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Macroinvertebrates As Indicators Of The Water Quality Of An Urbanized Stream, Kaduna Nigeria

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ABSTRACT: A survey was conducted from March to September, 2005 on a fourth order perennial Northern Nigerian stream to evaluate the water quality using the macrobenthic invertebrate community of the bankroot biotope. Physico-chemical variables were determined using standard methods, A total of 1304 macroinvertebrates were recovered. Twenty-seven taxa were recorded. The higher number of taxa (23) was recorded at station 2. The abundance of individuals was highest at station 3. The presence of low densities of pollution tolerant macroinvertebrate groups, the deteriorating water quality and the physco-chemical conditions of the water during the dry season months was a reflection of organic pollution stress caused by decomposing domestic refuse and inorganic fertilizer washed into the stream by irrigation. [Nature and Science. 2008;6(4):1-7]. ISSN: 1545-0740.

KEYWORDS: Macroinvertebrates, water quality, urbanized stream, Kaduna.

INTRODUCTION

Most major cities contain a number of waterways such as bays, harbors and rivers together with a small network of small streams. In Nigeria most of these streams have been subjected to an increasing pollution load from contaminated urban run-off water originating from industrial, agricultural, residential, commercial and recreational areas and institutions such as schools and hospitals (Adakole and Annune, 2003). Ogbogu and Hassan (1996) pointed out the effects of contaminants usually flushed into streams especially in areas of high human activities.

Macroinvertebrate organisms form an integral part of an aquatic environment and are of ecological and economic importance as they maintain various levels of interaction between the community and the environment (Anderson and Sedel, 1979). According to Marques *et. al.* (2003) knowledge of the structure of the benthic macroinvertebrate community provides precise and local information on recent events, which can be seen in their structuring. The use of invertebrates and fish as bioindicators of water quality has been advocated by several researchers (Victor and Ogbeibu, 1985; Ofojekwu *et. al.*, 1996; Edokpayi and Osimen, 2001; Adakole and Annune, 2003).

The Barnawa stream is the main drainage system of most parts of Barnawa, an urban settlement in Kaduna metropolis. Although it is not a major river for fisheries activities because of its size it is the major effluent receiving stream in Barnawa as many gutters are linked to it. It is also used in the irrigation of crops as well as source of drinking water for cattle during the dry season. As a river-let of river Kaduna (Beecroft, 1987) it has a significant contribution to its discharge and consequently its pollution load. The present study examines the effects of various activities associated with urban settlement on some water quality parameters and the macrobenthic invertebrate composition of the Barnawa stream.

MATERIALS AND METHODS

STUDY AREA

The Barnawa stream is located in the southern part of Kaduna Metropolis (Longitude $7^0$50'E and Latitude $10^0$50'N) about 645 meters above sea level. The stream takes its source within the Kalapanzy (Artillery) barracks in Kaduna south and joins other river-lets, which empty into River Kaduna (Mallo, 2001). It is a shallow, fast flowing stream. The area is characterized by flat land surface and easily worked sandy loam soil. The climate of Kaduna is tropical with a distinct rainy season (late April to October) and dry season (October to May) (Beecroft *et. al.*, 1987). The vegetation is guinea savanna, which has been cleared but only relic shrubs of *Isoherlinia doka* and few grasses are still striving.

The major human activity in the catchments area is dry season farming. Heaps of garbage, human excreta and cattle dung were found on slope of the bridge across the stream and these present ugly sites at various spots along the stream. Three sampling stations along a 2.5km stretch were chosen for the study. Station 1 is about 1km from the source. Here the stream is wider than deep. Heaps of refuse were seen by

the sides of the bridge across the stream, with the decomposing refuse emitting foul smell around the catchments area. The vegetation is mainly grasses and creeping plants and there was no farming activity at this station. Station 2 is about 500m from station 1. Human activities here include farming and washing of implements. Bankroot biotope included maize, vegetable crops like spinach, tomato, okra and herbaceous weed. The stream here is relatively wide. Station 3 is about 1km from station 2. The stream
Channel at this site is narrow and fast flowing. Mango trees, grasses and relic shrubs shade this area. The substratum is sandy loam soil. A mechanic workshop and block molding industry are located close to this station; Human activities include washing of block molding implements and motor spare parts.

SAMPLE COLLECTION AND ANALYSIS

Samples were taken at fortnightly intervals over a period of seven months (March – September, 2005) between 0900 hours and 1500hours from the sampling stations, Macrobenthic invertebrate fauna were collected by the kick method (Lenat *et. al.*, 1981; Victor and Ogbeibu, 1985). All invertebrates were killed in the field using small quantities of 40% formaldehyde and later preserved in 70% ethanol for further examination. Further analyses carried out in the laboratory include sieving (mesh size 1.4mm – 250mm), counting and sorting under suitable magnifications (7-40x). The macrobenthic invertebrates were identified using manuals of Pennak (1953); Needham and Needham (1962); Victor and Ogbeibu (1985); Egborge (1995).

Water samples for physico-chemical studies were also collected from stations 1, 2 and 3. Temperature, pH and conductivity were determined in the field using a portable pH/EC/TDS/temperature meter model H1-991301 while dissolved oxygen and Biochemical oxygen demand were determined by titration (APHA, 1985).
Water quality for each station was determined using the diversity (d) indices of Margalef. Magalef's water quality index >3.0 indicates clean condition; values <1.0 indicate severe pollution and intermediate indicate moderate pollution (Lenat *et. al.*, 1981).

All statistical procedures where appropriate were adopted from Zar (1984). SPSS 6.5 applications and Excel (Genstat release 4.03 packages) were used to calculate the two-way analysis of variance (ANOVA).

RESULTS

A summary of the physical and chemical parameters of the study area is given in Table 1. The mean, minimum and maximum values and the standard errors are shown. The water temperature followed closely that of the ambient temperature. Alkaline pH was recorded (pH between 8.5-8.7) during the dry season months. However the pH reduced from neutral to slightly acidic (5.3-7.0) during the rainy season months (July-September). The conductivity was lowest at station 1 and increased downstream. The highest conductivity value (63.0μScm^{-1}), was recorded at station 2. Dissolved oxygen was low during the study period (0.00-3.60mgL^{-1}) while the BOD ranged from 0.00-2.00mgL^{-1}.

The overall macrobenthic invertebrate composition, abundance and distribution in the study stations are summarized in table 2. Twenty-five taxa were identified from a total of 1304 individuals collected. Station 1 had 18 taxa, while stations 2 and 3 had 23 and 15 respectively. Also, station 1 contributed the highest (46.90%) of the total number of individuals and the least number of taxa (15) recorded (Table 2). A summary of the relative contribution of the major invertebrate groups to the overall macrobentthic population at the different stations is presented in Table 3, figure 1 . Station I was dominated by mollusc represented by *Bulinus* and *Biomphalaria* species while dipteran families dominated stations 2 and 3. The variations in taxa and number of individuals between stations were not significantly different ($P>0.05$). Aquatic insects represented 68.00% of all taxa and 65.97% of all individuals. Coleptera, Diptera, plecoptera and odonata mainly represent them. Three species of Annelida; *Tubifex, Nais,* and *Glassiponia* were recorded in all stations, but the fourth species *Stylaria* was absent at station I. Crustacea was poorly represented by a single taxon (Astacidae) in this study. Dipterans were dominated by Chironominae and Tanypodinae families, out of which *Chironomus* was the most abundant. *Simulium, Pentaneura and Anopheles* species were restricted to station 2. Two individuals of *Pseudocleon* species poorly represented Ephemeroptera.The indices of general diversity (H), evenness (E) and dominance calculated for the three stations are presented in table 4. Although diversity was higher at station 2 evenness and dominance were higher at station 1 and 3 respectively.

TABLE 1: SUMMARY OF SOME PHYSICAL AND CHEMICAL CONDITIONS OF THE BARNAWA STREAM STUDY STATIONS (March-September, 2002)

	STATIONS								
	1			2			3		
PARAMETERS	Mean ±SE	Min.	Max	Mean ± SE	Min.	Max.	Mean ± SE	Min.	Max.
Air temperature (^{0}C)	28.5± 1.00	26.0	32.0	27.5 ± 0.8	24.0	32.0	28.0 ± 0.7	25.0	31.0
Water Temp. (^{0}C)	27.5 ±0.72	25.0	32.0	27.4 ±1.00	24.0	31.8	26.5 ± 1.11	22.0	31.0
Conductivity (μScm^{-1})	34.5±2.54	32.0	39.0	52.7±1.11	42.0	63.0	54.3 ± 3.6	48.0	56.0
pH	7.0	5.3	8.7	7.6	6.6	8.7	7.7	6.7	8.7
Dissolved oxygen mgL^{-1}	1.58 ± 0.98	0.00	3.0	1.25 ± 0.62	0.00	2.1	2.50 ± 1.5	0.50	3.60
B O D (mgL^{-1})	1.48 ± 0.28	0.00	1.68	0.67 ± 0.60	0.00	1.5	1.15 ± 0.30	1.15	2.00

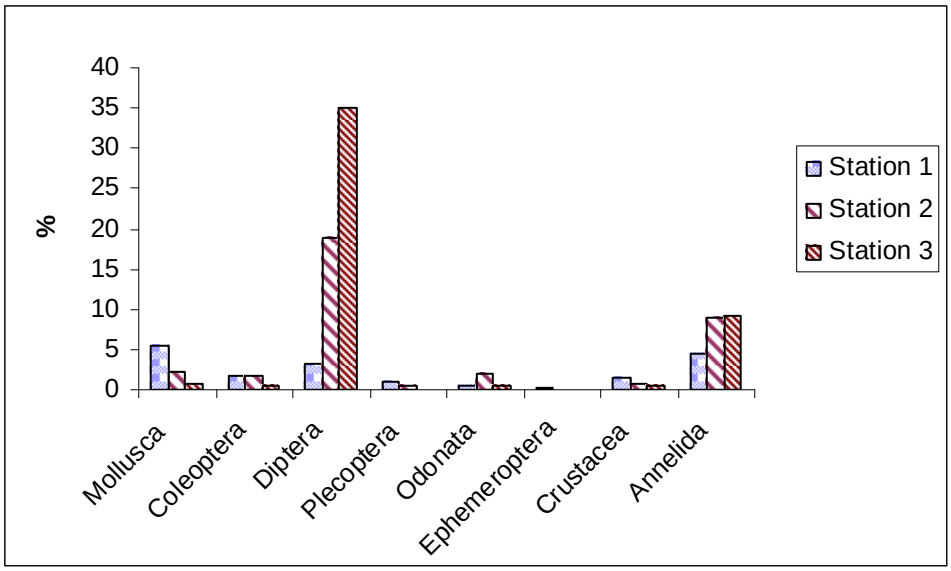

Fig. 1: Relative contribution of the major macro invertebrate groups in the Barnawa stream, March to September, 2005.

TABLE 2: OVERALL ABUNDANCE AND DISTRIBUTION OF MACROBENTHIC INVERTEBRATES AT THE STUDY STATIONS IN BARNAWA STREAM (FEB. TO SEPT., 2005)

	STATIONS			
	1	**2**	**3**	**Total**
MOLLUSCA				
Bulinus spp	12	8	2	22
Biomphalaria	58	12	8	78
Physa spp	-	8	-	8
COLEOPTERA				
Sphaerodema	10	12	2	24
Hydrous sp	2	8	2	12
Phihydrus sp	10	2	4	16
DITERA				
Enstalis larvae	6	16	14	36
Simulium	-	8	-	8
Chironomus	15	143	405	563
Pentaneura	-	40	-	40
Coatate pupa	4	16	18	38
Chronomus pupa	6	21	21	48
Pupa type 1	10	-	-	10
Anopheles larva	-	4	-	4
HEMIPTERA				
Notonecta	-	-	1	1
PLECOPTERA			-	4
Neoperla	2	6	-	8
Brachythermis	12	2	-	14
ODONATA (ZYGOPTERA)				
Coenagrion	-	18	-	18
Aeschna		-	-	-
Pseudagrion	3	3	6	12
Enallagma	-	6	-	6
EPHEMEROPTERA				
(*Pseudocleon)*	2	-	-	2
CRUSTACEA				
Astacidae	20	11	6	37
ANNELIDA POLYCHAETA				
Tubifex	40	10	12	62
Nais	9	24	63	96
Stylaria	-	66	45	111
HIRUDINEA				
Glossiphonia	10	16	4	30
TOTAL	232	460	612	1304
PERCENTAGE	17.8%	35.3%	46.9%	100%

TABLE 3: PERCENTAGE CONTRIBUTION OF MAJOR INVERTEBRATE GROUPS IN THE BARNAWA STREAM, MARCH TO SEPTEMBER 2005. THE VALUES ARE PERCENTAGES; ≥15% DORMINANT; ≥ 5% TO < 15% SUBDOMINANT.

TAXA	STAION1	**STATION2**	**STATION3**	**OVERRALL**
MOLLUSCA	5.37	2.15	0.77	8.29
COLEOPTERA	1.69	1.69	0.61	3.99
DIPTERA	3.14	19.00	35.10	57.24
PLECOPTERA	1.07	0.61	-	1.68
ODONATA	0.38	2.07	0.46	2.91
EPHEMEROPTERA	0.15	-	-	0.15
CRUSTACEA	1.53	0.84	0.46	2.83
ANNELIDA	4.52	8.89	9.20	22.61

TABLE 4: DIVERSITY OF INVERTEBRATES IN THE STUDY STATIONS OF BARNAWA STREAM, MARCH-SEPTEMBER 2005

STATIONS			
	1	**2**	**3**
	n = 14	n = 14	N = 14
No. of Taxa	18	23	15
No. of Individuals	232	460	612
Margalef's diversity (d)	3.12	3.56	3.24
Evenness (E)	0.173	0.156	0.146
Dominance (D)	0.03	0.12	0.22

DISCUSSION

The physical and chemical properties of the stream showed some variations. However, there was no significant difference between the stations studied. Slight longitudinal variation in water level was observed. The water level of aquatic ecosystem is usually influenced by the rainfall pattern of the drainage basin (Ikusima *et. al.*, 1982). Alkaline pH and low conductivity was recorded in all stations. High pH has been reported for most fluvial (Beecroft *et. al.*, 1987; Emere, 2000; Adakole and Annune, 2003) and Lacustrine ecosystems (Ufodike and Garba, 1992; Kemdirim, 2005) in Northern Nigeria. This may be due to the granite, which forms the basement rock of these water bodies. The low conductivity in this stream places it in class 1 of Talling and Talling's (1965).

Classification of African waters (the most dilute waters of conductivity < 600 mhoscm^{-1}): this class of water is said to be poor in nutrients.

The low dissolved oxygen concentration recorded agreed with values reported for some Nigerian waters (Ofojekwu *et. al.*, 1996; Bukar 2006 unpublished). The dissolved oxygen values revealed anoxic or septic condition during the dry season within the study period. Such low oxygen saturation has been reported in River Kaduna in dry season months when there was little or no flow (Beecroft, 1987; Emere 2000). Low dissolved oxygen has been reported to be deleterious to most aquatic fauna. Based on BOD classification of streams: unpolluted (BOD < 1.0mgL^{-1}), moderately polluted (BOD between 2-9mgL^{-1}) and heavily polluted (BOD > 10mgL^{-1}) (Vowels and Connel, 1980), the stream was moderately polluted during the study period.

The 27 taxa comprising of 1304 individuals recorded was low when compared with over 55 taxa reported for tropical streams (Victor and Ogbeibu, 1985; Edokpayi *et. al.*, 2000; Ogbeibu 2001; Adakole and Annune, 2003). The low species diversity could be due to some physico-chemical conditions like fast flow, high pH, low dissolved oxygen and low conductivity of the water. Odum (1971) had reported that diversity tends to be low in physically controlled systems. These factors probably caused disruption of life cycle, reproductive cycle, food chain and migrations or imposed physiological stress on even the tolerant macroinvertebrates (Adakole and Annune, 2003).

The taxonomic breakdown of the macrointerbrates indicated the dominance of arthropods in species richness followed by mollusc and annelids. *Biomphalaria* was the dominant mollusc. Among the

arthropods aquatic beetles (Coleoptera), and dipterans, which include the rattail maggot (*Eristalis*), *Culex* Coatate pupa and *Chironomus* species occurred in all stations. Gaufin (1973) reported that most aquatic beetles can renew their oxygen supply directly from the atmosphere, they are thus unaffected by oxygen depleting wastes while others possess special adaptations for obtaining oxygen (Marques *et. al.*, 2003). All the macroinvertebrates reported in this study during the dry season months belong to the tolerant classes in water bodies, which indicate organic pollution. However, these groups did not show the expected pattern of opportunistic population, that is, few species and large number of individuals (Ogbeibu, 2001; Marques, 2003). This suggests that there maybe other factors, which caused oxygen depletion such as oxidation of iron, accumulation of sediment or inorganic fertilizer from irrigation run-off. Few species of Odonata and Ephemeroptera which are fauna associated with clean water quality were recovered only during the rainy season months. This could be due to dilution during the rains, which caused some improvement in the water quality. The occurrence of stonefly, though low in number was the only sensitive class present during the dry season. Since most species of stoneflies are clean water species (Gaufin, 1973), it is possible that this species occupied in a niche where the oxygen concentration was higher than values recorded for the stream.

