursery substrate, Propagation and Sucker

INTRODUCTION

Plantain (*Musa paradisiaca* AAB) is a giant herbaceous perennial crop belonging to the family *Musaceae*. It originated from South East Asia, mostly in Malaysia and it is found in India, Africa and America (Swennen, 1990; Englberger *et al.*, 2006). Plantain has been relied upon as staple food for hundreds of years and the history of the plantain differs based on where they are located. In Nigeria, Akinyemi *et al.* (2010) reported that plantain is the third most important starchy staple grown after cassava and yam, with the majority of production being consumed nationally. Plantain production in Nigeria has been estimated to be 1,855,000 metric tonnes and they are produced in larger quantities in Edo, Delta, Ogun, Ondo, Oyo, Osun, Rivers, Cross river, Imo, Anambra, Lagos, Kwara, Kogi, Benue, Abia and Enugu States. The propagation of plantain suckers is grouped as macro-propagation and micro propagation. The macro- propagation techniques are methods that use whole suckers or relatively large pieces of the parent plants materials. Macro-propagation techniques include decapitation (false

and complete decapitation), corn techniques (whole corn, split corn and excised buds) while the micro propagation method deals with the use of an excised plant part such as shoot tip, buds, apical meristem etc. (Singh *et al.*, 2011).

Chambers 21st Century Dictionary (1996) defines substrate as the material or medium (soil, rock, agar, sawdust, ricehull, etc) that living organism, such as plant, bacterium, lichen, crustacean, etc, grows on or is attached to and which often provides it with nutrients and support. For any material to qualify as a good medium for plant propagation it must possess certain desired physical properties such as suitable bulk density of the component of the materials and that the component of the medium should be moderately retentive of moisture, aeration and drainage (Achaliwor, 2004). Several million kilograms of sawdust and other wood residue are produced annually in Nigeria. While most of this is burned, an increasing amount is being used for mulch by growers of small fruits and mushrooms. As a substrate, sawdust and other wood waste are clean to handle, easy to apply, long lasting and efficient in conserving moisture. This makes fine sawdust substrate a preferred planting material for plantain suckers multiplication (Boss, 2009). Watako (2002) compared the rooting of *Hypericum androsaemum* in different substrate compositions. Three substrates namely Sand (control), sawdust and ricehull in various compositions, and incubated for a period of six months and were tested for their suitability for the rooting of Hypericum cutting. The results showed that the ratio 2:3:1 (sand, sawdust and ricehull) gave the best performance. Root length percent, root fresh weight and dry weight significantly increased in 2:3:1 ratio over other mixture compositions. Eghball *et al.* (2004) also reported that increasing organic matter content of the soil improves biophysical characteristics and makes it more sustainably productive due to its long lasting residual effects on crop yield and soil properties. Aba *et al.* (2011) noted that soil pH increases progressively with the application and subsequent decomposition of poultry manure. They also observed that poultry manure is a good source of humus, the organic matter component with the most stability and nutrient availability for plants utilization, growth, suckering and over all performances.

In Nigeria, plantain production has gone seriously on the decline due to depleted soil nutrients and inadequate and indiscriminate use of soil amendments (Rosati *et al.*, 2000). Organic substrate provide adequate nutrients to the seedlings, better root substrate relation than conventional soil mix and range of crop residues, organic wastes and other industrial by-products could be used as organic growing medium, preference of any should largely be determined by consideration of availability, economics, physical and chemical characteristics. There is little research work available on organic nursery media in growing plantain suckers. Despite the fact that plantain is a major staple crop in Nigeria. The major objectives of this study were to determine the response of plantain suckers to different nursery substrate.

The specific objectives were as follows:

- To determine the impact of substrate on the multiplication of plantain sucker.
- To determine the best substrate needed to raise plantain suckers.

Materials and methods

Experimental site

The field experiment was conducted at the experimental field of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State in the South Eastern zone of Nigeria. The length and width of experimental field was 12m x 10m respectively, giving a total land area of 140m^2.

Raised field beds were used and they were manually cultivated. The experimental field was divided into four equal blocks and each block consisted of three sub-plots, giving a total of twelve plots, each measuring 2m x 2m ($4m^2$) with 1m between adjacent plot and 1m between blocks. The experiment was conducted as a Randomized Complete Block Design (RCBD). There were four replications of each treatment. The treatment comprised of three substrates. The substrates were: S – Sawdust, P – Poultry manure and C – Control.

