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Model for Predictive Analysis of the Leaching Solution Temperature Relative to the Final Solution pH during Oxalic Acid Leaching of Iron Oxide Ore

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Abstract
Model for predictive analysis of the solution temperature during leaching of iron oxide ore in oxalic acid solution has been derived. It was observed that the validity of the model is rooted in the expression $(InT)^{1/2} = N(In\gamma)$ where both sides of the expression are approximately equal to 2. The model; $T = \exp(1.0378In\gamma)^2$ was found to depend on the value of the final pH of the leaching solution measured during the experiment. The respective deviation of the model-predicted temperature values from the corresponding experimental values was found to be less than 36% which is quite within the acceptable range of deviation limit of experimental results. [Researcher. 2009;1(3):1-7]. (ISSN: 1553-9865).

Keywords: Model, Leaching Solution Temperature, Solution pH Oxalic Acid, Iron Oxide Ore.

1. Introduction

Studies [1,2] have shown that at a temperature as low as 25°C, the presence of Fe^{2+} significantly enhances the leaching of iron extraction from silica sand. Air quickly oxidizes ferrous oxalate during dissolution, giving room for an induction period of a few hours unless a strong acidic environment (<pH 1) or an inert atmosphere is maintained. It has been found [3] that maintaining the high level of ferrous oxalate in the leach liquor using an inert gas enhance the reaction kinetics. It is believed that during this process, removal of phosphorus from the iron compound and subsequent dissolution of the phosphorus oxide formed were effected.

The optimum pH for dissolving iron oxide has been reported [4] to be is pH 2.5 – 3.0. The solution pH governs the distribution of various oxalate ions in the leach system. Below pH 1.5, oxalic acid exists mainly as $H_2C_2O_4$, whereas HC_2O_4 is the most predominant species at pH 2.5 – 3.0.

It has been found [5,6] that the final pH of leaching solution depend on the leaching time, initial pH for the leaching solution and the leaching temperature.

Models for computational analysis of the concentration of dissolved haematite and heat absorbed by oxalic acid solution during leaching of iron oxide ore have been derived [7]. These models are:

$$\%Fe_2O_3 = K(\gamma/\mu) \quad (1)$$

$$Q = K_C \mu \quad (2)$$

Where

$\%Fe_2O_3$ = Concentration of dissolved haematite in oxalic acid solution.
γ = Final pH of the leaching solution at time t at which $\%Fe_2O_3$ was obtained.
μ = Weight of iron oxide added into the oxalic acid leaching solution (g)
K = Constant of proportionality associated with haematite dissolution
K_C = Constant of proportionality associated with heat absorption
Q = Quantity of heat absorbed by oxalic acid solution during the leaching process (J)

Nwoye [7] found that optimization of the weight input of iron oxide ore could be achieved using the model; ($\%Fe_2O_3 = K(\gamma/\mu)$) by comparing the concentrations of dissolved haematite at different weights input of the iron oxide ore, with the view to identifying the optimum weight input of iron oxide ore that gives the maximum dissolution of Fe_2O_3. The model also indicates that the concentration of haematite dissolved during the leaching process is directly proportional to the final pH of the leaching solution and inversely proportional to the weight input of the iron oxide ore.

It was also found [7] that values of Q obtained from both the experiment and model ($Q = K_C \mu$) agree to the fact that leaching of iron oxide ore using oxalic acid solution is an endothermic process, hence the absorbed positive heat energy by the leaching solution. The quantity of heat energy absorbed by the oxalic

acid solution during the leaching process (as calculated from the model; $Q = K_C \mu$) was found to be directly proportional to the weight input of the iron oxide ore. These results were obtained at initial pH 6.9, average grain size of 150μm and leaching temperature of 30^0C. The constants of proportionality K and K_C associated with the respective derived models were evaluated to be 0.0683 and 66.88 respectively.

Nwoye [8] derived a model for predicting the time for dissolution of pre-quantified concentration of phosphorus during leaching of iron oxide ore in oxalic acid solution as:

$$\tau = \text{Log}\left(\frac{\left(\frac{P^{1/4}}{1.8}\right)}{\text{Log}T}\right) \quad (3)$$

Where

T= Leaching temperature (^{0}C) in the experiment [9], taken as specified leaching temperature (^{0}C) aiding the expected dissolution of phosphorus .

N= 1.8 (Dissolution coefficient of phosphorus in oxalic acid solution during leaching of iron oxide ore) determined in the experiment [9].

P = Concentration of dissolved phosphorus (mg/Kg) in the experiment [9], taken as pre-quantified concentration of phosphorus expected to dissolve after a leaching time t (mg/Kg) in the model.

τ = Leaching time (sec.) in the experiment [9], taken as time for dissolution of the pre-quantified concentration of phosphorus (hrs) in the model.

The model was found to depend on a range of specified leaching temperatures (45-70^{0}C) for its validity. It was found [9] that the time for dissolution of any given concentration of phosphorus decreases with increase in the leaching temperature (up to 70^{0}C), at initial pH 5.5 and average grain size of 150μm.

Nwoye et al. [10] also formulated a model for predicting the concentration of phosphorus removed during leaching of iron oxide ore in oxalic acid solution. It was found to predict the removed phosphorus concentration, with utmost dependence on the final pH of the leaching solution and weight input of the iron oxide ore. The model indicates that the concentration of phosphorus removed is inversely proportional to the product of the weight input of the iron oxide ore and the final pH of the leaching solution. Process conditions considered during the formulation of the model [10] include: leaching temperature of 25^{0}C, initial solution pH 5.5 and average ore grain size; 150μm).

Biological processes for phosphorus removal have also been evaluated based on the use of several types of fungi, some being oxalic acid producing. Anyakwo and Obot [11] recently presented their results of a study on the use of Aspergillus niger and their cultural filtrates for removing phosphorus from Agbaja (Nigeria) iron oxide ore. The results of this work [11] show that phosphorus removal efficiencies at the end of the 49 days of the leaching process are 81, 63 and 68% for 5, 100 and 250 mesh grain sizes respectively.

An attempt has been made in the past [12] to leach Itakpe iron oxide ore using oxalic acid solution in order to determine the maximum concentration of phosphorus that is removable. Results of chemical analysis of the ore indicate that the percentage of phosphorus in the ore is about 1.18%, which from all indication is quite high and likely to affect adversely the mechanical properties of the steel involved; hence the need for dephosphorization. It was reported [12] that phosphorus can be removed from iron oxide ore through a process associated with hydrometallurgy. Phosphorus was removed at a temperature of 25^{0}C and initial solution pH 2.5, leading to the dissolution of the phosphorus oxide formed. This involved using acid leaching process to remove phosphorus from the iron oxide ore in readiness for steel making process.

Nwoye et al [13] derived a model for predicting the concentration of dissolved iron during leaching of iron oxide ore in sulphuric acid solution. The model is stated as;

$$\%Fe = 0.35(\alpha/T)^3 \quad (4)$$

Where

T = Solution temperature at the time t, when the concentration of dissolved iron is evaluated. (^{0}C)

0.35= (pH coefficient for iron dissolution in sulphuric acid solution during the leaching process) determined in the experiment [13].

α = Final pH of the leaching solution at the time t, when the concentration of dissolved iron is evaluated.

The model (formulated at conditions; leaching temperature of 25^{0}C, initial solution pH 5.0 and average grain size; 150μm) is dependent of the final pH and temperature of the leaching solution. The model shows that the concentration of iron dissolved during the leaching process is directly proportional to the third power of the ratio of final leaching and temperature.

Nwoye [14] derived a model for evaluating the final pH of the leaching solution during leaching of iron oxide ore in oxalic acid solution. The model evaluates the pH value as the sum of two parts, involving the % concentrations of Fe and Fe_2O_3 dissolved. The model can be expressed as;

$$\gamma = 0.5\left(\frac{K_1}{\%Fe} + \frac{K_2}{\%Fe_2O_3}\right) \quad (5)$$

Where

K_1 and K_2 = dissolution constants of Fe and Fe_2O_3 respectively.

γ = final pH of leaching solution (after time t).

It was also found that the model [14] could predict the concentration of Fe or Fe_2O_3 dissolved in the oxalic acid solution at a particular final solution pH by taking Fe or Fe_2O_3 as the subject formular. The prevailing process conditions under which the model works include: leaching time of 30mins., constant leaching temperature of 30°C, average ore grain size; 150µm and 0.1M oxalic acid.

Nwoye [15] has reported that the heat absorbed by oxalic acid solution during leaching of iron oxide ore can be predicted using the model he derived which works under the process condition; initial pH 6.9, average ore grain size; 150µm and leaching temperature; 30^0C. The model [15] can be stated as

$$Q = K_N\left(\frac{\gamma}{\%Fe_2O_3}\right) \quad (6)$$

Where

Q = Quantity of heat absorbed by oxalic acid solution during the leaching process. (J)

γ = Final pH of the leaching solution (at time t).

$\%Fe_2O_3$= Concentration of haematite dissolved in oxalic acid solution during the leaching process.

K_N = 4.57(Haematite dissolution constant in oxalic acid solution) determined in the experiment [15].

Nwoye [15] carried out further work on the model using the same process conditions and observed that on re-arranging the model as;

$$\%Fe_2O_3 = K_N\left(\frac{\gamma}{Q}\right) \quad (7)$$

the concentrations of haematite predicted deviated very insignificantly from the corresponding experimental values. In this case, the value of Q was calculated by considering the specific heat capacity of oxalic acid. Values of heat absorbed by the oxalic acid solution during the leaching of iron oxide ore as predicted by the model [15] agree with the experimental values that the leaching process is endothermic. This is because all the predicted values of the heat absorbed by the oxalic acid solution were positive. The model shows that the quantity of heat absorbed by oxalic acid solution during the leaching process is directly proportional to the final pH of the solution and inversely proportional to the concentration of haematite dissolved.

Model for evaluation of the concentration of dissolved phosphorus (relative to the final pH of the leaching solution) during leaching of iron oxide ore in oxalic acid solution has been derived [16]. It was observed that the validity of the model is rooted in the relationship $\ln P = N/\alpha$ where both sides of the expression are approximately equal to 4. The model; $P = e^{(12.25/\alpha)}$ is dependent on the value of the final pH of the leaching solution which varies with leaching time. In all, the positive or negative deviation of the model-predicted phosphorus concentration from its corresponding value obtained from the experiment was found to be less than 22%.

Temperature measured at the reaction sites gives an idea of whether the reaction is speeding up or stopping especially when it is measured consistently.

It has been reported [17] that the temperature of a reaction system plays the major role in controlling the rate of the reaction.

Past report [18] has shown that measurement of the temperature of a reaction system consistently shows whether the reaction involved is endothermic or exothermic.

Nwoye [19] derived a model for the computational analysis of the solution temperature during leaching of iron oxide ore in hydrochloric acid solution. The model is expressed as:

$$T = e^{(8.9055/\gamma)} \quad (8)$$

where

T= Solution temperature during leaching of iron oxide ore using hydrochloric acid.(^{0}C)

N= 8.9055(pH coefficient for hydrochloric acid solution during leaching of iron

oxide ore) determined in the experiment [19].

γ = Final pH of the leaching solution at the time t when the solution temperature is evaluated.

The model is dependent on the value of the final pH of the leaching solution which was found to also depend on the concentration of iron dissolved in the acid. The prevailed process conditions on which the validity of the model depended on include: initial pH 2.5, leaching time; 30 minutes, leaching temperature; 25^{o}C, average ore grain size; 150µm and hydrochloric acid concentration at 0.1mol/litre.

The aim of this work is to derive a model for predictive analysis of the leaching solution temperature relative to the final pH of the solution during leaching of Itakpe (Nigerian) iron oxide ore in oxalic acid solution.

2. Model

The solid phase (ore) is assumed to be stationary, contains the un-leached iron remaining in the ore. Hydrogen ions from the oxalic acid attack the ore within the liquid phase in the presence of oxygen.

2.1 Model Formulation

Experimental data obtained from research work [20] carried out at SynchroWell Research Laboratory, Enugu were used for this work.

Results of the experiment as presented in report [20] and used for the model formulation are as shown in Table 1.

Computational analysis of the experimental data [20] shown in Table 1, gave rise to Table 2 which indicate that;

$$(\mathrm{In}T)^{1/2} = N(\mathrm{In}\gamma) \quad \text{(approximately)} \qquad (9)$$

$$\mathrm{In}T = (N\mathrm{In}\gamma)^2 \qquad (10)$$

$$T = \exp(N\mathrm{In}\gamma)^2 \qquad (11)$$

Introducing the value of N into equation (11)

$$T = \exp(1.0378\mathrm{In}\gamma)^2 \qquad (12)$$

where

T= Solution temperature during leaching of iron oxide ore using oxalic acid (^{0}C)

N=1.0378 (pH coefficient for oxalic acid solution during leaching of iron oxide ore) determined in the experiment[20].

γ = Final pH of the leaching solution at the time t when the solution temperature is evaluated.

Equation (12) is the derived model**.**

Table 1: Variation of Weight input of ore with final solution pH and temperature. [20]

µ (g)	(γ)	T (^{0}C)
10	6.90	41.00
14	6.87	48.00
18	6.85	48.40
22	6.90	54.40
26	6.90	55.10
30	6.92	55.00
34	6.91	53.60
38	6.91	55.00
42	6.91	54.30

Where µ = Mass of iron oxide ore used for the leaching process (g).

Table 2: Variation of $(InT)^{1/2}$ with (NInγ)

$(InT)^{1/2}$	(NInγ)
1.9271	2.0045
1.9675	2.0000
1.9696	1.9970
1.9991	2.0045
2.0023	2.0045
2.0018	2.0075
1.9954	2.0060
2.0018	2.0060
1.9986	2.0060

3. Boundary and Initial Condition

Consider iron ore in cylindrical flask 30cm high containing leaching solution of oxalic acid. The leaching solution is stationary i.e (non-flowing). The flask is assumed to be initially free of attached bacteria. Initially, atmospheric levels of oxygen are assumed. Varying weights (10-42g) of iron oxide ore were used as outlined in Table 1. The initial pH of leaching solution; 6.5 and leaching time; 30 minutes were used. A constant leaching temperature of 25^{o}C was used. Ore grain size; 150μm, volume of leaching solution; 0.1 litre and oxalic acid concentration; 0.1mol/litre were used.. These and other process conditions are as stated in the experimental technique [20].

The boundary conditions are: atmospheric levels of oxygen (since the cylinder was open at the top) at the top and bottom of the ore particles in the liquid and gas phases respectively. At the bottom of the particles, a zero gradient for the liquid scalar are assumed and also for the gas phase at the top of the particles. The leaching solution is stationary. The sides of the particles are taken to be symmetries.

4. Model Validation

The formulated model was validated by direct analysis and comparism of T values predicted by model and the corresponding experimental T values for equality or near equality.

Analysis and comparison between these T values reveal deviations of model-predicted T values from the corresponding experimental values. This is believed to be due to the fact that the surface properties of the ore and the physiochemical interactions between the ore and leaching solution which were found to have played vital roles during the leaching process [20] were not considered during the model formulation. This necessitated the introduction of correction factor, to bring the model-predicted T values to those obtained from the experiment (Table 3).

Deviation (Dv) (%) of model-predicted T values from the corresponding experimental T values is given by

$$Dv = \frac{Tp - Te}{Te} \times 100 \quad (13)$$

Where Tp = Predicted T values from model

Te = Experimental data

Correction factor (Cf) is the negative of the deviation i.e

$$Cf = -Dv \quad (14)$$

Therefore

$$Cf = -100\left(\frac{Tp - Te}{Te}\right) \quad (15)$$

Introduction of the corresponding values of Cf from equation (15) into the model gives exactly the corresponding experimental T value [20].

5. Results and Discussion

The derived model is equation (12). A comparison of the values of T from the experiment and those from the model shows very minimum positive deviation hence depicting the reliability and validity of the model. This is shown in Table 3. The respective positive deviations observed is less than 36% which is quite within the acceptable range of deviation of experimental results. The validity of the model is believed to be

rooted on equation (9) where both sides of the equation are approximately equal to 2. Table 2 also agrees with equation (9) following the values of $(InT)^{1/2}$ and (NInγ) evaluated from Table1.

Table 3: Comparison between leaching solution temperature as predicted by model and as obtained from experiment [20].

T_{exp}	T_M	Dv (%)	Cf (%)
41.00	55.60	+35.61	-35.61
48.00	54.60	+13.75	-13.75
48.40	53.94	+11.45	-11.45
54.40	55.60	+2.21	-2.21
55.10	55.60	+0.91	-0.91
55.00	56.27	+2.31	-2.31
53.60	55.93	+4.35	-4.35
55.00	55.93	+1.69	-1.69
54.30	55.93	+3.00	-3.00

Where

T_{exp} = T values from experiment [20]

T_M = T values predicted by model.

6. Conclusion

The model predicts the leaching solution temperature relative to the final solution pH during oxalic acid leaching of Itakpe iron oxide ore. The validity of the model is believed to be rooted on equation (9) where both sides of the equation are approximately equal to 2. The respective deviations of the model-predicted T values from the corresponding experimental T values are all positive and less than 36% which is quite within the acceptable range of deviation limit of experimental results.

Further works should incorporate more process parameters into the model with the aim of reducing the deviations of the model temperature values from those of the experiment.

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2/25/2009

Model for Calculating the Quantity of Water Lost by Evaporation during Oven Drying of Clay

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Abstract
Model for calculating the quantity of water lost by evaporation during oven drying of clay has been derived. The model; $\gamma = \exp[(\ln t)^{1.0638} - 2.9206]$ indicates that the quantity of evaporated water during the drying process is dependent on the drying time, the evaporating surface being constant. It was found that the validity of the model is rooted on the expression $(\text{Log}\beta + \ln\gamma)^N = \ln t$ where both sides of the expression are correspondingly almost equal. The respective deviation of the model-predicted quantity of evaporated water from the corresponding experimental value is less than 37% which is quite within the acceptable deviation range of experimental results, hence depicting the usefulness of the model. [Researcher. 2009;1(3):8-13]. (ISSN: 1553-9865).

Keywords: Model, Water, Evaporation,Oven Drying, Clay.

1. Introduction

Studies [1] have shown that the contents of the basic clay materials are divided into three groups. The first group involves clays containing mainly the mineral kaolinite. The second groups are clays containing mineral rnontmorillorite, while the third group are clays which are intermediate product of disintegration of mica into kaolin. Unal [2] reported that the structure of sinters and pellets may be divided into two parts viz, the mineral and the pores. He stated that the properties of pellets and sinters are closely related to the mineral constituents.

Furnass [3] reported that voids volume in packed dispersed powder depend on the ratio of smallest size (Ss) to largest size (Ls) particle as well as the percentage of constituent monosized particles. He maintained that the smaller the (Ss/Ls) ratio, the more continuous the distribution and the lower the void volume of the system. Singer and Singer [4] found that on heating dried clays, water is given off. With time, a hard but porous piece forms. A swollen appearance might occur during the release of some gases, but overall shrinkage must occur when verifications set in leading to a strong dense piece.

Nwoye [5] reported that chemical composition of the pellet, pelletisation parameters and firing conditions affect the shrinkage of clay pellets. He posited that the rate of chemical reaction is very much dependent on the gas-solid contact area, which is mostly governed by the porosity of the pellet. He stated that shrinkage of clay is probably due to volume change resulting from evacuation of water from the voids, reduction of the size of the pores as well as decrease in the interparticle separation.

It has been reported [6] that fine particles shrink more, are denser and exhibit excellent mechanical properties. Studies [6] carried out to investigate the relationship between particle size and size distribution with linear drying shrinkage, firing shrinkage and apparent porosity shows that no visible relationship exists between particle size and linear drying shrinkage. In this work [6], finer particles were found tend to shrink more. They concluded that the finer the particle size, the lesser the apparent porosity and greater the bulk density.

The behaviour of ceramic products has been found [7] to be very dependent on their composition, grain size, grain distribution, structure of grain and pores. Nwoye [8] also posited that the grain size and grain distribution of the clays have significant effect on their physical and technological properties (binding ability, shrinkage and plasticity).

It has been reported [9] that pores are deleterious to the strength of ceramics not only because they reduce cross-sectioned area over which the load is applied but more importantly act as stress concentrators.

Pore deformation mechanism in shrinking Nigeria clays, was studied [10] over a range of heating temperature from 1000 to 1300^0C. The results of the study indicate that pores pre-existing before sintering deformed by the collapsing of the wall surrounding the pores. It was discovered [10] that the wall surrounding the pre-existing pores collapsed as a result of the weakening of the clay-binder contact surface and loosening of the macro structure of the formed clays, occasioned by the response of the clay and binder to temperature increase. It was also found [10] that binder burn-out which releases

gases,elimination of gaseous product of decomposition and oxidation of some clay constituents as well as evaporation of free water between clay and binder particles, all played very vital roles in decreasing the pre-existing interparticle separation hence deforming the pores.

Nwoye [11] studied the effect of porosity on the shrinkage behavior of clay pellets and briquettes of different porosities. The result of the investigation indicates that shrinkage which is a major cause of rupture in fired clay increased with decrease in porosity. It was also discovered [11] that the porosity of pellet/briquette plays important role in controlling and determining the shrinkage index of the pellet.

Reed [12] described firing as having three stages through which it proceeds; preliminary reactions which include binder burnout, elimination of gaseous product of decomposition and oxidation, sintering as well as cooling which may include thermal and chemical annealing.

Several works [1, 6, 12, 13] have been carried out on shrinkage of clay during drying. In all these works, porosity has been shown to influence the swelling and shrinkage behaviour of clay products of different geometry. It has been reported [12] that drying occurs in three stages; increasing rate, constant and decreasing rate. He pointed out that during the increasing rate; evaporation rate is higher than evaporating surface hence more water is lost. At constant rate, the evaporation rate and evaporation surface are constant. He posited that shrinkage occurs at this stage. Keey [13] also in a similar study suggested that at this stage, free water is removed between the particles and the interparticle separation decreases, resulting in shrinkage. During the decreasing rate, particles make contacts as water is removed, which causes shrinkage to cease.

Model for calculating the volume shrinkage resulting from the initial air-drying of wet clay has been derived [14]. The model calculates the volume shrinkage when the value of dried shrinkage experienced during air-drying of wet clays is known. The model was found to be third-order polynomial in nature. Olokoro clay was found to have the highest shrinkage during the air drying condition, followed by Ukpor clay while Otamiri clay has the lowest shrinkage. Volume shrinkage was discovered to increase with increase in dried shrinkage until maximum volume shrinkage was reached, hence a direct relationship.

The present work is to derive a model for calculating the quantity of water lost by evaporation during oven drying of Olokoro (Nigeria) clay at 90^0C.

2. Model formulation

Experimental data obtained from research work [15] carried out at SynchroWell Research Laboratory, Enugu were used for this work. Results of the experiment used for the model formulation are as shown in Table1.Computational analysis of the experimental data [15] shown in Table 1, gave rise to Table 2 which indicate that;

$$(\text{Log}\,\beta + \ln\gamma)^N = \ln t \quad \text{(approximately)} \tag{1}$$

Multiplying the indices of both sides of equation (1) by 1/N

$$\text{Log}\,\beta + \ln\gamma = (\ln t)^{1/N} \tag{2}$$

Introducing the value of N into equation (2)

$$\text{Log}\,\beta + \ln\gamma = (\ln t)^{1/0.94} \tag{3}$$

$$\text{Log}\,\beta + \ln\gamma = (\ln t)^{1.0638} \tag{4}$$

$$\ln\gamma = (\ln t)^{1.0638} - \text{Log}\,\beta \tag{5}$$

$$\gamma = \exp[(\ln t)^{1.0638} - \text{Log}\,\beta] \tag{6}$$

Introducing the value of β into equation (6) reduces it to;

$$\gamma = \exp[(\ln t)^{1.0638} - 2.9206] \tag{7}$$

Where

(γ) = Weight of water lost by evaporation during the drying process (g)

(β) = Area of evaporating surface (mm^2)

N = 0.94; (Collapsibility coefficient of binder-clay particle boundary at the drying temperature of 90^0C) determined in the experiment [15].

(τ) = Drying time (mins.).

Table 1: Variation of quantity of evaporated water with drying time.[15]

(t)	(β)	(γ)
30	833	2.50
50	833	4.40
70	833	5.60
90	833	6.60
110	833	7.70
130	833	8.60
	50	
	50	**Table 1: Variation of concentration of dissolved iron with weight input of iron oxide ore and final solution pH. (Nwoye;2006)**
	50	
	50	

Table 2: Variation of lnt with $(Log\beta + ln\gamma)^N$

lnt	Logβ	lnγ	$(Log\beta + ln\gamma)^N$
3.4012	2.9206	0.9163	3.5395
3.9120	2.9206	1.4816	4.0276
4.2485	2.9206	1.7228	4.2347
4.4998	2.9206	1.8871	4.3754
4.7005	2.9206	2.0412	4.5071
4.8675	2.9206	2.1518	4.6015

3. Boundary and Initial Conditions

Consider a rectangular shaped clay product of length 49mm, width 17mm, and breadth 9mm exposed to drying in the furnace while it was in wet condition. Initially, atmospheric levels of oxygen are assumed. Atmospheric pressure was assumed to be acting on the clay samples during the drying process (since the furnace is not air-tight). The grain size of clay particles used is 425μm, weight of clay and binder (bentonite) used (for each rectangular product); 100g and 10g respectively, quantity of water used for mixing; 2% (of total weight), drying temperature used; 90^0C, area of evaporating surface;833mm^2 and range of drying time used; (30-130 mins.).

The boundary conditions are: atmospheric levels of oxygen at the top and bottom of the clay samples since they are dried under the atmospheric condition. No external force due to compression or tension was applied to the drying clays. The sides of the particles and the rectangular shaped clay products are taken to be symmetries.

4. Model Validation

The formulated model was validated by direct analysis and comparison of the model-predicted μ values and those from the experiment for equality or near equality.

Analysis and comparison between these γ values reveal deviations of model-predicted γ from those of the experimental values. This is believed to be due to the fact that the surface properties of the clay and the physiochemical interactions between the clay and binder, which were found to have played vital role during the evaporation process [15] were not considered during the model formulation. This necessitated the introduction of correction factor, to bring the model-predicted γ value to that of the corresponding experimental value (Table 3).

Deviation (Dv) (%) of model-predicted γ values from the experimental γ values is given by

$$Dv = \frac{Pw - Ew}{Ew} \times 100 \quad (8)$$

Where Pw = Quantity of water evaporated as predicted by model (g)

Ew = Quantity of water evaporated as obtained from experiment (g) [15]

Correction factor (Cf) is the negative of the deviation i.e

$$Cf = -Dv \quad (9)$$

Therefore

$$Cf = -100 \left(\frac{Pw - Ew}{Ew} \right) \quad (10)$$

Introduction of the value of Cf from equation (10) into the model gives exactly the corresponding experimental value of γ [15].

5. Results and Discussion

The derived model is equation (7). A comparison of the values of γ obtained from the experiment and those from the model shows little deviations, hence depicting the reliability and validity of the model (Table 3).The respective deviation of the model-predicted quantity of evaporated water from the corresponding experimental value is less than 37% which is quite within the acceptable deviation range of experimental results, hence depicting the usefulness of the model. It was found that the validity of the model is rooted in equation (1) where both sides of the equation are correspondingly almost equal. Table 2 also agrees with equation (1) following the values of $(\text{Log}\beta + \ln\gamma)^N$ and lnt evaluated from Table 1 as a result of corresponding computational analysis.

Table 3: Comparison between quantities of evaporated water as predicted by model and as obtained from experiment [15]

γ_{exp}	γ_M	Dv (%)	Cf (%)
2.50	2.1316	-14.74	+14.74
4.40	3.8464	-12.58	+12.58
5.60	5.6897	+1.60	-1.60
6.60	7.6323	+15.64	-15.64
7.70	9.6571	+25.42	-25.42
8.60	11.7526	+36.66	-36.66

Where

γ_{exp} = Weight of water evaporated as obtained from experiment [15]
γ_M = Weight of water evaporated as predicted by the derived model

6. Conclusion

The model calculates the quantity of water lost by evaporation during oven drying of Olokoro (Nigeria) clay at 90^0C. It was found that the validity of the model is rooted in equation (1) where both sides of the equation are correspondingly almost equal. The respective deviation of the model-predicted quantity of evaporated water from the corresponding experimental value is less than 37% which is quite within the acceptable deviation range of experimental results.

Further works should incorporate more process parameters into the model with the aim of reducing the deviations of the model-predicted γ values from those of the experimental.

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On Simple And Bisimple Left Inverse Semi Groups

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ABSTRACT
This paper deals with Simple and bi-simple inverse semi-groups. The general properties and characteristics of simple and bi-simple semi- groups and inverse semi-groups were discussed. [Researcher. 2009;1(3):14-24]. (ISSN: 1553-9865).