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Determination of capacity building by life stage for the farmers in Bangladesh

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Abstract: Several researchers have identified capacity building is essential for sustainable development of the farming community in developing countries. It is assumed that improvement of the capacity depends on physical, technical and managerial skills of the farmers at different stages of their life, which has not yet studied for developing countries. The study found that children of the marginal and small farmers engage earlier in assisting physical activities in farming than medium farmers in Bangladesh because they have less opportunity to educate their children. Majority of the marginal and small farmers are well ahead in improving physical and technical skill at a high level than the medium farmers and therefore, they enter into the Gehilfen stage of capacity building. Moreover, they have started to build these skills independently at the early age of their farming. Medium farmers are, on the contrary, reluctant to engage independently in farming activities than the marginal and small farmers. None of the farmers enter into Meister stage of capacity building. The study also found that physical skill is the dominant factor followed by technical skill for increasing capacity of the farmers in Bangladesh. The marginal and small farmers could make agricultural productivity better than the medium farmers owe to skill development. [Nature and Science. 2008;6(4):8-15]. ISSN: 1545-0740.

Keywords: Capacity building, life stage, physical skill, Bangladesh

Introduction

Capacity is often defined in terms of ability and performance. For example, the United Nations Development Program (UNDP) defines capacity as `the ability to perform functions effectively, efficiently and sustainably` (UNDP 1997). This definition of capacity can also be used in agricultural production activity. Agricultural production activity comprises of physical involvement, application of technical knowledge, procurement efficiency of raw materials, efficient management of land and labor, short term and long term farm development plan, financial management using accounting knowledge, and efficient management of assets and property. Therefore, how efficiently a farmer can perform these activities determines his capacity to do the job. Capacity building is associated with increment in these activities or performance through transformation process of different activity.

In the present study capacity building is associated with efficient performance of different agricultural activities to increase agricultural production in a further extent. Efficient performance of a different agricultural activity is a dynamic process instead of static one. For example, younger farmers may concern about the technology of different crop production such as appropriate planting time, requirement of irrigation, usages of organic and inorganic matter, harvesting methods along with involvement of physical skill. Middle aged farmers may think about the marketing strategy, efficient management of financial resources along with receiving and payment of credit, development of short term and long term farm planning etc. Therefore farmers build their capacity in different stages of life. According to the German literature there are three stages of capacity building for the farming activity. The stages are Lehrling, Gehilfen and Meister. The farmers, who have high skill in the technical aspect along with efficient performance of physical activities, are in Lehrling stage. The farmers who have high capability of cash, capital and production management are in Gehilfen stage. The farmers are in Meister stage; they can analyze their farming activities well, can do long term financial management in efficient way, and have capacity to manage assets and property efficiently, and ability to prepare short and long term farm development plans. Some farmers achieve successfully high level of capacity building arriving at Meister stage and some farmers achieve low level with Lehrling stage. Different literatures published in German and Japanese language show that many farmers in developed country are in Meister stage. However, there are no literatures found for the farmers of developing countries regarding in which stage of capacity building they are. Therefore, present study is undertaken to determine capacity building by life stage for the farmers in Bangladesh as a representative of developing country.

In developed countries like Germany and Japan agriculture is mostly capital intensive because of using heavy machines like tractor, combined harvester or greenhouses. For using these machines or plants

farmers need huge capital and they have to borrow capital from different financial institutions like banks, agricultural cooperatives etc. For receiving and payment of huge amount of loan farmers need to have financial management skill. The economy of Bangladesh is still dominated by agriculture sector. Around 19.6% of gross domestic product comes from agriculture (BBS 2006) in which crop and horticulture contributed 11.5% (BBS 2006). Among total labor force 48.1% employed in agriculture sector (BBS 2006). Approximately 79.4% farmers are landless (≤0.20ha), marginal (0.20ha to ≤0.40ha) and small farmers (0.40ha to ≤1.00ha) along with a dependency ratio of 3.60 and family size 5.19 (BBS 2007). Of them 25.2% are landless, and 31.4% are marginal farmers. With this salient feature the present study will also identify the current situation of Bangladesh agriculture whether it is capital or labor intensive and at which stage of capacity building he/she is.

There are some researches available in which managerial ability is found an important factor for improving efficiency of farming. Johanson (2007) empirically estimated the impact of personal aspects and decision making characteristics on farm level efficiency, in a sample of Swedish dairy farms. Individual beliefs of a person which can influence his decision are taken as a personal aspect. Öhlmer (1998) and Öhlmer *et al.* (1997) found a connection between the ability of a farmer and his or her locus of control i.e. individual beliefs. Rougoor *et al.* (1998) considered managerial capacity as consisting of both personal aspects of the manager (in terms of drives and motivations, abilities and capabilities, and biography) which affect decision making and which in turn affects the performance of a farmer. Solano *et al.* (2006) studies the impact of a series of biographical variables and decision making profiles, as a representative of the managerial capacity of the farmers, on the management and performance of their farm. They found that managerial capacity positively influences the performance of the farm. Trip *et al.* (2002) measured managerial efficiency for the commercial greenhouse growers. They considered decision making process as reflected by producers` goal, planning, data recording and evaluation. Kularatne and Takeya (2005) examined the management factor in relation to perennial crops or measured the implementation process to evaluate the management. There are no analytical studies found so far which considered physical, technical and managerial skill as factors for estimating capacity building of the farmers in developing countries. Therefore, the present study is focused on two aspects. First, determination of capacity building by life stage for the farmers in Bangladesh and second, identifying some factors which affect capacity building of the same farmers. It is expected that the findings of the study have some potentials to add some important knowledge on existing literature of capacity building study.

Methodology

Sample selection and data collection

Comilla, Bogra and Jessore districts of Bangladesh are selected as study areas for the present research. From these three districts 46 marginal farmers, 36 small farmers and 18 medium farmers were chosen by random sampling as samples. The data were collected using a pretested interview schedule through face to face interview.

Regression analysis

A multiple linear regression analysis was used to identify factors affecting capacity building of vegetable farmers in Bangladesh. The regression model is as follows (Gujarati, 2001).

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 D_{1i} + \beta_5 D_{2i}}$$

Where, Y_i = Total return from vegetable production of i^{th} farm, X_{1i} = Physical skill score of i^{th} farm, X_{2i} = Technical skill score of i^{th} farm, X_{3i} = Managerial skill score of i^{th} farm, D_{1i} = Communication skill dummy for i^{th} farm (1 for mobile phone using, 0 for otherwise), D_{2i} = Communication skill dummy for i^{th} farm (1 for using broadcast media, 0 for otherwise). Interpersonal communication is taken as base for using dummy variables.

Definition and measurement of variables

Considering the German concept of capacity building farmers need to develop their physical, technical and managerial skill. In this study physical skill is comprised of physical involvement of labor doing several agricultural activities and knowledge on doing these activities. Physical involvement of labor is divided into three parts; (1) land preparation, (2) Intercultural operation and (3) harvest and post harvest activity. Land preparation includes: ploughing, seed bed preparation, sowing/transplanting. Intercultural operation includes: establishment of bamboo stack/plastic net, fertilizing, irrigating, hilling, weeding, spraying pesticides. Harvest and post harvest activity includes: harvesting, handling, and grading. Technical skill includes use of recommended dose of seed/plant following required spacing, different kinds of chemical fertilizer with organic matter, application of required irrigation water, use of integrated pest management and spraying of plant protection chemicals at tolerance level. Managerial skill comprises of marketing skill, short term farm planning, labor management and financial management.

Marketing skill includes selling of products at wholesale market with appropriate grading, collection

of spot price information using mobile phone. Marginal and small farmers usually make short term farm planning for one year only because they lease lands from medium and large farmers. Medium and large farmers are almost keeping them absent from farming and they do not make any farm plan for a long term. Labor management includes employment of family and hired labor in different activities, determination of wage rate. Farmers have no book keeping experience to prepare day book, balance sheet and profit & loss statement. Therefore, financial management includes rough estimation of income and expenditure from farming, receiving and payment of loan. Capacity building by life stage is determined differently in two stages; first, how and when family members of a farm assist the farmer in different farming activities and second, how and when a farmer operate different farming activities independently by his/herself.

The dependent variable of the multiple regression analysis is measured in monetary terms to avoid an aggregation problem. Some vegetables are sold in number of pieces and some of them are sold in weight basis. Therefore, total return is used in monetary terms instead of physical quantity as a dependent variable. The farmers consume a portion of their vegetable products by themselves, distribute some portions to the relatives and sell the balance to the markets. Therefore, total return is calculated by aggregating the market values of consumed, distributed, and sold quantities. There is a positive relationship between total return from vegetable cultivation and capacity building of a farmer (Kamruzzaman and Takeya 2007). Therefore, total return is used as a proxy of capacity building for estimating the multiple regression model.

Physical skill score = Capability of physical involvement in j^{th} activity + technical knowledge on j^{th} activity. Thirteen agricultural activities are considered in this study where physical involvement is necessary along with technical knowledge. At first how many hours of physical involvement required for each activity are calculated and then average hours needed for each activity along with standard deviation are calculated for the samples of the study. High physical involvement is determined as; less than (average – 1/2 of standard deviation), medium as; within (average ± 1/2 standard deviation) and low as; greater than (average + 1/2 standard deviation). High, medium and low involved scored as 3, 2 and 1 respectively for each activity. Technical knowledge for each activity divided into two categories; low and high. If the farmer has adequate technical knowledge then a score of 2 is given and if inadequate then 1 is given. Therefore, a maximum of 65 and a minimum of 26 score can be obtained from 13 activities by each farmer for evaluating his physical skill.

Technical skill is calculated as; if a farmer follow recommended practice for transplanting, fertilizer application, irrigation water applied, integrated pest management, weeding and spraying of plant protection chemicals then a score of 2 is given for his high technical skill and if a farmer does not follow recommended practice for these activities then a score of 1 is given for his low technical skill. With this idea a farmer can obtain a maximum score of 12 and a minimum of 6.

Managerial score calculated as; if a farmer makes short term farm planning, grades their product according to size and shape, distributes labor according to their skill, receives loan, pays the loan in due time, maintains income and expenditure statement then a score of 2 is given, if they do not do it then a score of 1 is given. In addition, a score of 3, 2, and 1 is given if a farmer sells his product to the wholesale market, intermediary and local market respectively. Therefore, a farmer can obtain a maximum score of 15 and a minimum of 7. Communication skill is separated from managerial skill, because it is assumed that communication skill has a vital role in earning total return from farming. Therefore, high communication skill is treated for a farmer if he uses mobile phone for buying raw materials and selling his products, and obtains a score of 3 for his high communication skill, if a farmer uses broadcast media and interpersonal communication for this purpose then he obtains a score of 2 and 1 respectively.

Categorization of level of skill

Technical and managerial skills as well as the physical skill are categorized into three groups according to their scores obtained. Those whose score is ≥0.5 standard deviation below the mean score are categorized as “low” in each skill. Farmers whose score is ≤0.5 standard deviation on either side of the mean are categorized as “medium” in each skill and farmers with ≥0.5 standard deviation above the mean are categorized as “high” in each skill.

Results and discussion

Intensity of farming

Majority of rice farmers used human labor for conducting several agricultural activities for rice production. Of the farmers, marginal and small farmers used more than 50% of their total cost of rice production for human labor (Table 1). Among these farmers, around 40% of total cost was covered by the family members of marginal and small farmers whereas only 14% was shouldered by family labor for medium farmers. Power tillers are used for ploughing of land by the medium farmers and a small portion of marginal and small farmers used a power tiller hiring from other farmers for ploughing of their land. Therefore, most of the agricultural activities are still depended on human labor which indicates labor intensive farming is still dominated in Bangladesh. However, in Japan, only 36.4% of total cost of rice production is covered by labor

cost (MAFF 2005) and in Germany only 10% of total cost of agricultural production is covered by labor cost (FMFACP, 2006).

Table 1. Cost of rice production (per hectare) across different category of farmers.

Unit: Taka

Input use	Marginal		Small		Medium	
	Cost	%	Cost	%	Cost	%
Family labor (A)	10780	40.4	11550	40.2	4950	14.0
Hired labor (B)	3190	11.9	3630	12.6	6980	27.4
Human labor (A+B)	13790	52.3	15180	52.8	14630	41.5
Animal/Mechanical power	3750	14.0	3920	13.6	7450	21.1
Seed	1470	5.5	1520	5.3	1745	4.9
Fertilizer	4850	18.2	5050	17.6	6370	18.1
Irrigation	2210	8.3	2450	8.5	4250	12.0
Plant protection	450	1.7	625	2.2	840	2.4
Total cost	26700	100.0	28745	100.0	35285	100.0
Total return	44658		47521		58750	
BCR	1.67		1.65		1.66	

Source: Collected data by authors from interviews. Data in all tables and figures are the same as Table 1.

Vegetable production in Bangladesh is more labor intensive than rice because around 68% of the total cost of vegetables was covered by human labor for the marginal and small categories of farmers (Table 2). Majority of labor comes from family source for them. Medium farmers also have to spend around 58% of total cost for human labor, but a significant portion of human labor is used on hired basis for vegetable production. Because, family members of medium sized farms engaged themselves in non-farm business and in service out of agriculture. Vegetable production is also highly labor intensive compared to developed countries like Japan where, 40.6% of total cost is covered by labor for upland vegetable production (MAFF 2005).

Table 2. Cost of vegetable production (per hectare) for different categories of farmer

Unit: Taka

Input use	Marginal		Small		Medium	
	Cost	%	Cost	%	Cost	%
Family labor (A)	27515	53.4	27726	52.7	7012	11.0
Hired labor (B)	7264	14.1	7738	14.7	29975	47.2
Human labor (A+B)	34779	67.5	35464	67.4	36986	58.2
Animal/Mechanical power	3197	6.2	3305	6.3	9832	15.5
Seed	955	1.9	946	1.7	1103	1.8
Fertilizer	8329	16.2	8448	16.0	9972	15.7
Irrigation	2357	4.6	2464	4.7	3242	5.1
Plant protection	1886	3.7	2006	3.8	2439	3.8
Total cost	51504	100.0	52632	100.0	63575	100.0
Total return	197934		178835		130927	
BCR	3.85		3.42		2.06	

Involvement of labor for vegetable cultivation

Vegetable production is labor intensive. It shows high profitability (Sahabuddin and Dorosh 2002) and high correlation with capacity building ability (Kamruzzaman and Takeya 2007). Therefore, vegetable farmers are considered for this study to determine their capacity building by life stage. The results show that 2650, 2702 and 2818 hours of labor are engaged in per hectare of vegetable production for marginal, small and medium farmers respectively (Table 3). There are thirteen farming activities identified which requires human labor to be employed for vegetable production. Among these activities weeding and harvesting are the most labor intensive job. Because farmers have to uproot each individual weed around the plants and harvesting is done periodically depending on the maturity stage and high price getting opportunity. Therefore farmers have to develop their physical skill to perform well in the thirteen farming activities. It is assumed that farmers can build their capacity if they develop their physical skill at an early stage.

Table 3. Labor involvement (hours/ha) in different farming activity across farm category

	Marginal	Small	Medium
Land preparation	66	69	75
Seed bed preparation	59	59	67
Sowing/transplanting	170	173	180
Bamboo stack/net	38	40	44
Irrigation	158	162	173
Fertilizer	66	69	75
Weeding	960	966	980
Spraying pesticides	43	46	51
Harvesting	706	715	729
Handling	122	127	141
Grading	124	132	144
Carrying	90	94	103
Total	2650	2702	2818

Capacity building by life stage

Family members of the marginal and small farmers begin to assist the farmer in different farming activity at the age of 12.0, whereas medium farmers begin at the age of 15.5 (Table 4). Marginal and small farmers face disadvantages in terms of their limited resource base and small scale operations for producing of diversified crops, therefore family members of these groups of farmers engaged earlier in different farming activities to build up their capacity to earn additional income. Whereas, family members of the medium farm category are less interested to do farming business and their tendency is to do non-farm business and engage in service sector for earning more income. They also treated farming activity as an activity for poor people and they tried to maintain their social status not by doing farming but doing some non-farm business. Another reason is that younger family members of the medium farmers are usually go to high school and they also tend to think that agricultural activities is for the poor people who are irrational and they should engage in agricultural activities for its better performance. The medium farmers mostly used hired labor and machines for their agricultural activities and therefore, some of their family members started to assist the farmer a little later than marginal and small farmers.