CULTURAL PRACTICES

Land preparation: The experimental field was manually cleared and raised field beds of 2m x 2m were made. The raised field beds were excavated up to 60cm depth and the different substrate were used to refill them.

Planting: Plantain suckers were planted in the planting holes at a spacing of 1m x 1m. One sucker was planted per hole.

Weeding: Weeding was carried out manually by hand picking and hoeing. This was done at two (2) weeks interval.

DATA COLLECTION

Number of leaves: The number of leaves per plant was counted at seven and fourteen weeks after planting.

Plant height (cm): The plant height was measured from the ground level to the junction of the last two fully unfurled leaves at seven and fourteen weeks after planting.

Leaf length (cm): The leaf length per plants was measured from the base to the apex of the plant leaf using graduated rule at fourteen weeks after planting. The mean length of the leave was recorded in centimetre (cm). Leaf width (cm): The leaf width per plants was measured at the middle of the plant leaf using graduated rule at fourteen weeks after planting. The mean diameter of the leave was recorded in centimetre (cm).

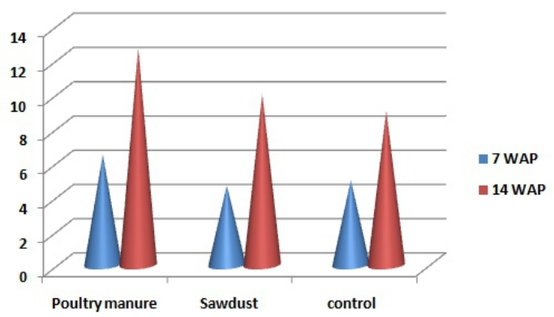
Pseudostem girth (cm**):** The pseudostem girth was measured using measuring tape at fourteen weeks after planting.

Statistical analysis

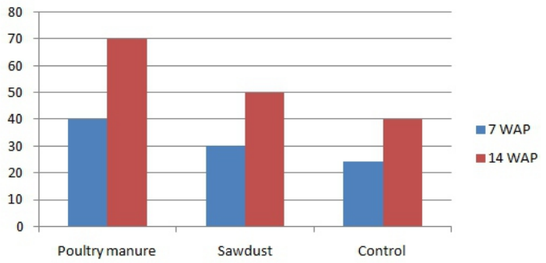
Statistical analysis of data was based on the procedure outlined by Onuh and Igwemma (2007) for Randomized Complete Block Design (RCBD). Separation of treatment means for significant effect was by the use of Least Significant Difference (LSD) as directed by Onuh and Igwemma (2007).

RESULTS

The effects of different nursery substrate on number of leaves per plantain (*Musa paradisiaca* AAB) sucker was significant at 7 and 14 Weeks After Planting (WAP) ($P \leq 0.05$) as shown in figure 1. Poultry manure substrate produced the highest number of leaves (6.46 leaves and 12.66 leaves) at 7 WAP and 14 WAP respectively while, the lowest number of leaves (4.64 leaves) at 7 WAP and (9.00 leaves) at 14 WAP were obtained on plants grown on sawdust substrate and control respectively and they were significantly different at 7 WAP and 14 WAP. However, the number of leaves recorded on poultry manure substrate at 14 WAP was significantly higher than all other treatments. At 7 WAP and 14 WAP, sawdust substrate and control produced number of leaves that were statistically similar.

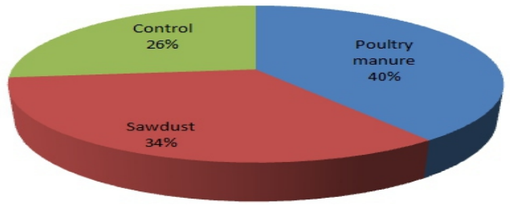


Substrate had significant effect on the plantain plant height produced at P = 0.05 (figure 2). Plantain suckers grown on poultry manure substrate produced the longest mean plant height (40.25cm and 78.20cm) at 7 WAP and 14 WAP respectively while plant height were shortest (24.50cm) at 7 WAP and (40.32cm) at 14 WAP on the plants grown under control and they differed significantly. Poultry manure substrate produced plant height that was significantly higher than all other treatments at both 7 WAP and 14 WAP. However, the plant height obtained on the sawdust substrate and the control did not differ significantly among themselves both at 7 WAP.