Key words: Simple, bi-simple semigroup, inverse semigroup

INTRODUCTION

Relevant publications on Simple and Bi-Simple are the work done by A.H. Clifford and G.B. Preston (1961–1967), E.S. Lyapin (1974), V.N. Klimov (1973), R. Baer and F. Levi (1932), K. Byleen, J. Meakin, and F. Pastijn (1978), F. Pastijn (1977), E.G. Shutov (1963), W.D. Munn (1969), J.M. Howie (1976). to mention but few. Recently Junghenn (1996) worked on Operator semigroup compactifications.

The importance of simple and bi- simple semi group in Algebra has developed into area of independent research of Mathematics, [1 - 13] have come to play a very significant role. In this paper, we look in to simple and bi- simple left inverse semi groups.

According to Encyclopaedia of mathematics, A semi-group not containing proper ideals or congruences of some fixed type. Various kinds of simple semi-groups arise, depending on the type considered: ideal-simple semi-groups, not containing proper two-sided ideals (the term simple semi-group is often used for such semi-groups only); left (right) simple semi-groups, not containing proper left (right) ideals; (left, right) 0-simple semi-groups, semi-groups with a zero not containing proper non-zero two-sided (left, right) ideals and not being two-element semi-groups with zero multiplication; bi-simple semi-groups, consisting of one $\mathcal{D}$-class (cf. Green equivalence relations); 0-bi-simple semi-groups, consisting of two $\mathcal{D}$-classes one of which is the null class; and congruence-free semi-groups, not having congruences other than the universal relation and the equality relation.

Every left or right simple semi-group is bi-simple; every bi-simple semi-group is ideal-simple, but there are ideal-simple semi-groups that are not bi-simple (and even ones for which all the $\mathcal{D}$-classes consist of one element).

Various types of simple semi-groups often arise as "blocks" from which one can construct the semi-groups under consideration. For classical examples of simple semi-groups see Completely-simple semi-group; Brandt semi-group; Right group; for bi-simple inverse semi-groups (including structure theorems under certain restrictions on the semi-lattice of idempotents) see [1], [8], [9]. There are ideal-simple inverse semi-groups with an arbitrary number of $\mathcal{D}$-classes. In the study of imbedding of semi-groups in simple semi-groups one usually either indicates conditions for the possibility of the corresponding imbedding, or establishes that any semi-group can be imbedded in a semi-group of the type considered. E.g., any semi-group can be imbedded in a bi-simple semi-group with an identity (cf. [1]), in a bi-simple semi-group generated by idempotents (cf. [10]), and in a semi-group that is simple relative to congruences (which may have some property given in advance: the presence or absence of a zero, completeness, having an empty Frattini sub-semi-group, etc., cf. [3]–[5]).

2. SIMPLE SEMIGROUP:- A semigroup S is said to be simple if it contains only one $\mathcal{J}$ – class and **BISIMPLE SEMIGROUP:** A semigroup S is said to be bisimple if it contains only one $\mathcal{D}$ – class.

Theorem 1.0

(i) If a $\mathcal{D}$ – class of a semigroup S contains a regular element , then every element of $\mathcal{D}$ is regular. ($\mathcal{J}$ -)

(ii) If $\mathcal{D}$ is regular then every $\mathcal{L}$ - class and $\mathcal{R}$ – class contained in $\mathcal{D}$ contain an idempotent.

Proof:

An element of a semigroup S is regular if and only if $\mathcal{R}_a$ [$\mathcal{L}_a$] contains an idempotent.

It then follows that an $\mathcal{R}$ – class $\mathcal{R}$- ($\mathcal{L}$ – class) contains a regular element ; then it contain an idempotent and every element of $\mathcal{R}$ ($\mathcal{L}$) is regular.

Since every $\mathcal{R}$ – class of S contained in $\mathcal{D}$ meet every $\mathcal{L}$ – class of S contained in $\mathcal{D}$, then (1) holds.

Lemma 1.0

If a and a^{-1} are inverse element of a semigroup S.
Then $e = aa^{-1}$ and $f = a^{-1}a$ are idempotent such
that $ea = af = a$ and $a^{-1}e = f\ a^{-1}a = a^{-1}$

Hence $e \in \mathcal{R}_a \cap \mathcal{L}_{a^{-1}}$ and $f \in \mathcal{R}_{a^{-1}} \cap \mathcal{L}_a$. The element a, a^{-1}, e and f all belong to the same $\mathcal{D}$ – class.

Theorem 1.1

Let 'a' be a regular element of a semigroup S

Then (i) Every inverse of a lies in $\mathcal{D}_a$

(ii) An $\mathcal{H}$- class, $\mathcal{H}_b$ contains an inverse of a if and only if both of the $\mathcal{H}$ – classes $\mathcal{R}_a \cap \mathcal{L}_b$ and $\mathcal{R}_b \cap \mathcal{L}_a$ contains idempotent.

(iii) No $\mathcal{H}$ – class contains more than one inverse of a

COROLLARY 1.0

A semigroup S is an inverse semigroup if and only if each $\mathcal{L}$ – class and each $\mathcal{R}$ – class contains exactly one idempotent.

Corollary 1 .1

A semmigroup S is simple if and only if
$S\ a\ S = S\ \forall\ a \in S$ i.e if and only if
$\forall a, b \in S\ \ni\ x, y$ in S such that $xay = b$

Theorem 1.2

The following statements about a semigroup S are equivalent.

(i) S is an inverse semigroup
(ii) S is regular and idempotent element commute.
(iii) Each $\mathcal{L}$ – class and $\mathcal{R}$ – class of S contain a unique idempotent.
(iv) Each principal left and right ideal of S contains a unique idempotent generator.

Proof:

It is clear by the definition of $\mathcal{L}$ and $\mathcal{R}$ that III and IV are equivalent.

To show that I $\Rightarrow$ II
Let e, f be idempotent and let $x = (ef)^{-1}$
Then, ef x ef = ef and xefx = x
The element fxe is idempotent since
$(fxe)^2 = f(xefx) = fxe$
Also, (ef) (fxe) (ef) = efxef = ef
(fxe) (ef) (fxe) = f(xefx) = fxe
and ef is an inversed of fxe.
But fxe being idempotent, it is its own unique inverse.
So fxe = ef.
It is then follows that ef is idempotent and
similarly we obtain that fe is also idempotent
Hence, (ef) (fe) (ef) = $(ef)^2$ = ef
(fe) (ef) (fe) = $(fe)^2$ = fe
:. fe is an inverse of ef.
But ef, being an idempotent is its own unique inverse and so,, ef = fe
:. I $\Rightarrow$ II.
To show that II $\Rightarrow$ III

Since S is regular every $\mathcal{L}$ – class contain at least one idempotent.

If e, f are $\mathcal{L}$- equivalent idempotent, then ef = e, fe = f.
Since by hypothesis, ef = fe, it follows that e = f

Similarly remark apply to $\mathcal{R}$ – class we can express the property III of inverse semigroups as follows.

$\mathcal{L} \cap (EXE) = \mathcal{R} \cap (EXE) = 1E$
Where E is the set of idempotent of S.
:. II $\Rightarrow$ III.
To show that III $\Rightarrow$ I

Since a semigroup with the property III is necessarily regularily, then every $\mathcal{D}$ – class contains an idempotent.

If $a,^1$ a^{11} are inverse of a, then aa^1 and aa^{11} are idempotent in S that are $\mathcal{R}$ equivalent to 'a' and hence to each other.
By property III, we have $aa' = aa''$
Equally, $a'a = a''a$ and so
$a' = a'aa' = a''aa'$
$\Rightarrow a''aa'' = a''$

Proposition 1.0
Let S be an inverse semigroup with semilattice of idempotent E.
Then (i) $(a^{-'})^{-'} = a \ \forall$ a in S.
(ii) $e^{-'} = e \ \forall$ e in E
(iii) $(ab)^{-'} = b^{-'}a^{-'} \ \forall$ a, b in S
(iv) $aea^{-'} \in E$, $a^{-'}ea \in E$, $\forall a$ in S and $\forall e$ in E
(v) a $\mathcal{R}$ b if and only if $aa^{-'} = bb^{-'}$
a $\mathcal{L}$ b if and only if $a^{-'}a = b^{-'}b$
(vi) If e, f $\in$ E, then e $\mathcal{D}$, f in S if and only if $\ni$ a in S such that $aa^{-'} = e$, $a^{-'}a = f$.

Proof:
I and II are mutuality of the inverse property of a semigroup

To proof III
Since bb^{-1} and $a^{-1}a$ are idempotent
$(ab)(b^{-1}a^{-1})(ab) = a(bb^{-1})(a^{-1}a)b$
$= aa^{-1} abb^{-1}b$
$= ab.$
Also, $(b^{-1}a^{-1})(ab)(b^{-1}a^{-1}) = b^{-1}(a^{-1}a)(bb^{-1})a^{-1}$
$= b^{-1}bb^{-1}a^{-1}aa^{-1}$
$= b^{-1}a^{-1}$
Thus $b^{-1}a^{-1}$is an inverse and hence the inverse of ab.
i.e $(ab)^{-1} = b^{-1}a^{-1}$
To proof IV
$(aea^{-1})^2 = ae(a^{-1}a)ea^{-1}$
$= aa^{-1}ae^2a^{-1} = aea^{-1}$
Similarly, $(a^{-1}ea)^2 = a^{-1}ea.$

Recall that a semigroup S is said to be simple if it contains only one $\mathcal{J}$- class. i.e S is simple if and only if $\mathcal{J} = S \times S$

i. e every element in $\mathcal{J}$ is related to each other.

Lemma 1.2

An inverse semigroup S with semilattice of idempotent E is simple if and only if

$(\forall e, f \in E)(\exists g \in E)\ [g \leq f \text{ and } e \mathcal{D} g]$.

Proof:

Let S be simple, if $e, f \in E$, then $e J_f$ and so $\exists\ x, y \in S$ such that $e = xfy$.
Let $g = fyex$, then
$g^2 = fye(xfy)ex = fye^3x$
since $g = fyex$, $g \in E$
Also,
$Fg = g$ and $g \leq f$
If $z = x^{-1}e$, then $xz = xx^{-1}e = xx^{-1}xfy$

$\Rightarrow xfy = e$ and so $e \mathcal{L} z$
Also
$Zx = x^{-1}ex = x^{-1}e^2x$
$= x^{-1}xfyex = x^{-1}xy = gx^{-1}x$
$= fyexx^{-1}x = fyex = g$
$gx^{-1} = gx^{-1}xx^{-1} = x^{-1}xgx^{-1}$
$= x^{-1}xfyexx^{-1} = x^{-1}e^2xx^{-1}$

$\Rightarrow x^{-1}xx^{-1}e = x^{-1}e = x^{-1}e = z$ and so $z \mathcal{R} g$.

Thus, $e \mathcal{D} g$ as required.
Conversely if S has the property described above, considering any two idempotent e, f in S then $\exists\ g \in E : g \leq f$ and $e \mathcal{D} g$ and so, $J_e = J_g < J_f$.

Equally, $\exists\ h \in E: h \leq e$ and $f \mathcal{D} h$ and so, $J_f = J_h \leq J_e$.
Hence.
$J_e = J_f$ and so all the idempotent of S fall in a single

$\mathcal{J}$ – class.

But every element of S in $\mathcal{J}$ – equivalent (indeed even $\mathcal{R}$ – or $\mathcal{L}$ – equivalent) to some idempotent and so it follows that S is simple.
As a consequence,if S is a simple inverse semigroup with semilattice of idempotent E, then E has the property
$(\forall e, f \in E)(\exists g \in E)\ [g \leq f \text{ and } Ee \sim Eg]$.
Recall that a semigroup S is said to be Bisimple if it contains only one D-class. It is a semigroup in which D is the universal relation.

If S is a Bisimple inverse seigroup with semilattic of idempotent E. then all the idempotent are mutually D- equivalent. i.e $D \cap (E \times E) = E \times E$.

Hence it follows that U = E x E, i.e E is a uniform semilattice.

Conversely, if we start with a uniform semilattice E, then we cannot expect that every inverse semigroup having E as semilattiec of idempotent will be Bisimple, E itself is one such inverse semigroup and are assumed not Bisimple.

DEFINTION

If (e, f) $\in$ U,

Let T_e, f be the set of all isomorphism from E_e onto E_f

Let $T_E = \underset{e,\, f \in u}{Y} T_e,f$

Since all the element of T_E are partial one-one mapping of E. We may therefore multiply element of T_E as element of $J_{(E)}$.

If α: $E_e \rightarrow E_f$ and

β: $E_g \rightarrow E_h$ are element of T_E, then the product of α and β in J_E maps $(E_f \cap E_g)\alpha^{-1}$ onto $(E_g \cap E_g)\beta$ i.e it maps $(E_{fg})\alpha^{-1}$ onto $(E_{fg})\beta$ $(f_g)\alpha^{-1}$ and $(f_g)\beta$ = j.

Then x E $(E_{fg})\alpha^{-1} \Leftrightarrow x\,\alpha \in E_{fg}$

i.e $x\,\alpha \leq f_g \Leftrightarrow x \leq (f_g)\alpha^{-1}$

$\Rightarrow x \in E_i$

Similarly, x E $(E_{fg})\,\beta$.

$\Rightarrow$ x E E_j.

Thus $\alpha\,\beta$ maps the principal ideal E_i onto the principal ideal E_j.

Since it is clearly an isomorphism, we have that $\alpha\,\beta \in T_E$. Thus T_E is a subsemigroup of $J_{(E)}$.

Proposition 1.2

If E is a uniform semilattice, then T_E is a Bisimple inverse semmigroup.

Proof:

This proves more generally that if E is any semilattice whatever, then in T_E D $\cap$ (E x E) = U.

Since T_E is an inverse semigroup whose semilattice of idempotent is (effectually) E, one half of this result is obvious.

Suppose that (e,f) E U. Then $E_e \sim E_f$ and so there exist at least one α in T_E such that dom(α) = E_e and ran(α) = E_f. i.e $\alpha\alpha^{-1} = 1E_e$ (= e) and

$\alpha^{-1}\alpha = 1E_f$ (= f) and so e,f are D – equivalent in T_E.

By applying it into the uniform case, we find that all idempotent in T_E are D- equivalent.

Hence since every element of a regular semigroup is D- equivalent T_E is therefore BISIMPLE

DEFINITION:

Let T be a semigroup with identify I and

Let θ be a homomorphism from T into H_i the H-class containing the identity of T (what is often called the group of units of T)

Let N = { 0, 1, 2---}.

We can make N x T x N into a semigroup by defining.

(m, a, n) (p, b, q) = $(m - n + t, a\theta^{t-n} b\theta^{t-p}, q - p + t)$

where t = max(n, p) and θ^0 is interpreted as the identity map of T.

To check that the given composition is associative, we observe that:

[(m, a, n) (p, b, q)] (r, c, s) = $m - n + w, a\theta^{w-n} b\theta^{w-r-p+q}$, s – r - + q + w)

where

$$\left.\begin{aligned} U &= \max(q - p + \max(n, p)\, r) \\ W &= \max(n, p - q \max(q - r)) \end{aligned}\right\} \quad \ldots \quad **$$

The outer coordinates in multiplication (**) combining exactly as in the bicyclic semigorp which associative since it is isomorphism to T_{cw}.

Hence by equating the first coordinates or (equivalently third coordinates) we obtain

W = u + p – q.

It is then clear that this result implies the quality of the two middle coordinates and so the composition (**) is indeed associative and shall be denoted by the semigroup obtained in this way by S = BR(T, θ) which refers to as the BRUCK – Reilly Extension of T determined by θ.

Proposition 1.3

If T is a semigroup with identity 1 and S = BR (T, θ).

Then,

(i) S is a simple semigroup with identify (0, 1, 0)

(ii) Two element (m, a, n) and (p, b, q) of S are D- equivalent in S if and only if a and b are D – equivalent in T.

(iii) The element (m a, n) of S is idempotent if and only if m = n and $a^2 = a$.

(iv) S is an inverse semmigroup if and only if T is an inverse semigroup.

Proof:

(1) We show that if (m, a, n) and (p,, b, q) are arbitrary element of S the ∃ (r, x, s) and (t, y, u) such that (r, x, s) (m, a, n) (t, y, u) = (pp, b, q).

(1) Let (r, u, s) = $(p(a\theta)^{-1}m + 1)$ and

(t, y, u) = (n + 1, b, q) where

$(a, \theta)^{-1}$ is the inverse of aθ in the group H_i

Then it is easy to check that the desired equality holds.

That (0, 1, 0) is the identify of S is a matter of routine verification.

(ii) Let us use superscripts S and T to distriquished between the green equivalent on S and those on T. if (m a, n) R^s (p, b, q) for some (r x, s) in S

Hence P = m – n + max (n, r) ≥ m

Equally, we show that m ≥ p and so infect m = p it follows that m – n + max (n, r) = m and

Hence that n ≥ r.

By equating the middle coordinate, we have

$A(x\theta^{n-r} = b$, so $R_b \leq R_a$ in T.

Similarly, we show that $R_a \leq R_b$ and so aR^Tb.

Conversely, if aR^Tb then ax = b, $bx^1 = a$ for some x, x^1 inT^1).

Hence,

(m, a n) (n, x, q) = (m, b, a)

(m, b, q) (q, x, n) = (m, a n) in S and so (m, a, n) R^s(m, b q)

⇒ (m, a, n) R^s (p, b, q) ⇔ mm = p and aR^Tb

A dual argument establishes that (m, a, n) L^s (p, b, q) ⇔ n = q and a L^Tb.

Suppose that (m, a, n) and p b, q) in S are such that

(m, a, n) D^s (p, b, q). Then there exist (r, c, s) in S for which (m, a, n) R^s (r, c s) L^s (p, b, q).

It then follows that aR^Tc and cL^Tb (and r = m, s = q)

Hence a D^Tb.

Conversely, if a D^Tb, then for some c in T we have aR^Tc and cL^Tb .

Therefore for every m, n p, q, in N

(m, a, n) R^s (m, c q) (m, c, q) L^s (p, b, q) and so (m, a n) D (p, b, q).

(iii) $(m, a, n)^2 = (m – n + t, a\theta^{t-m} b\theta^{t-m}, n – m + t)$

where t = max (m, n)

Hence (m, a, n) can be idempotent only if m = n.

Since $(m, a, m)^2 = (m, a^2, m)$, the element (m, a, m,) is idempotent if and only if $a^2 = a$.

(iii) If T is an inverse semigroup, then each element (m, a n) of S has an inverse (n, a^{-1}, m)

Thus S is regular.

To show that it is an inverse seigroup.

Let (m, e, m) (n, f, n) be idempotent in S (with m ≥ n say)

Then

$$\left.\begin{aligned}(m,e,m)(n,f,n) &= (m,e(f\theta^{m-n})m)\\ (n,f,n)(m,e,m) &= (m(f\theta)^{M-n}e,m\end{aligned}\right\}$$

Now $f\theta^{m-n}$ is an idempotent in T.

(indeed if m ≠ n, we must have $f\theta^{m-n}$ = 1the only idempotent in H_i)

Hence e ($f\theta^{m-n}$) = ($f\theta^{m-n}$) e and so idempotent commutes in S.

Conversely if S is an inverse semigroup and if (p, b, q) is the inverse of (m, a, n), then (m, a, n) (p, b, q) = (m – n + t,

$a\theta^{t-n}$ $b\theta^{t-p}$, q – p + t) with t = max (n, p) is an idempotent R^s – equivalent to (m,, a n) and L^s – equivalent to (p, b, q).

Therefore m = m – n + t = q – p + t = q

and so n = p (= t) , m, = q.

The inverse property now gives

(m, a, n) = (m, a, n)(n, b m) (m, a, n) = (m aba, n)

(n, b, m) = (n,, b, m) (m, a, n)(n, b, m) = (n, bab, n)

Thus aba = a bab = a and so is an inverse of a in T. Thus T. is regular.

If e,f are idempotent in T, then the commuting of the idempotent (o, e, o), (o, f, o) of S implies that e_f = f_e in T.

2.1 A semigroup S is called left inverse if every principal right ideal of S has a unique idempotent generator. Many authors and scholars have laid their hands in solving problems relating to simple and bisimple semigroup. Here in this chapter, we investigate the D- class of regular semigroups and of left inverse semigroups.

Lemma, proposition and Theorems were also considered to support each statement.

A description of a bisimple let inverse semigroup S with identity element **e** as a quotient of the contesian product L_ex L_e of L – class L_e of and the R – class R_e of S containing **e**.

We also describe the maximal inverse semigroup homomorphism of S.

3. D – CLASSES IN REGULAR SEMIGROUPS

Let S be a regular semigroup and **a** ∈ S. The L – class of S containing the element **a** is demoted by L_a.

Let A be a subset. Throughout a' denotes an inverse of a and A' denotes the set of all inverse of elements of A

Lemma 1

Let S be a regular semigroup. Then S is Bisimple if and only if for any two idempotent e, f in S there exist an element a of S and a' of a such that $\mathbf{aa^1}$ = f.

Lemma 2

Let S be a regular semigroup and e be an idempotent of S write L = L_e, R = R_e, H = H_e, and D = D_e, then

i. $L \subseteq R^1$ and $R \subseteq L^1$

ii. LR =D

iii. Let m, n, ∈ L and b, d ∈R. then mb = nd if and only if ∃ u ∈ H such that mu = n end ud = b.

Proof :

Let x ∈ L. then ∃ x′ of x such that x′ ∈ R. so x ∈ R′ and

Hence L ⊆ R′

Similarly, Let m, n, ∈ L and b, d ∈R then there exist inverse m′, n′, b′ and d′ of m, n, b, and d respectively such that m′m = n′n = bb′ = dd′ =e.

Let md = nd.

Then (mm′ nd) d′

And so mu′n = n. Let u = m′n.

Now mu = n and ud = m′nd = m′mb =b.

Further, eu = ue = u and u(d′b) = bb′ = e = n′n = (n′m)u.

Thus u ∈ H.

Remark The element u above is unique.

If X is a subset of a semigroup S. then E (X) denote the set of all idempotent in x.

Let S be a regular semigroup for any a ∈S.

Lemma 3

Let D be a D – class of regular semigroup S

Let E (D) be a subsemigroup of S. Then D is a bisimple subsemigroup of S

Proof:

Let a, b, ∈ D and let f = a′a and g = bb′

Then $f \in L_a$ and $g \in R_b$, so $f g \in L_a R_b$.
But $L_a R_b$ is contained in some D – class D′ of S.
Since $fg \in D$. By hypothesis we then conclude that $D' = D$ and $a b \in L_a R_b$
Hence, D is a subsemigroup of S

Lemma 4

Let S be a regular semigroup and **e** be an idempotent of S. Write $L = L_e$, $R = R_e$ and $D = D_e$
Let E (S) be a subsemigroup of S. Then the following condition on S are equivalent

i. $f e f = f$ for any idempotent $f \in D$
ii. R is a subsemigroup of S
iii. L is a subsemigroup of S

Proof:

Assume (1). Let $a, b \in R$. then there exist inverse a′ of a and b′ of b such that $aa' = bb' = e$
By (1) we have $a' a e a' a = a'a$ and $aea' = aa'aa' = e$
That is $abb'a' = e$, now $b' a'$ is an inverse of ab and therefore $ab \in R$.
Conversely Assume (ii)
Let $f^2 = f = D$. then exist $a \in R$ and an inverse a′ of a such that $aa' = e$ and $a'a = f$. by Hypothesis ef and fe are idempotent.
Therefore ea′ is an inverse of ae.
By (ii) we have $a e \in R$
Hence $aea' \in R$. Now $fef = a'aea'a = a' (aea'e)a$
$= a'ea = a'a = f$ given A.
thus (1) and (II) are equivalent
similarly (I) and (III) are also equivalent
therefore $1 \Rightarrow$ (II) $\Rightarrow$ (III) in an arbitrary regular semigroup S

Lemma 5

Let S be a regular semigroup and **e** be an idempotent of S write $L = L_e$, $R = R_e$ and $D = D_e$
Let **e** be a left or right identity element for D.
Then R and L are subsemigroup of S.

Proof :

Let $a, b, \in R$, then there exist inverse a′ of a and b′ of b such that $aa' = bb' = e$. As e is a left or right identity for D we get peq = pq or any $p, q, \in D$.
Now $abb'a = aea' = aa' = e$ and so b′a′is an inverse of ab. Hence $ab, \in R$ and R is a subsemigroup of S.
Similarly L is a subsemigroup of S.

Lemma 6

Let S be a regular semigroup and **e** be an idempotent of S.
Write $L = L_e$, $R = R_e$, $D = D_e$. The following conditions on S are equivalent .
(I) **e** is a right [left] identity element for D.
(II) **e** is an identity element for R [L]
(III) R [L] is a right [left] cancellative subsemigroup of S.

Proof:

Clearly (I) implies (II). Conversely assume (II).
Let $f^2 = f \in D$. let $a \in R \cap L_f$.
Then there exist an inverse a′a of a such that $a'a = f$.
Now by (II) we get $fe = a'ae = a'a = f$
So we get (I). Hence (I) and (II) are equivalent.
Now assume (I). Then by lemma 5.3 R is a subsemigroup of S.
Let $ax = bx$ where $a, b, x \in R$. As $xx' = e$
For some inverse x′ of x, by (I) we get a = b. and hence (III)
Assume (III) let $a \in R$, then $a e \in R$ now aee = ae and by right cancellative we get ae =a so we get (II) and hence (I).

Lemma 7

Let S be a regular semigroup and **e** be an idempotent of S. Write $R = R_e$ and $D = D_e$.

(I) $Sa \cap R \subseteq Ra$ for any $a \in R$

(II) if R is a subsemigroup of S then $Sa \cap R \subseteq R_a$ for any $a \in R$

(III) Let **e** be an identity element for D and $a \in R$, then

$S_a \cap R = Ra$ if and -only if $a \in R$

Proof:

(I) Let $a \in R$ and $x \in Sa \cap R$, then $x = t\,a \in R$ for some $t \in S$. Now there exist inverse a' of a and $(ta)'$ of ta such that $aa' = ta\,(ta)' = e$.

So $e = t\,(ea)\,(ta)' \in E\,e\,S$.

Again $ta = (te)\,a$ given $te = e\,t\,e \in S$.

Hence $te \in R$. now $x = ta = (te)\,a \in R_a$ proving (I).

(II) If R is a subsemigroup of S, then $R_a \in R$ for any $a \in R$. now from (I) we get (II)

(III) let **e** be an identify for D. then from lemma (5.1 and (2) above we get $S_a \cap R = R_a$ For any $a \in R$. the converge is obvious

4 D - CLASSES IN LEFT INVERSE SEMIGROUP

Recall that a semigroup S is called a left (right) inverse semigroup if every principal right (left) ideal of S has unique idempotent generator.

A left (right) inverse semigroup is clearly a regular semigroup.

Lemma 1

Let S be a regular semigroup. Then the following condition on S are equivalent.

(I) $S_e \cap S_f = S_{ef}$ $(=S_{ef})$ for any two idempotent e,f in S.

(II) fef = ef for any two idempotent e f in S.

(III) If a' and a'' are inverse of a in S , then $aa' = aa''$

(IV) S is a left inverse semigroup

COROLLARY 1

Let S be a left inverse semigroup and **e** be an idempotent of S. Then

(I) $aa' = e$ for any inverse a' of a in Re.

(II) E (S) is a subsemigroup of S.

(III) If a', b' are inverse of a, b in S then $b'a'$ is an inverse of ab.

Theorem 1

Let S be regular semigroup. Then S is a left inverse semigroup if and only if $L_e = (R_e)'$ for any idempotent **e** in S.

Proof:

Let **e** be any idempotent in S write $L = L_e$ and $R = R_e$

Let S be a left inverse semigroup and $P \in R^1$

Then $p = X'$ is an inverse of some $X \in R$.

Now xx' is an idempotent in Re.

Hence $xx' = e$ since S is left inverse.

Consequently $x' \in L$ $xx' = L_e$ and hence $R' \in L$.

Conversely, let $L = R'$ for any idempotent **e** in S.

Let f and g be idempotent of S and let fs = gs. then gf = f, fg = g and f is an inverse of g.

Now by hypothesis we get $f \in Lg$.

So fg = f an hence f = g.

Thus S is a left inverse semigroup.

Lemma 2

Let S be a left inverse semigroup and **e** be an idempotent of S. Let a, c, u, $\in$, R_e.

Let a',c' be inverse of a, c respectively, then

(I) if $a'u = c'$, then $a = uc$

(II) If $a' = c'$, then $a = c$.

Proof:

(i) let $a'u = c$, Let u' be an inverse of u.

Then $aa' = uu' = e$ and $a' = c'u'$.
Therefore $a'a = a'(uc)$
This implies that $a = uc$.
(ii) Let $a' = c'$, then a and c both are inverse of a'
$\therefore a'a = a'(uc)$
Hence $a = c$.