Table 4. Physical involvement of vegetable farmers in different farming activity across farm category

Activity	Marginal		Small		Medium	
	Mean	Range	Mean	Range	Mean	Range
Land preparation	14.4	12.5-17.5	15.3	12.8-17.0	16.4	15.5-17.3
Intercultural operation	15.1	12.5-18.1	16.7	15.1-18.5	18.0	17.0-18.5
Harvest and post harvest	15.3	13.0-19.8	16.2	14.3-17.3	17.3	16.8-18.5
Marketing	15.7	12.0-18.0	18.1	13.5-20.0	18.8	17.0-21.0
Farm planning	18.5	16.0-21.3	19.9	17.0-21.7	21.5	20.3-22.7
Accounting	19.9	17.0-23.0	21.3	18.5-24.0	24.4	22.5-25.5

Similar trend is found for these groups of farmers when they started different farming activity independently (Figure 1). The result shows that majority of the marginal and small farmers are well ahead in Gehilfen[1] stage of capacity building than the medium category. Because, resource poor marginal and small farmers have to do their farming for meeting up their subsistence need and to improve their standard of living by increasing capacity of farm production.

The result also shows that farmers cannot enter into the Meister stage because marginal and small farmers cannot make long term farm development and financial management plan, maintenance of assets and properties etc. The marginal and small farmers have a small piece of owned land and they have to lease some lands from medium and large farmers. When they lease lands they cannot make a long term plan because land owners can take lands any time for their own purpose. Moreover, farm development plan requires specialized education in agriculture but the farmers in Bangladesh have no formal education at agricultural high school or college. The long term financial management plan also requires specialization in farm business management which is absent for the farmers in Bangladesh. Almost 80% of the farmers cannot use heavy machines like tractor, combined harvester, greenhouses because of their very limited resources. Therefore, farmers in Bangladesh can hardly enter into the Meister stage of capacity building.

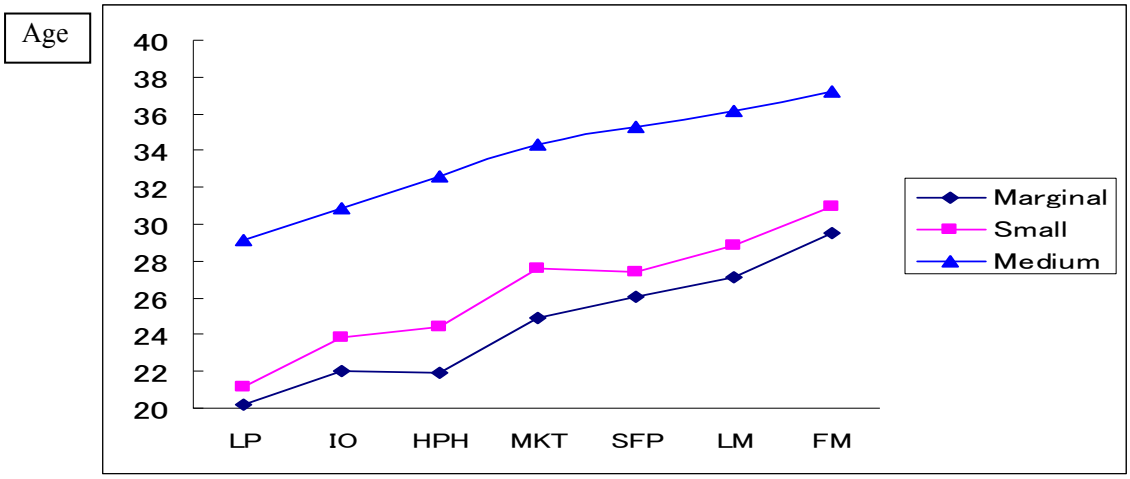

Figure 1. Similar trend is found for these groups of farmers when they started different farming activity independently.
Note: LP = Land preparation, IO = Intercultural operation, HPH = Harvest and post harvest activity, MKT = Marketing, SFP = Short term farm planning, LM = Labor management, FM = Financial management

Factors affecting capacity building

Physical and technical skill score is higher for marginal and small farmers than medium farmers (Table 5). Family members of the marginal and small farmers utilized their labor very efficiently because of their limited resource base. They participated in some training programs on how to produce vegetable in a scientific way, how to manage soil fertility, how to do integrated pest management etc given by department of agricultural extension or non-government organizations. Therefore, they have some technical knowledge on agricultural production which increases their technical knowledge base along with technical skill.

Table 5. Average score of physical and technical skills for the farmers across farm category.

Skills	Marginal	Small	Medium
Physical	56.5 (12.6)	52.0 (13.6)	33.9 (7.6)
Technical	10.5 (2.2)	9.5 (2.1)	6.8 (1.0)
Managerial score	13.4 (2.5)	12.1 (2.8)	9.0 (2.0)

Note: Maximum value for physical, technical and managerial score is 65, 12, and 15 respectively. Figures in the parentheses indicate respective standard deviation.

Regarding physical skill 67.4% of marginal and 58.3% of small farmers have high skill, whereas there are no medium farmers who have high skill (Table 6). Technical skill level was also high for marginal farmers (67.4%) followed by small farmers (44.4%). The tendency is also similar for managerial skill. The marginal and small farmers devoted themselves in farming activities to sustain their life using very limited resources. They have utilizes their family members owe to skill development to have high physical and technical skill of farming activities. Though physical and technical skill score is higher for marginal farmers than small and medium farmers but there is an increasing tendency of having high skill for small farmers also.

The result of multiple regression analysis shows that if physical score increase by 1 point then total return from vegetable production increases by Tk. 1762 (USD 25). The result also shows that mobile phone users for buying raw materials and selling products have a possibility of earning Tk. 18082 (USD 262) than the farmers who use interpersonal communication for this purpose (Table 7). The result also shows that physical skill is the most important factor with a standardized value of 0.58 for increasing total return than technical skill (0.21) and high communication skill dummy (0.20). The managerial skill factor does not show any significant factor for increasing total return. In earlier discussion we saw that vegetable production is highly labor intensive and it needs physical involvement of labor with some technical knowledge. The farmers also need to have some ideas on recommended practice of some agricultural activities which is defined as technical score also vital for increasing vegetable production. Communication skill also shows a significant role in increasing total return because farmers can sell their product at a high price prevailing in the market through mobile phone and broadcast media. Managerial skill in the study area can not play an important role because farmers do not use machines, greenhouses for vegetable production. Moreover, they cannot make any long term farm

development plan because of lease lands from the large and medium farmers, and medium farmers are almost out of farming business, engaging in non-farm business. Therefore, it can be concluded that physical skill is the dominant factor for increasing capacity building of the farmers in terms of earning total return.

Table 6. Distribution of different categories of farmers by physical, technical and managerial skill level.

Skill level	Marginal		Small		Medium	
	Count	%	Count	%	Count	%
Physical skill						
Low	12	26.1	11	30.6	15	83.3
Medium	3	6.5	4	11.1	3	16.7
High	31	67.4	21	58.3	0	0
Technical skill						
Low	12	26.1	12	33.3	17	94.4
Medium	3	6.5	8	22.2	1	5.6
High	31	67.4	16	44.4	0	0
Managerial skill						
Low	10	21.7	11	30.6	14	77.8
Medium	5	10.9	11	30.6	4	22.2
High	31	67.4	14	38.9	0	0

Table 7. Factors affecting capacity building of the farmers in the study area

Variable	Coefficient	Standard value	Sig. level
Constant	38042.4		
Physical skill	1762.3	0.58	8.16
Technical skill	3808.8	0.21	2.48
Managerial score	552.5	0.04	0.74
High communication skill dummy	18082.0	0.20	4.54
Medium communication skill dummy	5595.5	0.05	2.22

R^2 is 0.98 and F-value is 1734 with 5 and 94 degrees of freedom.

Conclusion

The findings of the present study revealed that some of the farmers in Bangladesh are in the second stage (Gehilfen) of capacity building and there is a minimum possibility to enter into final stage (Meister) of capacity building. Majority of Marginal and small farmers are well ahead in entering into the second stage of capacity building than the medium farmers. The study also identified that physical skill is the dominant factor for increasing capacity in vegetable production for the farmers. Therefore, marginal and small farmers could make agricultural productivity better than the medium farmers owe to skill development. This sort of studies has not yet done by any researchers for the developing countries. Moreover, the findings of the present study is based on the characteristics of Bangladeshi farmers, therefore, there is a possibility of including more developing countries to verify the present findings.

Note:

Lehrling, Gehilfen and Meister are the established stages of capacity building in developed countries like Germany and Japan. Farmers of those countries have to pass an examination with some designated experience to enter into next stage from the previous one. In Bangladesh, there are no formal licensing systems of capacity building by life stage like Germany and Japan. Therefore, it is hypothesized that the farmers who have high physical and technical skills are entering into the Gehilfen stage of capacity building from Lehrling stage.

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Water and pollution agents in the 21st century

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Abstract: Water is a vital element in socio-economic development; therefore the relationship between water and health cannot be overemphasized. Through ages, man has always strived to define a better living condition for himself. As a result of man's quest for comfort many anthropogenic activities lead to the pollution of our water, which limits the use to which it can be put to or its availability for use. This paper discussed pollution of water as the effect of dissolved solute, fluid or gas, which enters natural water body as a result of anthropogenic activities. Point or non-point describes the degree of localization of the sources. Pollutant can enter a water body through many sources, which sometimes make it difficult to attribute contamination to specific activity. Apart from the various activities that lead to the pollution of our fresh water bodies, the paper also discussed the need for an urgent action on a global, regional and national level in order to monitor and protect our fresh water bodies. Likewise, increased awareness, education and implementation of legislation are recommended. [Nature and Science. 2008;6(4):16-24]. ISSN: 1545-0740.

Keywords: water, pollutant, point source, non-point source.

1 Introduction

Water is a fundamental element in sustainable development. Better access to safe drinking water, adequate sanitation and increased water for food production and industry contribute to health, livelihood and broader economic development outcomes. It is also essential for the environment services provided by wetlands and other aquatic ecosystems. Water resources occupy a special place among other natural resources. It is the most widely distributed substance on our planet: albeit in different amounts, it is available everywhere and plays a vital role in both the environment and human life[1]. Comprising over 70% of the Earth's surface, water is undoubtedly the most precious natural resources that exist on our planet. Without the seemingly invaluable compound comprising of Hydrogen and Oxygen, life on Earth would be non-existent: it is essential for everything on our planet to grow and prosper.

Although we as humans recognize this fact, we disregard it by polluting our rivers, lakes, and oceans[2]. Subsequently, we are slowly but surely harming our planet to the point where organisms are dying at a very alarming rate. In addition to innocent organisms dying off, our drinking water has become greatly affected, as is our ability to use water for recreational purpose. In order to combat water pollution, we must understand the problems and become part of the solution.

Concern over massive anthropogenic change in the hydrological cycle of rivers, lakes and groundwater storage affecting their quality, their potential as water resources has been on the increase since the last century. In Mar del plata, Argentina (1977) the United Nations held the first World Conference on water resources. The 1977 conference contributed greatly to the strengthening and co-ordination of international co-operation in studying and assessing water resources. Since then technological advancement and development and other human activities has continue to put pressure on the sustainable exploitation, development and management of water resources as a human imperative. This has called for world attention in recent times and most recent among the international forum that discussed water as a key to sustainable development include:

3rd World Water Forum, Kyoto 2003.
World Summit on Sustainable Development, Johannesburg 2002.
International Conference on Fresh Water, Bonn 2001.
United Nations Millennium Summit, New York 2000.
The 2nd World Water Forum, Hague, 2000.

Other events where issues' relating to development and future global water crisis has been put on the international agenda are:

The 1994 Ministerial Conference in Noordwjik and the 1994 OECD/DAC meeting in Paris.
The 1992 Dublin meeting, the 1992 UNCED meeting in Rio de Janeiro,

The 1991 Nordic Freshwater Initiative in Copenhagen and the 1990 New Delhi meeting.

Africa has not been left out in the discussion on water resources issues. Forty-five African Ministers responsible for water resources in their respective countries met in Abuja, Nigeria on April 29 and 30 2002 to deliberate on the challenges facing the continent in its water resources sector. That gathering clearly underscores both the magnitude and realization by the highest water officials in the continent that urgent action is needed to address such problems. The ministers issued; "The Abuja Ministerial Declaration on Water-A key to Sustainable Development in Africa", and pursuit to the declaration, launched "the African Ministerial Conference on Water" (AMCOW). In furtherance to the actualization of the millennium development goal on sustainable environmental development in Nigeria the first National Water and Sanitation forum was held in Abuja between August 29 and September 1 2006.

Africa faces a multitude of problems in the water resources sector. Those problems include the temporal and spatial rainfall variability, the periodic cycle of droughts and floods, and the significant growth in population, urbanization and environmental degradation[3]. The population of the continent is approaching 700Million, and is expected to exceed a billion by 2025. This rapid increase in population accompanied by urbanization poor land use and unregulated waste disposal is taken a toll on water resources, at both the quantitative and qualitative levels. About 65 percent of the rural population and 25 percent of urban population are without adequate water[4]. The fact that Africans rely on natural resources for a part or all of their incomes call for improved natural resources management so that income levels can increase and to reduce the risk associated with the use of these degraded natural resources.

2 Concept of pollution

Pollution is the contamination of the earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of the ecosystem (living organisms and their physical surroundings)[5]. Less technically, it is the act of making the state and/or conditions of an environment unhealthy and unbearable[6]. Pollution can be of three types-air, water and land. But for the purpose of this discussion, the focus shall be water pollution.

Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water. When it is unfit for its intended use, water is considered polluted. There are two main categories of pollutants.

I) Biodegradable pollutants are materials such as sewage that rapidly decompose by natural process. These pollutants become a problem when added to the environment faster than they can decompose.

II) Non-degradable pollutants are materials that either do not decompose or decompose slowly in the natural environment. Once contamination occurs it is difficult to remove the pollutants from the environment.

Two types of water pollutants exist; point source and non-point source. Point sources of pollution occur when harmful substances are emitted directly into a water body. Point source pollution comes from specific, localized and identified sources.

A nonpoint source delivers pollutants indirectly through environmental changes. Nonpoint source pollution comes from dispersed or uncontained sources. An example of this type of water pollution is when fertilizer from a field is carried into a stream by rain, in the form of run-off, which in turn affects aquatic life. Whatever the nature of pollution, the effect may be immediate or delayed. Nonpoint sources are much difficult to control. Pollution arising from nonpoint sources accounts for a majority of the contaminants in streams and lakes.

In Africa fresh water is rapidly being depleted through inefficient use and pollution by industrial effluents, domestic effluents, and by degradation of watersheds in major river basins. Because of lack of resources, knowledge and organizational skills, to undertake measures for mitigating environmental degradation, poor societies often use poor quality water contaminated by sewage, industrial and agricultural pollutants or siltation from soil erosion and suffer from debilitating diseases. Thus evidently showing the close correlation between environmental degradation of water resources and poverty.

3 Contributing agents of water pollution

Agents of water pollution include;

3.1 Fertilizers and Agrochemicals.

Fertilizers, contain nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae[2]. Excessive growth of these types of organisms consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters. This in turn, proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water.

Agriculture is an important part of the Nigerian economy which engages about two-thirds of the country's labour force and generates on the average about 40 percent of the Gross Domestic Product. In the face of declining productivity in agricultural sector, the need to ensure food sufficiency and security has led to the application of fertilizers and agrochemicals to enhance the potentials of agriculture in Nigeria. Despite the roles of this inputs in the enhancement of agricultural potentials, they constitute a source of risk to the environment most especially water systems. For instance the main liquid effluent released from NICON Fertilizer Complex are benfield reflue urea disorder bottom, contaminated water run-off, and utility wastewater[7]. The waste water consists of boiler blow down, cooling tower blow-down, demineralized regenerant waste and sanitary plant treated effluent. These streams contain primarily and basically ammonia, urea and dissolved solids. The effluent discharged to the environment are as shown in table 1 and 2.

Table 1. Condensate Analysis

Components	**Stripper Inlet (ppm)**	**Stripper Outlet**	
		Design	Actual
CO_2	2000	25	5
NH_3	1000	25	10
Methanol	2000	50	5
Hydrocarbons	50	0	0

Table 2. Final Plant Liquid Effluent

Parameter	**Designed Criteria**	**Lab Results**	**% Compliance**
pH	6-9	7	100
Temp (^{0}C)	35	35	100
NH_3 (ppm)	10	10.8	83
PO_4 (ppm max)	150	128.1	100
BOD_5 (ppm max)	20	15	100
HM (ppm total)	3	1.02	100
Oil (ppm max)	10	0	100
TSS (ppm max)	30	11.5	100
TDS (ppm max)	1000	900	100
Colour	Clear	Clear	100

Pollution is also caused when the silt and other suspended solids such as soil; plowed fields, construction and logging sites, urban areas, and eroded riverbanks wash off when it rains. The flux of inorganic and organic particles of rivers is generally dictated by both natural and artificial factors[8]. Predominant among the natural factors are climate, geomorphology, vegetation and the mineralogical constitution of rocks within the basin. Urbanization, as manifested by population stress on the soil surface, and overgrazing and bush-burning or deforestation have been identified as the major causes of increased particulate loads of rivers in semi-arid environments[9].

Under natural conditions, lakes, rivers, and other water bodies undergo Eutrophication, an aging process that slowly fills in the water body with sediment and organic matter. When these sediments enter various bodies of water, fish respiration becomes impaired, plant productivity and water depth become reduced therefore, aquatic organisms and their environment become suffocated.