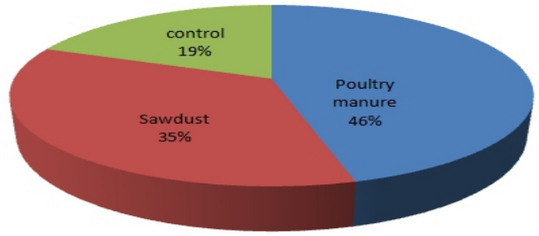
Effect of growth media on the plant height/plant at 7 and 14 WAP

There was significant effect of nursery substrate on the leave length of plantain suckers at P = 0.05 (figure 3). The longest leaves at 14 WAP (189.96cm) was on the plants grown with poultry manure substrate and the shortest leaves at 14 WAP (127.67cm) on control grown plants and they were statistically different. Plants grown with poultry manure substrate produced leave length that was significantly higher than all other treatments. However, the leave length obtained on sawdust substrate was statistically higher than that of control treatments.



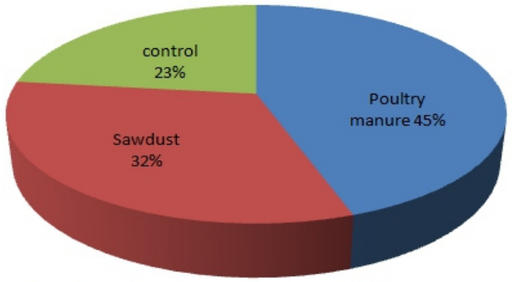
Effect of growth media on the leave length produced at 14 WAP

Substrate had significant effect on the leave width produced at P = 0.05 (figure 4). The highest leave width (103.22cm) 14 WAP was produced on plants grown with poultry manure substrate while the lowest leave width (43.22cm) at 14 WAP was obtained on the control and they differed significantly. Plantain suckers grown on poultry manure substrate produced leave width that was significantly wider than leave width of all other treatments. However, the leave width recorded on sawdust substrate at 14 WAP was significantly higher than the control treatments.



Effect of growth media on the leave width produced at 14 WAP

There was significant effect of substrate on pseudostem girth at 14 WAP (figure 5). Plants grown with poultry manure substrate produced the highest pseudostem girth (25.76cm) while the lowest pseudostem girth (13.32cm) was obtained on the control plot and they differed significantly. Plants grown on poultry manure substrate produced pseudostem girth significantly wider than all other treatments. Although, sawdust substrate grown plants produced pseudostem girth (18.50cm) that was significantly wider than pseudostem girth (13.32cm) obtained on the control.



Effect of growth media on pseudostem girth (cm) at 14 WAP

DISCUSSION

The results from the field trial showed that nursery substrate had significant effect on the number of leaves, plant height, leave length, leave width and pseudostem girth. The longest plant height, the highest number of leaves, leave length, leave width and pseudostem girth at 7 WAP and 14 WAP were obtained on plants grown with poultry manure substrate. This may suggest that poultry manure decomposed and added some nutrients to the soil in the form available for plant utilization, growth and yield. This observation agrees with the report by Baiyeri *et al.* (2013) who found that animal manure constitute a valuable source of nutrients and organic matter which can improve soil physical conditions. Eghball *et al*. (2004) also reported that increasing organic matter content of the soil improves biophysical characteristics and makes it more sustainably productive due to its long lasting residual effects on crop yield and soil properties. Aba *et al*. (2011) noted that soil pH increases progressively with the application and subsequent decomposition of poultry manure. They also observed that poultry manure is a good source of humus, the organic matter component with the most stability and nutrient availability for plants utilization, growth, suckering and over all performances.

Plants grown on control consistently produced the least values in all the parameters measured. This is in conformity with the observation by Rosati *et al*. (2000) who reported that plantain production in Nigeria has gone seriously on the decline due to depleted soil nutrients and inadequate and indiscriminate use of soil amendments. For any material to qualify as a good medium for plant propagation it must possess certain desired physical properties such as suitable bulk density of the component of the materials and that the component of the medium should be moderately retentive of moisture, aeration and drainage (Achaliwor, 2004).

CONCLUSION

Bearing in mind the importance of plantain to the people of Nigeria and standing on the position of these plants genetic resources in cushioning food and job security of our great country, it becomes imperative to create more awareness on the best nursery medium to propagate *Musa paradisiaca* AAB. The results of this study showed that poultry manure produced the highest vegetative growth of plantain suckers. Least values of plant height, number of leaves, leave length, leave width and pseudostem girth were obtained on plants grown on the control. However, to achieve optimum result and healthy plantain suckers there is need to use poultry manure as a substrate (nursery medium) for plantain suckers multiplication. Using poultry manure as nursery substrate in plantain multiplication will go a long way in improving the economy, food security and job security in Ebonyi State.