Lemma 3

Let S be a left inverse semigroup and **e** be an idempotent of S.
Let **e** be an identity element for D_e.
Let $c, d \in R = R_e$ then $Rc = Rd$ if and only if for any given inverse $c'$of c, there exist an inverse $d'$of d such that $c'c = d'd$.

Proof:

Let $Rc = Rd$ and Let c' be the given inverse of c.
Now $c = id$ and $d = jc$ for some $i, j \in R$.
Also $cc' = dd'' = e$ for any inverse $d''$of d
So $e = cc' = (i,j, c)\ c' = ij$ and
Similarly, $e = ji$.
Now $c'i$ is an inverse of $d = jc$ and $d'd = c'id = c'c$.

Theorem 2

Let D be a D – class of the left inverse semigroup S.
Let R be an R- class of S contained in D then.
The following condition on S are equivalent.
(I) E(D) is a subsemigroup of S.
(II) D is a (Bisimple) subsemigroup of S.
(III) For any a, b, $\in$ R there exist $c \in R$.
such that $Sa \cap Sb = Sc$.

Proof:

(i) Implies (II) by lemma 5.3.
Now Assume (II), Let a, b, $\in R$.
Let a' be an inverse of a and b' an inverse of b.
Let $a'a = f$ and $b'b = g$. then f, g and $fg \in D$
$\therefore Sa \cap Sb = Sf \cap Sg = Sfg$ by lemma 5.6
Let $c \in R \cap Lfg$. Then, $Sfg = Sc$.
Assume (III):
Let $f, g \in E(D)$.
Let $a \in R \cap Lf$ and $b \in R \cap Lg$.
Then by lemma 5.6, $Sa \cap Sb = Sfg$.
But there exist $c \in R$ such that $Sfg = Sc$
$\therefore fg \in D$, so $fg \in E(D)$.

Conclusion

We only focused on the D-classes of left inverse semigroup whereby we established that a left inverse semigroup is clearly a regular semigroup.

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3/4/2009

SWOT ANALYSIS – A USEFUL TOOL FOR COMMUNITY VISION

A concept paper of central Himalayan village

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Abstract: SWOT Analysis is a strategic planning method used to evaluate the **S**trengths, Weaknesses, **O**pportunities, and Threats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieving that objective. SWOT analysis provides a framework for visioning by helping the planners to identify and priorities the organization's GOALS and to further identifies the strategies of achieving them. SWOT analysis is a technique to analyze the Strengths, Weakness, Opportunity and Threats of a decision, problem ad place etc. In community development or urban planning SWOT is often used at community meeting to structure conversations about projects carrying out this analysis often illuminates what needs to be done and puts problems in to prospective. A tool that identifies the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats of an organization. Specifically, SWOT is a basic, straightforward model that assesses what an organization can and cannot do as well as its potential opportunities and threats. The method of SWOT analysis is to take the information from an environmental analysis and separate it into internal (strengths and weaknesses) and external issues (opportunities and threats). Once this is completed, SWOT analysis determines what may assist the firm in accomplishing its objectives, and what obstacles must be overcome or minimized to achieve desired results. [Researcher. 2009;1(3):25-27]. (ISSN: 1553-9865).

Keywords: SWOT; business venture; analysis

SWOT ANALYSIS FOR THE VILLAGE PATHARKOT- AN EXAMPLE

Small holder farming system: strategies for economic and environmental viability in Western Himalaya is addressing the project objectives as (assessment of farming systems and its economic growth in western Himalaya, identify on farm and off farm income issues/ option, restore the village commons, strengthen the village institutions and to develop pathways and policies) in a span of five years. It is identifying basic related to farming system development with a main focus on documenting 'best stories' of successful community initiatives for on and off farm livelihoods and natural resource management and implementation of such initiatives as per community prospective in a rural set up. Patharkot village has been identified as one such site to begin with. Village Patharkot is situated in Kosi watershed, Hawalbagh block, Almora district Uttarakhand.

Village Profile & landuse – Box 1

PATHARKOT
Profile of the village
Total Population – 733
Nos. of families – 106
Population:
Male – 433
Female – 300
Literacy:
Male – 95%
Female – 71%
Nos. of SC families – 9
Service holders - 14%

Land use:
Total area: 163.62 ha
Van – panchyat: 33.40 ha
Agriculture: 65.97 ha
Others: 64.24 ha
(Wastelands & settlements)
No. of agriculture fields: 739

Box No. 1 & 2 - Profile and landuse of the village

APPRICIATIVE PARTICIPATORY PLANNING

The appreciative participatory planning was focused to develop/ built a common community vision for village development along with empowering the community and individuals to take initiatives for development planning by taking the pride in what and who they are, and what they do; to dream of what they might be after 10,20, 30….. years; to plan that what can be given the village / individual resources; and to energies the community through making commitments and taking such progress themselves. The effort was to assist them to vision and plan conservation and economic development which would help the community in the long term. The above whole concept was based on the SWOT analysis of the rural community in village Patharkot.

SWOT ANALYSIS FOR THE COMMUNITY

The exercise was focused on and aimed to understand the status of the village or community in terms of their strengths, weakness, opportunities and threats. The discussion highlighted some important components that are crucial for community led planning process for the area. The analysis identified following points.

VILLAGE STRENGTHS

- Collective Strengths and unity of the villagers
- Better natural resource base
- Organized men and women groups/ institutions in the village
- Availability of enough agricultural lands
- Basic infrastructure
- Good educational status of the villagers
- A well established Paryavaran Samati working since 1992
- Strong will power of the villagers for village development

WEAKNESS

- Few water sources are drying
- Poor health facilities
- Poor livelihoods opportunities and low technical low how
- Communication gap between government and villagers
- Rainfed agriculture, low productivity of the agriculture fields, traditional cropping and no concept in cash crops
- Infestation of Kurmula (a local name of white grub insects) in agricultural fields
- Great deficit in fodder and fuel

OPPORTUNITIES

- Use of modern techniques in agriculture, new cropping pattern and scope of irrigation in agriculture
- Soil improvement by different institutions such as GBPIHED Kosi and VPKAS Almora
- Development of cash crops and horticulture in the village
- Conservation of natural resources by villagers as well as different village institutions
- Development of wastelands, abandon lands and other village lands
- Promotion of different livelihoods opportunities in dairy, farming practices, horticulture, poultry, fisheries, candle making and other sectors.

THREATS

- Crop damage by wild animals
- Occasional forest fire
- Low rain fall and dry season for crops
- Lack of funds and technical knowledge in agricultural fields

SHARED VISION OF VILLAGERS AFTER SWOT ANALYSIS

After SWOT analysis of the village a complete exercise was done to develop a shared community vision for development of village. The basic approach used was to visualize the major areas that arte key factor for the village development. Based on this exercise the following five categories identified and prioritized by villagers for their village development for future.

1. Conservation and utilization of natural resources (with particular reference to water and forest)
2. Development of the wasteland, agriculture and livestock sector
3. Promotion of livelihoods resources and human resource development
4. Promotion of health, cleanliness and education
5. Development of village institutions

CONCLUSION

After the above shared vision in different prioritized issues there was a clear action plan for the village development. All villagers discussed at length the major activities to be taken up in future for the village development. SWOT analysis was very much helpful in whole approach for this action plan for villagers as well as project activities also. As a conclusion SWOT analysis is very important tool or activity for community shared vision.

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Micropropagation Of *Prosopis Cineraria* (L.) Druce – A Multipurpose Desert Tree

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ABSTRACT
A protocol has been developed for micropropagation of a multipurpose desert tree species *Prosopis cineraria* under *in vitro* conditions. Nodal explants from mature plant of *Prosopis cineraria* were taken and cultured after surface sterilization. One to multiple shoots were induced on Murashige and Skoog's (1962) medium supplemented with various cytokinins and auxins individually and in various combinations. 5.0 mg/l BAP and Kinetin were found to be effective individually. 5.0 mg/l BAP +1.0 mg/l IAA responded batter than all other media combinations. Rooting of *in vitro* regenerated shoots (>2.5 cm long) was achieved on half strength MS medium supplemented with 3.0 and 5.0 mg/l IBA. *In vitro* regenerated plantlets were transferred in pots containing sterilized sand and vermiculites (1:1). After four weeks plantlets were acclimatized to field conditions successfully with 60% survival rate. The survived plants grew normally. [Researcher. 2009;1(3):28-32]. (ISSN: 1553-9865).

Key words: Micropropagation, Nodal explants, *Prosopis cineraria*, Axillary shoots.

Micropropagation is an important area of plant biotechnology. Many leguminous trees have been micropropagated namely *Acasia* (Skolmen and Mapes,1976,)*Albizzia lebbeck*(Gharyal and Mahaswari,1981),Upadhayay and Chandra,1983),*Dalbergia* (Mukhopadhayay,MohanRam,1981)*Leucaena leucocephala* (Dhawan and Bhojwani,1985, Nangia and Singh,1996),*Prosopis juliflora* (Nandwani and Ramawat,1991),*Prosopis laviegata* (Gonzalvez *et al*.,2007). *Prosopis cineraria* is a versatile species commanly known as Jhand or Khezri. *Prosopis* species are the dominant species in Indian desert. *Prosopis cineraria* has a very good economic importance in arid regions and is assumed to treat snake bite and scorpion stings. Green pods of this plant are used as food. This species is highly drought tolerant and can withstand in the area having 50mm rainfall annually(Bhandari,1978).

MATERIALS AND METHODS

The nodal explants (approximately 1-1.3 cm long) were obtained from a mature tree growing in ,Kurukshetra university,Kurukshetra.The nodal segments were kept under running tap water for 1 hr followed by treatment with a commercial liquid detergent Tween 80(1%) and then were surface sterilized in 90%ethyl alcohol(2 min) followed by mercuric chloride 0.1%(4-5) minute. Thereafter nodal segment were washed several time in double distilled sterilized water. These nodal segments were inoculated in MS medium supplemented with various growth regulators individually and in combinations.

MS basal medium (Murashige and Skoog,1962) was used for present investigation. MS medium supplemented with Various growth regulators individually (auxins i.e.IAA, NAA, 2,4-D and IBA) and (cytokinins i.e. BAP and kinetins) and in combinations(Kn+IAA, Kn+NAA and BAP+IAA,BAP+NAA) were tried for shoot regeneration and callus induction. The pH of the media was adjusted to 5.6 followed by addition of 0.5W/V agar prior to autoclaving at 120^0C at 1.06 KPa for 15 minutes for the purpose of sterilization. All the culture conditions were maintained at 25 ± 1^0C, with 16 hrs light and 8 hrs dark period with 60% relative humidity.

Observations like callus formation, growth of callus, number days taken for bud break, percentage of bud break and number of shoots regenerated per explants were recorded regularly. A mean of 15 replicates was taken per treatment.

RESULTS

Axillary shoot formation: Direct shoots regeneration was observed in all media fortified with various auxins and cytokinins. M S basal medium without growth regulators served as the control. This medium could produce only one shoot per explant. Supplementation of cytokinins gave better results than auxins in present investigation. Among cytokinins 5.0 mg/l BAP and Kn resulted better in terms of period

required for bud break, percent bud break, number of shoots regenerated per explant and length of regenerated shoots (Table1).

Among auxins 1.0mg/l IAA and NAA gave better results. The rate of percent bud break and number of shoot regenerated per explant media supplemented with these hormones was maximum(Table-2.).

Excised nodal segments were also cultured on MS medium fortified with different cytokinins (BAP and kinetin) and auxins (IAA, NAA and 2,4-D) in various combination(Table3.). As the nodal explants cultured on media with 1.0mg/l NAA and 1.0mg/l IAA individually responded better, these concentrations were taken for further study in combination with cytokinins. The combination of Kn with IAA and NAA gave better results as compared to their individual treatments. Supplementation of NAA in place of IAA with kinetin did not make much difference. Substitution of BAP in place of Kn resulted better in terms of percent bud break, number of days required for bud break and multiple shoots formation. The explants cultured on MS medium fortified with 5.0mg/l BAP+1.0 mg/l IAA responded best among all media used in combinations.

Callus regeneration: Simultaneously, callus formation was noticed in media fortified with various concentrations of kinetin and BAP. Highest percentage of callus induction was observed in the media supplemented with 5.0 mg/l Kn. Among auxins, the medium supplemented with 1.5mg/l IAA supported highest (60%) percent of callus induction. Callus so produced was greenish, white and fragile . However there was not reported any correlation between concentration of different auxins and percentage of callus formation. A combined effect of cytokinins (BAP and kinetins) and auxins (IAA, NAA and 2,4-D) was also studied for callus formation. Callus formation was noticed in all media supplemented with the combination of auxins (IAA,NAA and 2,4-D) and Cytokinins (BAP and Kinetin).MS medium fortified with 5.0mg/l BAP+ 1.0mg/l NAA resulted in the hundred percent callus formation after 10.5 days of inoculation **.**

Rooting of *in vitro* regenerated shoots

Root formation was not achieved on half strength and full strength MS medium devoid of growth regulators (Table.4.).Among all treatments of NAA (0.5, 1.0, 2.0, 2.5, 3.0 and 5.0 mg/l) used, 3.0 mg/l NAA was found effective in regeneration of roots. IBA proved better as compared to NAA .Rooting was observed in media fortified with 2.0, 2.5, 3.0, 5.0 mg/l IBA. The medium supplemented with 5.0 mg/l IBA was found most suitable for rooting because it regenerated roots in least time (15-19 days) Fig5.

Hardening of Plantlets – *In vitro* regenrated complete plantlets were implanted in pots having sterile soil and vermiculites (1:1). The plantlets were irrigated with half strength MS salt solution. High humidity was maintained for initial 15 days with the help of polythene bags and thereafter, these pots were exposed to natural conditions for 3-4 hours daily in an attempt to acclimatize the plantlets to natural conditions.(Fig.4.58-4.61). After a month these plants were shifted to glasshouses where they grew normally with 60% survival rate. After six weeks of glass house period, the plants were transfered to fields. The survived plants grew normally.

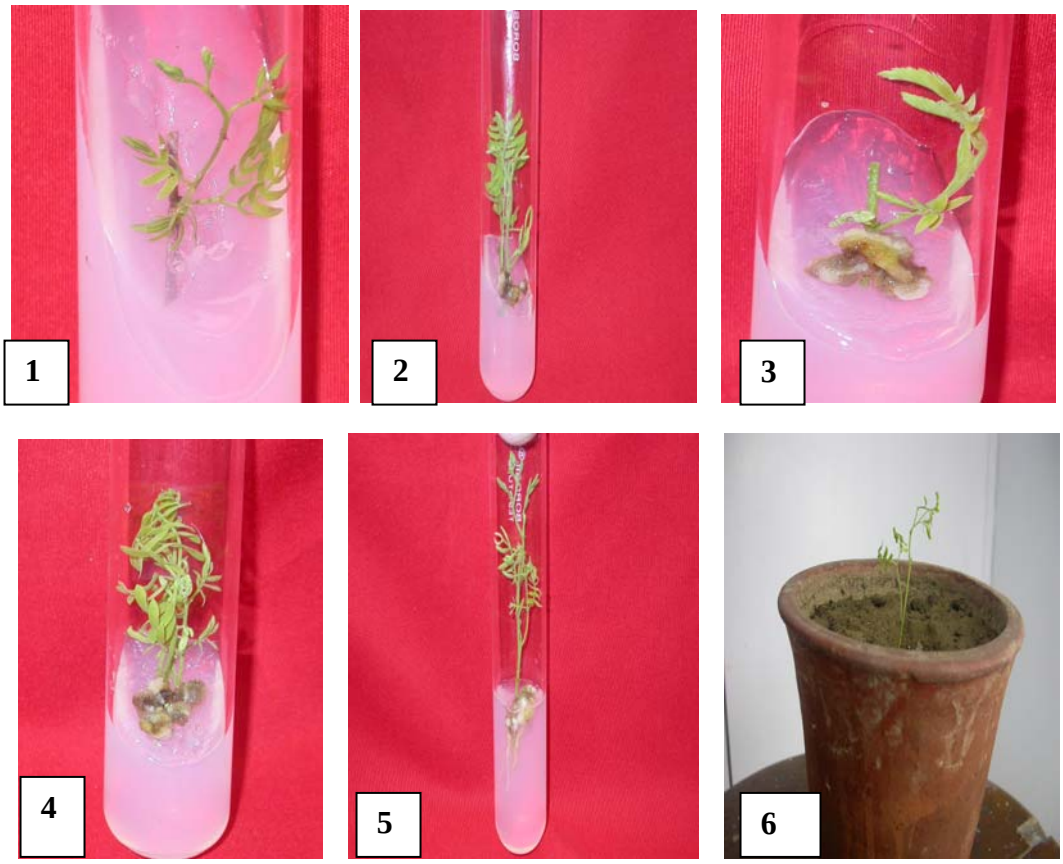

Fig.1 Shoot regeneration from nodal explant on MS +1.0 mg/l Kn.
Fig.2 Callus growth and shoots proliferation on MS+5.0 mg/l BAP.
Fig.3 Development of shoot and callus formation on MS+1 mg/l IAA.
Fig.4 Induction of multiple shoots and callus formation from nodal explant on MS + 5.0mg/l BAP+1.0 mg IAA.
Fig.5 Root formation from *in vitro* grown shoots on half strength MS + 3.0 mg/l IBA.
Fig.6 Establishment of *in vitro* grown plantlets under *in vivo* conditions.

Discussion

In present study shoot regeneration was reported without growth regulators but the percentage of shoot regeneration was less as compared to shoots regenerated by various media supplemented with different concentration of cytokinins (BAP and kinetin). Similar observation were made by Paal *et al.* (1981) and Cavallini and Lupi (1987).

BAP responded best for shoot formation .Other leguminous trees species where BAP induced shoot multiplication has been reported are *Acacia koa* (Skolmen and Mapes,1976),*Dalbergia* sissoo(Mukhopadhayay and Mohan Ram,1981,*Albizzia lebbeck*(Upadhayay and Chandra,1983) *Leucaena leucocephala* (Dhawan and Bhojwani,1985, Nangia and Singh,1996), *Prosopis juliflora*(Nandwani and Ramawat,1991),*Prosopis laevegata* (Gonzalez,et al.,2007)).Higher concentration of auxins did not supported better results as compared lower concentration of the same. Among all treatments of auxins, IAA was found to be more effective as compared to NAA and 2,4-D as also reported by Sudha Devi and Natraja (1987) in *Dalbergia latifolia*. In present investigation Combination of BAP and IAA proved better than other media tried. However Goyal and Arya(1979) reported that Kn with IAA proved better for shoot multiplication in *Prosopis cineraria*. Combination of BAP and IAA considerably enhanced shoot bud differentiation on nodal explantssimilar results were reported by Nandwani and Ramawat(1991) in

Prosopis juliflora. The development of axillary shoots from the nodal explants was accompanied by basal callusing of the explants. However this remained undifferentiated. Same type of observation have been made by Dhawan and Bhojwani(1985), Nandwani and Ramawat(1991) working with *Leucaena leucocephala* and *Prosopis juliflora* respectively. This may be due to production of endogenous auxins from the damaged cells of cut surface which triggered the cell division as found in *Ornithogallum* (Hussey,1976) when active division was observed in cut ends of the tissue. Root formation was observed on half strength MS medium supplemented IBA and NAA as reported by Nandwani and Ramawat in *Prosopis juliflora*(1991). The mixture of sterile soil and vermiculite in the ratio of 1:1 was used to acclimatize the plantlets with newly formed roots in Plastic pots. Similar soil composition i.e. Soil and sand was used to acclimatize *Dalbergia latifolia* (Raghwaswamy *et al*.,(1992)

Thus the present investigation has resulted in the establishment of a reliable and reproducible protocol of this important tree species. It could be used for mass multiplication as well as for the conservation of germplasm.

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3/5/3009

EXTRACTION OF HIGH QUALITY DNA FROM *DIPLOKNEMA BUTYRACEA*

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ABSTRACT

Diploknema tree species (MPTs) has a great economic value in respect of fodder, fuel wood, timber and other product. It has also a great medicinal value in Rheumatism, Ulcers, Itching, Hemorrhage, Inflammation of tonsils etc. Having such a great economic and medicinal value *Diploknema* is facing extinction because of relentless anthropogenic pressure. These species are failing to regenerate in spite of reasonable seed production. Very little information exists on the molecular aspects of *Diploknema* which requires high quality DNA. A protocol for extraction of high quality DNA from *Diploknema butyracea* is hereby discussed. [Researcher. 2009;1(3):33-35]. (ISSN: 1553-9865).

INTRODUCTION

Diploknema butyracea also known as Indian butter tree, and locally known as Cheura is a multi purpose tree (MPT). The National Wildlife Development Board (NWDB) has found *D. butyracea* to be useful for block planting and also to be grown in the ravines of hills. The latex yielding plant such as *D. butyracea* suits to different edapho climatic conditions and thus does not compete with the traditional crops. It is a large tree of family Sapotaceae, flowers during cold season and fruit ripens in June-July. It commonly occurs in the sub Himalayan tract between 300-1500m from sea level. In Uttarakhand it occurs abundantly in Pithoragarh district and adjoining areas of Almora, Bageshwar and Nainital District (**Negi *et al*., 1988**). Its seed kernel contains saponins. The yield of oil is 42-47% of the weight of seeds. It has consistency of ghee with white colour, pleasant taste and odour. It has a high titer test. The palmitic acid content (56.6%) is the highest yet observed among seed fats. The oil is convenient source of natural oleodipalmitin (62%). The tree produces a durable, hard and strong wood comparable to teak. Bark of the tree is used in the treatment of rheumatism, ulcers, itching, and hemorrhage, inflammation of the tonsils, leprosy and diabetes. The bark contains 17% tannin and is used in tanning, dyeing and as a fish poison. The seeds of *D. butyracea* yield edible oil, known as "Phulwara Butter" which is used in chocolate, soap and candle manufacture. Oil is used as an external ointment to ease rheumatism, paralysis and sprains. Phulwara butter is a valuable preservative for mustard and sweet scented oils. The oil cake contains saponins and act as fertilizer, fish intoxicant, pesticide and detergent. The tree is lopped for fodder and the viability of seed is very low which adversely effects its regeneration.

MATERIALS AND METHOD

Plant material

Biotypes of *Diploknema butyracea* were collected from Berinag, district- Pithoragarh, and Department of Forestry, D.S.B. Campus, Nainital.

DNA Extraction

Total genomic DNA was extracted using CTAB method (Doyle & Doyle, 1987) with some modification. 1 gm freshly harvested leaf whose gel was removed was ground to fine pulp using liquid nitrogen along with 0.1 g PVP. Extraction buffer (pH-8) preheated to 65^{o}C containing 2% CTAB (w/v), 5.0 M NaCl, 0.5 M EDTA and 0.5 m tris HCl were added to the pulp in a centrifuge tube, shacked and incubated for 1 hour at 65 ^{o}C in a water bath with intermittent shacking and swirling in every half an hour. To this equal volume of Chloroform:Isoamylalohol (24:1) was added and mixed by inversion for 30 min and centrifuged at 12,000 rpm for 15 min. Supernatant was transferred to a new tube and was precipitated with equal volumes of cold Isopropanoal, and gently mixed to produce fibrous DNA and incubated at -20 ^{o}C for 30 min. Samples were centrifuged at 12,000 rpm for 15 min. The pellete was washed with 70% ethanol and kept for drying. After drying, the pellete was dissolved in 3 µl of TE buffer (1 mM EDTA and 10 mM Tris HCL pH-8). To remove contaminating RNA 5 µl of RNAs (10 mg/ml) was added. The tubes were incubated over night at 37 ^{o}C. Dissolved DNA was extracted with equal amount of Phenol:Choloroform:Isoamylalcohol (25:24:1.v/v/v) and centrifuged at 8000 rpm for 15 min. then aqueous layer was transferred to a fresh 15 ml tube and equal volumes of chloroform:isoamyalcohol (24:1) was add and centrifuged at 12,000 rpm for 15 min. Finally supernatant was transferred to a fresh tube, equal volume of absolute alcohol and 1/10 volume

of sodium acetate were added and incubated at -20 ^{o}C for 30 min and centrifuged at 12,000 rpm for 15 min. The final pellet was dried and resuspended in TE buffer.

RESULT AND DISCUSSION:

The DNA of leaf tissues from two biotypes of *Diploknema* was analyzed and the amount of DNA in mg per gm was calculated by taking absorbance at 260 nm/290 nm. The ratio of absorbance 260 nm/280 nm was found to be in the range of 1.8 to 2.0 and the DNA yield ranged from 0.67µg/ml to 0.86µg/ml. This work shows that the DNA which was isolated by some modifications in the CTAB method was of high quality containing very low contamination of terpenoids and polysaccharides. The chemicals which were used during isolation of DNA by CTAB method increase DNA purity by removing all impurities. Long term chloroform isoamylalcohol treatment removes chlorophyll, pigments and dyes. Overnight treatment of RNase degrades RNA. Other precipitates (detergents, protein, polysaccharides etc.) were removed by additional step of phenol:chloroform:isoamylalcohol (25:24:1,v/v/v) and phenol:chloroform (24:1).

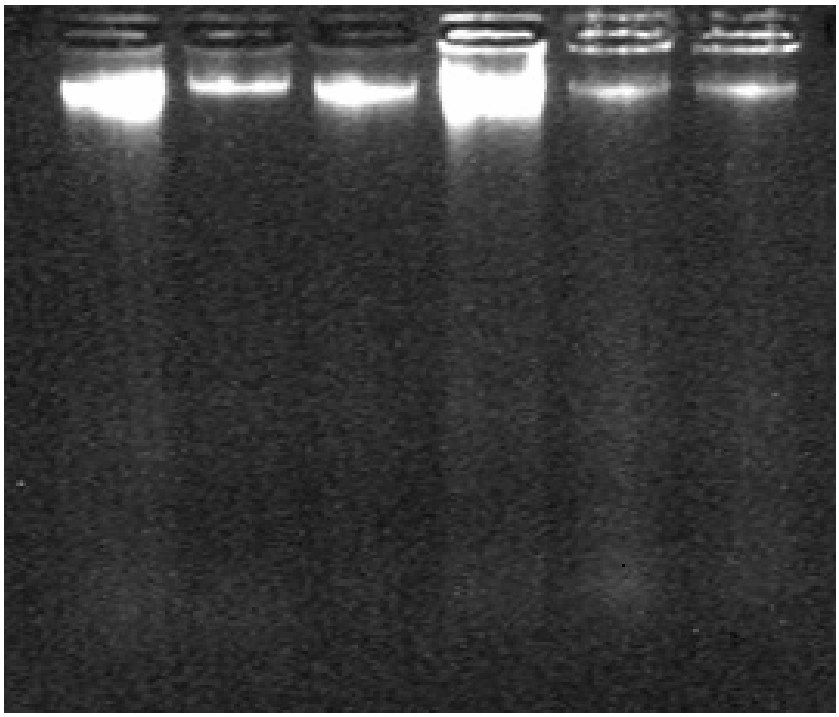

Fig 1. Agarose gel photograph of DNA extracted from leaf tissue of *Diploknema butyracea*

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Exploring Biotechnology For Conserving Himalayan Biodiversity

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Abstract: The Himalaya is one of the largest and youngest mountain ranges of the world, and covers 10 percent of India's land area. Extending across much of the northern and northeastern borders of the country, the Himalayan massif regulates climate for a broad portion of Asia and provides ecosystem services (especially perennial water systems) to much of the heavily populated plains of India. In addition, due to its unique location as the meeting place of three biogeographic realms, species diversity and endemism in the region is unique. At the same time the region is extremely fragile as a complex result of tectonic activities and anthropogenic influences. On account of its unique and diverse ecosystems and high levels of threat, the Himalaya has been recently designated as a global biodiversity hotspot by Conservation International. [Researcher. 2009;1(3):36-45]. (ISSN: 1553-9865).

Keywords: Biotechnology; Himalayan; Biodiversity; species; ecosystems

"*Biodiversity is the very core of our existence within our communities. You cannot say how many dollars this is worth because it is our culture and our survival. In this context biodiversity is invaluable … We value our surroundings as our identity, as who we are and our inheritance that is given to us … Our environment is many things, a classroom, a pharmacy, and a supermarket*."

Ruth Lilongula, Solomon Islands (UNEP/IT, 1999, p.162)

Himalayan Biodiversity

The Himalaya is one of the largest and youngest mountain ranges of the world, and covers 10 percent of India's land area. Extending across much of the northern and northeastern borders of the country, the Himalayan massif regulates climate for a broad portion of Asia and provides ecosystem services (especially perennial water systems) to much of the heavily populated plains of India. In addition, due to its unique location as the meeting place of three biogeographic realms (the Palaearctic, Indo-Malayan and Mediterranean), species diversity and endemism in the region is unique. At the same time the region is extremely fragile as a complex result of tectonic activities and anthropogenic influences. On account of its unique and diverse ecosystems and high levels of threat, the Himalaya has been recently designated as a global biodiversity hotspot by Conservation International.