Pollution in the form of organic materials enters waterways in many different forms as sewage, as leaves and grass clippings, or as runoff from livestock feedlots and pastures. When natural bacterial and protozoan in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom dwelling animals cannot survive when levels of dissolved oxygen drop below two to five parts per million. When this occurs, it kills aquatic organisms in large numbers, which leads to disruptions in the food chain. This can lead to serious nutrition problems in regions where such event takes place. Many marine, coastal and freshwater fisheries that provide protein for a large part of the population are threatened by poor water quality emanating from pollution.
Pollution of rivers and streams with chemical contaminants remains one of the most critical environmental problems of the 21st century.

3.2 Sewage

Water has a very significant effect on human health. The relationship between water and health has been recognized from the time of Hypocrites, if not earlier, in the association of marshy places with fevers[10]. Yet until the second half of the 19th century, mankind had no true appreciation of the significance of water as a vehicle of disease.

Pathogens are another type of pollution agents that prove harmful. They can cause many illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. Pathogens are organisms such as bacteria, viruses and protozoan. These pollutants enter waterways through untreated sewage, storm drains, septic tanks, runoff from farms and particularly boats that dump sewage. In 2004, it was reported that Baghdad's three wastewater treatment plants which were yet to function discharges raw sewage from the city's 3.8 million residents into the Tigris River"[11] More so, in many major cities of developing countries, the huge volume of water used in homes ends up as sewage or in open drains as wastewater polluted with chemicals and irritating odors not even suitable for irrigation which finds its way to either surface water body or underground aquifers. This fact is evident of the Lagos lagoon, Nigeria. The increasing population experienced in major cities of the world especially developing countries has led to crowded and unhygienic settlements. This has resulted in the littering of every available space with refuse, illegal structures and abandoned vehicles. Many public drains have been converted to receptacles for domestic, industrial and human wastes.

In Nablus and Tulkarm, Palestinians have been wrestling with a growing environmental nightmare for years. Untreated human sewage flows into the Nablus River, the Alexander's main tributary for much of the year. In addition, Tulkarm residents contribute raw sewage to the Alexander. Indeed, waste generated by 240,000 Palestinians, Olive oil press in late fall and stone cutting plants contaminate the Alexander at scores of different sites, reportedly causing human health problems. Though microscopic, these pollutants have a tremendous effects evidenced by their ability to cause sickness. Cholera and typhoid are caused by the bacteria *Vibro cholerae* and *salmonella typhi* respectively. Other diseases traceable to water pollution by pathogens from human faeces, human urine and animal excreta include gastroenteritis, infectis hepatitis, leptospirosis, schistomiasis, salmonellosis[12, 13, 14].

3.3 Petroleum and Petrochemicals

Other agents of water pollution exist in the forms of petroleum, radioactive substances, and heat. Petroleum often pollutes water bodies in the form of oil, resulting from oil spills. These large-scale accidental discharges of petroleum are an important cause of pollution along shorelines. Besides the supertankers, offshore drilling operations contribute a large share of pollution. One estimate is that one ton of oil is spilled for every million tons of oil transported. This is equal to about 0.0001 percent[2]. Oil pollution is a growing problem, particularly devastating to coastal wildlife. Small quantities of oil spread rapidly across long distances to form deadly oil slicks. Whether or not accidental oil spill occur during exploration or transportation, its impact on the delicate marine ecosystem of coral reefs, and land could be devastating. Tankers spills are an increasing environmental problem because once oil has spilled, it is virtually impossible to completely remove or contain it. Even small amounts spread rapidly across large areas of water. Because oil and water do not mix, the oil floats on the water and then washes upon broad expanses of shoreline. Attempts to chemically treat or sink the oil may further disrupt marine and beach ecosystems.

The major effluent of petroleum and petrochemical industries are wastewaters, oil spills and leaks. The petroleum and petrochemical industries have been identified as major producers of effluents into the environments. The Kaduna Refinery in Nigeria was one of the seven largest contributors to the poor quality

of Kaduna River. It is estimated that 3,160 tons per year of grease and oil is been released into Nigerian environment[15]. Several other endemic pollution activities of this sector have also been reported in the Niger Delta. The different types of effluent from oil refineries includes;

- Waste water from the handling of raw materials and product stores, and oil and its components pollute rainwater run off from the refinery area;
- Acidic waste water containing hydrogen Sulphide originating from the distillation of oil under reduced pressure;
- Alkaline waste water from washing petroleum products with caustic soda. This waste water contains Sodium Sulphate, Sodium Hydrogen Sulphide at concentration as high as 100g/litre;
- Acidic waste water from washing oil products with Sulphuric acid and from the processing of acid pitch;
- Waste water containing arsenic (III) oxide up to a concentration of 10g/l from removal of hydrogen Sulphide from the produced gas;
- Waste water containing mercaptans arising from acid pitch cooking processes; and
- Waste water containing lead as Sodium Plumbite (Na_2PbO_2) is formed by removal of mercaptans from oils. The median effluent characteristics of different operations are as listed in Table 3.

Table 3: Median Waste Flows and Loading for Petroleum Refinery Operations Following Oil/Water Seperation. (Net Kg per 1,000m^3 of feed stock[a])

Parameter					
	Topping	**Cracking**	**Petrochemical**	**Lube**	**Integrated**
BOD_5	3.4	73	172	217	197
COD	37	217	463	543	329
TOC	8.0	41	149	109	139
TSS	12	18	49	72	58
O/G	8.3	31	53	120	75
Phenols	0.03	4.0	7.7	8.3	3.8
NH_3-N	1.2	28	34	24	20
Sulphides	0.05	0.94	0.86	0.01	2.0
Total Cr	0.01	0.25	0.23	0.05	0.49
Cr^{+6}	0.007	0.15	0.13	0.02	0.30
Flow[b]	67	93	109	117	235

Source: Nigerian Strategic Options for Redressing Industrial Pollution (World Bank Publication)

a: Feedstock= Crude Oil and/or natural gas liquid throughput
b: Except flow, which is m^3 per 1,000m_3 of feed stock.

3.4 Radioactive Substances

Radioactive substances are produced in the form of waste from nuclear power plants, and from the industrial, medical, and scientific use of radioactive materials. Special forms of waste are Uranium and Thorium mining and refining. About 200 tones of Uranium (Depleted Uranium-half life of 4.7 billion years) lying around Baghdad, the containers which carried the ammunition were discarded. For months afterwards, many used them to carry water while other used them to sell milk publicly. During the Gulf war, over 300 tones of depleted Uranium weapons was used by American forces in 1991. This penetrates tanks and caused health problem affecting over 3000,000 people. In Basra, two years study shows that DU has caused Leukaemia in all age groups (under 15 most), breast cancer, sterility in man, anopthalmia, micropthalmia, corneal opacities and coloboma of the iris. Miscarriages and premature births, congenital malformations, additional abnormal organs, hydrocephaly, anecephaly and delayed growth have also been reported[16].

3.5 **Heat**

The last form of water pollution is heat. Heat is a pollutant because increased temperatures result in the deaths of many organisms. These increases in temperatures are caused when there is a direct discharge of cooling water by factories and power plants into water body.

The pathway of contamination is illustrated in figure 1.

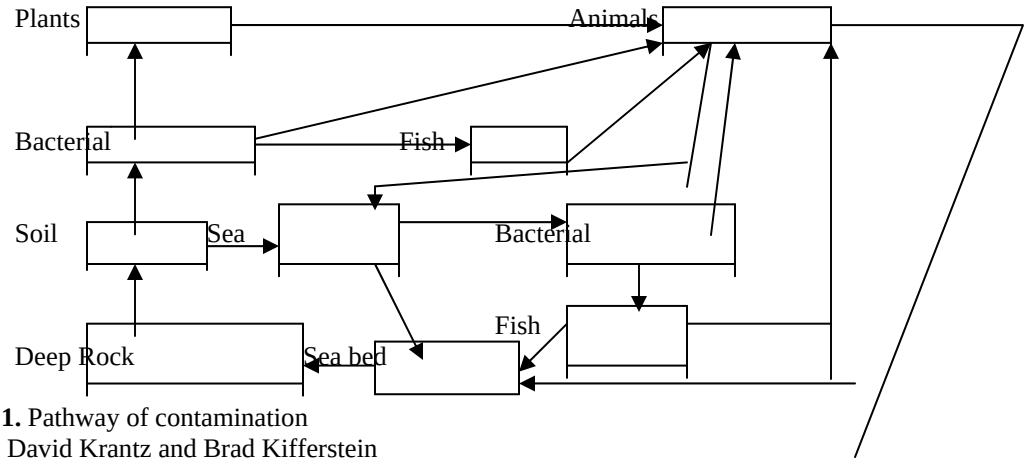

Figure 1. Pathway of contamination
Source: David Krantz and Brad Kifferstein

5 Water Related Diseases

It has been customary to classify water-borne human pathogenic diseases according to microbes causing the infections. Few examples are Salmonellosis caused by *Salmonella*, Shigellosis caused by *Shigella species*, Giardiasis caused by *Giardia species* and Schistosomiasis caused by *Schistosoma species*. This system of classification has not been useful in consideration of how to improve water supplies. Thus it has been more useful to reclassify infective diseases associated with water supplies into four categories[17, 18, 19]. These categories

1. Infections spread through water supplies (i.e. drinking water) are known as water borne diseases.
2. Infections due to lack of personal hygiene are known as water-washed diseases.
3. Infections transmitted through aquatic animals known as water-based diseases.
4. Infections spread by water-dependent insects are known as diseases with water related insect vectors.

Diseases transmitted from infected persons through water belong to category 1; hence infected persons acquire the infections through oral contact with faecally contaminated water.

5.1 Infection through water supplies - water-borne diseases

Diseases in man can be caused by the presence of pathogenic bacteria, and also by other organisms such as virus, protozoan and worms[20]. Intestinal bacterial diseases which are commonly, although not invariably, water borne are given below.5.1.1 Cholera

The cause is the bacterium *vibro cholerae* and its variant *el tor vibrio*. Infection is usually contacted by ingestion of water contaminated by infected human faecal material, but contaminated food and personal contact may also spread infection. Cholera is not likely to spread in communities with controlled water supplies and effective sewerage.

5.1.2 Typhoid fever.

The cause is bacterium *Salmonella typhi.* Infection is usually contracted by ingestion of material contaminated by human faeces or urine, including water and food. *Salmonella typhi* occasionally continues to proliferate in the gall bladder of a few patients who have recovered from primary infection, and these carriers continues to excrete the organisms in their faeces or, occasionally, in their urine for long period, even for life. The largest water borne outbreak of typhoid fever in Britain, investigated by Suckling, killed 43 people in Croydon in 1937[21]. It was caused by a combination of circumstances, which included a person who was a carrier of Salmonella typhi working down a well that was pumping into supply when the filtration and chlorinating plants were bypassed. Other outbreak of typhoid include: Aberdeen in 1964

involving 400 people (HMSO, 1964), Dade country, Florida USA 1973, involving 210 cases, Poiters in France 1974 involving 60 cases[22]. Both are believed to have been due to water contamination coinciding with inefficient disinfect ion.

5.1.3 Paratyphi fevers

These are caused by *Salmonella paratyphi* A, B, or C. Infection may exceptionally be via contaminated water, but is more commonly due to ingestion of contaminated food.

5.1.4 Bacillary dysentery

This is caused by bacteria of the genus *Shigella-sh. Dysenteriae I, Sh. Flexneri, Sh. Boydii and Sh. Sonnei* – there are several subspecies. Infections can occasionally be contracted via water contaminated by human faeces, but is more commonly due to ingestion of food contaminated by flies or by unhygienic food handlers who are carriers. The most virulent is *Sh. dysenteriae* I (formerly known as *Sh. shigae*) which produces an exotoxin and has often proved fatal.

5.1.5 Traveller's diarrhea (Turista)

The cause is not definitely known, but may be some forms of pathogenic *Escherichia coli* or rarely *shigella.* It is probably transmitted in the same way as bacillary dysentery and water may sometimes be the vehicle. Infants' diarrhea is probably related to this.

5.1.6 Virus diseases

Virus differ from bacteria-they are very much smaller and they multiply only within suitable cells in which they produce changes which gives rise to a range of diseases. More than one hundred different types of virus have been identified in faeces.

5.1.7 Poliomyelitis

This virus persist in the intestines of infected, not necessarily paralyzed, persons for a short while after infection, and is shed in the faeces: it can often be found in untreated sewage and even in the effluent from sewage disposal units. Like other viruses, it does not multiply in the absence of living cells. Infection probably takes place from contaminated fingers directly, or on food, there have been a few reports of water-borne infection, but little confirmation. It is common where sanitation and food hygiene are poor, and in such communities children are widely infected.

Presently, Nigeria is ranked highest in polio infections and effort is ongoing with the assistance of WHO to eradicate it.

5.1.8 Infectious hepatitis

The virus inhabits the intestine and is discharged in the faeces. Carriers may be infected for long periods. Transmission is probably as for poliomyelitis. Several water-borne epidemics have been reported, especially where water treatment has broken down, where the distribution system has been disturbed, or where badly constructed wells have been contaminated from cesspits, or as a result of heavy rainfall.

6 Chalenges of water pollution in the 21st century

It has been estimated that nearly 1.5billion people lack safe drinking water and an estimated 5million deaths per year has been linked to water borne diseases. It is a fact that oceans cover 70 percent of our planet but most unfortunate, humans have long acted as if these bodies of water could be used as a limitless dumping site for wastes. Raw sewage, garbage, and oil spills have begun to overwhelm the diluting capabilities of the oceans, and most coastal waters are now polluted. Beaches around the world are closed regularly, often because of high amounts of bacteria from sewage disposal, and marine wildlife is beginning to suffer.

Our continued existence on planet earth is greatly tied to the availability of safe drinking water, and as a result of this, the world is perhaps faced with the challenge of a worldwide effort to monitor and restrict global pollution of water in any form. Because of the concern for increased unabated degradation of environment, the United Nations in 1972 (Stockholm, Sweden) created the United Nations Environmental Program (UNEP), the first UN agency to be headquartered in a developing country, with offices in Nairobi, Kenya. The UNEP was designed to be "the environmental conscience of the United Nations", and in addition to encourage sustainable development, increasing Standard of living without destroying the

environment. At the time of creation of UNEP in 1972, only 11 countries had environmental agencies. Ten years later that number had grown to 106, of which 70 were in developing countries[2]. Although many countries have consented to various treaties on environmental protection, these are not been implemented to the letter most especially in developing countries because of the belief that developed world want to keep the developing world in an economically subservient position. Water pollution goes on unabated in many developing cities. Sewage and effluent are been discharged into water bodies without proper treatment; banned pesticides have continued to be employed in pest control. For instance in August 2004 in a monitored BBC report (Network Africa), DDT was being used to control mosquitoes in the snowy region of Tanzania. Again most chemical discharge, radioactive and nuclear discharge takes place in developing countries of Africa, Asia and South America where problem of war still persists and where oil exploration does not employ adequate modern technology that minimize pollution. There is now an urgent need for the protection of our fresh water resources than ever before. We should be aware that human health is linked to availability of good quality water. More so, global population has continued to soar which means an increase demand for potable water. Any water related outbreak could spread like wild fire, which may cause death and paralyze economic activities. As reported on BBC news headlines (14-9-2004, 04:00H GMT), in Darfur, western Sudan, an estimated 10,000 displaced people die monthly due to lack of access to food and potable water.

7 Conclusion

Water if polluted can be made unfit for use and made home to millions of pathogens. It is also evident that water pollution related problems have the potentials to disrupt life on our planet in a more devastating manner. At global, continental, regional and national levels, congress has passed laws to try to combat water pollution act. Thus acknowledging the fact that water pollution is, indeed, a serious issue and call for urgent attention. But the government alone cannot solve this enormous problem of water pollution. It is ultimately up to us, as individuals, as a people and as corporate body, to be informed, responsible and involved when it comes to the problems we face with our water. We must become familiar with our local water resources and learn about ways of disposing harmful household and industrial wastes so that they don't end up in sewage treatment plants that can't handle them or landfills not designed to receive hazardous materials. Application of fertilizers should be considered with the need for it and better alternative where there is possibility of fertilizers been washed into surface water.

Global environmental collapse is inevitable. The developed world must work with developing nations to ensure that process of industrialization does not add to the world's environmental problem. Conservation strategies have to become widely adopted and accepted. People must learn that energy use can be dramatically diminished without sacrificing comfort, politicians must think of sustainable development rather than economic expansion.

Water is a necessity of life, life begins in it, and it sustains life. Therefore if measures are not taken and water pollution continues, life on earth will suffer surely. Collective and concerted efforts in awareness and education certainly remain the two most important ways to prevent water pollution in the 21st century.

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Physico-chemical analysis of ground water of selected area of Ghazipur city-A case study

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Abstract: A laboratory study was conducted to monitor the ground water quality of selected sites of Ghazipur city by examining the various physico-chemical parameters like pH, T.D.S., D.O.& CO_2 etc.. A comparision with ICMR standard shows that the water is nearly suitable for drinking purpose, the DBPs (Disinfection by products) analysis is required to corroborate the present study. [Nature and Science. 2008;6(4):25-28]. ISSN: 1545-0740.