RECOMMENDATIONS

1. Government and non-governmental agencies should engage the youth in plantain sucker multiplication programme especially in the agrarian communities.
2. Individual and groups should adopt poultry manure substrate as a nursery medium for plantain sucker multiplication at both small and commercial scales.

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RETIREMENT: FUTURE PLANS FOR LIBRARIANS

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RETIREMENT: FUTURE PLANS FOR LIBRARIANS

ABSTRACT

Retirement has mixed meaning for people. Some look forward to it while others dread it. Retirement should be a thing of joy which employees should eagerly look forward to. Unfortunately employees dread it and many do not bother to make adequate preparation for it Identifying and implementing an exit strategy should be a top priority for intending retirees at least a few years in advance of the retirement date so as to be emotionally prepared for the proposed date. Establishments should also organize preretirement programmes for the retirees so as to have a smooth transition from work to retirement Librarians in retirement or planning for retirement have many employment opportunities available to them ranging from working for part-time in libraries and other organizations, travel librarianship, volunteer opportunities, to establishing information management and consultancy services, publishing, book-selling, etc to help them cope with post work life challenges. This paper calls for librarians to plan and prepare for retirement, in order to have a smooth passage into retirement and ensure the survival of their life's work.

Keywords: *Retirement, Life, Preretirement, Planning and Librarians*

INTRODUCTION

There is a basic assumption that an individual's orientation towards his job, the amount of job satisfaction he derives from his job relate positively to his attitude towards requirement. This assumption was by and large true with academic staff in Nigerian institutions of higher learning until recently when lecturers experienced retrenchment, sack and forced retirement, mostly due to political cum-economic considerations (Durotolu, 2013). Negative relationships have been established between attitudes to work and retirement among workers (Goudly, 1975). However, Atchley (1976), cited in Durotolu [2013), concludes that relationship between attitude to work and retirement is contingent upon such indices as adequacy of expected retirement income, age, difficulty in getting work, health occupational level and sex.

According to Chambers 21st century Dictionary retirement is an act of retiring or state of being retired from work. Retiring on the other hand means stopping or making someone to stop working permanently, usually on reaching an age at which person is received. Retirement has varied meanings for people. Some look forward to it, while others dread it. Various policies affect the way people will live in retirement. These-include compulsory or flexible retirement (Ivancevich, 1992). A major issue regarding retirement has been whether it should be compulsory or flexible. Flexible retirement policies take account of individual differences, but can cause difficulty in administration especially in regard to favoritism. Compulsory retirement assures a predictable turnover of old employees, opening up positions for younger ones and equality of treatment for all employees.

Traditionally, people retire when they are too old to be able or willing to work. Today, the concept is broader and more flexible. Some employees prefer not to work to the normal retirement age, and hence retire early. Some retirees leave one job to prepare for a career in another field. Some leave the work force temporarily to care for young children or older parents. Typically, the normal retirement age for civil servants in Nigeria is 60 years of age and thirty-five years of services while employees of tertiary institutions retire at 65 years of age and judges as well as professors now retire at the age of 70 years. Most early retirement plans require a minimum, number of years of work (usually 10-15 years), before an employee is eligible for early retirement and to receive pension or benefits.

Retirement is a major change and should be prepared for. As Armstrong (2016) put it, retirement policies need to be specified, thus:

When people are due to retire.

The circumstances, if any, in which they can work beyond their normal retirement date,

- The provision of retirement training
- The provision of advice to people about their retirement.

PREPARING FOR RETIREMENT BY LIBRARIAN

Since retirement is inevitable in the lives of employees and as the phenomenon of untimely or early retirement is being experienced by academic staff including librarians, one should begin early enough to prepare and plan for retirement. It should be a thing of joy which employees should eagerly look forward to. Unfortunately, retirement has largely been seen as death, which though an inevitable end to life is dreaded and many employees do not actually bother to make adequate preparations for it. That is why worker continuously falsifying their records in order to remain in the workforce and not to leave it at the appropriate time and when they actually leave the workforce by retirement, they become deadwood, unable to do anything for their livelihood. In order to change the attitude of