In northern India, the Himalaya extends across the states of Jammu and Kashmir, Himachal Pradesh and Uttaranchal. The Himalayan region falling within this zone is classified into two major biogeographic zones: the Trans-Himalaya and the Himalaya. The windward slopes of the Great Himalaya and associated ranges form a large biophysical zone is classified under the Himalaya biogeographic zone **(Rodgers and Panwar 1988)**. Ecosystems in this zone encompass one of the largest altitudinal gradients in the world, range from the subtropical forests of the Siwaliks to alpine meadows and scrub in the higher peaks of Great Himalayas. Some of the richer assemblages of wild and medicinal plants are found in this region. It has been estimated that the region supports over 4500 species of vascular plants **(Western Himalaya Ecoregional BSAP 2002)**. **Champion and Seth (1968)** classification includes 11 major types (and 47 subtypes including several stages and disturbance types) in the Himalaya. The key features of biological diversity in this region include: i) wide latitudinal, altitudinal and moisture gradients encompassing a large number of ecosystem types, ii) high levels of diversity and endemism, iii) unique examples of agro-biodiversity, iv) species of great commercial value, and v) unique indigenous knowledge systems.

Agro-biodiversity recorded from the region is unique and records of medicinal plant species are available which are traditionally being used by the people. The mid-elevation oak (*Quercus spp*.) forests found in the region are ecologically as well as economically important. A number of species such as *sal* (*Shorea robusta*), *chir* pine (*Pinus roxburghii*) and *deodar* (*Cedrus deodara*) has been extracted for their wood. Recently extensive harvesting of medicinal species such as *Taxus wallichiana, Aconitum heterophyllum* and *Picrorrhiza kurrooa* is causing concern. High plant species diversity and productivity of

this zone is matched by a diverse assemblage of faunal elements. Avifauna in this region is diverse and over 640 species of birds have been reported of which 205 are endemic **(Western Himalaya Ecoregional BSAP 2002).** Bird species of maximum conservation importance include the pheasants such as the Western Tragopan (*Tragopan melanocephalus*), the satyr tragopan (*Tragopan satyra*) and the Cheer pheasant (*Catreus wallichi*). With respect to mammals, the lower altitudes, especially the Siwalik zone has significant populations of elephant (*Elephas maximus*) and tiger (*Panthera tigris*). The temperate zone has a large number of resident species; among these are endangered species like the musk deer (*Moschus chrysogaster*), the Himalayan *tahr* (*Hemitragus jemlahicus*) and the Kashmir stag or *hangul* (*Cervus elaphus hangulu*). Compared to birds and mammals, reptiles and amphibians are less studied and less diverse, especially in the higher altitudes. Fish species diversity is considerable and a large number of fish species have been introduced into the region. The golden *mahseer* (*Tor*), which is found in the lower and middle altitude streams and rivers, is now endangered. Reliable estimates of invertebrate diversity for the region are not available. Over 450 species of butterflies (*Lepidoptera*), more than (each) of *Hemiptera* and *Isoptera* are reported from the region **(Western Himalaya Ecoregional BSAP 2002).**

The impact of biotechnology on various aspects and economic progress of various nations around the world has given a major impetus to accelerate research, development and application of this field in relevant socio-economic sectors. Himalayan biodiversity is a woderful niche for exploring the potential of microbial, animal and plant world. The cell fusion techniques, recombinant DNA technology, protein engineering and structural biology have made phenomenal progress as priority research areas. In addition to basic research, the scientists are actively engaged in fermentation based activities, production of valuable biologicals, plant or animal cell culture, marker assisted selection and breeding, value addition, prospecting of biological resources, molecular taxonomy and micropropagation methods for producing high quality, genetically superior planting materials.

Present Problem

The primary threats to biodiversity conservation in the Himalaya include deforestation, commercial extraction of medicinal plants, grazing, invasive species, poaching, and growth of orchards, pollution, eutrophication and global warming. Over the last decade, the high rates of biodiversity loss, particularly in developing countries, have come to the forefront as one of the two most urgent global environmental issues. At the same time, the biotechnology industry has grown rapidly, and the two issues have become closely linked.

The Convention on biological diversity started as a document drawn up by IUCN on the *in situ* conservation of biodiversity. The document was submitted to the UNEP Governing Council, which accepted the need for an international biodiversity convention and accepted responsibility for its drafting. The draft convention was broader than the IUCN document and covered conservation, wild species of commercial crops, and the transfer of technology, biotechnology and expertise to developing countries. Formal negotiations, involving different delegates from 75 countries, started in November 1990 and a final version of the convention was signed in 1992 by 156 nations (including Pakistan) at the UN Conference on Environment and Development, the Earth Summit, in Rio de Janeiro. The convention aims to save animal and plant species from extinction and restore their habitats.

The convention stipulates that parties must develop national strategies for the conservation and sustainable use of biological resources; establish protected are as, resuscitate degraded ecosystems, control alien species and establish conservation facilities; establish training and research programmes for the conservation and sustainable use of biodiversity and support such programmes in developing countries; promote public education and awareness regarding conservation and sustainable use of biodiversity; carry out an environment impact assessment prior to any proposed project that may reduce biodiversity; recognize the right of governments to regulate access Dragon fly/Khushal Habibi Cobra/Ayesha Vellani *Calotropis procera*/WWF-Pakistan to their own genetic resources, and wherever possible, grant other parties access to genetic resources for environmentally sound uses; encourage technology and biotechnology transfer, particularly to developing countries; establish an information exchange between the parties on all subjects relevant to biodiversity; promote technical and scientific cooperation between parties, particularly between developing countries, to enable them to implement the convention; ensure that countries that provide genetic resources have access to the benefits arising from them; and, provide financial resources to developing countries in order to enable them to carry out the requirements of the Convention.

OVERVIEW OF BIOTECHNOLOGY AND BIODIVERSITY CONSERVATION

Strengths and Status

The Himalaya a global hotspots of biodiversity, is now receiving importance from researchers as well as policy makers and a number of institutions are involved in biodiversity conservation in the region. A few of these are solely focused on the Himalaya, and the region also benefits from a number of national level state of the art institutions and scientific expertise that is located within the region. Significant strides in biodiversity research have been made by universities and institutes located in the region. Although yet to be implemented at the grass-roots level, sustainable use models, traditional livelihood practices, knowledge and benefit-sharing are finding mention in recent policies and planning documents. These prepare the ground for future initiatives relating to participatory conservation and sustainable use frameworks. Currently, a number of NGO initiated livelihood and sustainable use projects are going on. One of the unique capacities of the region is the heightened environmental consciousness of local communities. This is especially so in the Uttarakhand Himalaya where voluntary movements to protect forests and biodiversity have been initiated by the local people .

Priorities and Strategies

The need of the hour is to conserve biodiversity through physiological and biotechnological advancements. In particular, it is to determine whether the biotechnology industry, through bioprospecting, can generate enough socially sustainable profits to function as an incentive to biodiversity conservation. After an overview of the links between biodiversity conservation and biotechnology and their early history, present goal is to analyze the current institutional framework surrounding this issue, and in particular the conflict between the TRIPs regime and the Convention on Biological Diversity over property rights on genetic resources and traditional knowledge. Additionally, need is to look at whether bioprospecting efforts have achieved enough economic viability – in terms of profits generated for the private sector – and social sustainability – in terms of benefits to local communities be an effective way to promote biodiversity conservation. While the evidence is mixed, there are enough success stories to suggest that under a stable institutional framework, bioprospecting efforts in which local communities are fully involved can be an effective tool in order to help preserve certain biodiversity rich areas.

Along with climate change, biodiversity loss is probably the most pressing environmental issue currently facing the planet. Broadly defined, "*biodiversity encompasses the diversity of life forms present on the planet*". Traditionally, this has meant species diversity, but the definition can be broadened to include genetic diversity. The importance and visibility of biodiversity conservation as a crucial international issue have been greatly increased since the signing of the Convention on Biological Diversity (CBD) in Rio de Janeiro in 1992, and the CBD's definition best broaches the different views of biodiversity: '*biological diversity means the variability among living organisms from all sources, including interalia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity between species, within species, and of ecosystems'*. The CBD also highlighted the fact that biodiversity protection and economic development issues are inexorably linked. This is due to the fact that the most important areas for biodiversity conservation fall almost entirely within the developing world. A survey of **Mittermeier *et al* 1997** has identified seventeen countries – which have been named "megadiversity" countries, which alone account for over 80% of the planet's biodiversity. The majority of these seventeen countries are in the developing world, particularly in the Andean region (Venezuela, Colombia, Ecuador, Peru), the Amazon basin (the above plus Brazil), and in south Asia (Malaysia, Philippines, Indonesia, India, China), along with several other large countries, most of which are part of the developing world.

While overall levels of biodiversity are obviously an important indicator of conservation importance, there are two other factors which need to be taken into account when identifying priority areas for biodiversity conservation. The first is levels of endemism, meaning the number of species which are found in a particular area and nowhere else in the world. The second is the level of threat faced by an area, as urgent conservation efforts need to be concentrated where the threats are most imminent. Particularly high levels of endemism are to be found in island ecosystems in countries such as Madagascar, Indonesia, Papua New Guinea and the Philipines, but key areas also include the Chocò ecoregion of Colombia and Ecuador, the Tumbesian region in Ecuador and Peru, the Upper Guinea rainforests of West Africa and many others.

Among the most highly threatened ecosystems are the Atlantic coastal forests of Brazil and, again, island ecosystems in countries such as the Philippines. It is easy to see how any discussion of global

biodiversity conservation policies must take into account international development issues, and how conflict can easily arise between developed and developing countries when dealing with such issues. There are different types of efforts and strategies currently underway to preserve global biodiversity, and a brief overview, particularly with regards to how they can be linked to biotechnology development, is useful. The most widespread and the most effective way to preserve biodiversity is through, direct, *in situ* conservation that is, establishing protected areas where biodiversity levels are particularly high or threatened, and these are the types of conservation efforts recommended under the CBD.

However, this is not always as straightforward as it sounds, as the creation of protected areas inevitably means that access to natural resources is restricted. In order to better involve local communities in biodiversity conservation efforts, a number of market based conservation strategies have been developed, which aim to make biodiversity conservation profitable. The better studied ways to achieve this has been ecotourism, the attempt to promote sustainable, low impact tourism to protected areas as a a way of generating income for local communities that would then find economic incentives for the conservation of natural ecosystems. Bioprospecting, the exploration of poorly-known ecosystems aimed at finding potentially useful genetic material that can be used in biotechnology falls into such market based biodiversity conservation efforts. Furthermore, biotechnology can play an important role in *ex situ* conservation efforts, as one of the cornerstones of such efforts is the establishment of gene banks which are vital to the success of the biotechnology industry.

Policy and Priorities of indigenous knowledge and benefit-sharing

Inadequacies among policies include blanket adoption of policies on these regions without considering the present culture, customs, practices and traditions. Advocacy is absent and seems to be adopted only as a political tool for delaying actual development. A few advocacy projects in the region are taken up by small NGOs and do not seem to have an impact on a regional scale. Various institutions dealing with utilization of resources need to be brought on a common platform to frame guidelines for sustainable use, IPR and benefit sharing and biotechnology policy.

Linkages need to be made between research institutions and key regulatory agencies for the region as a whole. Currently these linkages are somewhat blurred. Areas that should be addressed as priorities are biotechnology and benefit-sharing. Policies need to emerge from research outputs. Similarly linkages need to be established between various agencies carrying out development activities and regulatory agencies. Environmental impact assessment plans also need to be drafted specially for the Himalaya. An important systemic need for the Himalaya would be a region specific action plan. Inter-institutional linkages need to be improved for specific issues such as climate change. Studies on climate change require multidisciplinary inputs ranging from bio-physical sciences to socio-economic studies. Inter-institutional collaborations can also contribute to sharing scientific infrastructure and expertise, infrastructural development such as field stations and effective interdisciplinary research.

For the Himalayan region in particular specific policies are needed to address equitable benefit sharing, documentation and preservation of traditional knowledge (e.g., health, agro-pastoral, water conservation systems) and intellectual property rights. It is desirable that a separate set of policies be developed for the Himalaya. As a part of such a project, checklists, databases and status reports of species with commercial importance (especially medicinal plants) can be compiled. Policy formulation needs to be comprehensive and should be developed in conjunction with research institutions as well as all concerned higher level governmental departments to avoid contradictory policies. Efforts need to be made to communicate policy guidelines to the relevant customs departments and regulatory bodies.

In the absence of a comprehensive agro- biodiversity policy, the erosion of agro- biodiversity in the hilly regions of Uttaranchal is continuing unabated. Consequently, there is significant ecological degradation and furthermore, food security of poor farmers is threatened. The objectives of the project are: (i) exploration of the variety of agro ecosystem practices, (ii) the development of appropriate policy instruments that will promote the conservation of agro-biodiversity and achieve food security in the region. A central feature of the degradation of multiple ecological functions is a loss of natural and crop biodiversity in this fragile Himalayan ecosystem. The area under traditional crops has been declining and these have been replaced by cash crops. However, the popular notion is that access to roads in the hills reduces agro-biodiversity. The thrust of government policy instruments, like credit, subsidy, and the public distribution system, has been directed towards promoting high productivity monocultures.

India has a rich and varied heritage of biodiversity covering ten biogeographically zones, the trans- Himalayan, the Himalayan, the Indian desert, the semi-arid zone(s), the Western Ghats, the Deccan

Peninsula, the Gangetic Plain, North-East India, and the islands and coasts (**Rodgers; Panwar and Mathur, 2000).** The COP to the Convention on Biological Diversity adopted a supplementary agreement to the Convention known as the Cartagena Protocol on Biosafety on 29 January 2000. The protocol seeks to protect biological diversity from the potential risks posed by living modified organisms (LMOs) resulting from modern biotechnology. It establishes an advanced informed agreement procedure for ensuring that countries are provided with the information necessary to make decisions before agreeing to the import of such organisms into their territory.

Environment and Biodiversity Conservation

In recent years, efforts of conservation are being made in the country. Many international organizations like IUCN, WWF, ICIMOD and KMTNC rendered help in this effort. By establishing national parks, wild life reserves, and botanic gardens measures of *in situ* conservation have been taken to protect plants animals *from* human encroachment. Such activities are very expensive and thus remained limited. Field gene banks are also costs a lot to maintain and moreover plants and animals maintained in such gene banks are susceptible to natural calamities. Diseases, cattle, herds, other animals, human encroachment and natural disasters often damage them. Therefore, conservation of rare and endangered species through multiple means is desirable. Biotechnological methods can be implemented to support *ex situ* and *in situ* conservation. The accessible means of biotechnological method in developing countries can be implemented in conservation of plant species. Application of hormones can promote propagation of rare species through seeds and other vegetative parts. Dissemination of propagated plants in wild is expected to make the measure of conservation a success. It is possible to maintain biodiversity *ex situ* using tissue culture, protoplast fusion, embryo transfer, cryopreservation and gene banks. The approaches of reintroduction of tissue culture raised plants and establishment of gene banks in nature may thus be effective both *in situ* and *ex situ* conservation of plant genetic resources.

To facilitate absorption and utilisation of technology, major emphasis has been given on involvement of user industry and demonstration of technologies developed at the site of the industry. In over a dozen projects, a number of industries are involved in process development, process optimisation and validation. A number of technology packages such as ecorestoration of mine spoil dumps, microbial remediation of petroleum sludge and oil spill, phytoremediation of dye industry effluent treatment and palm oil mill effluent treatment have been standardised and are being negotiated for technology transfer.

Characterization and conservation of endangered species including medicinal and aromatic plants

A number of valuable plants species bearing food, fodder fuel wood, fiber and medicine are being used in huge amount by people. Adequate measures have not been taken yet to multiply and domesticate these plant species in order to conserve them. Genetic diversity of important species of the Himalayan region has been studied using molecular markers for conservation of these identified elite's in the Alpine region, field stations have been established in Himachal Pradesh – Rahala (2250 m) and Uttaranchal, Katochira, Distt. Almora (1850 m) and Khaljum, Dist Bageshwar (2450 m). These field stations are concentrating on the maintenance of germplasm and on farm cultivation of the elite material. Based on the genetic profiling studies, elites of *Aconitum heterophyllum, A. balfourii, Podophyllum hexandrum, Valeriana jatamansi, Gentiana kurroo and Picrorhiza kurroa* are now being taken up for mass multiplication at Rahala, H.P. and Almora. Morphological studies of *Podophyllum hexandrum, Valeriana jatamansi, Picrorhiza kuroa* and *Gentiana kurroo* have been done. The phenomenon of gynodioecism has been established in *Valeriana jatamansi*. In *Gentiana kurroo*, the peculiar mechanism of dichogamy has been established. Flowering in *Picrorhiza kurroa* occurs in two phases in May/June and August. Seed germination studies in *Podophyllum hexandrum, Valeriana jatamansi, Aconitum heterophyllum* and *Gentiana kurroo* have been done. The best sowing time for *P. hexandrum* and *A. heterophyllum* is November while as that for *V. jatamansi* and *G. Kurroo* is June. Besides, the use of conventional propagation methods, application of *in vitro* propagation techniques offers an additional alternative for recovery as well as multiplication of endangered species. Therefore, attempts were made to develop effective *in vitro* propagation protocols for *P. hexandrum, P. kurrooa* and *A. balfourii*.

The Network of the three gene banks set up by the DBT is fully equipped with state-of- the art facilities for conservation of seeds, live plants and *in vitro* material of rare, threatened and economically important species. A fourth gene bank has been established at RRL, Jammu to cover Western Himalayan Region. Under an integrated programme on taxol, about 1500 rooted stem cuttings of *Taxus* were planted in their natural habitats in Himachal Pradesh. The genetic diversity among *Taxus wallichiana* growing in the

North Himalayan region has been estimated by RAPD analysis. This will help tagging high - yielding genotypes using DNA markers for micropropagation and mass multiplication. Various callus lines of *Taxus baccata* were screened by TLC/HPLC for taxol/10-DAB (a taxol precursor) production. Three promising cell lines were identified. The work carried out at NII; New Delhi has led to the identification and isolation of an isoquinoline alkaloid, berberine, an immunomodulatory agent from *Berberis aristata*. An MOU has been signed between NII and an industry for production of a herbal product. Permission from Drug Regulatory Authority is being sought for carrying out clinical trials in collaboration with the industry. A programme on "Biotechnological approaches for herbal product development" has been launched under the National Jai Vigyan Science & Technology Mission. It aims at developing improved ergot production technology, agrotechnologies for high yielding variety of *Artemisia annua* and developing herbal therapeutic products for curing hyperlipidemia and arthritis alongwith other immunomodulators.

Biological diversity in Himalayan region is closely linked to the livelihood and economic development of the people of hill areas and relates to agricultural productivity and sustainability. Countries with strong capacity in modern technologies would be interested for effective implementation of Plant variety Protection as envisioned in Trade Related Intellectual Property Rights (TRIPS) under the regime of World Trade Organization and, Private sectors investment is increasing in these countries because of increasing profit prospects in modern biotechnology sector where competition for exclusive rights for gene structures or gene sequences through patents is high. Countries rich in genetic resources, like India, would be more interested in implementation of the provisions of the CBD to honor the national sovereign rights on genetic resources, prior informed consent for the access of the material sharing of benefits and rewarding farming communities for their roles in conservation and management of genetic resources to meet their present needs and aspirations of future generations.

With the advent of substantial improvements in biotechnology and insufficient naturally occurring plants to meet the increasing demands of the medical markets, more wild medicinal plants with promising economic value have been identified and cultivated. Among these, wild yam (*Dioscorea* spp.) is a good example. The discovery of diosgenin, a steroidal sapogenin that occurs naturally in very high levels in some yam species, led to a revolutionary means of synthesizing birth control agents. Since the strict Birth Control Plan was carried out in China from the 1970s onwards, demands for contraceptive pills increased very rapidly, leading to the investigation, analysis, cultivation, and processing of yams. Over-exploitation has threatened yams in the wild and they are now being cultivated in western Sichuan especially for diosgenin production. From 1996 until about 2000, the number of households in Maoxian County involved in the cultivation of wild yams rose to around 1,000.

Due to the simple skills required, a minimal input of labour, a guaranteed output of products, the fact that farming field space did not have to be taken up, more and more farmers are involved in this industry on a voluntary basis. Various schemes has contributed to farmers' participation in development projects sponsored by government or development agencies aiming at poverty alleviation in this region. The cultivation of high-value wild or introduced plants by farmers has played an important role in their economy. Meanwhile, the policy of encouraging diversified economic activities, as adopted by the provincial government in 1980, has also had a positive impact on the development of sideline production. When the state monopoly for the purchasing and marketing of all specialized local products (except musk) was rescinded in 1985, the farmers perceived this as a crucial incentive to exploit wild plant resources. Subsequently, business organizations at all levels have been engaged in the purchasing and marketing of all medicinal plants. Indigenous agro-ecosystems have played an important role in the conservation of biodiversity, and some ethnobotanical practices of agroforestry management have been integrated into the reforestation projects.

Cryopreservation

Experiments were initiated on cryopreservation of *A. heterophyllum* and *P. hexandrum* seeds collected in the year. In *A. heterophyllum*, the initial moisture percentage was low (6%) and were therefore directly stored under liquid nitrogen. The seeds were retrieved after regular intervals for evaluation of viability, germination and cryoinjury. Seeds showed about 90-100% germination after 30 days storage. However, there was a higher ion leakage in the seeds stored for 30 days as compared to the seeds stored for 10 days only. The seeds of *Podophyllum* had much higher initial moisture content (50%) and were therefore initially desiccated to 10 and 5 moisture levels and then stored in liquid nitrogen. Further time interval studies and development of protocols for liquid nitrogen storage were undertaken.

NOVEL PRODUCTS FROM WESTERN HIMALAYAS

Rhizosphere exploration for PGPR (Plant growth promoting responses) was often associated with enhanced plant growth and crop productivity, particularly under conditions of poor availability of mineral nutrients and stressful milieu. Aimed at developing plant growth promoting formulations for economically important crops of Lahaul and Spiti, evaluation of carrier-based microbial inoculants was initiated in multi-location trials. The microbial formulation was based on a consortium of efficient and stress tolerant phosphate-solubilizing and nitrogen-fixing rhizobacteria, selected for high PGPR activity under controlled environment. The phylogenetic relationships were worked out for these phosphate-solubilizing PGPR. Stress-tolerant and efficient phosphate-solubilizing bacterial isolateswere also subjected to diversity analysis with PCR-RFLPof 16S rRNAgene, employing the four-base-cutting restriction enzymes *Alu I, Rsa I, Hae III* and *Taq I*. Five distinct restriction patterns, with 3 to 5 restricted fragments/ pattern, were obtained with the restriction enzymes

Why biotechnology and biodiversity conservation are closely linked

Various institutes play a significant role in the conservation of plant resources in this region. To maintain their precious germplasm, a large number of medicinal and other economically useful plant taxa are grown in the medicinal-plant section as well as in its high-altitude extension. Agro-techniques for several of these and other potential bioprospective taxa have been developed for their successful mass propagation. Emphasis is laid on growing *ex situ* collections of Rare, Endangered and Threatened (RET) taxa of the region **(Dar & Naqshi 2002).** By virtue of these projects, a large proportion of our precious plant germplasm, collected from far-off and difficult habitats, has been maintained *ex situ*. Various ongoing research projects pertain to the conservation of medicinal plants, being funded by the Ministry of Environment & Forests (MoEF), Govt. of India, Department of Biotechnology (DBT) Govt. of India, and the G. B. Pant Institute of Himalayan Environment and Development (GBPIHED), Almora, India.

Biotechnology and biodiversity are undoubtedly closely linked, especially if one uses a broad definition of biotechnology that includes pharmaceutical uses of natural compounds, and not just genetic engineering. Broadly biotechnology is perhaps best defined as '*any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop micro-organisms for specific uses*' **(US OTA 1991).** However, because the pharmaceutical, agricultural, environmental and genetics industries are those who are funding the bulk of bioprospecting efforts, they will receive most of the focus **(Ernst & Young 1995)**.

The biotechnology industry's boom is a relatively recent one. The rise of firms devoted exclusively to biotechnology research and development started in the 1970's and gained momentum in the 1980's and especially the 1990's **(Acharya 1999).** While in strictly economic terms multinational 5 companies remain far more important that small companies devoted exclusively to biotechnology (multinationals accounted for US$ 87 billion in annual sales in 1995, compared to US$ 9 billion for smaller firms), their rapid growth accurately reflects the growing importance of biotechnology, and such small companies are often at the forefront of bioprospecting efforts, and therefore particularly significant in light of links to biodiversity conservation.

As of now, the biotechnology industry is overwhelmingly located in the developed world. The lack of resources devoted to scientific research and a weak institutional regime in which public research institutions such as universities are poorly linked with private sector companies has made it difficult for biotechnology firms to establish themselves. This is particularly true when one looks at more modern biotechnology techniques – those of more interest to the pharmaceutical industry, and those most likely to be the focus of bioprospecting efforts – although a number of countries in east Asia, as well as Brazil, Mexico, Cuba, India, and China, are currently funding research in such areas. In other parts of the developing world, such as Africa, biotechnology research efforts are even further behind, and indeed most African countries have no institutions in charge of coordinating biotechnology research on a national level. It would be therefore expected for the biotechnology industry to reflect the views of developed countries in international forums dealing with trade and environment issues.

In order for biotechnology to exist as an industry, it needs a reservoir of biological and genetic material from which to draw its resources: the planet's biodiversity is therefore of fundamental importance to the industry. At the most basic level, many patents deposited by biotechnology firms are simply natural compounds found in certain plants and animals which may have beneficial medical, agricultural or other uses. In the US, the anti-coagulant properties of the venom of two Asian and South American pit vipers (*Agkistrodon rhodostoma* and *Bothrops athrox*) have been patented, while in Europe the therapeutic

applications of extracts from the Indian plant *Cammiphora mukul* have also been patented **(Acharya 1999).** Both of these cases deals with compounds found in nature that can be used with little further elaboration from man, showing that often the biotechnology industry is dealing directly with the discovery and use of particular taxa.

Can the use of biotechnology promote biodiversity conservation?

This has led to the idea that biotechnology can help promote biodiversity conservation. The basic premise is that biodiversity contains hidden assets of potentially huge value to humanity, such as useful medical compounds found in plants or animals, new or better food crops. The search for new commercial applications for plant and animal species therefore gives biodiversity a significant enough innovation option value that biotechnology companies would be willing to pay for its preservation, and as such conserving a patch of biodiversity rich rainforest, for example, becomes more financially viable than converting it to farmland. The opportunity costs of biodiversity conservation would then be offset by the potential gains. Furthermore, as the private sector recognizes the economic value of biodiversity landowners and local communities in biodiversity rich areas will recognize the value and the potential benefits of their natural resources and will find it profitable to work towards their conservation.

Bioprospecting plays a key role in this argument. Bioprospecting refers to research undertaken in high biodiversity areas in order to discover potentially useful properties in local plants and animals, which can then be developed by the biotechnology industry. In many ways it is a form of basic scientific exploration. In fact, when one considers that only about 1.75 million of an estimated 14 million species of plants and animals have been described and named (World Conservation Monitoring Centre 2000; although some estimates run as high as 100 million species),bioprospecting can contribute to global biodiversity conservation in the most basic way, by contributing to the global inventory of known species. The compounds most sought after by the biotechnology industry are usually found in plants, of which 270 000 of an estimated 320 000 species have been described **(WCMC 2000).** This figure however is deceptive, as only about 25% of the world's estimated plant species are currently held in botanical gardens, and thus easily accessible to scientists **(Acharya 1999).** Furthermore, only a small percentage of these have been fully studied in order to identify their chemical properties, and bioprospectors are therefore taking the first steps in studying poorly-known taxa and contributing to global knowledge about biodiversity. The general way these efforts have been undertaken has been for a country to allow access to its genetic resources, and for prospectors to then identify and collect potentially useful taxa, which are then evaluated for potential use by the biotechnology industry. The countries from which these genetic resources come from are then compensated by the companies involved in the research, either through royalties paid on the use of commercially viable compounds, or though a "prospecting" fee paid in advance.