Key words: Physico-chemical parameters, Water characteristics, Ground water analysis, Potable water.

1. Introduction

Ground water is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Over burden of the population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water. Studies regarding the ground water quality analysis has been made by many authors like B. K. Gupta and R. R. Gupta (1999), M. Rajasekara et al. (2005), M. R. Rajan and I. Paneerselvam. (2005), S. B. Thakare et al. (2005), Shikha Bisht et al.(2007).They concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid as well as liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality. Municipal Corporation of Ghazipur facilitates the drinking water in limited area, in alternate to this people keeps option as hand pumps and jet pumps etc. from last few years it has been seen that the water quality of the alternative sources like hand pumps, wells has been deteriorating and its responses are in the form of yellowish and uncommon odor of the water people in this area using chlorine tablets for disinfect the drinking water. The objective of this work is to assess the quality of drinking water in Ghazipur city.

2. Materials and Methods:

2.1 Study area:

The experiment was conducted at Deptt. of Environmental Science, P.G.College,Ghazipur. This is suburban area and district head quarter, located in the eastern gangetic plain of the Indian sub continent at $25^0$19`and $25^0$54`N latitude, $83^0$4`and $83^0$58`E longitude and 67.50 m above the sea level. The coldest months here are December-January and the hottest months are May-June. The Temperature varies from 5° to 17° centigrade in winters and 30° to 42° in summers. But some times winter temperature ebbs to 3° C and summer temperature shoots up to 45° C. In the summers, which begin from March and last till Mid June the temperature starts rising and sometimes it reaches 45° C. The annual rainfall in the district was between 800 mm. and 1200 mm and in 1997 the rainfall was 1034 mm. On the average there are 49-55 rainy days (days with rain fall of 2.5 mm or more) in a year in the district July and September the relative humidity are high being over 70 %. During the Post-Mansoon and winter season the humidity is high in the morning. By summer, the relative humidity become very low i.e. less than 25 %.Anonymous (2007).It having 25 wards with some extension areas of the city five sites are selected for the study as mentioned in Fig.:-1 Map View. The average boring depth of the city is 45-60 meter

2.2 Sampling and sampling sites:

A fluorinated plastic bottle of capacity 2 litre has been used to collect the sample, before sampling evacuation of the stored water in the pipelines has been made to take the fresh ground water sample the selected sampling sites are populated and urban areas of the city depicted in the Fig.:1 A map view of ghazipur city as site 1 to 5.The sampling has been carried out in the month of April year 2007.

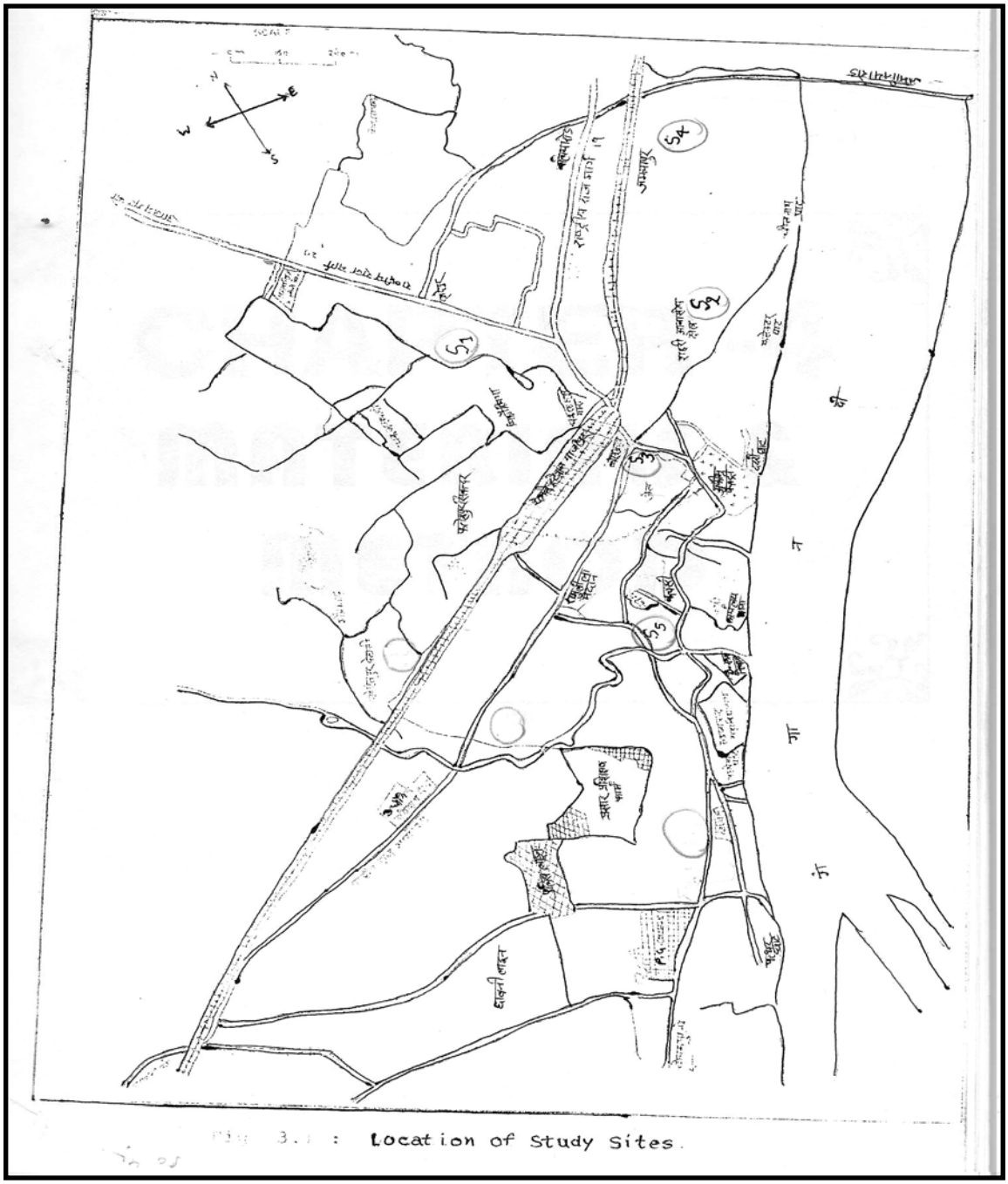

Figure 1: A map view of study site Ghazipur city.

2.3 Methodology:

pH was measured with the help of pH meter (Model no. 101 E) of Electronic India , standardized with pH buffer 4,7 and 9.2. TDS was estimated by evaporation method at 180^0C, Alkalinity, Hardness, D.O., Chloride, CO_2 and all parameters were analyzed by standard procedure mentioned in APHA (1995). The elemental analysis carried out by digital flame photometer.

2.4 Statistical analysis:

The data were subjected to one way ANOVA analysis of variance using SPSS ver. 10 software Ducan's multiple range test performed to test the significance difference among the treatments.

3. Result:

Table 1: Reading of water quality parameters at different sites in Ghazipur city.

Parameters	**S1**	**S2**	**S3**	**S4**	**S5**	**ICMR**
pH	7.4±.00^{c}	7.2±.00^{c}	6.8±.12^{d}	8±.11^{b}	8.3±.00^{a}	7.0-8.5
T.D.S.	200±6.5^{c}	175±2.5^{d}	145±2.8^{e}	225±2.8^{b}	245±7.6^{a}	500
T. H.	256±.1^{c}	235±.11^{d}	240±4.04^{d}	266±1.15^{b}	304±3.05^{a}	300
Cal. Hard.	108±.11^{c}	99±.7^{d}	106±2.3^{c}	140±.35^{b}	158±3.05^{a}	-
D.O.	3.4±.005^{e}	4.1±.006^{b}	3.6±.00^{d}	4±.00^{c}	5±.00^{a}	4-6
Cl	78±.30^{e}	100±1.5^{b}	83±1.1^{d}	91±.57^{c}	106±.17^{a}	200
Alk.	120±.10^{b}	140±7.5^{a}	110±5.77^{b}	140±.17^{a}	149±1.7^{a}	200
Co_2	7.42±.009^{c}	7.84±.003^{a}	7.92±.002^{a}	7.02±.002^{d}	7.67±.00^{b}	-
Na	23±.17^{b}	28±.005^{b}	25±.00^{b}	42±6.7^{a}	46±2.3^{a}	-
K	4±.00^{e}	4±.00^{d}	6±.00^{c}	8±.00^{b}	10±.00^{a}	75

Different letters in each group shows significant difference at P<0.05 levels.(Mean ± stand. error)
S1- Rauza, **S2**-AamGhat, **S3**-Vishweshwar Ganj, **S4**-Shastri Nagar, **S5**-GoraBazar.

4. Discussion:

The value of pH range among 6.8 to 8.3. It is in the prescribed limit of ICMR. A little bit increase in pH level may depress the effectiveness of the disinfectants like chlorinations thereby requiring the additional chlorines. The value of total dissolved solid ranges from 145-245 mg/l all the values of total dissolved solid is in the prescribed limit of ICMR it is due to high dissolved salts of Ca, Mg and Fe it requires specific cation and anion analysis. Total hardness ranges from 235-304 mg/l, total hardness is with in the prescribed limit of ICMR except the site-5 which is 304 it fall in hard water category it means it contains appreciable amount of Calcium and Magnesium ions. Calcium hardness ranges from 99-158 mg/l. Dissolved Oxygen ranges from 3.4-5 mg/l, D.O. indicating the nearly pure symptoms. Chloride content is 78-106. Chloride content is also in the limit of ICMR. Alkalinity ranges from 110-149 mg/l. Alkalinity is the cause of carbonate and bicarbonate ion and its salts. It is in the prescribed limit of ICMR. Cabon dioxide content is from 7.02-7.92 ppm. According to Henry's law the gaseous dissolution has been determined by partial pressure of gases, soluble salt content and ambient temperature. Increase in CO_2 content may be by high dissolved salt contents. One more possibility is there that is the degradation of DOC (dissolved organic carbon).Higher DOC on post disinfectant application causes some DBPs (Disinfection byproducts) like THM (Trihalomethanes),HAA (Haloaceticacids) etc. Some of them are potential carcinogens, and a short-term exposure can lead to dizziness, headaches, as well as to problems associated with the central nervous system. so it is more relevant for those areas where OM contaminations

are high with high use of disinfectants. Quality of ground water under study is nearly fit for drinking purpose, but it is recommended that ground water analysis should be carried out from time to time to monitor the rate and kind of contamination along with analysis of DBPs to corroborate the present study.

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Why Could Paul Dirac Not Derive The Correct Conclusions From His "Large Number Hypothesis" ?

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Abstract: In the beginning of 20 century, some scientists had some doubts to the gravitational constant G as a constant value. In 1937, Pual Dirac, a most imaginative scientist in England, proposed a "large number hypothesis" (LNH). He said: 'The very large numbers of no dimensions appeared in nature are interrelated.' [1] "Any two large numbers of no unit in nature can be linked with simply mathematical operations." [2] According to the hypothesis, he at least derived two important conclusions: (1). The value of gravitational constant G is inversely proportional to the increase in universal time t_b, i.e. $G \propto t_b^{-1}$. (2). The universal mass M_b and number of the universal particles (proton) N_p is proportional to the increase in the square of universal time t_b, i.e. $M_b (N_p) \propto t_b^2$. Obviously, his intention was to give an explanation for our universal expansion discovered by Bubble's law in 1929. However, now it can be verified that above conclusions derived from Dirac's Hypothesis are not right. In this article, according to the theories about black holes (BH), "Our universe was born from the collision and amalgamation of a large amount of minimum gravitational black holes (MGBH) at the Big Bang, and the expansion of our universe would just be the expansion of our universal black hole (UBH)." [4][5][6] the results can be derived in this article : "G is not a variable, but still a constant, and $M_b \propto t_b$." [Nature and Science. 2008;6(4):29-34]. ISSN: 1545-0740.

Key words: Pual Dirac's "large number hypothesis", G is not a variable,

I. According to the idea of Pual Dirac's "large number hypothesis", comparing the static electricity F_e with universal gravitation F_g, taking the hydrogen atom as an example, the mass of proton $m_p = 1.67\times10^{-24}$g, the mass of electron $m_e = 9.11\times10^{-28}$g, the capacity of electron e = - e = 1.602×10^{-19} C, r is the distance between two electrons, G is the gravitational constant, $G = 6.67\times10^{-8}$ $cm^3/s^2{*}g$, $k = 9.0\times10^9$ $N\bullet m^2/C^2$

$F_g = G\, m_p m_e / r^2 = 6.67\times10^{-8}\times1.67\times10^{-24}\times9.11\times10^{-28}/ r^2 = 101\times10^{-60}/ r^2$

$F_e = ke^2/r^2 = 9.0\times10^9\ N\bullet m^2/C^2\times(1.6\times10^{-19}C)^2/ r^2 = 9.0\times10^9\times10^5\times10^4\times (1.6\times10^{-19}C)^2/r^2 = 23\times10^{-20}/ r^2$

$$\textbf{Let } \eta = F_e/ F_g = k e^2/ G m_p m_e = 23\times10^{-20}/101\times10^{-60} = 2.3\times10^{39} \qquad (1)$$

Or, $1/\eta = F_g/ F_e = 4{,}348\times10^{-40}$

In above formula (1), only e and –e can be simultaneously adopted, if two e or two –e are adopted, then, $m_p m_e$ in (1) would be changed into m_p^2 or m_e^2 , as a result, η will increase

or decrease in 1840 times, and make a big difference with 2.3×10^{39} which was not needed by Pual Dirac's "large number hypothesis (LNH)".

Let the value $\eta = 2.3\times10^{39}$ as a basic standard, Dirac measured and calculated the universal age t_b with the ratio of time t_e which is the time of light passing through the electron radius R_e, he got a value, it was almost equal to $\eta = 2.3\times10^{39}$.

Taking the classical electron radius $R_e = ke^2/ m_e C^2 = (k=1)(4.803\times10^{-10})^2/(9.11\times10^{-28} \times 9\times10^{20}) = 2.8179\times10^{-13}$ cm,
$t_e = R_e/C = e^2/m_eC^3 = 2.8\times10^{-13}/3\times10^{10} = 0.934\times10^{-23}$s, (1a)
Suppose $t_b/t_e = 2.3\times10^{39} = \eta$, αs a result, $t_b = 6.8\times10^8$yrs. (1b)

But that universal age of $t_b = 6.8\times10^8$yrs was not accordance with the observational value in 1937. Steven Wienberg said: "In 1930s and 1940s, the Hubble's constant H_0 was regarded as a bigger number than present. It was about H_0=170km/s/Mly, so, the calculated universal age t_b was corresponding about 20×10^8yrs. If the gravitational brake was considered, the universal age t_b should be less." [3] Let $t_b = 20\times10^8$yrs**,** so,

$$\eta_b = t_b/t_e = 6.76\times10^{39} = 2.94(2.3\times10^{39}) = 2.94\eta \approx \eta. \quad (2)$$

Therefore, t_b = **20×10^8yrs was approximately needed by Dirac's LNH in 1937.** According to Dirac's Hypothesis, from formulas (1) and (2), Dirac derived his equation,
$$k e^2/ G m_p m_e \approx t_b/t_e \quad (3)$$

In formula (3), k, e, m_p ,m_e , and t_e are all constants, he imaginary got a result from (3),
$$G \propto t_b^{-1} \quad (4)$$

But now our universal real age t_r is 137×10^8yrs, so. $t_r \approx 7\ t_b$ in 1937. Thus, Dirac's $t_b = 20\times10^8$yrs was still a estimated value, which had much difference with the real universal real age t_r. The result of $G \propto t_b^{-1}$ is not reliable. If G is a variable, from $t_b = 20\times10^8$yrs to $t_r = 137 \times 10^8$yrs, the universal age increased in 7 times, G should correspondingly decrease in 7 times. i.e, $G = 6.67\times10^{-8}cm^3/s^2{}_*g/7 = 10^{-8}cm^3/s^2{}_*$ g. Why could the variance of G not be measured? Therefore, Dirac did really regard the numerical coincidence as the general law. Really,

$$k e^2/G m_p m_e \neq t_b /t_e \quad (5)$$

II. How did Dirac get universal mass M_b and the number of universal particles (proton) $N_p = 10^{78}$, and $N_p = (t_b /t_e)^2$? It was known, that in 1937, Dirac could only get the values of M_b and N_p from Hubble's constant H_0. It is shown above, at that time,

$H_0 \approx 170$km/s/Mly and $t_b \approx 20\times10^8$yrs, so, the universal density,
$\rho_c = 3H_0^2/8\pi G = 5.8\times10^{-28}$ g /cm^3 (6)

$M_b = 4\pi\rho_c R^3/3 = 4\pi\rho_c C^3 t_b^{\ 3}/3 = 1.649\times10^{55}$ g (7)
$N_p = M_b/1.67\times10^{-24} = 9.87\times10^{78} = (3.14\times10^{39})^2$ (8)

The result below accorded with the need of Pual Dirac's "LNH", N_p should be equal to:

$N_p=(3.14\times10^{39})^2, t_b/t_e=6.76\times10^{39}, (t_b/t_e)^2 = (2.6\times10^{39})^2, N_p=(t_b/t_e)^2$ (9)

Discussion:

A. Though formula (9) might approximately accord with Dirac's requirement of $N_p \propto t_b^2$ in the numerical value, but it is not a general mathematical equality and an equation at all, because only under the conditions of $H_0 \approx 170$km/s/Mly and $G = 6.67\times10^{-8}cm^3/s^2{*}g$, (9) may be tenable and exist. Therefore, the existence of (9) was a pure numerical coincidence. Formula (7) can be directly changed into:

$M_b = 4\pi\rho_c R^3/3 = 4\pi(3H_0^2/8\pi G)C^3t_b^3/3 = 4\pi(3H_0^2/8\pi G)C^3t_b/3H_0^2 = C^3\, t_b /2\, G$ (10)
Formula (10) which is a complete equation has accurately proved that $M_b \propto t_b$. Did Dirac not know formula (10) or wouldn't like to adopt formula (10) ? I think, for the requirement of his "large number hypothesis", Dirac forgot or didn't adopt (10) selectively.