The argument that bioprospecting and biodiversity conservation could be positively linked first surfaced in the 1980's and gained strength in the 1990's. These arguments initially focused on the potential undiscovered economic value of biodiversity, especially with regards to the pharmaceutical industry. Early studies tried to estimate biodiversity's value to the pharmaceutical industry by estimating the probability of discovering a commercially valuable substance, and multiplying it by the value of the discovery **(Simpson et al 1996)**. While the results of these studies were extremely variable, most suggested that the untapped economic potential of biodiversity was quite significant, with estimates running as high as US$ 27.3 million per untested species in situ **(Principe 1989).** The link between bioprospecting and biodiversity conservation was further bolstered by some important discoveries. A much-publicized example is that of the rosy perwinkle *Catharanthus roseus*, a wildflower native to Madagascar used in traditional medicine there. The plant was found to contain alkaloids active against leukemia, and it is now used to treat cancer, Hodgkin's disease and is the best known-treatment for childhood leukemia (the synthetic compound used to treat childhood leukemia is only 20% as effective as the natural alkaloids found in the rosy perwinkle). This discovery was highly touted and served to put bioprospecting on the map as a possible strategy to promote biodiversity conservation.

The discovery of the anti-cancer properties of the bark from the Pacific yew tree *Taxus brevifolia* was also crucial in highlighting the value of biodiversity to the pharmaceutical industry. The discovery of taxol not only strengthened the argument that important discoveries were still to be made through bioprospecting, but more importantly from the pharmaceutical industry's point of view it proved that such discoveries could be immensely valuable from a financial standpoint, not only as a short-term return on the initial investment but also as a long-term source of income. It also provided a blueprint for other bioprospecting and biodiversity development agreements between the private sector and government

institutions **(Day-Rubenstein and Frisvold 2001).** In particular, the attention of pharmaceutical companies was quickly drawn towards the developing world, where the potential for new discoveries was far greater due to their richer ecosystems, whose levels of biodiversity were both far higher and far less studied than they were in developed countries. This however created artificially high expectations in many developing countries about the potential economic benefits to be achieved thanks to bioprospecting, and meeting such expectations has become a major issue in assessing the success of these efforts.

Other studies have built upon and refined **Simpson *et al* (1996)'**s model, in some cases changing some of the basic assumptions, and the results have been somewhat more encouraging. **Rausser and Small (2000)** expand upon Simpson et al's (1996) work by identifying a key flaw in their argument. Simpson *et al* assumed that research on the potential value of species was random, all species being tested in the same way; as a result, the odds of finding a valuable compound for any given species are extremely low. **Rausser and Small (2000)** however assume that research on the potential pharmaceutical value of previously unstudied species concentrates on those that are likely to contain useful compounds, through models that identify the most promising research areas and leads. Indeed, bioprospecting efforts do not take place randomly across the world, but are concentrated in areas and ecosystems where potentially useful taxa are expected to occur, or on species that are closely related to those that have already proven to be commercially viable – for example, taxol is now being extracted from the Himalayan yew tree, a close relative of the Pacific yew from which the drug was first extracted. The odds of finding useful compounds are therefore significantly higher than those calculated by **Simpson *et al* (1996),** who assumed that bioprospectors operated without prior information to help them focus their efforts. It suggests that bioprospecting can be an efficient incentive mechanism for conserving biodiversity rich areas. Furthermore, Rausser and Small (2000) suggest that firms' willingness to pay for bioprospecting rights may be even higher in light of the competition for patenting new discoveries, as firms may be willing to pay a premium for exclusive access to promising areas.

FUTURE STRATEGIES

The main question is whether bioprospecting can generate enough socially sustainable profits to serve as a useful tool for biodiversity conservation. An optimistic answer is that it can, at least on a local level, if the conditions are right. Early estimates on the economic potential of bioprospecting were widely divergent. The most optimistic of these, which suggested that profits from bioprospecting could be high enough to serve as a significant force for biodiversity conservation, have proven to be overstated. However, a number of carefully structured biodiversity sharing agreements have indeed been profitable, both for the private sector and for the developing country institutions with which they have been signed and can serve as blueprints for future such efforts. Indeed, it should be noted that one of the most successful aspects of such agreements, perhaps even more important than the financial rewards, has been the investment in capacity building in developing countries, and the benefits in training for local biodiversity conservation technicians that have arisen **(Porzecanski *et al*, 1999).**

In order for bioprospecting to fully contribute to biodiversity conservation, local communities, the ultimate stewards of biodiversity, must be fully involved and receive enough benefits to offset conservation costs. The major challenge for successful bioprospecting efforts in the future will be to more fully integrate local communities in their efforts. This issue has been relatively overlooked so far, and apart from a few success stories where agreements were negotiated directly with local communities (as was the case with the Kani people in India), local communities have often been by-passed. Involvement of these communities is a critical step in protection of biodiversity.

The institutional framework in which these issues evolve is also crucial. At the moment, there is a conflict between the CBD, which reflects developing country interests and serves as a more effective framework for biodiversity conservation, and the TRIPs regime. Because of TRIPs' enforcement mechanisms, it is *de facto* the most relevant of the two in terms of influencing national and international policies. However, the CBD does have great resonance, and recent developments, such as the Doha conference, suggest that in the future TRIPs may move closer to CBD positions, thus providing a clearer and more favorable institutional framework. The outlook for the future of bioprospecting and biodiversity conservation is difficult to predict, but the fact that the issue remains at the forefront of current debate, and that there are ongoing developments on both the institutional and economic front, suggests that much work remains to be done. There is a growing realization of the need for a clearer institutional framework, and for better involvement of local communities, but until concrete steps are taken in this direction, success stories will remain scattered. Under ideal conditions, bioprospecting can be an effective way to preserve

biodiversity locally, and it can play an effective, albeit limited role, in overall efforts to conserve global biodiversity.

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Somatic Embryogenesis And *In Vitro* Regeneration Of An Endangered Medicinal Plant Sarpgandha (*Rauvolfia serpentina. L*)

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ABSTRACT

An efficient protocol for *in vitro* regeneration of endangered medicinal plant *Rauvolfia serpentina* has been developed. The juvenile leaf explants were transferred to MS medium containing different combinations of PGRs. Among the various combinations of BAP (1.0-3.0) and IAA (0.1-0.5) the intensity of callus induction was highest in BAP (2.5) + IAA (2.0) mg/l and BAP (1.0) + IAA (0.5) mg/l. The frequency of callus induction was highest 77.77% in BAP (1.0) + IAA (0.5) mg/l. During organogenic callus formation, different types of calli with variation in colour and texture were noticed and among them, the light green, fragile calli responded well for the induction of shoots. Among the various combinations of BAP and IAA used the frequency of shoot regeneration was highest 75% in BAP (2.5) +IAA (0.4) mg/l. For elongation of shoot 1ppm GA_3 was also used, this provides a better result. The shoot was transferred to M.S. Media for root regeneration containing PGRs BAP (2.5) + IAA (0.3-0.5) + NAA (0.3-0.5) mg/l. The frequency of root regeneration was 100% in MS Medium containing BAP (2.5) + IAA (0.5) + NAA (0.5) mg/l. After rooting on shoots the plantlets were shifted to sterile soil field pots for acclimatization. The survival percentage of plants after hardening was 67%. The protocol was optimized by manipulations of different PGRs for enhanced multiplication. Protocol explained in this research paper provides a rapid plant regeneration system which could be used for the somaclonal variation; shoot induction and producing transgenic plants in *Rauvolfia* through *Agrobacterium* and biolistic methods. [Researcher. 2009;1(3):46-53]. (ISSN: 1553-9865).

INTRODUCTION

Medicinal plants have been the subjects of man's curiosity since time immemorial **(Constable, 1990).** Almost every civilization has a history of medicinal plant use **(Ensminger et al., 1983).** Approximately 80% of the people in the world's developing countries rely on traditional medicine for their primary health care needs, and about 85% of traditional medicine involves the use of plant extracts **(Vieira and Skorupa, 1993**). *In vitro* cell and tissue culture methodology is envisaged as a mean for germplasm conservation to ensure the survival of endangered plant species, rapid mass propagation for large-scale revegetation, and for genetic manipulation studies. Combinations of in vitro propagation techniques **(Fay, 1992)** and cryopreservation may help in conservation of biodiversity of locally used medicinal plants.

Rauvolfia serpentina. L commonly known as sarphgandha is an important medicinal shrub of family Apocynaceae **(Nathan Kline, 1954**). The snake-weed genus includes about 50 species, this has fairly wide area of distribution, including the tropical part of the Himalayas, the Indian peninsula, Sri Lanka, Burma, and Indonesia. The plant is indigenous to India, Bangladesh and other regions of Asia and found to grow in the wild in many places around the country **(Ghani, 1998).** Its roots contain 0.15% resperine-rescinnamine group of alkaloids **(Anonymous, 1969).** It also contains a number of bioactive chemicals, including ajmaline, deserpidine, rescinnamine and yohimbine **(Lewis, W.H., 2003).** This herbal plant is used as medicine for high blood pressure, insomnia, anxiety and other disorders of the central epilepsy **(Ghani, 1998).**

Rauvolfia is threatened in India due to indiscriminate collection and over exploitation of natural resources for commercial purposes to meet the requirements of pharmaceutical industry, coupled with limited cultivation **(Nayar and Sastry, 1987; Gupta, 1989).** IUCN has kept this plant under endangered status. The chemical resperine is an alkaloid first isolated from roots of *Rauvolfia serpentina* and is used to treat hypertension (**Ford, R.V. *et al.*, 1953; Vida, F., 1953)**. Although, for centuries they have been used empirically in India for a variety of conditions that they were effective in relief of hypertension was first commented on by Bhatia in 1942. Subsequently, other clinical investigators working in India confirmed the effectiveness of *Rauvolfia serpentina* for that purposes (**Chakraverti, N.K. *et al.*, 1951; Gupta, J.C., 1942).** In a short term study, a significant decrease in systolic as wall as diastolic blood pressure of patients to whom the drug was given was observed **(Vakil, 1949).** Insanity, Snakebite and Cholera can also be

treated by use of this alkaloid **(Wild, R., 1994).** The pectic polysaccharide named rauvolfian RS was obtained from the dried callus of *Rauvolfia serpentina* L. by extraction with 0.7 % aqueous ammonium oxalate and it was found to posses some anti-inflammatory effect (**Popov, S.V. *et al.*, 2007**).

In approximately 60% of medicinal plants used in traditional medicines, roots are the principal source of drug preparation **(Kamboj, 1988)**. The development of fast growing culture system can offer an opportunity for producing drugs from the roots in the laboratory with out having to depend solely on field cultivation **(Sudha and Seeni, 2003**).

In vitro regeneration of sarphgandha has been done from several genotypes. Micropropagation has been achieved from explant of *Rauvolfia micrantha* Hook F cultures **(Sudha and Seeni, 1996**). Micropropagation can be considered as an important tool for the production of higher quality plant based medicines **(Debnath, M., 2006).** In view of this, there is an urgent need to apply in vitro culture methods for the micropropagation and conservation of this valuable endangered plant. Here efforts have been made to define efficient protocol for the recovery of plants through organogenesis of *Rauvolfia serpentina. In vitro* regeneration of *Rauvolfia* has been reported by many authors **(Butenka, 1964; Mitra and Kaul, 1964; Vollosovich and Butenka, 1970; Kukreja *et. al.* 1989 and Roy *et. al.* 1994)**. The present study was undertaken to develop a more efficient protocol for rapid *in vitro* multiplication of *Rauvolfia serpentina* using leaf explant as an initial plant material.

MATERIALS AND METHODS :

Plant material

Plantlets of *Rauvolfia serpentina* were obtained from Corbett jadibuti Udhyan Kaladhungi, Nainital, Uttarakhand and grown in sterile vermiculite at 25-30 ^{0}C in light. All the explants were taken from these donor plants for present investigation. Leaf explants from 2 month old donor plant was kept for 2 hrs in systemic fungicide Bavistin (VIMCO pesticides, Gujarat) and Tween-80 an antimicrobial agent, prior to surface sterilization. For surface sterilization, chemicals such as $HgCl_2$ (0.1%), NaOCl (1%), H_2O_2 (1%) and ethanol (70%) was used. Juvenile leaves were washed thoroughly in running tap water for 30 min. and then with distilled water three times. Leaves were treated with bavistin solution for 4-5 min., and then rinsed thoroughly with sterile distilled water. The leaves were subjected to 0.1% $HgCl_2$ for 30 sec., washed with distilled water and then placed in 70% ethanol for 1 min. and again washed with distilled water, followed by addition of three drops of antibiotic solution (Cefotaxime) in laminar airflow cabinet. In the antibiotic solution, all leaves were dissected into small pieces and treamed so that maximum part can be exposed to media. All the chemicals used were purchased from Hi-media unless stated otherwise.

Culture media and growth condition

The medium comprised of macro and micro elements according to Murashige and Skoog (1962) with Mesoinosotol (100 mg/l), Thiamine-HCL (0.5mg/l), pyridoxine-HCL (1mg/l), Nicotinic acid (0.5mg/l) and sucrose (30g/l), solidified with (0.6%) agar. The Plant growth regulators used were 6- Benzyl-aminopurine (BAP), α- naphthalene acetic acid (NAA) and indole acetic acid (IAA). All experiments were carried out in culture tubes (150 × 25 mm) containing 30 ml of culture medium. The pH of media were adjusted to 5.8 prior to autoclaving at 121^{0}C at 15 lbs pressure for 20 min. Culture were incubated under 16 h /8h light/ dark cycles (artificial light , 80 µM per m^2/s).

Callus induction and shoot regeneration:

For callus induction juvenile leaf section (3-5 mm in length) with cut end surface in contact with culture medium were placed on MS medium supplemented with various concentrations of PGRs BAP and IAA. After 20 days of culture, the leaves cultured on MS basal medium supplemented with 3% (w/v) sucrose, BAP (1.0 ppm) and IAA (0.5ppm) were found to give profuse callusing and when callusing was observed in entire explant, the callus was cut into small pieces transferred to MS media having BAP and IAA in same concentration as for callus induction. Subculturing was done after every 1-2 week. After 3-4 weeks of subculturing first shooting is observed in callus.

Regeneration of roots and development of complete plantlets:

For initiation of roots the 6-8 weeks old shoots (2.5-4.0 cm. in length) were cultured on half strength MS basal medium supplemented with 2% (w/v) sucrose and different concentration of PGR were tested BAP(2.5ppm) **:** IAA(0.3ppm): NAA(0.3ppm),BAP(2.5ppm) **:** IAA(0.4ppm) **:** NAA(0.4ppm), BAP

(2.5ppm) **:**IAA(0.5ppm) **:** NAA(0.5ppm), for 2-3weeks. The shoots were also tested on hormone free full and half strength MS basal medium with 3% sucrose ((w/v) for root initiation.

The complete rooted plantlets (6-10 weeks old) were washed free of agar and dipped in 0.2% bavistin fungicide for 5-10 min., and potted in small plastic pots containing sterilized soilrite. The plantlets were covered with polythene bags to maintain high humidity**.** These were acclimatized at 25±3^{0}C under 16h photoperiod and watered regularly. After 3-4weeks, the polythene bags were removed and established plantlets were transplanted to earthen pots in a greenhouse.

RESULTS AND DISCUSSION

The smaller size of explants were chosen due to fact that smaller size of explants provide less chance of contamination, as well as longer leaves showed total loss of morphogenic potential. **(Mujib, A., 2003**). Initiation of calluses from leaf explants did not pose a major problem. During initiation the explants did not show any leaching or browning of tissues. MS basal medium was the most effective for callusing of leaf explants. The explant cultured on MS basal medium supplemented with different combinations of BAP and IAA show varied response for callusing **(Table1**). Leaf explants culture on MS basal medium without any PGR supplementation show only swelling of explants that were not significant for callusing. This was possibly due to significant role of PGR over callusing. In the media supplemented with BAP and IAA, the leaf segments remain green for long period with very slow process of callus induction **(Fig .1).** Further transfer into media containing BAP and IAA rapidly shows callus induction because the excretion of phenolic compounds from explants to the medium was strictly avoided by regular sub-culturing of callus. **(Fig. 2)**

Callus is an unorganized mass of plant cells and its formation is controlled by growth regulating substances present in the medium (auxins and cytokinins) **(Shah et. al., 2003**). The specific concentration of plant regulators needed to induce callus, varies from species to species and even depends on the source of explant (**Charriere et. al., 1999).** It has been demonstrated in many cases that 2,4-D is usually the choice of auxin for callus induction and subculture of grasses (**Bhaskaran and Smith, 1990; Chaudhury and Qu, 2000**). Lately more and more experimental results indicate that the addition of a low concentration of cytokinin in callus culture medium often enhances callus regeneration (**Alpeter and Posselty, 2000; Chaudhury and Qu, 2000; Cho et. al., 2000; Bai and Qu, 2001; Bradely et. al., 2001).** Minimal cytokinins and auxins in culture media would avoid somaclonal variation and efficiently produce true to type plantlets **(Edson et. al., 1996**).

The success of micropropagation largely relies on the selection of suitable plant part, which is to be used as the starting material for the experiment. In the present experiment leaf explants was best fit for purposes. The best callusing was observed in media having BAP: IAA in concentration ratio of (1.0**:** 0.5ppm). In the media supplemented with only BAP and IAA the callus induction was very significant (**Fig. 2)**. This remains in accordance with previous reported work of **(Mathur et.al., 1987).** Different types of calli with variation in colour and texture were noticed **(Table 1)** and among them, the light green, fragile calli responded well for the induction of shoots.

This study further demonstrates that shoot regeneration from callus was very earlier in media supplemented with BAP and IAA in concentration ratio of (2.5**:** 0.4 ppm), in comparison to 2.5**:**0.3, 1.0**:**0.5 or 2.0**:**0.5 (**Table 2; Fig. 3**). Thus, the PGR concentrations have significant impact on shoot regeneration. This is basically due to endogenous level of growth regulators. For elongation of shoot 1ppm GA_3 was also used, this provides a better result **(Fig. 4**).

No root could be induced in either basal medium of full or half strength MS media. However, when 2.5-4.0 cm. elongated shoots were placed on half strength MS basal medium supplemented with BAP ,IAA and NAA in concentration ratio of (2.5**:** 0.5**:** 0.5 ppm)roots were induced in nearly 100% of shoots within 2 weeks. (**Fig. 5,6,7**) Other concentration BAP, IAA and NAA (2.5**:**0.4**:**0.4 and 2.5**:**0.3**:**0.3) induce rooting in slightly lower percentage **(Table 3**). Basal media supplemented with NAA was found to be better for root regeneration this was in accordance with previous reported work of **Kumar, *et al*., 1993**.

Taking care of root regeneration data it can be concluded that the standard protocol developed for regeneration of *Rauvolfia* was nearly 100% efficient but in accordance with hardening data **(Table 4)** there is a need for further standardization and work to increase the efficiency, during hardening so that this medicinally important plant could be propagate at larger scale and its medicinal importance properties could be utilized for well being of human population. This further become important due to advancement in commercialization of plant tissue cultured plantlets by commercial sectors have led to continued exponential growth within the industry in terms of numbers of new units as well as numbers of plants

produced by the units **(Govil, S. and Gupta, S.C., 1997**). The development of a reliable *in vitro* protocol are of great importance for producing plant material and for conservation of rare plant species, and offset the pressure on the natural populations as well as plant medicinal purposes.

The present study describes a well documented and reliable protocol of *R. serpentina* from leaf explants with much higher rate of multiplication. This protocol can be used as a basic tool for commercial cultivation of sarphgandha plant.

Table 1. Effect of different concentrations of PGR added to MS medium on induction of callus from leaf in *R. serpentina*. Observation after 27 Days:

PGR(mg/l)		Intensity of callus induction	Nature of callus
IAA	BAP		
0.1	-	-	No callus formation
0.1	1.0	++	White coloured, fragile
0.1	1.5	+	Green coloured ,fragile
0.2	0.0	-	No callus formation
0.2	1.0	++	Light green coloured ,fragile
0.2	1.5	+	Light green coloured ,fragile
-	2.0	-	No callus formation
-	2.5	-	No callus formation
-	3.0	-	No callus formation
0.1	2.0	+	White coloured, fragile
0.1	2.5	-	No callus formation
0.1	3.0	-	No callus formation
0.2	2.0	-	No callus formation
0.2	2.5	+++	White coloured, fragile
0.2	3.0	-	No callus formation
0.3	-	-	No callus formation
0.3	1.0	++	Green coloured ,fragile
0.3	1.5	+	Light green coloured ,fragile
0.3	2.0	-	No callus formation
0.3	2.5	++	Light green coloured ,fragile
0.3	3.0	-	No callus formation
0.4	-	-	No callus formation
0.4	1.0	++	Light green coloured ,fragile
0.4	1.5	+	Light green coloured ,fragile
0.4	2.0	-	No callus formation
0.4	2.5	++	Light green coloured ,fragile
0.4	3.0	-	No callus formation
0.5	-	-	No callus formation
0.5	1.0	+++	Light green coloured ,fragile
0.5	1.5	+	Green coloured ,fragile
0.5	2.0	++	Light green coloured ,fragile
0.5	2.5	-	No callus formation
0.5	3.0	-	No callus formation
-	-	-	Swelling of the explant observed.

Table. 2: Effect of different concentration of PGRs added to MS medium on induction of callus and regeneration of shoots from leaf of *R. serpentina*.

PGR (mg/l) BAP	IAA	Days for Callus formation	Days of shoot Regeneration after callusing	Frequency of Callusing	Frequency of Shoot Regeneration (%)
2.5	0.4	24	18	72.00	75
2.5	0.3	24	36	40.00	45.03
1.0	0.5	24	37	77.77	52
2.0	0.5	24	38	70.00	39.45

Table. 3. Effect of different concentration of PGR added to MS medium for root regeneration from shooted callus of *R. serpentina*.

PGR (mg/l) BAP	IAA	NAA	Days of Rooting	Frequency of Rooting (%)
2.5	0.3	0.3	12	85
2.5	0.4	0.4	15	96
2.5	0.5	0.5	10	100

Table. 4. Estimated survival of plants after hardening.

Number of pots containing Plants	Number of plants survived	Percentage of survival (%)
5	3	60
3	2	67
4	2	50

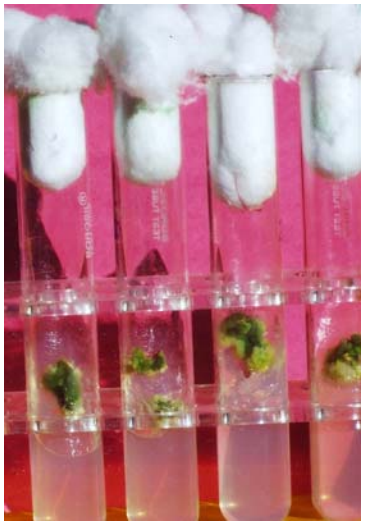

Fig.1. Callus induction in *R. sepentina* from leaf explants in MS media containing BAP(1.0) and IAA(0.5)mg/l ***Fig .2.*** Shoot regeneration from callus on BAP (2.5) + IAA (0.4) mg/l MS media. ***Fig.3.*** Rooting regeneration on BAP (2.5) + IAA (0.5) + NAA (0.5) mg/l MS media.

Fig.4. *In vitro* regeneration of complete plantlets of *R. serpentina* from leaf explant. ***Fig.5***. Hardening of plantlet to mixture of sterile soil, sand and vermicompost.

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Performance Evaluation Of A Locally Fabricated Mini Cassava Flash Dryer

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Abstract: A mini cassava flash dryer was parameterized, developed and tested. The flash dryer is a mechanized way of drying cassava mash for mass production of cassava flour for flour mills, confectionery and pharmaceutical industries. The traditional method of producing cassava flour cannot give product of high quality and quantity for industrial usage because its mode of drying is dependent on climatic conditions and susceptible to contamination. After three passes of cassava mash through the flash dryer, the percentage of dryness achieved was 57.1%. [Researcher. 2009;1(3):54-60]. (ISSN: 1553-9865).

Keywords: Flash dryer, parameterized, mechanized, industrial uses, percentage of dryness.

1. Introduction

With an estimated population of 120 million people, a land mass of approximately 93,700 square kilometers and vast mineral and agricultural resources, Nigeria has substantial economic potential in its agricultural sector. However, despite the importance of agriculture in terms of employment creation, its potential for contributing to economic growth is far from being fully exploited. The sector's importance has fluctuated with the rise and fall in oil revenue. Over the past 10 years, Nigerian agricultural sector has remained stagnant while the contribution of the manufacturing sector to the GDP has declined over the same period.

Although efforts at the political level have been intensified to increase the agricultural sector's contribution to economic growth, there has been no significant impact on employment creation, or improvement in rural incomes. This is because growth in agriculture has been incapacitated by lack of adequate agro industries to spur demand for agricultural raw materials. While various programs have been designed to achieve sustainable agricultural growth, they have mainly focused largely on increasing farm productivity through the maximization of agronomic efficiency. Through the efforts by various agricultural research institutes, technologies for transforming smallholder agriculture have been developed for production through postharvest, but adoption of these remains low. Also, efforts to promote commercialization and agro enterprise development have not received adequate attention [1].

Nigeria is the largest producer of cassava in the world as shown in table 1 below. Its production is currently put at about 33.8 million tonnes a year [2]. Total area harvested of the crop in 2001 was 3.1 million ha with an average yield of about 11 t/ha. Cassava plays a vital role in the food security of the rural economy because of its capacity to yield under marginal soil conditions and its tolerance to drought. It is the most widely cultivated crop in the country; it is predominantly grown by smallholder farmers and dependent on seasonal rainfall. Rural and urban communities use cassava mainly as food in both fresh and processed forms. The meals most frequently eaten in the rural areas are cassava-based.

Cassava production is still carried out by manual labour using local simple farm implements such as hoes and knives in most parts of the country. There is a general absence of mechanized production to the local farmers who constitute the majority of the producers. Cassava roots are processed at household and cottage levels in the rural areas of the major cassava producing states by traditional methods handed down through time as cassava was adopted as food by the people. Processing at these levels involve mainly the production of garri, fermented and unfermented flour, as well as fufu(local delicacy) for both domestic consumption.

The processing of cassava roots into garri, flour and fufu are done involve peeling – grating (mashing) – dewatering/fermentation –sieving – frying – packaging. The process for production of flour involve peeling – cutting into pieces – sun drying – milling – sieving – packaging (for unfermented flour); peeling – cutting – steeping (soaking in water) and fermentation – (mashing) – sun drying –milling – sieving – packaging (for fermented flour). The process for fufu production is similar to fermented flour production except that the sun drying is omitted and the mash dewatered after sieving.

There was no indication of processing cassava root into chips and pellets for animal feeds in the country. Likewise, processing of cassava to value added products like alcohol, dextrins, glue, sweeteners, monosodium glutamate (MSG), modified starch etc are very low in the country and as at present, no bakery uses cassava flour for bread or biscuits [3].

Table 1: Production Levels of Cassava in Nigeria and other major Cassava Producing Countries (Reproduced from [3])

Country	Harvested Area (x160Ha)			Production Levels (MT)			Yield kg/0.16Ha		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
World Total	101,175	104,812	100,619	158,620	169,062	172,737	1,568	1,613	1,717
Nigeria	16,856	19,200	19,200	30,409	32,697	32,697	1,804	1,703	1,707
Brazil	9,913	9,891	10,667	19,809	20,892	22,960	1,998	2,112	2,152
Thailand	6,527	6,659	7,068	15,591	16,507	19,049	2,389	2,479	2,695
Indonesia	7,531	8,500	8,500	14,728	16,347	16,347	1,956	1,923	1,923
Congo	13,750	12,710	6,855	16,500	16,500	15,959	1,200	1,298	2,328
Ghana	3,938	4,063	4,063	7,172	7,845	7,845	1,821	1,931	1,931
India	1,531	1,563	1,563	5,868	5,800	5,800	3,833	3,711	3,711
Tanzania	4,331	4,375	5,301	6,193	7,182	5,758	1,430	1,642	1,086
Uganda	2,138	2,344	2,388	2,285	3,300	4,966	1,069	1,408	2,080
Mozambique	6,344	5,988	5,000	5,639	5,353	4,643	889	894	929
Others	28,316	29,519	30,014	34,426	36,603	36,713	1,216	1,240	1,223

2. Cassava processing and utilization

Cassava is a very versatile commodity with numerous uses and by-products. Each component of the plant can be valuable to its cultivator. The leaves may be consumed as a vegetable, or cooked as a soup ingredient or dried and fed to livestock as a protein feed supplement. The stem is used for plant propagation and grafting. The roots are typically processed for human and industrial consumption.

In Nigeria, the consumption pattern varies according to ecological zones. Garri, a roasted granule is the dominant product and is widely accepted in both rural and urban areas. It can be consumed without any additives, or consumed with a variety of additives such as sugar, groundnut, fish, meat and stew. *Fufu* and *Akpu*, a fermented wet paste from cassava is also widely consumed throughout the country especially in the southern zones.

Estimates of industrial use of cassava suggest that approximately sixteen percent of cassava root production was utilized as an industrial raw material in 2001 in Nigeria. Ten percent was used as chips in animal feed, five percent was processed into a syrup concentrate for soft drinks and less than one percent was processed into high quality cassava flour used in biscuits and confectionary, dextrin pre-gelled starch for adhesives, starch and hydrolysates for pharmaceuticals, and seasonings [4].

Cassava processing operations in Nigeria can be described at 5 levels of capacity. The common terms used to describe these capacity levels are household (or cottage), micro, small, medium and large. Household level processing typically does not employ any outside labour. The household consumes virtually all of the processed products and sells a small amount to raise income for additional household needs. At present, most Nigerian processors fall within this category.

At the micro processing capacity the employment of one or two units of labour may take place while processing a variety of cassava products. This enterprise typically uses batch processing. Batch processing may take four hours per day and this would be sufficient for the owner/operator.

Nigeria has a few cassava processors in this category of operation. The small and medium processing operations typically employ three to ten workers and are very sparse at present.

Large scale cassava processing is virtually non-existent in Nigeria. Large-scale operations are enterprises employing 10-30 or more labourers. Large-scale operations would also have the capacity for large tonnage processing with wider marketing opportunities.

Medium to large scale cassava processing equipment and fabricators of this equipment are few and far between in Nigeria. Garri is the only product that is currently able to push the industry from a traditional to a semi-mechanized process. Table 2 below shows daily cassava processing capacity by product and scale of operation in Nigeria.

Table 2. Daily processing capacity by scale of operation and product (Reproduced from [4])

Processing	Cottage to Small Scale	Small to Medium Scale	Medium to Large Scale
Chips	1 tonne/day		
Ethanol	50 litres/day	1 000 litres/day	2 000 litres/day
Malt Drink		100 litres/day	500 litres/day
Feeds	1 tonne/day	2 tonne/day	
Flour	1 tonne/day		
Gari	1 tonne/day		
Hard Pellet			120 tonne/day
Starch	1 tonne/day		

The need for innovative cassava processing technologies is enormous. Traditional cassava processing has a number of undesirable attributes. It is time consuming, provides low yields and lacks storage capacities. Time is spent peeling roots, washing, soaking, wet sieving and copiously adding water before pressing.

3. Cassava utilization in food industries

Most industrial processing of cassava is to produce starch and its by-products. Adhesives are made from cassava starch using simple technologies. These include gums made by gelatinizing starch by heat treatment without any additives and those made by adding different materials.

Starch is a polymer of glucose and hence it is the raw material for glucose. The hydrolysis of starch to glucose can be carried out by acid hydrolysis or enzyme hydrolysis. Starch is suspended in water approximately 25-30% solids, and sufficient HCL is added to bring it to a normality level of 0.01 – 0.02 HCL. It is heated in a converter under a pressure of 0.35kg/cm^2 for 15minutes and temperature range of 140-160^{0}C [5]. Glucose syrup is used widely in the confectionery and pharmaceutical industries.

Fructose syrup has gained importance in view of the harmful effects of synthetic sweeteners. Fructose is four times sweeter than glucose and the conversion of glucose to fructose can be achieved by alkali or by the enzyme glucoisomerase. Maltose is a disaccharide formed from two glucose units and is a reducing sugar. It can be obtained commercially from starch by enzyme treatment.

The process of producing starch-based plastics involve mixing and blending starch with suitable synthetic polymers as stabilizing agents and suitable amount of appropriate coupling, gelatinizing and plasticizing agents.

The Federal Government of Nigeria put in place a policy of ten percent inclusion of High Quality Cassava Flour (HQCF) into wheat flour for Bakery and Confectionery. This policy created a huge demand for HQCF by flour millers. However the government could not properly enforce the compliance of this policy as a result of inadequate supply of HQCF. So also there was a glut of cassava root tubers as a result of insufficient cassava processing facilities.

4. Production of cassava flour using flash dryer

Drying is an energy-intensive process. A pneumatic dryer is used in various branches such as: in the chemical, ceramic, mining, and food industries for drying grains, tubers and their flours. Pneumatic drying can be classified as a gas-solid transport system which provides a continuous convective heat and mass transfer.

A typical example of a pneumatic dryer is the cassava flash dryer. It major components are the heating chamber, flash duct, cyclone and exhaust fan as shown in Figure 1 below. The lumps of wet cassava flour are fed into the flash dyer through the feeder. It enters the drying chamber having a 1000 Watts rated heater and an agitator operated by a 3kW electric motor breaks the lumps of cassava mash into smaller particles. For the drying of cassava residues the transport and heating media is hot air, which is available through direct heating. The large surface for heat and mass transfer, as well as the high turbulence and relative velocities lead to high drying rates.

The mixture of the cassava flour passes through the inlet line and then to the flash duct. In the flash duct, drying take place due to reduction in pressure and the larger space for the air and cassava flour to mix together. From the flash duct through the inlet line, the mixture of cassava flour and hot air enters the cyclone.

Due to large pressure drop in the cyclone, cassava flour drops by gravity and the dried product is then collected at the exit port while hot air proceeds through the exhaust line. Furthermore the dryer needs only a small installation area and impresses with low capital costs in comparison with other types of dryers.

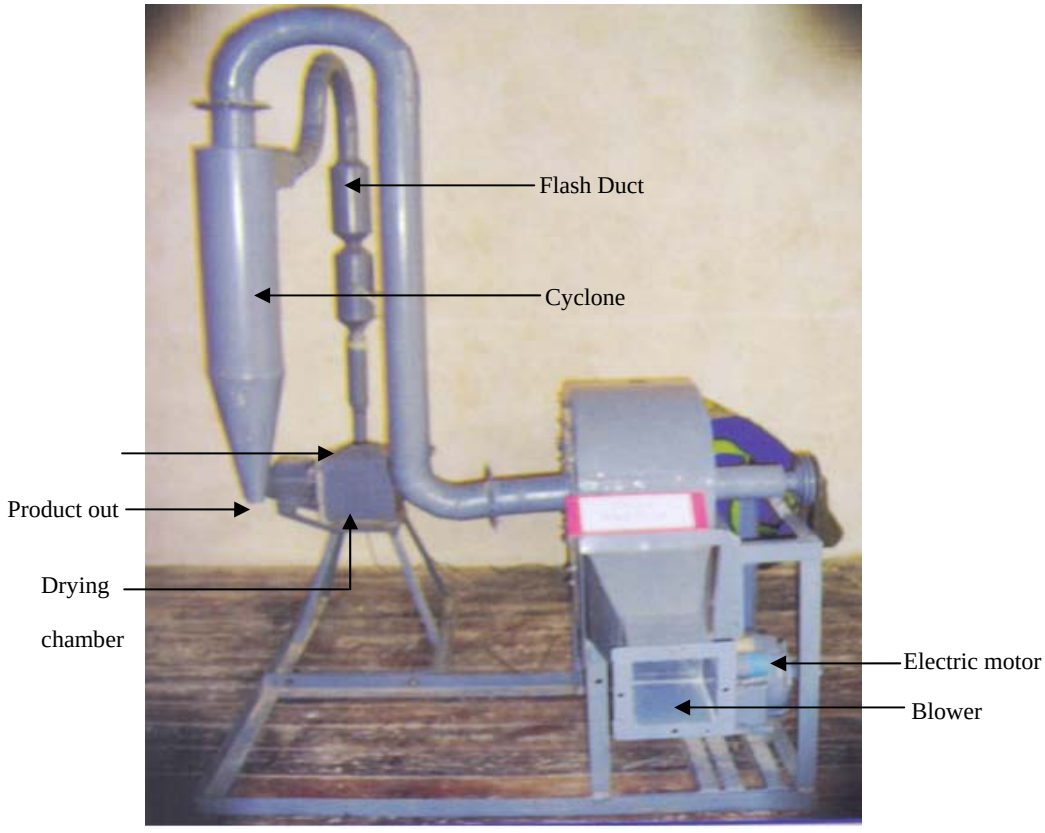

Figure 1: Locally fabricated mini cassava flash dryer

5. Experimental results and discussion

Pneumatic drying is generally described by the equations of convective heat transfer. The total energy input is necessary for: water evaporation, heating up the dry material and heat losses by radiation. The energy balance shows appropriate relations between the total provided energy, utilized energy, and heat losses in the drying process. The simplified drying system model is composed of four flows i.e. input and output of the drying mediums and the input and output flow of the drying material.
The calculation of the drying processes of a given flow rate of drying material leads to the necessary heat consumption. Therefore the calculation equation energetic balance for a drying process is given by [6]:

$$Q'_{Total} = Q'_{Evap.} + Q'_{Mater.} + Q'_{Loss} \quad (1)$$

Where, Q'_{Total} = Total heat supplied (kJ/s)

$Q'_{Evap.}$ = Heat for water evaporation

$Q'_{Mater.}$ = Heat for heating of drying material

Q'_{Loss} = Heat loss

$$Q'_{Mater.} = c.m'.(\theta_2 - \theta_1) \quad (2)$$

Where, c = specific heat capacity of the material (kJ/Kg^{0}K)

m' = quantity of moist material before drying (kg/s)

θ_1, θ_2 = temperature of the material before and after drying (^{0}C)

The quantity of drying air m^3/s is given by

$$V' = \frac{Q'_{Total}}{c_p(t_1 - t_2)} \quad (3)$$

c_p = specific heat capacity of air (kJ/Kg^{0}K)

t_1 = Air temperature at the inlet of the dryer (^{0}C)

t_2 = Air temperature at the out of the dryer (^{0}C)

Specific heat consumption in kJ/kg is given by:

$$q = \frac{Q'_{Total}}{W'} \quad (4)$$

Where, W' = quantity of evaporated water (kg/s).

During testing of the flash dryer, at the drying chamber temperature of 90^0C, a sample of 125.6g of cassava mash is fed into the chamber through the feeder. Three passes of the sample was carried out and the percentage drying per pass is calculated:

Initial mass of cassava mash before drying M_i = 125.6g

Mass of cassava flour after 1st pass M_1 = 58.7g

Percentage dryness after 1st pass $$D_1 = \frac{(M_i - M_1)}{M_i}\% \qquad (5)$$

D_1 = 53.2%

Mass of cassava flour after 2nd pass M_2 = 55.3g

Therefore percentage dryness after 2nd pass D_2 = 2.7%

Mass of cassava flour after 3rd pass M_3 = 53.3g

Percentage dryness after 3rd pass D_3 = 1.2%

Hence, 57.1% dryness was achieved after three passes of operation. The mass of cassava flour after the 3rd pass was then oven dried to remove the remaining moisture content of the flour.

Mass of cassava flour after oven drying M_4 = 41.2g

Percentage dryness after oven drying D_4 = 10.03%

The dryness curve for the drying operation in the flash dryer is shown in Figure 2 below.

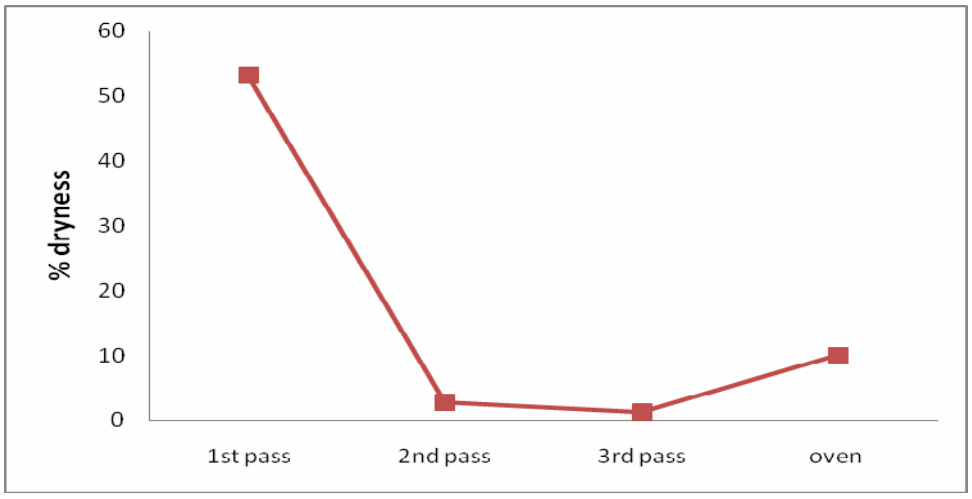

Figure 2. Dryness curve for cassava flour in the flash dryer

6. Conclusion

The parameterization, development and testing were carried out for a mini cassava flash dryer. The percentage of dryness achieved after three passes of cassava mash through the flash dryer was 57.1%. There is a greater need for improvement in component designing, assembly and testing over a period of time.

If cassava is processed and sold only at the primary level, the prospects for cassava as a source of income are limited. Nigeria has demonstrated the importance of cassava as more than a mere subsistence crop, and that a large volume industrial processing system can be developed around this crop. Value addition to cassava is a gradual process and long term survival will necessitate that higher value cassava flour be developed to meet local and international demands.

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Impediments To Educational Development Of Primary School Pupils In Ogbomoso. Ogbomoso Local Government Councils, (North And South). Oyo State. Nigeria

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ABSTRACT: Announcement across the World today perfectly reflects the scope of the sound knowledge receives from the primary schools. Additionally, the competence of Specialists, Engineers, Scientists, Bankers, technologist, Technicians must acquire their skills formally or informally are firmly connected and rated by other foundation in the primary schools. Among the major responsibilities of primary education are to train the child ability to reason logically and develop concepts which are formulated upon basic knowledge. In this paper, we study the impediments to educational development of primary school pupil in Ogbomoso, Oyo state - Nigeria. The study revealed the impediments to educational development of Primary Schools in Ogbomoso Local Governments, Oyo State. Nigeria. [Researcher. 2009;1(3):61-67]. (ISSN: 1553-9865).

KEYWORDS: Impediments, Primary School Pupils, Educational Development, Local Government Councils, Factors impending Educational Development.

INTRODUCTION

Comments and Statements about the state of our schools indicate that the standards of education have fallen. Many references have been made to English Language and Mathematics as prerequisites to success in overall examination. Those who point to the controversial issue possibly implies that the performance of Public Schools in Nigeria is declining when compared with past standards. In fact, an individual observation of primary school pupils in Oyostate unveils the traces of dividing educational quality. Questions are now being asked about what could be the cause of falling standards of education. (Joseph S. Owoeye, 2000) Evidence has shown that Foundation is very important in a building. A building with a weak Foundation may likely be a bad building which cannot with stand tension. The building that is good is the one whose foundation is solid. This analogy can be applied to educational development of a child. Primary education is the foundation of any educational attainment in life. The quality of education obtained by a pupil at primary school would determine the performance of such a student at secondary and tertiary levels. Additionally, the competence of Specialists, Engineers, Scientists, Bankers, Technologist, and Technicians who acquire their skills formally or informally are firmly connected and rated by their Primary education foundation. Among the major responsibilities of Primary education are to train the child the ability to reason logically and develop concepts which are formulated upon basic knowledge. It is important to have it in mind that Primary education is the foundation for subsequent education and training, academic and vocational and for some people, preparation for modern economic effort. Thus Primary education must lay the foundations for an industrial and agricultural labor force in which the most common skill is that of functional literacy and also provide a sufficiently rigorous preparation for more advance level of education. According to Akinboye (1980) in his book titled "Psychology of Discipline in Contemporary Nigerian Education System" stated that the aims of primary education in Nigeria today are to train the children physically, intellectually, morally and spiritually. Ukeje (1979) in his own book titled "Foundation of Education" pointed out that the aims of primary education is to make it possible for one to live as full and as happy a life as possible. The most important reason for that is to help one to learn and to appreciate things in life- good books, art, health, law, government rending source etc. rather than pursuit of money for its sake and for the power that it brings.

It is an undisputed fact that Nigeria needs Improvement in the educational development of primary school in Oyo state. Why does the country need that, one may ask? To the question, a good answer is to improve or solve the impediments to educational development of primary school pupils in Oyo state-Nigeria.
The present state of primary education system as compared with the past has assumed a declining trend, which is to the dissatisfaction of the general public; therefore the need arises as to look into the impediments to educational development of primary school pupils in Oyo state- Nigeria.

The purpose of this study is to look at the impediments to educational development of primary school pupils in Oyo state- Nigeria, and make suggestion(s) on how to improve and promoting educational development of primary school pupils. Also advocate convincing the policy makers.

STATISTICAL ANALYSIS: The data analysis was done using X^2 (Chi-square) test at α level of Significance, to determine the hypothesis to be accepted or rejected.

HYPOTHESIS TESTING: The following hypotheses were made.

Ho_1 ÷ There is no significant difference between family socio-economic status and educational development of primary school pupils.

Ho_2 ÷ There is no significant difference insufficient funding of primary school and educational development of primary school pupils.

Ho_3 ÷ There is no significant difference between lack of professional guidance and counseling service and educational development of primary school pupils.

MATERIALS AND METHODS

The investigation of the study was carried out ex-post facto. A multi-stage probability proportion to size (MPPS) sampling technique was used to determine the number of schools to be chosen as sample. These schools spread across Ogbomoso North and South local government area in Ogbomoso, Oyo state-Nigeria. Five primary schools were selected in each local government to carry out the study. Secondary data were collected from 10 schools five each from the two local governments: [Ogbomoso North and South local government] The Schools were randomly selected on the basis of the following formula:

$$S = \frac{L}{O} * \frac{M}{I}$$

Where:

S = Number of sample from the selected Local Government Area.
L = Number of primary schools in the each Local Government.
O = Total number of primary schools in Ogbomoso Township.
M = Maximum number of schools to be sampled.

We critically examine and have the following outcomes from the questionnaires that were given to the respondents. Out of 150 questionnaires 100 were returned.

RESULTS

For convenience and easy understanding of the descriptive analysis, the results of the study were tabulated as shown in Table 1.The parameters/factors used were highlight in terms of frequency and percentage.

Table 1: Distribution of Respondents by their Personal Characteristics.

Variable	No of Respondents	% Scored
Age:		
Below 20	-	
21 - 30	18	18
31 - 40	52	52
41 - Above	30	30
Total	**100**	**100**
Sex:		
Male	39	39
Female	61	61
Total	**100**	**100**
Marital Status:		
Single	11	11
Married	89	89
Divorced	-	-
Widow/Widower	-	-
Total	**100**	**100**
Religion:		
Christianity	64	64
Islam	36	36
Traditional	-	-
Free Thinker **Total**	-	-
	100	**100**
EDUCATION:		
Sec. Schl. Cert.	1	1
Grade II Cert.	3	3
N.C.E./ OND	90	90
B.Sc /B.A / B.Ed	3	3
HND	3	3
M.Ed / PhD	-	-
Total	**100**	**100**
Occupation:		
Trading	-	
Teaching	100	100
Civil Servant	-	
Clergy	-	
Others	-	
Total	**100**	**100**

Table 2: Observed frequency regarding the family socio- economics status against educational development of primary school pupils.

	Yes	No	Total
Male	35	4	39
Female	56	5	61
Total	91	9	100

Table 3: Expected frequency regarding the family socio- economics status against educational development of primary school pupils.

	Yes	No
Male	35.49	3.51
Female	55.51	5.49

Table 4: The calculated Chi-square, regarding the family socio- economics status against educational development of primary school pupils.

Trial	1	2	3	4	
Observed Fr (O)	35	4	56	5	
Expected Fr (E)	35.49	3.51	55.51	5.49	
O- E	-0.49	0.49	0.49	-0.49	
$(O - E)^2$	0.2401	0.2401	0.2401	0.2401	
$(O - E)^2 / E$	0.006765	0.068	0.004	0.04	0.118765

Table 5: Observed frequency regarding insufficient funding of primary school impedes educational development of primary school pupils.

	Yes	No	Total
Male	33	6	39
Female	58	3	61
Total	91	9	100

Table 6: Expected frequency regarding insufficient funding of primary school impedes educational development of primary school pupils.

	Yes	No
Male	35.49	3.51
Female	55.51	5.49

Table 7: The calculated Chi-square regarding insufficient funding of primary school impedes educational development of primary school pupils.

Trial	1	2	3	4	
Observed Fr (O)	33	6	58	3	
Expected Fr (E)	35.49	3.51	55.51	5.49	
O- E	-2.49	2.49	2.49	-2.49	
$(O - E)^2$	6.2001	6.2001	6.2001	6.2001	
$(O - E)^2 / E$	0.17	1.17	1.1116	1.04	3.0216

Table 8: Observed frequency regarding lack of professional guidance and counseling services retards primary school pupils educational attainment.

	Yes	No	Total
Male	35	4	39
Female	36	5	61
Total	91	9	100

Table 9: Expected frequency regarding lack of professional guidance and counseling services retards primary school pupils educational attainment .

	Yes	No
Male	35.49	3.51
Female	55.51	5.49

Table 10: calculated Chi-square, regarding lack of professional guidance and counseling services retards primary school pupils educational attainment.

Trial	1	2	3	4	
Observed Fr (O)	35	4	56	5	
Expected Fr (E)	35.49	3.51	55.51	5.49	
O- E	-0.49	0.49	0.49	-0.49	
$(O - E)^2$	-0.2401	-0.2401	-0.2401	-0.2401	
$(O - E)^2 / E$	0.006765	0.068	0.004	0.004	0.118765

DISCUSSION OF RESULTS

Table 4, shows the calculated Chi-square, regarding the family socio- economics status against educational development of primary school pupils which is less than Chi-square Table which is 3.84 at α = 0.05, with degree of freedom of 1. Hence we accept the working hypothesis. Conclusively, this signifies that family socio-economic status hindering educational development of primary school pupils.

Table 7, shows the calculated Chi-square regarding insufficient funding of primary school impedes educational development of primary school pupils. It was observed from this table 7 that the Chi-square table value of 3.84 at α = 0.05, degree of freedom of 1 is greater than X^2 calculated which is 3.0216. We now concluded that insufficient funding of primary schools impedes educational development of primary school pupils.

Table 10, shows the calculated Chi-square, regarding lack of professional guidance and counseling services retards primary school pupils educational attainment. From this table 10, we discovered that the table X^2 at α = 0.05, degree of freedom 1, which is 3.84 is greater than calculated X^2 which is 0.118765. This result leads to the acceptance of the working hypothesis. Conclusively, this signifies that lack of professional guidance and counseling service retards primary school pupils educational development.

CONCLUDING REMARKS ON THE FACTORS IMPENDING EDUCATIONAL DEVELPOMENT OF PRIMARY SCHOOL PUPILS IN OYO STATE, NIGERIA

What constitutes to impediments of educational development of primary school pupils in Oyo state, Nigeria, can be discussed on there main points

- **ON THE PART OF THE GOVERNMENT**
  1. **Increase in the number of primary school pupils / poor renumeration / irregular promotion:** According to Aderounmu and Eliametatlor (1983) in their book titled "An Introduction to the Administration of School in Nigeria" asserted that increase in the number of primary school pupils without corresponding increase in the basic infrastructure vis-à-vis teachers, poor renumeration vis-à-vis irregular promotion, salaries and allowances not promptly paid at months end, and all contributing factors impending education development of primary school pupils.

2. **Lack of educational teaching equipment / materials:** On the 10th Nov, 1992, Nigeria Daily Newspaper, page 4 enumerated some causes of falling standard of pupils' educational development in primary school nowadays. It claimed that the schools lacked necessary equipments including school furniture .The paper agreed that there are instances when parents were forced to contribute money to buy Chalks, desks, benches and other minor teaching materials for use in school, describing the situation as dangerous to the future of education and pupils educational development in general.
3. **Government educational policies:** The introduction of educational policy like, continuous assessement . According to W.O Aderounmu et al; in the book titled " Nigerian Certificate in Education series published for the Ondo state College of Education Ikere – Ekiti, observed that the continuous assessement programme introduced by the Government requires much time and devotion on the part of the teachers.
4. **Lack of personnel:** The process of assessement is characterized by metriulous keeping of records.when there is shortage of special personnel to handle records keeping,
5. **Re - evaluation of School Curriculum:** The Curriculum in our school need to be re – evaluated and the government the Government need to look into the improvement of the Curriculum.

- **ON THE PART OF THE PARENT**

1. **Socio – economic Status of Parents:** According to Chapman Dictionary he said that "the socio – economic status can be judged by income, occupation, education, culture and the standard of living of an individual in a society"

In 1973, Ogunlade conducted a reseach on the family socio – economic status and educational development of some pupils in Western State of Nigeria. His findings showed that Children from literate homes had educational achievement than those from illiterate homes.

2 **Non provision of educational material by Parents**: Many Parents fail to provide necessary school materials like School Uniform, Text Books, Exercise Books, Pens and Rulers. Failure to have these, the pupil may be Sent out or going to the classroom lately, he will surely miss some subjects taught while he was not in the class. Take home assignments are generally given to pupils from their textbooks and pupils without such textbooks will either not do them or will do well at the end of the examination, this factor impedes educational development of such pupils.

- **ON THE PART OF THE PUPIL(S):**

1 Absence from school: Pupil constant and proper attendance at School Constitute on improvement factor which influence his educational development both nature and academic. Such Pupil would have enough time to prepare himself for Classes more so text and assessment. Rate of School attendance serve as a dominant factor impending educational development of primary school pupils.

2 **Failure to do assignment:** Failure of the pupil(s) to be doing the assignment given to them serve as impediment to educational development of primary school pupil(s)

RECOMMENDATIONS

Evidence have shown that there were many factors responsible for the impediments to educational development of primary school pupils, in respect of these factors there is necessary to provide solution to these problems. The recommendations below may make for curbing or minimizing the impediments to educational development of primary school pupils.

- Qualified trained teachers should be employed by Government to achieve meaningful services in our primary schools.
- Funds should be make available by the government for the provision of teaching aids, Instructional materials, books, libraries and their services in our schools.
- Boarding – house system should be re-introduced by government in our primary schools to solve the problem of absenteeism by pupils and close supervision of pupils by their teacher will be easily done.
- Government should make funds and adequate transport available to supervisory personnel in the Ministry of Education to enable them undertake visitation to primary school regularly.
- Government should see to it that there are regular and adequate supervision of primary school teachers.
- Unnecessary transfer of teachers should be reduce or minimize by the Ministry of Education.
- Social amenities like good pipe-borne water, adequate power supply, hospitals or clinic should be provided by the government.
- Recreational facilities for sport activities and indoor games should be provided in all our primary schools.
- Professional Counselor's should be employed by government to render their services of guidance and counseling to our primary school pupils.
- Parents should make sure that they provide necessary materials that will facilitate learning to their wards, like text book, exercise books, pens, ruler, school uniform, etc.
- Government should see to the primary education to be more meaningful and interesting to our pupils.
- Teaching and learning should be carry out in local language(s) to make the primary school education more interesting to the pupils.

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Population Model of Esan West Local Government Area of Edo State, Nigeria

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ABSTRACT: This paper focused on population dynamics of the people of Esan West Local Government Area of Edo State, in Nigeria. The logistic model was used and it was found that the growth rate of the people for the sixteen years to be 0.035. A projection of the population for the next twenty years was then made. The carrying capacity was equally studied in this paper. [Researcher. 2009;1(3):68-72]. (ISSN: 1553-9865).

Keywords: Population dynamics, carrying capacity, growth rates and logistic Model

1. INTRODUCTION

Population dynamics is the study of marginal and long term changes in the number of individuals, sex, and weight and age composition in a particular location. Several factors which include the individual biological and environmental processes influence the changes in the population. This changes according to Ibrahim and Lewis (2006) results in addition or reduction of members of the population.

This study reviews mathematical models of population dynamics of human population and explores the varying rate of population growth of the people over a defined period of time. Apart from scattered census records or figures kept, there has been no unified mathematical model of such population figure or data developed with the aid of describing the statistical properties of data related to such population figures or data. Due to ever increasing population growth naturally, it become more necessary to introduce the most common quantitative approach to population dynamics, taking note of the different theoretical foundations and assumptions to such population. Strategic planning gives an interesting background the population research survey and evaluation of the data with the aid of mathematical models. "The study of population dynamics must begin with fertility. This refers to the population" (McFalls, 1995). The number of people that the environment can support is called the carrying capacity.

Keyfitz and Flieyer (1990) were the first to analysis the human population in their work on world population growth and aging. The use of logistic model to study human population was received in 1920 by Pearl and Read. They compared the census figures for the population of United State of America from 1790 – 1910 with the values which was predicted from logistic model. An illustration of a population which is growing exponentially has results described in Rubinon (1975). Kimbir et al (2003) in the work using compartmental modeling for stable student population found the rate and the population of graduating students of Benue State University, Makurdi, Nigeria.

Ibrahim and Lewis (2006) used the logistics model to study and determine the population growth and projection of the people in Gwer local government area of Benue State.

2. METHODOLOGY

The following assumptions will be applied to this study:

i. Age and sex differences between the population can be ignored
ii. Each member of the population has an equal chance of dying and surviving.
iii. The population is isolated, that is no immigration or emigration or that immigration equal to emigration.
iv. Birth rate and death rate are proportional to the size of the population at any given time.
v. The rate of growth of the population is proportional to the size of the population.