B. If G is a variable due to the need of Dirac's "large number hypothesis", from formula (3), $k\, e^2\, t_e/m_p\, m_e = t_b\, G =$ constant $= 1.4\times10^9\ cm^3/s{*}g$ (11)
From formulas (10), (11) and (1a) and $t_e = ke^2/m_e C^3 = 0.934\times10^{-23}$s (k=1),
$M_b = C^3\, t_b^{\ 2}/2(k\, e^2\, t_e / m_p m_e) = 1.835\times10^{22}g\times t_b^2$ **(12)**
$N_p = M_b/m_p = [C^3 m_e/2(k\, e^2)] \times [t_b^2/t_e] = (t_b^2/t_e^2)/2 = 1.099\times10^{46}\, t_b^2$ **(13)**

Formula (13) should be derived by Dirac in 1937 from formula (9) and (10) under the condition of Gt_b = constant = $1.4\times10^9\ cm^3/s{*}g$. It shows that (9) and (13) are two different ways to get $N_p = (t_b/t_e)^2$. It can be seen from formula (13) that, though Dirac derived the better result needed by his LNH in 1937, but it can not be verified that our universal real evolution would better accord with the variances of formulas (11), (12) and (13).

C. Now, let us check the correctness of formulas (11) and (13) with the better accurately numerical values of our universal age A_o recently observed and calculated by scientists. According to measurements by the WMAP satellite, the age A_o of the universe to about 1%: $A_o = 13.7\pm 0.13$ billon years can be precisely estimated.[7] Then, from formula (10), the universal real mass at present $M_r = C^3\, t_b/2\, G = 0.875\times10^{56}$g. Of course, the numerical value of $A_o = 137\times10^8$yrs and $M_r = 0.875\times10^{56}$g can be verified by another recent observed numerical value, for example, the better recent observed value of H_o = 73km/s/Mpc, on this value, A_o can be calculated out $A_o = 134\times10^8$yrs, and $M_r = 0.856\times10^{56}$g. According to formulas (11) and (12) to checking Dirac's universal mass $M_b = 1.099\times10^{46}\, t_b^2 m_p = 34.3\times10^{56}$g. As a result: $M_b = 39.2\, M_r$. From formula (11), $G = 1.4\times10^9/t_b = 0.324\times10^{-8}$. It can be seen that our universal age from 2×10^9yrs estimated by Dirac in 1937 to 13.7×10^9yrs at present just increased in 13.7/2 = 6.85 times, but the gravitational constant G decreased too much in $6.67\times10^{-8}/0.324\times10^{-8} = 20.6$ times.

Furthermore, if looking back at the moment at Big Bang of our universe, i.e $t_b = 10^{-43}$s, from formula (11), $G = 1.4\times10^{52}$ $cm^3/s^2{*}g$, and M_b at that time, from formula (12), $M_b = 1.835\times10^{-64}$g. So, here $M_b < 10^{-59}$ times of Planck mass which was 10^{-5}g. It is an inevitably absurd results got from Dirac's LNH.

D. In dirac's mind, he might grant the expansion of the universe and the increase in universal mass and atomic numbers (showed as $M_b(N_p) \propto t_b^2$) as if the cell division with the increase in time.

III. In 1937, when Dirac proposed his LNH, he didn't know white dwarfs and neutron stars. What was more, he had no way to know black holes (BH) at that time. Therefore, Dirac's LNH as a research on the hidden mysteries of our universal evolution had very important significance, because decrease in G with increase in t_b could at least give some reason to explain our universal expansion discovered by Hubble's law in 1927. Perhaps, in nature, the very large numbers of no dimensions might have some interrelationship, but formulas (11), (12) and (13) derived from Dirac's LNH are completely wrong. Now, applying the theories about black holes (BH) to research our universal expansive progress from its birth at Big Bang to the present, the progress can be very consistent with the numerical values got from recent observations and theories of BH. Our universe was born from a large number of minimum gravitational black holes (MGBH) at the Big Bang. Now our universe is still a super giant black hole and its last end will finally go to the death as the general black boles. The expansion of our universe would only be the same with the expansion of a giant black hole. Therefore, applying the theory about BH and the newly observed numerical values to explain the law of our universal expansion should be the most effective and reliable. [4][5][6]

The numerical values of the original MGBHs at Big Bang as below: [4][5][6]
mass of a MGBH: $m_b=10^{-5}$g, it is Plank mass, from Schwarzchild solution, $C^2/2 = Gm_b/r_b$,
the completely expanded radius $r_b = 1.5\times10^{-33}$cm, from $t_{bo} = r_b / C$,.
t_{bo} was the time of light passing through radius of MGBH, $t_{bo}=0.5\times10^{-43}$s,
$\mathbf{T_{bo}}$ was the temperature of MGBH, from $\mathbf{T_{bo} = (C^3/4GM_b)\times(h/2\pi\kappa) \approx 0.4\times 10^{-6}M_\theta/M_b}$,
$T_{bo} = 0.65\times10^{32}$k, proton numbers of MGBH, $n_p = m_b/m_p = 10^{-5}/1.67\times10^{-24} = 0.6\times10^{19}$

Now, the recent observed and calculated numerical values of our universal black holes (UBH) are listed as below:
The precisely age of our UBH, $A_o = 13.7$ billon years, from $C^2/2 = G M_b/R_b = G M_b/ CA_o$,
The mass of our UBH, $M_b = 8.75\times10^{55}$g,
The completely expanded radius of our UBH, $R_b = C A_o = 1.297\times10^{28}$cm,
The time of light passing through radius of UBH, $t_b = A_o = 0.432\times10^{18}$s.
The proton numbers of our UBH, $N_p = 8.75\times10^{55}/1.67\times10^{-24} = 5.23\times10^{79}$,
The temperature of UBH, $T_b = 0.9\times10^{-29}$k

The ratios between above two corresponding items:
The ratio of corresponding mass, $R_m = M_b/m_b = 8.75\times10^{55}/10^{-5} = 8.75\times10^{60}$,
The ratio of corresponding radius, $R_r = R_b / r_b = 1.297\times10^{28}/1.5\times10^{-33} = 8.65\times10^{60}$,

The ratio of corresponding time, $R_t = t_b/t_{bo} = 0.432\times10^{18}/0.5\times10^{-43} = 8.64\times10^{60}$,
The ratio of corresponding temperature, $R_T = T_B /T_{bo} = 0.9\times10^{-29}/0.65\times10^{32} = 13.85\times10^{-60}$,
The ratio of corresponding proton numbers, $R_n = N_p /n_p = 5.23\times10^{79}/0.6\times10^{19} = 8.72\times10^{60}$,

IV. Analyses and conclusions:

A. From almost the same amount of above 5 ratios, it can be seen that, applying the theory about BH and the newly observed numerical values to explain the law of our universal expansion and the increase in mass M_b and proton (atom) numbers N_p is really effective and reliable. The above 5 consistent ratios have also proved that, only under the condition of G = constant, our universal expansive law is surely harmonious, so,
$M_b \propto N_p \propto R_b \propto 1/T_B \propto t_B$ (14)

Dirac's conclusions of "The universal mass M_b and number of the universal particles (protons, atoms) N_p is proportional to the increase in the square of universal time t_b, i.e. M_b (N_p) $\propto t_b^2$, and Gt_b = constant." are not right.

B. Why would the expansion of our universe accord with the expansive law of BH? Schwarzchild solution to General Relative Theory (GRT) is $C^2/2 = GM_b/ R_b$, it is the necessary condition of existence of BHs. From $R_b = CA_0 = Ct_b$, as a result,
$$\mathbf{M_b = C^3 t_b /2G} \qquad (15)$$

Formula (15) derived from BH is completely equal to formula (10) derived from Hubble's law. It clearly indicates that the law of expansion of our universe described by Hubble's law is just the law of expansion of our universal BH.

C. A special BH was indicated out by Hawking in 1971, its mass $M_s = 10^{15}$g. and its particle (proton, atom) numbers are $N_s = M_s/ m_p = 10^{15}/1.67\times10^{-24} = 0.6\times10^{39}$. In addition, the radius r_s of M_s is just equal to the classical electron radius R_e [see formula (1a)], i.e $r_s = R_e \approx 10^{-13}$ cm, then, the time t_s of light passing through r_s is equal to t_e, if according to Dirac's LNH in formula (2), $t_b/t_s = t_b/t_e = 6.76\times10^{39} = 2.94(2.3\times10^{39}) \approx 2.3\times10^{39}$, of course, here let $t_b \approx 20\times10^8$yrs like Dirac in 1937. Therefore, from this special BH M_s, N_p like Dirac's equation can be established from two ways and got into two equations, $N_p = N_s^2$, and $N_p = (t_b/t_s)^2$, because N_s and t_b/t_s are all the same certain value of no dimension of the same special BH. Thus, no matter whether N_s or t_b/t_s is selected into a equation like formula (3) established by Dirac's LNH, formula (15) would be became into the absurd result like Dirac's LNH. Obviously, in case $M_s \neq 10^{15}$g, m_p would become a variable, $m_p \neq 1.67\times10^{-24}$g, $N_s \neq 10^{39}$ and $t_b/t_s \neq 2.3\times10^{39}$.

D. From above calculations and analyses, it has clearly showed that why Dirac's LNH did not derive the correct conclusions. [**1**]. In 1937, nobody knew BH, so, Dirac only knew protons. He considered that our universe was only originated from protons, and the increase in universal mass M_b and atomic numbers N_p would be with the increase in universal time t_b. Thus, Dirac imagined how to measure M_b and N_b with t_b /t_e or t_b. From formula (1) to (9), with the wrong numerical values of H_o=170km/s/Mly and the corresponding $t_b = 20\times10^8$yrs got in 1937, Dirac got two wrong results: Gt_b = constant, and from formula (9), $N_p = (3.14\times10^{39})^2$, $(t_b / t_e) \approx 6.76\times10^{39}$, $(t_b / t_e)^2 = (2.6\times10^{39})^2$, but

our universal real age at present $A_o = 13.7\times10^9$yrs, according to Dirac's formula (13), $N_{p137} = 20.5\times10^{80} = (4.5\times10^{40})^2$, $t_{b137} / t_e = 4.6\times10^{40}$, so, $(t_{b137} / t_e)^2 = (2.15\times10^{40})^2$. It can be seen that, the ratio $N_p/(t_b / t_e)^2$ from 3.14/2.6 = 1.2 to 4.6/2.15 =2.13 had increased in about 1 time. **[2]. However, Dirac's idea of measuring M_b and N_b with t_b/t_e has still had significant.** Changing the time t_e of light passing through the electron radius R_e into the time t_{bo} of light passing through r_b of MGBH, according to the theory of BH, the correct result was calculated above, i.e. **$R_t = t_b/t_{bo} = 8.64\times10^{60}$, $R_m = M_b/m_b = 8.75\times10^{60}$ and $R_n = N_p/n_p = 8.72\times10^{60}$, then, $M_b/m_b = N_p/n_p = t_b/t_{bo}$. It can be seen that all above numerical ratios calculated by the theory of BH are perfectly consistent and harmonious under the condition of G = constant. It shows again that explaining the expansion of our universe with the theories of BH is completely correct. Owing to no BH and the theory of BH appeared in 1937, Dirac had no way to know $t_b/t_{bo} = 8.64\times10^{60}$, it let Dirac derive the wrong conclusion of $N_p = (t_b/t_e)^2$ from his $t_b/t_e \approx 10^{39}$ got in 1937. [3]. Importantly, Dirac's way of establishing a general equation with the coincidence between two special equal large numbers of no dimension would not be an effective, reliable and correct thinking.**

----The End----

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Asmari Reservoir modeling of the of Shadegan Oil Field Using RMS Software

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Abstract

The Shadgan petroleum oil field located in Dezful Embayment is a symmetrical anticline with 23.5Km length and 6.5Km width in the Asmari top horizon. The field trend is similar the regional Zagros trend. The aim of the present study is to construct 3D-modeling of the Asmari reservoir using RMS software. The computer program utilizes of advanced mathematical and geostatical function to provide 3D insight of different reservoir properties such as structure and geology, dynamic fluids, well planning. Structural modeling is the first stage in modeling which was made in two steps: (1) prepare stratigraphic and structural planes and (2) generate fault modeling. Petrophysical and volumetrical calculation which were utilized geostatistical methods are second stage. Each parameter can be tested internally and determine any arbitrary points and planes. Data preparation was also made by the following steps: a) transformation and normalization, b) remove truncated trend and c) spatial structure.

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To calculate in situ oil volume, fluid and reservoir data are input data to software. This model constructed by help of critical limit concerned porosity, water saturation and shale ratio.

Generally, zonation, and evaluation of the reservoir, fault effects and oil volume determination are the main out put results of RMS software.

Biometrical Studies On Genetic Diversity Of Some Upland Rice (*Oryza Sativa* L.) Accessions.

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ABSTRACT: Field experiments were conducted in 2005 in the Experimental Farm Station of the University of Agriculture. Makurdi, Nigeria to evaluate the performance and genetic diversity of some upland rice accessions. Preliminary results indicates highly significant ($P<0.01$) differences on all traits studied except for grain length, grain width, grain length/width ratio and 1000 grain weight, indicating genetic diversity among these accessions. Grain yield ranged between 0.54 t/ha (TOX 1870-30-102) and 3.7 t/ha (TOX 1010-21-5-124). Genotypic coefficient of variability (GCV) was generally lower than phenotypic coefficient of variability (PCV). Days to 50% heading, days to maturity, flag leaf area, panicle weight, panicle length, number of branches/panicle, number of seeds/panicle, grain weight/panicle and seed yield showed very low differences between their PVC and GCV values. Also these traits had high estimates for heritability and genetic advance. Genotypic correlation analysis of yield with other traits revealed that yield had a significantly positive correlation with flag leaf area, number of tillers, number of panicles, panicle weight, panicle length, number of branches/panicle, number of seeds/panicle and seed weigh/panicle, grain length and 1000 seed weight. The direct and indirect effect of the rice traits on yield was assessed. The implications of these results for varietal recommendations and crop improvement are highlighted. [Nature and Science. 2008;6(4):36-41]. ISSN: 1545-0740

Keywords: Diversity, Coefficient of variability, Heritability, Genetic advance, Correlation, Path coefficient

INTRODUCTION

Rice in Nigeria is the sixth major crop in area cultivated after sorghum, millet, cowpea, cassava and yam (FAO, 1994). It is grown in four major rice growing environment: Upland, rainfed lowland, irrigated lowlands, and deep water. Singh *et al*., 1997. Rainfed upland is the major rice growing ecology in West Africa, accounting for nearly 60% of the total regional rice area. In Nigeria, upland rice comprises around 32% of the total rice area (Singh *et al*. 1997).

Chaudhary and Nanda (1986) estimated 4.6 million ha as potential areas for rice cultivation in Nigeria. The rice area has increased tremendously since 1989, The average annual growth rate from 1983 to 1992 was 14.2% (WARDA 1996) due to ban on importation in 1986. There is still vast potential for increasing the rice area; especially for upland ecologies.

Rice production increased from 0.94 million tonnes to 2.54 million tonnes in 1994 (Singh *et al*., 1997). This increase is however due to mark expansion and not increased productivity per unit area, which remain around 1.5 t/ha.

Rice consumption is on increase, the annual growth rate in rice consumption average 7.7% from 1983 to 1992 (Singh *et al*., 1997). To meet up with this about 0.35 million tonnes valued at 91 million US dollars was imported in 1993 (Singh *et al*, 1997). Local production has not met the demand due to lack of adequate suitable flood plains and unavailability or affordable irrigation facilities to the local farmers, hence limiting lowland rice area expansion in addition to other bio physical constraints. Also human health risk poses important constraints to rapid development of the lowland areas.