In the derivation of the logistic equation, the plausibly of the mathematical form of the growth rate is assumed without any assumptions about the relationship between the population growth rate and the environment support, or about the mechanisms of interactions between individuals and the environment. We supposed that, for individual or members of the population, the environment ensures enough resources. The carrying capacity can only be measured a posterior through the asymptotic solution.

$$N(t) \rightarrow k \text{ as } t \rightarrow \infty$$

Let the rate of growth of the population be the sizes of population. That is

$$\frac{dN}{dt} = r\,N(t) \qquad (1.1)$$

r is the growth rate constant. Equation 1.1 can be solved by separating the variable and on integrating, we have

$$N(t) = Ce^{rt} \qquad (1.2)$$

Where C is the constant representing e^{c} for increasing population without bound, as $t \rightarrow \infty$, the population reaches a point where the environment can no longer support it. We call this point k, the carrying capacity of the environment.

If r is the growth constant, then a reasonable modification of r to support k is given as

$$r = \left(1 - \frac{N}{K}\right) \qquad (1.3)$$

Substituting for r in equation 1.1 gives

$$\frac{dN}{dt} = r\left(1 - \frac{N}{K}\right) \qquad (1.4)$$

Equation 1.4 is known as the logistics equation.

Separating the variables and integrating equation 1.4 and using partial fraction technique, we have

$$\ln\frac{N}{K} - \ln\frac{(N-K)}{K} = \frac{rt}{K} + c \qquad (1.5)$$

Solving for ℓ as t = 0 and $N = N_0$,

$$\ln\frac{No}{K} - \ln\frac{(No-K)}{K} = c \qquad (1.6)$$

Substituting for ℓ in equation 1.5 and multiplying through by k and taking exponential of both sides of equation gives

$$\frac{N}{N-K} = e^{n}\frac{No}{No-K} = \frac{No}{No-K} \qquad (1.7)$$

Solving for N and dividing through by N_0e^{n}, we have

$$N = \frac{K}{\left(-1+\frac{K}{No}\right)e^{-n}+1} \qquad 1.8$$

We re – write equation 1.8 as

$$N(t) = \frac{K}{\left(\frac{K}{No}-1\right)e^{-n}+1} \qquad (1.9)$$

If the limits $t \to \infty$, N (t) $\to$ k, the expression N (t) gives the initial condition $N = N_0$ the carrying capacity K can be found from equation 1.7as

$$K = \frac{(NNoe^{rt} - NNo)}{Noe^{rt} - N} \qquad (1.10)$$

3. MATERIALS

Esan – West local government has approximately 125,842 inhabitants with 63,785 males and 62,057 females in the Census Report (2006). See Appendix.

The projected annual growth rate from 1991 population census was 3.1%, where the total population was estimated to be 75,832 people with 37,635 males and 38,197 females.

4. APPLICATION

Given that N (t) = 125,842; c = 75,832; t = 15. Using $N(t) = N_0e^{rt}$, where

N_0 = 75,832; r = 0.35%, which means that the percentage rate of growth is 3.5%.

Using equation (1.10), we have k = 210,830.

To predict the population in the Local Government Area from the year 2008,

t = 10 years, r = 3.5%, N_0 = 125,842; k = 210,830; therefore N (t) = 190,157

And for (t = 20 years) in the next 20 years N (t) = 268,236 and the carrying capacity k = 210,830.

This means that the Local Government Area can no longer contain the population of the people and this would result in chaos. That is N (t) as t $\rightarrow \infty$ would equal k = 210,830.

5. CONCLUSION

From the logistic model used, it was found that for the next twenty years the population estimate of the local government would be 268,236 but that as t tends to infinity the carrying capacity k would be 210,830. This implies in a realistic situation, resources would be exhausted when the population attains the equilibrium value. That is, when N (t) = k = 210,830. This means that the population becomes more than the local government can carry or readily carter for and thus this result in competition for space, land dispute, food, shelter and finally outbreak of various diseases.

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APPENDIX

Male	Year	Female	Total
37635	1991	38197	75832
38802	1992	39381	78185
40005	1993	40602	80607
41245	1994	41861	83106
42523	1995	43158	86681
43841	1996	44496	88338
45201	1997	45876	91077
46602	1998	47298	93900
48046	1999	48764	96810
49536	2000	50276	99812
51072	2001	51836	102906
52655	2002	53442	106096
54288	2003	55099	109385
55970	2004	56807	112776
57706	2005	58568	116272
63785	2006	62057	125842

Source:

NPC, Nigeria; State and L.G.A. Demographic Profile 1991 – 2010, published November, 1991: NPC New Census 2006 Result.

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Evaluation Of The Rotor Aerodynamics Of A Wind Turbine Using Combined Blade Element And Momemtum Theory

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Abstract: The analysis of the rotor aerodynamics is based on the combined blade element and momentum theory and the content is directed toward the physics of power extraction by wind turbines at both the near and far wake regions. The near wake is the area just behind the rotor, where the properties of the rotor can be discriminated, so approximately up to one rotor diameter downstream and the far wake is the region beyond the near wake, where the focus is put on the influence of the wind turbines in farm situations. A wind turbine extracts energy from the wind by producing a step change in static pressure across the rotor-swept surface. Turbine rotor is the component which exhibits the largest proportion of fatigue failure and the centrifugal and gravity loads are primarily responsible. The generalized Fokker-Planck equation which is a partial differential equation satisfied by the probability density function is employed in modeling the turbine power. [Researcher. 2009;1(3):73-83]. (ISSN: 1553-9865).

Keywords: Rotor aerodynamics, near wake, far wake, rotor-swept surface, turbine power.

1. Introduction

The conversion of wind energy to useful energy involves two processes: the primary process of extracting kinetic energy from wind and conversion to mechanical energy at the rotor axis, and the secondary process of the conversion into useful energy, mostly electrical energy [1]. Wind turbines extract energy from the wind by producing a step change in static pressure across the rotor-swept surface. As the air approaches the rotor it slows down gradually, resulting in an increase in static pressure. The reduction in static pressure across the rotor disk results in the air behind it being at sub atmospheric pressure. As the air proceeds downstream the pressure climbs back to the atmospheric value resulting in a further slowing down of the wind. There is therefore a reduction in the kinetic energy in the wind, some of which is converted into useful energy by the turbine [2].

The major field science involved in this process is aerodynamics, but it needs meteorology (wind description) as input, and system dynamics for the interaction with the structure. The latter is important since all movement of the rotor blades, including bending of the blades out of their plane of rotation, induces apparent velocities that can influence or even destabilize the energy conversion process.
Aerodynamics is the oldest science in wind energy; in 1915, Lanchaster [3] was the first to predict the maximum power output of an ideal wind turbine. A major break-through was achieved by Glauert [4], by formulating the blade element momentum (BEM) method. This method extended with many ‘engineering rules’ is still the basis for all rotor design codes.

Progress is significant in the 30-year history of modern wind energy. Nevertheless, many phenomena are still not fully understood or quantified. This is due to several aspects that are unique for wind turbine aerodynamics.

2. Generalized Actuator disc model

To aid the understanding of combined blade element and momentum theory it is useful initially to consider the rotor as an "actuator disc". Although this model is very simple, it does provide valuable insight into the aerodynamics of the rotor. In fluid mechanics the actuator disc is defined as a discontinuous surface or line on which surface forces act upon the surrounding flow. In rotary aerodynamics the concept of the actuator disc is not new. Indeed, the actuator disc constitutes the main ingredient in the one-dimensional momentum theory, as formulated by Froude [5] and the 'classical' BEM method by Glauert. Some of the assumptions made are that, thrust load and velocity are uniform over the disc and the upstream and downstream, the pressure is freestream static pressure.

Usually, the actuator disc is employed in combination with a simplified set of equations and its range of applicability is often confused with the particular set of equations considered.

In the case of a horizontal axis wind turbine the actuator disc is given as a permeable surface normal to the freestream direction on which an evenly distribution of blade forces acts upon the flow. In its general form the flow field is governed by the unsteady, axisymmetric Euler or Navier-strokes equations, which means that no physical restrictions need to be imposed on the kinematics of the flow.

The first Non-linear actuator disc model for heavily loaded propellers was formulated by Wu [6]. Although no actual calculations were carried out, this work demonstrated the opportunities for employing the actuator disc on complicated configurations as e.g. ducted propellers and propellers with finite hubs. Later improvements, especially on the numerical treatment of the equations are due to [7,8] and recently Conway [9,10] has developed further the analytical treatment of the method. In the application of the actuator disc concept for wind turbine aerodynamics the first non-linear model was suggested by Madsen [11], who developed an actuator cylinder model to describe the flow field about a vertical-axis wind turbine, the Gyro mill. This model has later been adapted to treat horizontal axis wind turbines. Recent development of the method has mainly been directed towards the use Navier-stokes equations.

2.1 The Navier-Stokes Equations

In a numerical actuator disc model, the Navier-stokes (or Euler) equations are typically solved by a second order accurate finite difference volume scheme as in a usual computational fluid dynamics (CFD) computation. Equations:

$$\frac{\partial \vec{V}}{\partial t} = \nabla.(\vec{V} \otimes \vec{V}) \qquad = -\frac{1}{\rho}\nabla P + \nu\nabla.\left[\left(1+\frac{\nu_t}{\nu}\right)\nabla\vec{V}\right] + \vec{f} \tag{1}$$

$$\nabla.\vec{V} = 0, \tag{2}$$

Where $\vec{V}$ denote Reynolds-averaged velocity, P is the pressure denotes time and ρ is the density of the fluid and ν is the kinematic viscosity. The Reynolds stresses are modeled by the eddy-viscosity, ν_t and body force, $\vec{f}$, is introduce in order to model external forces fields.

These equations constitute three transport equations, which are parabolic in time and elliptic in space, and equation of continuity stating that the velocity is solenoidal. The main difficulty of this formulation is that the pressure does not appear explicitly in the equation of continuity. The role of the pressure, however, is to ensure the continuity equation be satisfied at every time instant. A way to circumvent this problem is to relate the pressure to the continuity equation by introducing an artificial compressibility term into this [12] .Thus, an artificial transport equation for the pressure is solved along with the three momentum, equations ensuring a solenoidal velocity field when a steady state is achieved. The drawback of this method is that only time-independent problems can be considered.

Another approach, the pressure correction method, is to relate the velocity and pressure fields through the solution of a Poisson equation for the pressure. This is obtained by taking the divergence of the momentum equations, resulting in the following relation:

$$\nabla^2 P = -\rho\nabla.\left[\nabla.(\vec{V} \otimes \vec{V}) - \nu_t\nabla\vec{V}\right] \tag{3}$$

which is solved iteratively along with the momentum equations. As an alternative to the $\vec{V}$ - P formulation of the Navier-stokes equations, vorticity based models may be employed. The vorticity, defined as the curl of the time-average velocity

$$\vec{\omega}^{*} = \nabla \times \vec{V} \qquad (4)$$

This is introduced as primary variable by taking the Curl Eqn. (1).The result is the following set of equations:

$$\frac{\partial \vec{\omega}}{\partial t} + \nabla \times (\vec{\omega} \times \vec{V}) = -\nu \nabla^2 \left[\left(1 + \frac{\nu_t}{\nu} \right) \vec{\omega} \right] + \nabla \times \vec{f} + Q_\omega \qquad (5)$$

$$\nabla \times \vec{V} = \vec{\omega}, \quad \nabla . \vec{V} = 0, \qquad (6)$$

Where Q_ω contains some additional second order terms from the Curl operation. The equations can be formulated in various ways. The Cauchy-Riemann part of Eqn.(6) may be replaced by a set of Poisson equations

$$\nabla^2 \times \vec{V} = -\nabla \times \vec{\omega} \qquad (7)$$

If we consider Eqn.(5) in an arbitrarily moving frame of reference we get

$$\frac{\partial \vec{\omega}^{*}}{\partial t} + \nabla \times (\vec{\omega}^{*} \times \vec{V}) = -\nu \nabla^2 \left[\left(1 + \frac{\nu_t}{\nu} \right) \vec{\omega}^{*} \right] + \nabla \times \vec{f} + Q_\omega, \qquad (8)$$

Where the velocity vector $\vec{\omega}^{*}$ refers to the inertial system

$$\vec{\omega}^{*} = \vec{\omega} + 2\vec{\Omega}$$

$$\vec{\Omega} = (\Omega_{x,} \Omega_y, \Omega_z \qquad (9)$$

$\vec{\Omega}$ denotes the angular velocity of the coordinate system. However, the geometry of the blades and the viscous flow around the blades are not resolved. Instead the swept surface of the blades is replaced by surface forces that act upon the incoming flow at a rate corresponding to the period-averaged mechanical work that the rotor extracts from the flow.

In the simple case of an actuator disc with constant prescribed loading, various fundamental studies can be easily carried out. Comparisons with experiments have demonstrated that the method works well for axisymmetric flow conditions and can provide useful information regarding basic assumptions underlying the momentum approach [13,14] turbulent wake states occurring for heavily loaded rotors [15,16], and rotors subject to coning [17,18].

When computing the flow past an actual wind turbine, the aerodynamic forces acting on the rotor are determined from two-dimensional aerofoil characteristic, corrected for three-dimensional effects, using a blade-element approach.

In Figure1, a cross-sectional element at radius r_i defines the aerofoil in the (θ,z) plane.

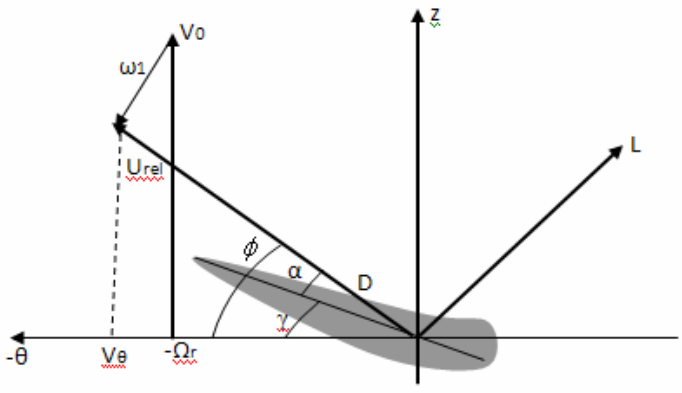

Figure 1. Cross-sectional aerofoil element

Denoting the tangential and axial velocity in the inertia frame of reference as V_o and V_z respectively. The local velocity relative to the rotating blade is given as

$$V_{rel} = (V_\theta - \Omega r, V_z). \quad (10)$$

The angle of attack is defined as

$$\alpha = \phi - \gamma, \quad (11)$$

Where $\phi = \tan^{-1}(V_z / (\Omega_r - V_\theta))$ is the angle between V_{rel} and the rotor plane.

The distribution of the surface forces, ie force per unit rotor area is given by the following expressions:

$$f_{2D} = \frac{dF}{dA} = \frac{1}{2}\rho V_{rel}^2 Bc(C_L e_L + C_D e_D)/(2\pi r_i) \quad (12)$$

Where $C_L = C_L(\alpha, R_e)$ and $C_D = C_D(\alpha, R_e)$ are the lift and drag coefficients respectively is the chord length is the numbers of blades and e_L and e_D denote the unit vectors in the directions of the lift and drag respectively.

2.11 Lift and Drag Coefficients

The lift and drag coefficients are defined for an aerofoil by

$$C_L = L/(\frac{1}{2}\rho V^2 S^*) \quad (13)$$

$$C_D = D/(\frac{1}{2}\rho V^2 S^*) \quad (14)$$

Where L and D are the lift and drag forces, S^* is the platform area of the aerofoil.

The lift and drag coefficients are determined from measured or computed two-dimensional aerofoil data that are corrected for three-dimensional effects. There are several reasons why it is necessary to correct the aerofoil data. First, at separation rotational effects limit the growth of the boundary layer, resulting in an increased lift as compared to two-dimensional characteristics. Next, the aerofoil characteristics depend on the aspect ratio of the blade. This is in particular pronounced at high incidences where the finite aspect ratio drag coefficient, C_D, is much smaller than the corresponding one for an infinite blade.

As and example, for a flat at an incidence $\alpha=90^0$, the drag coefficient C_D =2 for an infinitely long plate, whereas for aspect ratio corresponding to the geometry of a wind blade C_D takes values in the range 1.2-1.3.

Hoerner [19] stated that the normal force from a flat plate is approximately constant for $45^0 < \alpha < 135^0$, indicating that in this range both C_L and C_D have to be reduced equally.

Hassen [20] proposed to reduce C_L and C_D by an expression that takes values in range from 0.6 to 1.0, depending on the ratio between the distance to the tip and the local chord length. It should be noticed, however that this is only a crude guideline and that most aerofoil data for wind turbine use is calibrated against actual performance and load measurement.

3. Blade-Element Model

Combined blade element and momentum theory is an extension of the actuator disc theory described above. The rotor blades are divided into a number of blade elements and the theory outlined above used not for the rotor disc as a whole but for a series of annuli swept out by each blade element and where each annulus is assumed to act in the same way as an independent actuator disc. At each radial position the rate of change of axial and angular momentum are equated with the thrust and torque produced by each blade element.

The thrust dT developed by a blade element of length dr' located at radius r' is given by

$$dT = \frac{1}{2}\rho W_i^2 (C_L \cos\phi + C_D \sin\phi) c dr' \quad (15)$$

Where W_i is the magnitude of the apparent wind speed vector at the blade element.

Also, the torque dQ developed by the blade element of length dr' is given by

$$dQ = \frac{1}{2}\rho W^2 r' (C_L \sin\phi - C_D \cos\phi) c dr' \quad (16)$$

In order to solve for the axial and tangential flow induction factors appropriate to the radial position of a particular blade element, the thrust and torque developed by the element are equated to the rate of change of axial and angular momentum similar to those derived for the actuator disc.
The annular induction factors may be expressed as follows

$$a = \frac{g_1}{(1+g_1)}, a' = \frac{g_2}{(1-g_2)} \quad (17)$$

Where, $g_1 = \frac{Bc}{2\pi r'} \frac{(C_L \cos\phi + C_D \sin\phi)}{4F \sin^2\phi} H$

And , $g_2 = \frac{Bc}{2\pi r'} \frac{(C_L \sin\phi - C_D \cos\phi)}{4F \sin\phi \cos\phi}$ (18)

The parameter H is defined as follows:

for $a \leq 0.3539$, $H = 1.0$, and for $a > 0.3539$, $H = \frac{4a(1-a)}{(0.6 + 0.61a + 0.79a^2)}$

In the situation where the axial induction factor a is greater than 0.5, the rotor is heavily loaded and operating in what is referred to as the "turbulent wake state".

4. Modeling the Wind

The wind field incidence on the turbine may be specified in a number of ways. For some simple calculations, a uniform, constant wind speed is assumed, such that the same incident wind speed is seen by every point on the rotor. For more detailed calculation however, it is important to be able to define both the spatial and temporal variations in wind speed and direction.
The steady-state spatial characteristics of the wind field may include any combination of the following elements, wind shear, tower shadow and upwind turbine wake. When regarding wakes, a distinct division can be made into the near and far wake region. The near wake is taken as the area just behind the rotor, where the properties of the rotor can be discriminated, so approximately up to one rotor diameter downstream. Here, the presence of the rotor is apparent by the number of blades, blade aerodynamics, including stalled flow, 3-D effects and the tip vertices.
The far wake is the region beyond the near wake, where the focus is put on the influence of the wind turbines in farm situations. Here the focus is on wake models, wake interference, turbulence models and topographical effects.

4.1 Near wake Computations

Although there exist a large variety of method for predicting performance and loadings of wind turbines, the most widely used approach today is based on the blade element and momentum theory. A basic assumption in the BEM theory is that the flow takes place in independent stream tubes and that the loading is determined from two-dimensional aerofoil characteristics. The advantage of the model is that it is easy to implement, it contains most of the physics representing rotary aerodynamics, and it has proven to be accurate for the most common flow conditions and rotor configurations. A drawback of the model is that it, to a large extent relies on empirical input which is not always available. Even in the simple case of a rotor subject to steady axial inflow, aerofoil characteristics have to be implemented from wind tunnel measurements. The description is further complicated if we look at more realistic operating situation. Wind turbines are subject to atmospheric turbulence, wind shear from the ground effect, wind directions that change both in time and in space, and effect from the wake of nearby wind turbines.
When the wind changes direction, misalignment with the rotational axis occurs, resulting in yaw error. This causes periodic variation in the angle of attack and invalidates the assumption of axisymmetric inflow conditions. Furthermore, it gives rise to radial flow component in the boundary layer. Thus both the aerofoil characteristics and the wake are subjected to complicated three-dimensional and unsteady flow

behaviour, which only in an approximate way can be implemented in the standard BEM method. In all cases there is a need to develop three-dimensional models from which parametrical studies can be performed.

4.1.1 Vortex Wake Modeling

Vortex wake models denote a class of methods in which the rotor blades and the trailing and shed vortices in the wake are represented by lifting lines or surfaces. At the blades the vortex strength is determined from the bound circulation which is related to the local inflow field. The trailing wake is generated by spanwise variations of the bound vorticity along the blade. The shed wake is generated by the temporal variations as the blade rotate.

Assuming that the flow in the region outside the trailing and shed vorticies is curl-free, the overall flow field can be represented by the Biot-Savart law. This is most easily shown by decomposing the velocity in solenoidal part and a rotational part, using Helmholtz decomposition:

$$\vec{V} = \nabla \times \vec{A} + \nabla \Phi' \qquad (19)$$

Where $\vec{A}$ is a vector potential and Φ' a scalar potential.

The vector potential automatically satisfies the continuity Eqn. (2), and from the definition of vorticity, Eqn.(4), we get

$$\nabla^2 \vec{A} = -\vec{\omega} \qquad (20)$$

In the absence of boundaries, this can be expressed as an integral relation:

$$\vec{A}(\vec{X}) = \frac{1}{4\pi} \int \frac{\vec{\omega}'}{\left| \vec{X} - \vec{X}' \right|} dV_{ol} \qquad (21)$$

Where $\vec{X}$ denotes the point where the potential is computed and the integration is taking over the region where the vorticity is non-zero, designated by V_{ol}.

From the definition Eqn.(19), the resulting velocity field is obtained by

$$\vec{V}(\vec{X}) = -\frac{1}{4\pi} \int \frac{(\vec{X} - \vec{X}') \times \vec{\omega}'}{\left| \vec{X} - \vec{X}' \right|^3} dV_{ol} \qquad (22)$$

This is the most usual form of the Biot-Savart law.

In its simplest form the wake is prescribed as hub vortex plus a spiraling tip vortex or as a series of ring vortices. In this case the vortex system is assumed to consist of a number of line vortices with vorticity distribution

$$\omega(\vec{X}) = \Gamma \delta(\vec{X} - \vec{X}') \qquad (23)$$

Where Γ is the circulation, δ is the Dirac delta function and $\vec{X}'$ is the curve defining the location of the vortex lines.

Combining this with Eqn.(22) results in

$$\vec{V}(\vec{X}) = -\frac{1}{4\pi} \int_s \Gamma \frac{(\vec{X} - \vec{X}')}{\left| \vec{X} - \vec{X}' \right|^3} \times \frac{\partial \vec{X}'}{\partial s'} \partial s' \qquad (24)$$

Where s is the curve defining the vortex line and s' is the parametric variable along the curve. Utilizing Eqn.(24), simple vortex models can be derived to compute quite general flow fields about wind turbine rotors.

In a study of Miller [21], a system of vortex rings was used to compute the flow past a heavily loaded wind turbine. It is remarkable to simulate the vortex ring/turbulent wake state with good accuracy, as compared to the empirical correction suggested by Glauert [2].

4.12 Far Wake Computations

If the turbine rotor being model led is assumed to be wholly or partially immersed in the wake of another turbine operating further upwind, a model is provided to define the modification to the steady-state mean wind profile caused by that wake.

A Gaussian profile is used to describe the wake of the upstream turbine. The local velocity at a distance r from the wake centerline (which my be offset from the hub position) is given by:

$$V = V_o[1 - \Delta e^{-\frac{r^2}{2W^2}}] \quad (25)$$

Where V_o is the undisturbed wind speed, Δ is the fractional centerline velocity deficit, and W is the width of the wake.

To define the velocity deficit Δ and the wake width W ,the eddy viscosity model is used.

[i] Eddy viscosity wake model

The eddy viscosity wake model is a calculation of the velocity deficit field using a finite-difference solution of the thin shear layer equation of the Navier-Stokes equations in axisymmetric co-ordinates. The eddy viscosity model automatically observes the conservation of mass and momentum in the wake. An eddy viscosity, averaged across each downstream wake section, is used to relate the shear stress term in the thin shear equation to gradients of velocity deficit. The mean field can be obtained by a linear superposition of the wake deficit field and the incident wind flow.

An illustration of the wake profile used in the eddy viscosity model is shown in Figure 2.

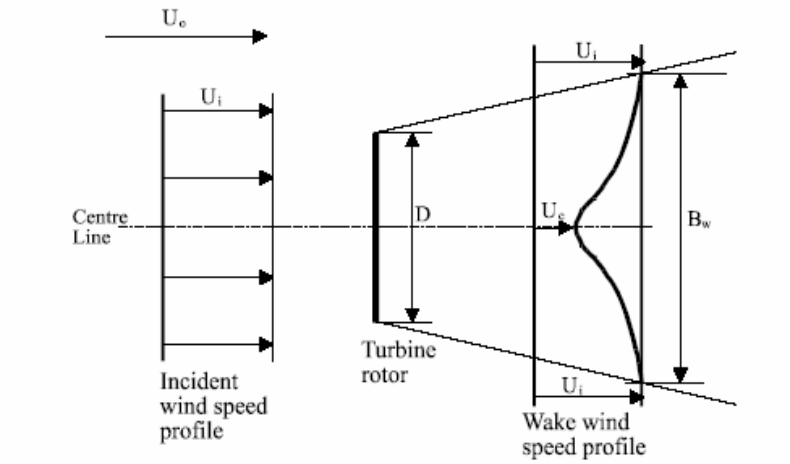

Figure 7.1: Wake profile used in the eddy viscosity model

Figure 2: Wake profile used in eddy viscosity model

The Navier stokes equations with Reynolds stresses and the viscous terms dropped gives:

$$U\frac{\partial U}{\partial x} + V\frac{\partial U}{\partial r} = \frac{-1}{r}\frac{\partial(r\overline{uv})}{\partial r} \quad (26)$$

The turbulent viscosity concept is used to describe the shear stresses with an eddy viscosity defined by [22].

$$\varepsilon(x) = L_m(x).U_m(x)$$

and $$-\overline{uv} = \varepsilon\frac{\partial U}{\partial r} \quad (27)$$

L_m and U_m are suitable length and velocity scales of the turbulence as a function of the downstream distance x but independent of r . The length scale is taken as proportional to the wake width B_w and the velocity scale is proportional to the difference U_i -U_c across the shear layer.

Thus the shear stress $\overline{uv}$ is expressed in terms of the eddy viscosity. The governing differential equation to be solved becomes:

$$U\frac{\partial U}{\partial x}+V\frac{\partial U}{\partial r}=\frac{\varepsilon}{r}\frac{\partial(r\partial U/\partial r)}{\partial r} \quad (28)$$

Because of the effect of ambient turbulence, the eddy viscosity in the wake cannot be wholly described by the shear contribution alone. Hence an ambient turbulence term is included and the overall eddy viscosity is given by Ainslie [23].

$$\varepsilon = FK_1B_W(U_i - U_c)+\varepsilon_{amb} \quad (29)$$

Where the filter function F is a factor applied for near wake conditions. This filter can be introduced to allow for the build up of turbulence on wake mixing. The dimensionless constant K_1 is a constant value over the whole flow field and a value of 0.015 is used.

The ambient eddy viscosity term is calculated by the following equation,

$$\varepsilon_{amb} = F.K_k^2.I_{amb}/100 \quad (30)$$

K_k is the Von Karman constant with a value of 0.4. Due to comparisons between the model and measurements reported by Taylor [24] ,the filter function F is fixed at unity.

The centre line velocity deficit can be calculated at the start of the wake model (two diameters downstream) using the following empirical equation by Ainslie [25].

$$D_{mi}=1-\frac{U_c}{U_i}=C_t-0.05-\left[(16C_t-0.5)I_{amb}/1000\right] \quad (31)$$

Assuming a Gaussian wind speed profile and momentum conservation an expression for the relationship between the deficit D_m and the width parameter B_w is obtained as,

$$B_W=\sqrt{\frac{3.56C_t}{8D_m(1-0.5D_m)}} \quad (32)$$

Using the above equations, the average eddy viscosity at a distance 2D downstream of the turbine can be calculated. The equations can then be solved for the centre- line deficit and width parameter further downstream.