Increase in rice production can only be achieved through area expansion and increase yield per unit area by employing high yielding varieties. To sustain local production and rice area expansion the potential of upland rice varieties to fit into the length of growing period, and it's cultivation ease (requiring less land clearance) has to be utilized.

Rice varieties had been evaluated in the country across rainforest and the Sudan Savanna agro-ecological zone (Kehinde *et al*., 1989). Vange *et al*., 1999; 2000, studied lowland rice genotypes in the

Southern Guinea Savanna zone. Such evaluation Offers Scientist opportunity to select varieties/lines that are promising for breeding purpose or for on-farm farmers participatory varietal selection (a dual mechanism for obtaining feed back on farmers preferences in new rice varieties) and for technological transfer. These form the objective of this present study.

MATERIALS AND METHODS

Field experiments were conducted during 2005 cropping seasons at the Experimental Farm of the University of Agriculture, Makurdi (7.40^{o}N, 8.37^{o}E, altitude 106.m) Nigeria. Prior to the experimentation, soil analysis of the site was done (83.5% sand, 8.6% silt, 7.7% Clay and Bulk density 1.40 with pH (H_20) 6.19, 13.12% organic matter and 0.09% total N). Total rainfall data during the crop season June, to November, 2005 was 872.70 mm.

Upland rice varieties obtained from International Network for Germplasm Evaluation (INGER) Africa, West Africa Rice Development Association (WARDA) and National Cereal Research Institute (NCRI) Badeggi-Nigeria were laid in a Randomised Complete Block Design in 4 replications with plot size of 12m^2/plot.

The experimental site was ploughed and harrowed twice before seeding. The seeds were broadcasted (farmers most adopted seeding method) at 50kg/ha (60g/plot). Fertilizer was applied at 75Kg N, 60Kg P and 60kg K in 3 split doses at 2nd harrowing, 5th week after planting and at panicle initiation with NPK 15:15:15 for the first 2 doses and Urea (46N:0:0) at top dressing. Weeds were controlled manually by weeding at 4 weeks after planting and subsequently as the weeds appear.

The observations were recorded from 5 random plants from each plot. The characters studied were grain yield, panicles/m^2, 1000-grain weight, grain weight/panicle, Total number of panicles branches (both primary and secondary branches), production tillers (%), plant height, days to 50% heading and days to maturity.

All data were subjected to analysis using relevant analysis of variance according to Steel and Torrie (1980), means were separated with List significant Difference (LSD) at P≤0.05.

Genotypic and phenotypic variance was estimated by the formulae suggested by Singh and Chandhary (1977), while broad since heritability was estimated on a replicated plot mean basis according Burton and De Vane (1953). Also genetic and phenotypic coefficient of variability was estimated according to Burton and De Vane (1953). The estimated genetic Advance was estimated using the formula given by Allard (1960) at 50% selection intensity. Path coefficient analysis and genotypic correlation between yield and yield components was computed.

RESULTS AND DISCUSSION

The genotypes showed significant genotypic variation for all traits studied except for grain length, grain width, grain length/width ratio and 1000-grain weight (Table 1). This indicates wide variability among genotypes especially for the traits that are significant thus genetic improvement through selection could be promising. Singh *et al.,* 1986, reported genetic variability in 98 upland rice cultivars they studied with respect to seedling height, days to 50% flowering, culm angle, leaf angle, leaf length, plant height (cm), panicle length (cm), shealth length (cm), tillers/plant, grains/panicle and grain yield (g). Mehetre *et al.*, 1994, reported similar findings on upland rice they studied.

The mean values are presented in Table 2. TOX 1010-21-5-12-4 (TOX 1010) had the highest yield of 3.70t/ha. TOX 1010 also had the highest panicle length, number of panicles/m^2 seed weight/panicle, grain length and grain width with high 1,000-grain weight, and number of seeds/panicle, and panicle weight. Similar trend were obtained for ITA 315, WAB 36-34-FX, ITA 150, and WAB 96-1-1 that had grain yield of 2.67, 2.63, 2.09, 2.08 t/ha respectively.

TOX 1870-30-102 gave the lowest yield of 0.54t/ha, the lowest 1000 grain weight, and generally low seed weight per panicle, panicle weight and panicle length. WARDA (1990) reported avenge yield of 2211kg/ha and 1738kg/ha for WAB-56-104 and WAB 6-125 in their replicated on Station yield trials.

The results of the phenotypic coefficient of variability (PVC) and genotypic coefficient of variability (GCV) revealed that PCV was generally higher than the GCV in the genotypes studied (Table 3). The difference was low for Days to 50% heading, panicle length, no of Branches/Panicle, No of seeds/panicle, and weight of seeds per panicle. Seed yield had a moderate amount of difference between

PCV and GCV, while plant height had a considerable high difference between PCV and GCV. These results implies that traits with low difference in PCV and GCV shows that variability is due more to genetic cause. Heritability and Genetic advance estimates was observed to be high for Days to 50% heading, Days to maturity, flagleaf area. Panicle weight, panicle length, No of branches per panicle, no of seeds/panicle, seed weight/panicle at seed yield (Table 3). High heritability coupled with high Genetic advance observed for these traits indicates a predominance of additive gene effects. Vange and Ojo 1997 reported similar results in lowland rice genotypes.

The results of the path coefficient analysis and genotypic correlation of yield with other traits revealed generally that, the genotypic correlation estimates was positive and significantly correlated with flag leaf area, number of tillers, number of panicles, panicle weight, panicles length number of branches/panicle, number of seeds/panicle, seeds weight/panicle, grain length and 1000 seed weight. Number of tillers (0.30174), number of panicles (0.28615), panicle weight (0.27933), and seed weight per panicle (0.2294) had positive high direct effect on yield while Flag leaf area (0.17938), grain length (0.16251) and 1000 seed weight had direct effect on yield. Number of tillers had high positive indirect effect via number of panicles while panicle weight had indirect effect on yield via panicle length, number of panicle branches, number of seeds per panicle and seed weight per panicle. These traits can serve as indicators in selecting for high yield in the material studied. Ramalingam *et al.* (1993) assert that traits that have high positive correlations, very high direct effects and positive indirect effects on yield through many traits should be emphasised for selecting yield. Panicle length, number of panicle branches, number of seeds per panicle hand negative direct effect on yield. While days to 50% heading, Days to maturity, and productive tillers seem to have limited practical usefulness as indicators for selecting high yield in these genotypes. Chauhan *et al.* (1986), Suarez *et al*. (1989), Vange *et al.* (1999; 2000) reported similar results.

In conclusion: TOX 1010, WAB 36-34-Fx, and WAB 96-1-1 appear promising while Number of tillers, number of panicles, panicle weight, seeds weight/panicle, number of seeds/panicle could be use for indirect selection criteria for grain yield improvement.

Table 1: MEANSQUARES FROM ANALYSIS OF VARIANCE FOR AGRONOMIC TRAITS, YEILD AND YIELD COMPONENTS OF 19 UPLAND RICE GENOTYPES.

Sources of Variation	Replications	Genotypes	Error	F pr.
Df	3	18	54	
Days to 50% Heading	45.14	298.79**	8.94	< 0.001
Days to Maturity	47.63	295.87**	9.05	< 0.001
Plant Height (cm)	475.8	219.20**	101.90	< 0.016
Flag Leaf Area (cm^3)	66.64	741.83**	97.10	< 0.001
No. of Tillers/M^2	427.2	1429.6**	357.8	< 0.001
No. of Panicles/M^2	508.3	883.1**	308.5	< 0.001
Productive Tillers (%)	149.09	280.12**	46.28	< 0.001
Panicle Weight (g)	0.715	2.685**	0.424	< 0.001
Panicles Length (cm)	2.74	41.528**	4.235	< 0.001
No. of Branches/Panicle	1.93	38.00**	6.672	< 0.001
No. of Seeds/Panicle	296.7	5623.5**	541.5	< 0.001
Seeds Weight /Panicle (g)	0.497	1.8819**	0.345	< 0.001
Grain Length (mm)	0.27	0.484	0.287	0.072
Grain Width (mm)	0.0695	0.0771	0.107	0.777
Grain Length/Width ratio	0.154	0.1299	0.1932	0.822
1000 Grain Weight (g)	44.11	45.86	31.81	0.150
Seed Yield (t/ha)	0.285	2.903**	0.788	< 0.001

** = significant at P = 0.01

Table 2: PERFORMANCE OF 19 UPLAND RICE GENOTYPES FOR AGRONOMIC TRAITS, YIELD AND YIELD COMPONENTS

Genotypes	Source	Days to 50% Heading	Days to Maturity	Plant Height (cm)	Flag Leaf Area (cm^3)	No. of Tillers/M^2	No. of Panicles/M^2	Productive Tillers (%)	Panicle Weight (g)	Panicles Length (cm)	No. of Branches/ Panicle	No. of Seeds/Panicle	Seeds Weight /Panicle (g)	Grain Length (mm)	Grain Width (mm)	Grain Length / Width Ratio	1000 Grain Weight (g)	Seed Yield (t/ha)
WAB 96-1-1	NCRI	83	118	89.8	107.6	97.2	88	98	3.4	23.85	13	159	2.45	9.55	3.00	3.18	23.3	2.08
WAB 99-1-1	NCRI	65	100	79.7	60.2	113.6	91	81	2.1	20.35	10	65	1.38	9.05	3.00	3.03	28.0	1.24
WAB 181-11	NCRI	64	99	83.2	51.2	97.2	64	72	2.5	23.28	11	70	1.35	9.40	2.95	3.20	26.4	0.67
WAB 36-34-Fx	NCRI	69	104	102.2	62.3	116.0	104	90	2.9	23.85	14	94	1.70	10.25	3.15	3.53	34.5	2.63
WAB 56-128-Fx	NCRI	66	102	92.4	80.3	109.6	93	86	3.4	27.90	17	148	2.40	9.85	3.00	3.25	25.4	2.22
WAB 56-144-Fx	NCRI	66	100	89.2	59.1	103.6	73	78	2.1	20.00	11	81	1.33	9.45	3.00	3.08	26.3	0.97
WAB 56-21-Fx	NCRI	71	106	87.4	55.7	111.2	91	83	2.6	20.85	12	113	2.03	9.45	3.00	3.15	29.6	1.85
TOX 1010-21-5-12-4	IITA/WARDA	85	120	85.6	81.7	140.0	124	99	3.9	25.95	12	135	2.90	10.10	3.05	3.30	32.3	3.70
ITA 150	IITA/WARDA	65	100	97.9	60.6	124.0	102	83	3.0	24.35	11	120	2.03	9.90	3.00	3.28	29.8	2.09
ITA 315	IITA/WARDA	80	115	76.2	74.1	111.2	96	87	4.2	24.80	18	162	3.00	9.00	3.00	3.05	27.0	2.67
WAB 18-844	NCRI	83	118	76.0	74.5	67.2	65	97	3.4	24.60	14	124	2.53	9.35	3.15	3.08	25.0	1.02
WAB 35-1-Fx2	NCRI	72	107	83.9	48.0	92.2	86	93	1.3	15.55	7	35	0.68	9.55	3.05	3.05	25.3	1.23
WAB 56-1-Fx2	NCRI	70	105	96.8	55.5	90.5	89	98	1.6	15.50	8	53	1.15	9.30	2.90	3.13	28.9	0.63
ITA 337	IITA/WARDA	87	122	86.3	69.0	85.5	80	93	4.0	24.45	18	159	2.86	9.50	3.05	3.10	24.7	1.45
TOX 1870-30-102	IITA/WARDA	76	111	88.9	63.4	96.7	91	96	1.6	20.85	9	74	0.95	9.55	2.85	3.45	19.3	0.54
ITA 343	IITA/WARDA	83	118	89.4	58.3	89.5	90	100	3.1	23.05	12	122	2.43	9.00	3.05	2.95	29.9	1.37
WABIS 675	INGER	81	116	85.2	60.8	82.2	79	96	3.1	24.10	12	127	2.33	9.15	3.50	2.70	26.4	1.12
ITA 143	INGER	85	120	75.8	66.5	66.5	66	98	2.3	19.60	11	95	1.65	9.40	2.90	3.25	27.1	0.65
FARO 43	NCRI	88	123	80.5	59.9	77.7	76	98	2.4	22.40	13	115	1.95	9.25	2.90	3.15	24.7	0.89
$LSD_{(0.05)}$		4.3	4.3	14.4	14.09	27.0	25.1	9.7	0.9	2.94	3.69	33.2	0.84	0.77	0.47	0.63	8.06	1.27
C.V (%)		3.95	2.72	11.66	15.00	19.20	20.3	7.50	23.6	9.20	21.1	21.6	30.18	5.66	10.8	13.9	20.87	58.0

Table 3: GENETIC PARAMETERS FOR 13 TRAITS IN UPLAND RICE GENOTYPES.

Traits	Means	Standard Error	Broad Sense Heritability (h^2)	Genotypic Coefficient of Variability	Phenotypic Coefficient of Variability	Genetic Advance as % of mean
Days to 50% Heading	75.61	2.11	0.89	11.26	11.93	21.88
Days to Maturity	110.64	2.13	0.89	7.654	8.122	14.86
Plant Height (cm)	86.63	7.14	0.22	6.251	13.22	6.087
Flag Leaf Area (cm^3)	65.72	6.97	0.62	19.32	24.45	31.44
No. of Tillers/M^2	98.52	13.38	0.43	16.62	25.39	22.4
No. of Panicles/M^2	86.58	12.42	0.32	13.84	24.56	16.07
Productive Tillers (%)	90.74	4.81	0.56	8.426	11.28	12.97
Panicle Weight (g)	2.76	0.46	0.57	27.24	36.04	42.42
Panicles Length (cm)	22.38	1.46	0.69	13.64	16.45	23.31
No. of Branches/Panicle	12.22	1.83	0.54	22.9	31.16	34.67
No. of Seeds/Panicle	107.9	16.45	0.70	33.03	39.45	56.98
Weight of Seeds/Panicle (g)	1.95	0.42	0.53	31.79	43.79	47.54
1000 Grain Weight (g)	27.03	3.99	0.10	6.934	21.99	4.504
Seed Yield (t/ha)	1.53	0.63	0.40	47.53	74.99	62.06

TABLE 4: A PATH COEFFICIENT ANALYSIS† AND GENOTYPIC CORRELATION OF YIELD WITH 10 YIELD RELATED TRAITS

	Flag Leaf Area (cm^3)	No. of Tillers/M^2	No. of Panicles/M^2	Panicle Weight (g)	Panicles Length (cm)	No. of Branches/Panicle	No. of Seeds/Panicle	Seeds Weight /Panicle (g)	Grain Length (mm)	1000 Grain Weight (g)
Flag Leaf Area (cm^3)	**0.17938**	0.022602	0.042513	0.110139	0.099556	0.087896	0.126642	0.109242	0.04054	-0.03319
No. of Tillers/M^2	0.038019	**0.30174**	0.25316	0.067288	0.085091	0.013277	0.028364	0.038924	0.15962	0.153284
No. of Panicles/M^2	0.067818	0.24008	**0.28615**	0.078691	0.070393	0.015452	0.057802	0.072682	0.150229	0.146509
Panicle Weight (g)	0.171509	0.062291	0.076816	**0.27933**	0.238827	0.239386	0.257822	0.270112	0.034637	0.057821
Panicles Length (cm)	-0.08881	-0.04513	-0.03936	-0.13682	**-0.16002**	-0.1245	-0.13106	-0.12706	-0.04609	-0.01472
No. of Branches/Panicle	0.071075	0.006382	0.007833	0.124308	0.112849	**0.14505**	0.123147	0.117926	0.007833	0.002611
No. of Seeds/Panicle	-0.09479	-0.01262	-0.02712	-0.12392	-0.10996	-0.11399	**-0.13426**	-0.12701	-0.00765	0.001477
Seeds Weight /Panicle (g)	0.139759	0.029604	0.05829	0.221917	0.182215	0.186575	0.217098	**0.22949**	0.001836	0.040849
Grain Length (mm)	0.036727	0.085968	0.085318	0.020151	0.046803	0.008776	0.009263	0.0013	**0.16251**	0.057529
1000 Grain Weight (g)	-0.025	0.068661	0.069202	0.027978	0.012435	0.002433	-0.00149	0.024058	0.047847	**0.13516**
Genotypic Correlation with Yield (t/ha)	0.49568*	0.7596**	0.8128**	0.6690*	0.5782**	0.460*	0.5533*	0.6097**	0.55131*	0.54733*

† = Direct (underlined) and indirect effect of rice traits on rice yield.

*, ** = Significant at P = 0.05 and P = 0.01 respectively.