Assuming to the Gaussian profile, the velocity deficit a distance 'r' from the wake centerline is given by,

$$D_{m,r}=\exp[-3.56(r/B_w)^2 \quad (33)$$

Therefore the wake width W is given by

$$W=B_W\sqrt{\frac{0.5}{3.56}} \quad (34)$$

(ii) Turbulence in the wake

Using the eddy viscosity model, it is also possible to calculate the additional turbulence caused by the wake. The added turbulence is calculated using an empirical characterization by Quarton and Ainslie [26].

This characterization enables the added turbulence in the wake to be define as a function of ambient turbulence I_{amb}, the turbine thrust coefficient C_t, the distance X downstream from the rotor plane and the length of the near wake, X_n.

To improve the prediction, the characterization was subsequently amended slightly by Hassan [27].

$$I_{add}=5.7C_t^{0.7}I_{amb}^{0.68}(x/x_n)^{-0.96} \quad (35)$$

Here all turbulence intensities are expressed as percentages. Using the value of added turbulence and the incident ambient turbulence, the turbulence intensity I_{tot} at any turbine position in the wake can be calculated as,

$$I_{tot}=\sqrt{\left(I_{amb}^2+I_{add}^2\right)} \quad (36)$$

The near wake length X_n is calculated according to Vermeulen [28] in term of the rotor R and the thrust coefficient C_t as

$$x_n = \frac{nr_0}{\left(\frac{dr}{dx}\right)} \tag{37}$$

Where , $r_0 = R\sqrt{\frac{m+1}{2}}$, $m = \frac{1}{\sqrt{1-C_t}}$, $n = \frac{\sqrt{0.214+0.144m}\left(1-\sqrt{0.134+0.124m}\right)}{\left(1-\sqrt{0.214+0.144m}\right)\sqrt{0.134+0.124m}}$

and the wake growth rate is given by:

$$\frac{dr}{dx} = \sqrt{\left(\left(\frac{dr}{dx}\right)_\alpha^2 + \left(\frac{dr}{dx}\right)_m^2 + \left(\frac{dr}{dx}\right)_\lambda^2\right)} \tag{38}$$

Where, $\left(\frac{dr}{dx}\right)_\alpha = 2.5I_0 + 0.005$ is the growth rate contribution due to ambient turbulence.

$\left(\frac{dr}{dx}\right)_m = \frac{(1-m)\sqrt{1.49+m}}{(1+m)9.76}$ is the contribution due to shear-generated turbulence. And,

$\left(\frac{dr}{dx}\right)_\lambda = 0.012B\lambda$ is the contribution due to mechanical turbulence, where B is number of turbine blades and λ is the tip speed ratio.

5. Modeling the wind turbine power

As an application, the generalized Fokker-Planck equation is used to assess the uncertainty in the power output of a variable-speed wind turbine [29]. The dynamics of the wind turbine is given by the angular momentum theorem,

$$J\frac{\partial\omega}{\partial t} = \frac{P_{drive} - P_{brake}}{\omega} \tag{39}$$

Where ω is the rotor speed, J the moment of inertia, P_{drive} the aerodynamic power captured by the wind turbine and P_{brake} the braking power from the generator. The generator power output is related to the braking power by the simple relation

$$P_G = \eta P_{brake} \tag{40}$$

η is a constant.

The aerodynamic power is given by the algebraic relation

$$P_{drive} = \frac{\pi}{2}\rho R^2 C_p(\lambda,\theta)V^3 \tag{41}$$

Where ρ is the air density, R the rotor radius, θ the blade pitch angle.

The tip speed ratio (TSR) λ is the rotor tip speed divided by the oncoming wind speed and is given by

$$\lambda = R\omega/V \tag{42}$$

The power coefficient C_p is defined as the power from the wind turbine divided by the power available in the wind.

6. Conclusion

Wind turbine wake aerodynamics has been extensively studied both experimentally and analytically. Nevertheless, their knowledge is far from being satisfactory. Many of the numerical models proposed show an acceptable degree of agreement with the experiments with which they are compared.

The models which depend on the least simplifying assumptions are better suited in dealing with different configuration and in reproducing wake development in detail. Some aspects of individual wake modeling, such as full near wake representation, rotor tower interaction, dynamic inflow, convergence problems, influence of atmospheric stability and others are still issues of active research.

One of the most important difficulties that have not been treated satisfactorily is the choice of appropriate input parameters to define ambient unperturbed flow particularly in complicated terrains. Usually, a comparison with wind tunnel experiments is reasonably straightforward, but when field experiments are used for comparison there are many difficulties and effects like meandering, that have not yet been satisfactorily modeled.

Improved understanding of complex wind turbine aerodynamics formalized in accurate, robust models will constitute a powerful capability for analyzing and designing wind energy machines of the future.

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Helminth communities in Cichlids in natural and man-made ponds in south-west Nigeria.

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ABSTRACT: Three hundred and fifty-four cichlid fishes from a natural reservoir, Eleyele Reservoir (unpolluted station A and polluted station B) and a fish farm, Agodi fish farm in Ibadan, south-west Nigeria were examined for ecto- and endoparasites. *Oreochromis niloticus Tilapia zilli, Hemichromis fasciatus, Sarotherodon melanotheron, Sarotherodon galilaeus, Tilapia mariae* harboured larval trematodes, C*linostormum tilapiae, Neascus* species, *Allocreadium ghanensis, Phagicola longa, Euclinostomum heterostomum, Alloglossidium corti* and Acanthocephalans, *Acanthella* and *Acanthogyrus tilapiae. Hemichromis bimaculatus* haboured no parasites. In the reservoir, males had higher parasitic infections than females but difference was not statistically significant (P>0.05).In the fish farm, females had higher parasitic infections than males and the difference was statistically significant (P<0.05).No infection was recorded in larger sizes of fish examined from all sites. The intestine of the fish hosts at stations A and B of the reservoir, had the highest parasitic load of 24.39% and 36.20% respectively while the body cavity had the highest parasitic load of 43.47% in the fish farm. *O. niloticus* had the highest level of infection (67.03%) and the least level of infection was found in *S. galilaeus* (22.5%). *C. tilapiae* was the most prevalent (66%) while *E. heterostomum* had the least prevalence (1%). [Researcher. 2009;1(3):84-92]. (ISSN: 1553-9865).

Keywords: Cichlids; Fish parasites; Reservoir; Fish farm; Nigeria

INTRODUCTION

Fishing is an important component of aquaculture in Nigeria. Fish is important as a source of protein with low cholesterol level in the diets of the populace and economically as a source of subsistence income (Aken'ova, 2000). With the ever-increasing need for cheap sources of protein, more and more attention is being focused on fish, both from natural waters and fish farming (Khalil and Polling, 1997).

Parasite infections in fish causes production and economic losses through direct fish mortality, reduction in fish growth, fecundity and stamina, increase in the susceptibility of fish to diseases and predation and through the high cost of treatment (Cowx, 1992). Intensive fish culture favours the spread of many diseases and parasites (Anyanwu, 1983)

Knowledge of the disease and pathology of fish in our tropical and sub-tropical waters is far from adequate (Akinpelu, 1983). Studies by Paperna(1980) show that cestodes and trematodes(diplostomatida) are common among cichlids and wild fishes. A close scrutiny of tilapia species for parasites by Meyer (1966) reveal the thorny headed worms, Acanthocephalans, which are common in the intestine of fishes all over the world.

This present work examines the helminthic and acanthocephalan parasites of the cichlids in polluted and unpolluted sites of a natural reservoir and in a fish farm.

MATERIALS AND METHODS

STUDY AREAS

This study was carried out in a natural reservoir, Eleyele Reservoir (with unpolluted station A and polluted station B fishing points) and in a fish farm, Agodi fish farm both in Ibadan city, south-west Nigeria.

Eleyele dam is located on Latitude 7^0 26^1 N and Longitude 3^0 52^1 E in Eleyele area of Ibadan metropolis and with an altitude of 125m above sea level. Seasonal temperature occurs with the mean minimum temperature (24.5^0C) occurring in August when there is dense cloud cover. The mean annual

rainfall is 1262.3mm.It is flood controlled with a maximum depth of 12m during the floods. The polluted point was covered with water hyacinth at the time of this study.

Agodi fish farm is involved in the intensive culture of cichlids. It receives water from the Ogunpa river, a major river in the city.

SAMPLE COLLECTION AND IDENTIFICATION

Live *Tilapia* spp were collected at the three sites during the months of April, May and June fortnightly, cutting across the end of the dry season and the start of the rainy season. Samples were collected between 0700 and 1000 hours at each of the three sampling sites as recommended by Adebisi (1981).Fishes were randomly caught by fishermen using cast nets at stations A and B and drag nets at Agodi farm. The fishes were transported to the laboratory where they were sorted by sizes and species. Identification was done using the atlas by Olaosebikan and Raji (1998). Sexes of fishes were determined by the presence or absence of an intromittent organ on the ventral side just before the anal fin. This was later confirmed by the presence of testes or ovaries observed during dissection.

Length and weight of the fishes were taken using a measuring board and a chemical balance respectively.

EXAMINATION FOR PARASITES

A cut was made on the ventral side of fish from the anal opening to the lower jaw. Two more cuts were made on the lateral side to expose the body cavity and most of the internal organs. Parasitic helminthes that were visible to the naked eyes were looked out for and removed from the fish carcass. These could be cysts, juveniles or larval forms. For better observation, hand lens and dissecting microscope were used. Gills were examined under water, eyes were removed and cut open under water to examine the lens and retina and the body cavity was thoroughly examined. The gall bladder was removed and the content examined on a slide. Squash preparations of the liver, gonads and kidney were made and examined for parasites. Contents and the walls of the swim bladder were also examined. Urinary bladder was removed and opened under water and examined. The stomach and heart were dissected and examined. The abdominal wall was cut laterally to expose the gut. This was opened up into a specimen bottle containing normal saline solution and was left for about 4 hours. The intestines were then teased open from the anterior to the posterior ends in a Petri dish. The surface of the skin was examined and fish flesh was sliced at the dorsal edge to expose the muscles for visible parasite examination.

Helminth cysts were excysted by subjecting them to slight increase in temperature in a bile solution as medium.

PRESERVATION AND IDENTIFICATION OF PARASITES

All helminthes recovered were allowed to die and stretch fully in 0.09% normal saline as recommended by MAFF(1971).They were later preserved in 70% alcohol with one or two drops of glycerine to prevent contraction of the worms and complete evaporation.

The parasites were transferred from the 70% alcohol fixative to Para carmine (1g carminic acid, 0.5g aluminium chloride, 4g calcium chloride, and 100cc 70% alcohol) and left in the stain for one day. They were then washed in 70% alcohol and placed in acid alcohol for differentiation, the process being watched under a microscope. When the preparation was completed, the helminthes were transferred to 70% alcohol. They were then dehydrated in series of alcohol concentrations as follows: three changes of 70% alcohol for 15 minutes each, 95% alcohol for 1 hour and three changes of absolute alcohol for 15 minutes each. They were then cleared in xylol and mounted in Canada balsam (MAFF, 1971).

The specimens were then viewed under the microscope and identified using the keys by Yamaguti(1959).

DATA ANALYSIS

The prevalence and intensity of the parasites were calculated. The chi- square was used to calculate the significant difference between levels of infection at the different stations.

RESULTS

Five species from the three sites sampled out of the seven species of fish hosts belonging to the family Cichlidae, harboured larval trematodes. The larval trematodes were found to infect more than one

host. The two species that did not harbour larval trematodes were *Hemichromis fasciatus* (Peters, 1857) and *Hemichromis bimaculatus* (Gill 1862).

Table 1 shows that *Sarotherodon melanotheron* (Ruppell 1852) had the highest mean number of parasite per host in station A (2.45) and B (4.18) and the highest number of infected hosts in station A (40%) and B (81.8%).This is followed by *Tilapia zilli* (Gervais 1848) with mean number of parasite per host in station A, 0.67 and in B, 1.6 and 27.63% and 45% were infected in stations A and B respectively. At Agodi farm, *Oreochromis niloticus* L. had the highest mean number of parasite per host (3.18) and the highest number of infected host (70.1%). *S.melanotheron, Tilapia mariae* (Boulenger 1899) and *T.zilli* were not found at this site.

All the infected fish species in all stations harboured both trematodes and Acanthocephalans except *T. mariae* which harboured only trematodes at stations A and B and *Sarotherodon galilaeus* L. which also harboured only trematodes at Agodi farm (Table 2).

Table 3 shows that the males had higher percentage of parasitic infection than the females in polluted and unpolluted stations but the difference in parasitic infection and the sex of the fish hosts is not statistically significant ($P > 0.05$). However, this was statistically significant ($P < 0.05$) at the fish farm.

Fish hosts with sizes ranging between 21g – 140.9g recorded the highest percentage of infection while fishes with a size range of 10 – 20.9g and 141 – 470.9g recorded very low or no percentage of infection (Table 4). At station A (Table 5), no infection was recorded in the eyes, operculum and the mouth. The intestine had the highest total parasitic load (24.39%) at a geometric mean of 2.17 and 36.2% at a geometric mean of 2.24 in station A and B respectively (Tables 5). However the total parasitic load was highest in the body cavity (43.47%) at a geometric mean of 2.27 followed by 33.04% at a geometric mean of 1.60 in the gills at the fish farm (Table 5).

Table 6 shows the summary of prevalence of parasite types from all sites. Highest prevalence of parasite was found in the intestine (23.2%) followed by the body cavity (15.2%). *Clinostomum tilapiae* had the highest prevalence in the body cavity (15.2%) followed by the gills (12.4%).

Total parasitic load of the fish hosts decreased from the first sampling (in April) to the sixth sampling (in June) when the rainfall was at its peak at stations (Table 7). *C. tilapiae* maintained the highest percentage of infection throughout the sampling periods, followed by *Acanthella* (Table 7).

Table 1: Infection rate of Fishes examined in all sites

	Eleyele Reservoir				Eleyele Reservoir				Agodi Farm			
	Station A(Unpollted)				Station B(Polluted)							
Fish Host	No. Ex	No. Inf%	Total Parasit	Mean/ Host	No Exm	No Inf%	Total Prst.	Mn Hst	No. Exm	No. Inf%	Ttl Prst	Mn/ Hst
O. niloticus	1	0	0	0	3	0	0	0	87	61(70.1)	277	3.18
S. melanotheron	20	8(40)	49	2.45	11	9(81)	48	4.18	-	-	-	-
S.galilaeus	24	5(20.8)	8	0.33	20	4(10)	4	0.2	14	9(64.3)	21	1.5
T.mariae	1	1(100)	1	1	1	1(100)	1	1	-	-	-	-
H.bimaculatus	1	0	0	0	10	2(20)	2	0.2	14	9(64.2)	24	1.7
T. zilli	76	21(27.6)	51	0.67	71	32(45)	115	1.6	-	-	-	-
Total	123	35(28.5)	109	0.9	116	48(41)	170	1.5	115	79(68.7)	322	2.8

Table 2. Distribution patterns of various parasite types among the cichlids in study areas.

Host	Reservoir St A(Unpoluted) No Ex	No Inf	Parasite Type	Taxa	Reservoir St B(Polluted) No Ex	No Inf	Parasite Type	Taxa	Agodi Fish Farm No Ex	No Inf	Parasite Type	Taxa
O. niloticus	0	-	-		3	0	-	-	87	61	Pl,Ct,Eh, Ac	Trem Acanth
S. melanotheron	20	8	Ag,Ns,Pl, Ct,Al,At	Trem Acanth	11	9	Ag,Ns,Pl Ct,Aa,Ac, At	Trem Acanth	-			
S. galilaeus	24	5	Ag,Ns,Eh, Ac,At.	Trem Acanth	20	2	Pl,Ac,At.	Trem Acanth	14	9	Ct	Trem
T. mariae	1	1	Ct	Trem	1	1	ct	Trem	-			
H. Bimaculatus	1	0	-	-	10	2	Pl,At.	Trem Acanth	*14	9	Ct,Ac.	Trem Acanth
T. zilli	76	21	Ag,Ns,Pl, Ct,Ac,At.	Trem Acanth	71	32	Ag,Ns,Pl, Ct,Eh,Aa Ac,At.	Trem Acanth	-			

Ag-*Allocreadium ghanensis* **H.fasciatus*
Ns-*Neascus*
Pl-*Phagicola longa*
Ac-*Acanthela*
Ct-*Clinostomum tilapiae*
At-*Acanthogyrus tilapiae*
Eh-*Euclinostomum heterostomum*
Aa-*Alloglossidium cortis*

Table 3. Relationship between infection rate of parasites and the sex of cichlids.

Parasites	*O.niloticus*		*S. melan*		*S.galilaeus*		*T.mariea*		**H.bimaculatus*		*T.zilli*	
	M	F	M	F	M	F	M	F	M	F	M	F
A.ghanensis	-	-	-	3	-	2	-	1	-	1	1	-
	-	-	-	1	-	-	1	-	-	-	2	1
	-	-	-	-	-	-	-	-	-	-	-	-
Neascus	-	-	1	-	-	1	-	-	-	-	4	1
	-	-	-	2	-	-	-	-	-	-	1	2
	-	-	-	-	-	-	-	-	-	-	-	-
P.longa	-	-	1	2	-	-	-	-	-	-	2	2
	-	-	2	3	1	-	-	-	-	-	5	10
	1	-	-	-	-	-	-	-	-	-	-	-
Acanthela	-	-	-	2	-	-	-	-	-	-	3	5
	-	-	2	3	1	-	-	-	-	-	8	2
	4	1	-	-	-	-	-	-	1	-	-	-
C.tilapiae	-	-	-	1	-	-	-	-	-	-	1	4
	-	-	1	-	-	-	1	-	-	-	4	2
	43	13	-	-	6	3	-	-	2	6	-	-
A.tilapiae	-	-	1	1	-	1	-	1	-	-	2	5
	-	-	1	3	1	-	-	-	-	-	6	2
	-	-	-	-	-	-	-	-	-	-	-	-
E. Heterostomum	-	-	-	-	1	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	1	-
	3	-	-	-	-	-	-	-	-	-	-	-
A.corti	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	1	-	-	-	-	-	-	-	2	-
	-	-	-	-	-	-	-	-	-	-	-	-

---- Station A; ---- Station B; ---- Station C *(or *H.fasciatus*)

Table 4: SIZE OF CICHLIDS IN RELATION TO INFECTION WITH PARASITES AT STATIONS A, B, AND C.

Group infected	Size(g)	Fish host	No.Examined	No infected	%	Mean No/host	Mean No/infected host
1	10-20.9	*S.melanotheron*	1	1	100	1	1
		S.galilaeus	1	0	0	0	0
		O.niloticus	-	-	-	-	-
		T.zilli	3	0	0	0	0
		H.fasciatus	1	0	0	0	0
		T.mariae	-	-	-	-	-
		H.bimaculatus	-	-	-	-	-
2	21-50.9	*T.mariae*	4	3	75	1.25	1.67
		H.bimaculatus	22	10	45.45	1.09	2.4
		S.melanotheron	7	3	42.86	1.71	4.0
		S.galilaeus	24	5	20.83	0.29	1.4
		O.niloticus	14	7	50	1.07	2.14
		T.zilli	-	-	-	-	-
		H.fasciatus	1	0	0	0	0
3	51-80.9	*S.melanotheron*	9	6	66.67	5.33	8
		S.galilaeus	24	3	12.5	1.5	2
		O.niloticus	37	27	72.97	3.05	4.19
		T.zilli	64	20	31.25	0.67	2.15
		H.fasciatus	9	4	44.44	1.22	2.75
4	81-110.9	*S.melanotheron*	15	6	40	2.06	5.16
		S.galilaeus	7	2	28.57	0.29	1
		O.niloticus	35	24	68.57	3.2	4.67
		T.zilli	51	25	49.01	1.62	3.32
		H.fasciatus	-	-	-	-	-
		T.mariae	1	1	100	1	1
5	111-140.9	*S.melanotheron*	1	0	0	0	0
		S.galilaeus	-	-	-	-	-
		O.niloticus	8	6	75	5	6.67
		T.zilli	3	0	0	0	0
6	141-170.9	*S.melanotheron*	-	-	-	-	-
		S.galilaeus	2	1	50	0.5	1
		O.niloticus	1	0	0	0	0
		T.zilli	1	1	100	10	10
7	171-200.9	*S.galilaeus*	2	0	0	0	0
		O.niloticus	1	0	0	0	0
8	201-230.9	*O.niloticus*	1	0	0	0	0
9	231-260.9	*S.melanotheron*	1	1	100	10	10
10	321-350.9	*T.zilli*	1	1	100	27	27
11	381-410.9	*T.mariea*	1	1	100	1	1
12	441-470.9	*O.niloticus*	1	0	0	0	0

Table 5: Distribution patterns of the parasite types among the various fish organs from all stations.

Station	A					B						C						
Organs	Gd	G	Int	Liv	BC	Gd	G	Int	Liv	M	BC	E	G	Int	Liv	Operc	M	BC
	P GM	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*	*P GM*
Allocreadium ghanensis	- -	- -	*4.8 1.7*	- -	- -	- -	- -	*4.3 1.6*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Neascus	- -	- -	*5.9 1.9*	- -	- -	- -	- -	*4.3 1.4*	- -	- -	- -	--	- -	- -	- -	- -	- -	- -
Phagicola longa	- -	- -	*5.7 1.7*	- -	- -	- -	- -	*17.2 1.6*	*1.71.4*	- -	- -	- -	- -	- -	*1.0 0.9*	- -	- -	- -
Acanthela	*0.8 1.0*	*10.6 1.7*	- -	- -	- -	- -	- -	*12.9 2.0*	- -	- -	- -	- -	- -	*5.2 1.8*	- -	- -	--	- -
Clinostomum tilapiae	*0.8 1.0*	*1.6 2.0*	- -	*1.6 2.0*	*2.4 1.0*	*0.9 1.0*	*3.5 1.4*	- -	*2.6 1.6*	- -	*0.9 3.0*	*0.91.0*	*33.0 1.6*	*0.9 1.0*	*5.2 1.2*	*12.2 1.7*	*5.2 1.8*	*43.5 2.3*
Acanthogyrus tilapiae	- -	- -	*8.9 1.9*	- -	- -	- -	- -	*0.86 1.0*	*12.1 1.6*	- -	- -	- -	- -	- -	- -	- -	--	- -
Euclinostomum heterostomum	- -	- -	*0.81 1.0*	- -	- -	- -	- -	*0.86 1.0*	- -	- -	- -	- -	- -	*2.6 9.2*	- -	- -	- -	- -
Alloglossidium corti	- -	- -	- -	- -	- -	- -	- -	*1.72 1.7*	- -	*0.9 21.0*	- -	- -	- -	- -	- -	- -	- -	- -
Total	1.6 2.0	1.6 2.0	24.4 2.2	1.6 2.0	2.4 1.0	0.9 1.0	3.5 1.7	36.2 2.2	4.3 1.5	0.9 21.0	0.9 3.0	0.9 1.0	33.0 1.6	8.7 2.8	6.1 1.2	12.2 1.7	5.2 1.8	43.5 2.3

Table 6: DISTRIBUTON PATTERN OF THE PARASITE TYPES AMONG THE VARIOUS FISH ORGANS FROM ALL THREE STATIONS

PARASITE	EYES		GONADS		GILLS		INTESTINE		LIVER		OPERCULUM		MOUTH		BODY CAVITY	
	Prev%	GMI	Prev%	GMI	Prev%	GMI	Prev%	GMI	Prev%	GMI	Prev%	GMI	Prev%	GMI	Prev%	GMI
Allocreadium ghanensis	-	-	-	-	-	-	3.11	1.65	-	-	-	-	-	-	-	-
Neascus	-	-	-	-	-	-	3.39	1.67	-	-	-	-	-	-	-	-
Phagicola longa	-	-	-	-	-	-	7.63	1.57	0.85	1.26	-	-	-	-	-	-
Acanthella	-	-	0.28	1.0	-	-	9.61	1.85	-	-	-	-	-	-	-	-
Clinostomum tilapiae	0.28	1.0	0.85	1.0	12.4	1.60	0.28	1.0	3.11	1.42	3.96	1.70	1.70	1.82	15.2	2.18
Acanthogyrus tilapiae	-	-	-	-	0.28	1.0	7.06	1.74	-	-	-	-	-	-	-	-
Euclinostomum heterostomum	-	-	-	-	-	-	1.41	3.78	-	-	-	-	-	-	-	-
Allogossidium corti	-	-	-	-	-	-	0.57	1.73	-	-	-	-	0.28	21.0	-	-
Overall parasitic load	0.28	1.0	1.13	1.0	12.4	1.62	23.2	2.27	3.96	1.39	3.96	1.70	1.98	2.58	15.2	2.18

Table 7: DISTRIBUTION PATTERN OF THE PARASITIC HELMINTHES AT VARIOUS SAMPLING PERIODS (FORTH NIGHTLY) FOR ALL THE STATIONS.

PARASITE	SAMPLING PERIODS						
	1	2	3	4	5	6	ENTIRE SAMPLE
	Prev% GMI	Prev% GMI	Prev% GMI	Prev% GMI	Prev% GMI	Prev% GMI	Prev% GMI
Allocreadium ghanensis	7.27 1.57	9.62 1.82	- -	- -	1.49 1.0	1.64 2.0	3.11 1.65
Neascus	5.46 2.0	1.92 10.0	1.67 1.0	1.70 1.0	8.96 1.35	- -	3.39 1.67
Phagicola longa	10.91 1.78	7.69 1.78	8.33 1.89	15.25 1.22	2.99 1.41	4.92 1.82	8.19 1.58
Acanthella	23.64 1.89	3.85 3.87	11.67 1.10	5.09 1.26	4.48 1.59	11.48 2.82	9.89 1.82
Clinostomum tilapiae	32.73 2.79	21.15 1.84	26.67 2.64	15.25 2.70	23.88 1.98	29.51 2.02	24.86 0.26
Acanthogyrus`tilapiae	16.36 2.13	3.85 1.41	6.67 2.63	8.48 1.25	8.96 1.26	- -	7.35 1.70
Euclinostomum heterostomum	- -	1.92 1.0	- -	- -	4.48 9.17	1.64 1.0	1.41 3.78
Alloglossidium corn	1.81 21.0	- -	1.67 1.0	- -	- -	1.64 3.0	0.85 3.98
Overall parasitic load	65.46 3.02	40.39 2.00	46.67 2.32	35.59 2.04	38.81 3.05	44.26 2.29	44.91 0.13

DISCUSSION

The Cichlids species (*Tilapia, Hemichromis and Sarotherodon*) harboured larval trematodes of the genera *Clinostomum, Euclinostomum, Allocreadium phagicola* and *Neascus*. Acanthocephalans and *Acanthella* were also harboured by these cichlids. The flukes proved to be more widespread than the observed Acanthocephalans. Huggins (2000) states that the most frequently observed parasites of fish are flukes. Paperna (1980) also noted that the two Clinostomatids, *C. tilapiae* and *E.heterostomum* recorded in this present study are widespread. The harbouring of both nematodes and acanthocephalans by cichlids in this study is in accordance with the reports by Awachie (1965) and Ukoli (1965) of cichlids of Lake Chad.

The fish farm, had the highest percentage of infection (62.60%) of *C.tilapiae* compared to the unpolluted station A (6.50%) and polluted station B (6.86%). There was no significant difference in the percentage of infection of *E.heterostomum* at the three sites. The percentage infection of *A . ghanensis* was not significantly different at stations A and B and was absent at the fish farm. *Neascus* had a greater percentage infection at station A than B and was not found at the fish farm. *Alloglossidium corti* was found only at station B. Acanthella was observed at all the stations. *Acanthogyrus tilapiae* was found in stations A and B but not at the fish farm.

The man-made pond, fish farm, had the highest percentage of infection of parasites, then followed by station B (polluted) and A (unpolluted). Most Acanthocephalans were found in the fish intestine except for a few number of Acanthella found in the gonad of fish hosts at station A. *A. tilapiae* were found in the gills of fish hosts at station B. This was also reported by Huggins (2000).The intestine had the highest parasitic load in stations A and B.

There was no relationship between the percentage of infection with sex of the cichlids at stations A and B but this relationship existed at the fish farm. Low level of infection in larger sizes of fishes in this study were also reported by Prah (1969) in a dam reservoir in Ghana.

The significant decrease in the percentage of infection at stations A and B from the month of April to June might be due to the fact that molluscan intermediate hosts of parasites might have been swept away by the tide as rainfall increases during the month of June. This was also reported by Ukoli, 1965; Hofman, 1967 and Schell, 1970.

The difference in infection rate and sites of infection in the fishes might be due to the diet. Fishes from stations A and B feed on detritus, benthos, plankton which transmit parasites while fishes at the fish farm are fed with artificial feeds. This could also explain why most of the parasitic helminths of fishes in the wild were found to be harboured in the gut while most of the domesticated tilapiae parasites were found to be more in the body cavity.

The parasites of fish ought to receive more attention and study especially parasites in fish farms where as shown in this study had the highest percentage of infection.

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