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Survival threat to the Flora of Mudumalai Wildlife Sanctuary, India: An Assessment based on Regeneration Status

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ABSTRACT: The present study investigates the regeneration status in tropical dry and moist deciduous forests of Mudumalai Wildlife Sanctuary, Western Ghats, India. A total of 124 tree species were recorded in tropical deciduous forest system. Out of the 104 species (young and mature trees) recorded 28.8% showed good regeneration,5.8% represented fair, 33.7% poor, 29.8% showed no regeneration and 6 (5.8%) were considered as new arrivals in moist deciduous forest. In the case of dry deciduous forest out of 86 (young and mature trees) 33.7 % showed good regeneration, 3.5% fair, 16.3% poor, 17.4% showed no regeneration and 9 species (10.5%) were considered as new arrivals. Absence of Younger type of most of the species infers impact of anthropogenic disturbances such as recurrent forest fires, cattle grazing and biological invasion of exotic weeds on natural regeneration. The basic analysis may be considered here to be driven by two criteria: Species endemism and degree of threat, and therefore survival threat to the flora of the Mudumalai wildlife sanctuary was studied. [Nature and Science. 2008;6(4):42-54]. ISSN: 1545-0740

KEYWORDS: Regeneration, Dry deciduous, Moist deciduous, IVI, forest fires, Mudumalai, India.

INTRODUCTION

The degradation of tropical forests and destruction of habitats due to anthropogenic disturbances are a major cause of decline in global diversity. To compensate this decline, in many areas, restoration of degraded ecosystems is being taken up on a priority basis which will help in long term conservation of biodiversity of protected areas. Floristic inventory is an essential component in proper management measures so that a systematic monitoring process can be evaluated for changes that may have taken place in the protected areas due to biotic pressure from surrounding human influences.

The present study deals with the regeneration status of tree species in dry and moist deciduous forest types of Mudumalai Wildlife Sanctuary, which is a part of Nilgiri Biosphere Reserve and is also under consideration by the UNSECO as World Heritage site. Tropical deciduous forests assume unusual significance for conservation since they are the most used and threatened ecosystems, especially in India (Janzen, D.H, 1986). In accordance with the International effort of large scale permanent plots, Indian Institute of Science and Smithsonian Tropical Research Institute (STRI) established a 50 ha plot in Mudumalai Wildlife Sanctuary for studying dry forests dynamics in 1988 (Sukumar *et al*. 1992, Joshi *et al*. 1997, Condit *et al*. 2000, Plotkin, 2000). The fire frequency in the sanctuary has been studied by Kodandapani *et al*. (2004). The flora of the sanctuary was prepared by Sharma (1977) and Suresh *et al*. (1996). Except these studies, the detailed assessment of regeneration status has not been studied so far in the whole sanctuary. This basic lack of information hampered the conservation prioritization of the area from various threats (Sudhakar & Reddy 2005) and according to the IUCN category of protected areas Mudumalai falls under category IV (Habitat/Species conservation) so such study was considered as significant with regard to the aspect of species conservation.

In general, regeneration of species is affected by anthropogenic factors (Khan and Tripathi 1989; Barik *et al*. 1996). Studies related to this field will contribute in planning, conservation and decision making in natural forest resource management. Natural regeneration is important as it addresses mainstream biodiversity concerns. (Ramesh *et al*. 2006). Such studies are relevant for studying natural regeneration mechanism. So, an attempt has been made to assess the regeneration status of Mudumalai wildlife sanctuary with reference to dry and moist deciduous forests.

STUDY AREA:

Mudumalai Wildlife Sanctuary lies on the northwestern side of Nilgiri hills about 80 km north – west of Coimbatore in the western part of Tamil Nadu, on the interstate boundaries with Karnataka and Kerela states in South India. It is situated between $11^{o}32'$-$11^{0}43'$N, $76^{0}22'$-$76^{0}45'$E. Originally 60 sq kms, the sanctuary was enlarged to 295 km² in 1956 and subsequently to its present size of 321 km². The park is contiguous with Bandipur National Park (874 km²), Wynad Wildlife Sanctuary (344 km²), Sigur and Singara reserve forests. Its topography is extremely varied and comprises of Hills, valleys, Ravines, Water courses and Swamps. The Moyar River finds its way through this sanctuary, gifting it a number of awesome cascades. The main forest types in Mudumalai Wildlife Sanctuary are Dry deciduous and Moist deciduous. Semi-evergreen, riparian and Scrub types are localized in distribution and represents minor part of the study area.

MATERIALS AND METHODS:

Phytosociological studies were carried out using quadrat method since it is the most widely used technique for the plant census. The data was collected from 36 and 25 randomly selected quadrats of 0.1 ha size with a sampling intensity of 0.03% for dry deciduous and moist deciduous types respectively. Trees measuring <30 cm GBH were considered as young ones (saplings) and >30 cm as mature (adults). One quadrat of 10 x 10 m was laid within 0.1 ha quadrat for recording number of young trees. Herbarium specimens were prepared and identified with the help of floras and confirmed with the specimens deposited at Botanical Survey of India, Coimbatore. The spatial location (latitude, longitude and altitude) of each quadrat was collected using a Global Positioning System (GPS). Care has been taken to cover different elevation, slope, aspects, drainage density, rainfall and temperature gradients to study overall spectrum of tree species diversity and regeneration.

The data collected were analyzed to determine Relative values of density, frequency and abundance. The Importance Value Index for each species was also computed as the sum of the relative frequency, relative density and relative basal area (Cottam and Curtis, 1956; Phillips, 1959). The different indices such as Shannon diversity index (Shannon-Weaver, 1949), Simpson dominance index (Simpson, 1949) along with Margalef Species richness index (Margalef, 1958) was determined. Similarity between the two forest types was determined using Sorenson's index of similarity (Sorenson, 1948).

Regeneration status of species was determined based on population size of young ones (saplings) and matured trees (Khan *et al*. 1997; Uma Shankar, 2001; Ashalata *et al*. 2006). If a species is present only in adult form it is considered as not regenerating. Species are considered as 'new' if the species has no adults, but only young ones.

RESULTS AND DISCUSSION:

The present study focuses on the dry deciduous and moist deciduous forest types. To understand the status of regeneration, information on young ones (saplings) and mature trees was taken into account. Species endemism and degree of threat was also considered as one of the aspects to understand the survival threat to the flora of Mudumalai wildlife sanctuary.

A total of 124 tree species were recorded in tropical deciduous forest system. Of the 124 species recorded 104 species were of moist deciduous forest type, within this category 89 were belonging to mature stratum and 21 species to young category. 86 species were belonging to dry deciduous forest type 64 mature trees category and 22 species are belonging to young category.

The highest Shannon and Weiner index was observed for moist deciduous (4.90) followed by dry deciduous (3.94). The high value of 4.90 in case of Moist Deciduous was probably due to the association of various species in and along the riverine tracts. The highest Simpson Index of Dominance also observed for moist deciduous Forest (0.94) followed by dry deciduous (0.86). The highest Margalef index of Species richness was observed for moist deciduous (8.31) followed by dry deciduous type (6.28). Similarity index reveals that 83.9 % of floristic composition of dry deciduous forest is similar with moist deciduous forest. The stand density was 407 ha^{-1} for moist deciduous followed by 406 ha^{-1} for dry deciduous type and mean basal area was 36 m² ha–1 (table1). Growth forms, namely young and mature trees when considered with reference to density, young species were less abundant.

Out of the 104 species (young and mature trees) 28.8% showed good regeneration, 5.8% represented fair, 33.7% poor, 29.8% showed no regeneration and 6 species (5.8%) were considered as new arrivals in moist deciduous forest. In the case of dry deciduous forest 33.7% showed good regeneration,

3.5% fair, 16.3% poor, 17.4% showed no regeneration and 9 (10.5%) species were considered as new arrivals.(table: 3).Complete absence of young tree species in a forest indicates poor regeneration, while presence of sufficient number of young individuals in a given species population indicates successful regeneration (Saxena and Singh 1984). In the present study under investigation out of the 104 species, 70 species showed no young category in moist deciduous type indicating that 67.3% indicating the overall regeneration status of the forest as poor and 44 species were not found in mature category (42.3%) in moist deciduous type and 76 species (88.4%) of mature trees were not found in dry deciduous forest type.

Absence of saplings of most of the species infers impact of anthropogenic disturbances such as recurrent forest fires, cattle grazing and biological invasion of exotic weeds (mainly *Lantana camara*) on natural regeneration. (Chandrasekhar *et al)*. Six species were new (*Bauhinia racemosa, Bridelia crenulata, Cinnamommum* sp., *Croton oblongifolius, Murraya koenigii and Vernonia arborea)* which were not recorded in mature stratum in the moist deciduous type. But, *Murraya koenigii* is a small tree, which may not attain a girth of 30 cm and beyond. In the case of dry deciduous type *Acacia leucophloea, Atalantia monophylla, Casearia graveolens, Cordia wallichii, Lagerstroemia parviflora, Miliusa tomentosa, Soymida febrifuga, Tamarindus indica and Terminalia paniculata* were found to be new. Invasion of 'new' species indicates a possible outcome of co-existence.

The dominant tree species (which had higher values of IVI) for dry deciduous forest type are *Anogeissus latifolia, Tectona grandis, Terminalia alata* and *Phyllanthus emblica*. (table: 2). In young category *Anogeissus latifolia* (n=203), *Terminalia alata* (n=69) and *Tectona grandis* (n=36) represents fewer individuals. In the case of mature tree category *Anogeissus latifolia* (n=143), *Tectona grandis* (n=81) and *Terminalia alata* (n=61) represents high number of individuals.

The dominant tree species for moist deciduous forest are *Tectona grandis, Lagerstroemia microcarpa, Grewia tilifolia, Terminalia alata* and *Syzygium cumini*. (table 2). Analysis of young and mature tree species categories in this forest type also shows interesting results. Young trees showed Tectona *grandis* (n=52), *Grewia tilifolia* (n=56) with fewer individuals and *Lagerstroemia microcarpa* (n=72). In the case of mature trees *Tectona grandis* (n=59), *Lagerstroemia microcarpa* (n=46) and *Grewia tiliifolia* (n=34) (table 3). Based on the relative proportion of young and mature trees the future community structure and regeneration status of dry and moist deciduous forest type could be predicted. Greater number of young category indicates that these species will persist and may determine the future composition of forest type.

In dry deciduous forest, *Shorea roxburghii* represents 1075 individuals in young category, but mature trees are about13. It indicates that in the past, *Shorea roxburghii* was exploited for timber (table 3).

Overall, regeneration was poor indicated by fewer young species in the forest. This may lead to the reduction of mature trees and hence change in the structure of the forest. Due to the less number of the young individuals there may be threat to the most of the tree species in near future. The species diversity was more, however, only a few species had more number of individuals as compared to the other species. Many rare, localized and old growth 'specialists' species may decline over time and regeneration can be adversely affected so there is a need for continuous monitoring of population dynamics on a long term basis in order to know whether a species is increasing, stable or declining. Grazing by resident as well as migratory livestock in and around the forest corridors, have adversely affected the forest regeneration and helped proliferation of weed species such as *Lantana camara*, *Casia tora*, *C. occidentalis* and *Ageratum conyzoides*. Livestock grazing, a major biotic interference in this forest corridor, originates from seven settlements of the Masinagudi group of villages on the eastern and the southeastern fringes of the sanctuary and this interference may in long run hamper the ecodevelopment which may affect long term conservation of species population. The endemic species found here include *Cinnamomum sp, Ehretia canarensis and Glohidion velutinum, Actinodaphne malabarica, Bridelia crenulata, Deccania pubescens, Eriolaena quenquelocularis, and Terminalia paniculata, Dolichandrone arcuata, Syzygium malabaricum, Antidesma menasu, Lagerstroemia microcarpa, Litsea coriacea* and *Phyllanthus indofisheri*. These species when correlated with regeneration status showed interesting results with in which *Glochidion velutinum* showed poor regeneration status, *Ehretia canarensis* as good followed by *Cinnamomum s* as new, *Actinodaphne malabarica* showed poor regeneration, *Deccania pubescens and Eriolaena quenquelocularis* as not regenerating, *Terminalia paniculata* as good, and *Bridelia crenulata* as new arrival. *Syzygium malabaricum* showed no regeneration and *Antidesma menusa* showed poor where as *Dolichandrone arcuta* showed no regeneration. *Lagerstroemia microcarpa* was showing good regeneration followed by *Litsea coriacea* and *Phyllanthus indofisheri* showed poor regeneration.

Similar studies in other tropical forests shows reversible tendency as compared with present study. Konthoujam Lairembi sacred grove in North-East India, out of the 55 species, 15% showed good regeneration, 22% fair, 22% poor and 16% were not regenerating, while14 species (25%) were represented only by seedlings or saplings. The species falling under the last category were regarded as the new arrivals in this grove. In Mahabali grove out of 38 species, 7 (19%) showed good regeneration, while 6 (16%) and 5 (13%) species exhibited fair and poor regeneration, respectively. Two species (5%) showed no regeneration and 18 species (47%) were 'new' to this grove (Ashalata *et al*. 2006). However in the present study area higher percentage (47.1%) showed no regeneration in moist deciduous forest type emphasizing the need to evaluate the reasons for such higher percentage.

Table 1: Consolidated details of species inventory in dry and moist deciduous forest types of Mudumalai Wildlife sanctuary, Western Ghats

Description	Dry Deciduous	Moist Deciduous	Total
No. Of Sample Points	36	25	61
No. of Tree Species	66	83	124
Density (stems/ha^{-1})	406	407	407
Basal area (m^2/ha^{-1})	25	49	36
Species Diversity Index H'	3.94	4.90	4.42
Simpson Index	0.86	0.94	0.9
Margalef Species Richness Index	6.28	8.31	7.3
Similarity Index :			
Dry deciduous	-	83.9	
Moist Deciduous	-	-	

Table 2: Ecological dominance of top ten species in dry deciduous and moist deciduous forest types of Mudumalai Wildlife Sanctuary, Western Ghats

			Dry Deciduous		
Sl.no.	Species	Relative Density	Relative Frequency	Relative Dominance	IVI
1	*Anogeissus latifolia*	35.2	14.4	30.8	80.4
2	*Tectona grandis*	19.8	11.52	33.9	65.3
3	*Terminalia alata*	15.1	10.7	13.0	38.8
4	*Phyllanthus emblica*	1.92	5.76	0.84	8.51
5	*Lagerstroemia microcarpa*	1.98	4.9	1.31	8.23
6	*Shorea roxburghii*	3.22	3.7	1.02	7.94
7	*Dalbergia latifolia*	1.23	4.12	2.53	7.88
8	*Radermachera xylocarpa*	1.57	2.06	2.57	6.20
9	*Ziziphus xylopyrus*	1.98	3.29	0.47	5.75
10	*Buchanania lanzan*	1.03	3.29	0.56	4.88
			Moist Deciduous		
1	*Tectona grandis*	14.6	7.35	21.1	43.0
2	*Lagerstroemia microcarpa*	11.4	6.53	15.2	33.2
3	*Grewia tiliifolia*	8.26	6.94	9.37	24.6
4	*Terminalia alata*	8.55	6.12	8.96	23.6
5	*Syzygium cumini*	7.28	6.12	8.47	21.9
6	*Anogeissus latifolia*	7.28	4.08	3.62	15.0
7	*Radermachera xylocarpa*	4.03	2.45	5.66	12.1
8	*Schleichera oleosa*	2.65	3.67	4.96	11.3
9	*Cassia fistula*	5.21	3.67	0.41	9.30
10	*Bambusa arundinacea*	5.51	2.04	0.40	7.94

Table 3: Percentage proportion of young and mature trees in dry and moist deciduous forest types of Mudumalai Wildlife Sanctuary

		Moist Deciduous Forest					Dry Deciduous Forest					Total	
SL	Species	Young		Mature trees		Status	Young		Mature trees		Status		
		NO.	%	NO.	%		NO.	%	NO.	%		NO.	%
1	*Acacia chundra*	1	7.1	-	-	P	6	39.7	7	51.6	F	14	100
2	Acacia *ferrugenia*	-	-	1	12.9	N	6	71.7	1	17.9	G	8	100
3	*Acacia leucophloea*	-	-	-	-	-	3	100	-	-	NEW	3	100
4	*Albizia amara*	-	-	-	-	-	8	90.9	1	9.1	G	9	100
5	*Actinodaphne malabarica*	1	100	-	-	P	-	-	-	-	-	1	100
6	*Albizia odoratissima*	4	52.8	1	13.2	G	3	36.7	-	-	-	8	100
7	*Anogeissus latifolia*	8	2.1	30	7.7	F	203	52.9	143	37.3	G	383	100
8	*Atalantia monophylla*	1	32.7	-	-	P	3	90.9	-	-	NEW	3	100
9	*Anthocephalus chinense*	1	100	-	-	P	1	100	-	-	P	1	100
10	*Antidesma menasu*	1	100	-	-	P	-	-	-	-	-	1	100
11	*Aporosa lindleyana*	1	100	-	-	P	-	-	-	-	-	1	100
12	*Bauhinia racemosa*	28	63.9	-	-	NEW	14	31.7	2	4.4	G	44	100
13	*Bambusa arundinacea*	436	77.5	22	4.0	G	100	17.8	4	1	G	562	100
14	*Bauhinia malabarica*	1	50	-	-	P	-	-	1	42	N	2	100
15	*Bombax ceiba*	-	-	1	100	N	1	100	-	-	P	2	100
16	*Bridelia crenulata*	16	100	-	-	NEW	-	-	-	-	-	16	100
17	*Bridelia montana*	1	20	-	-	P	3	55.6	1	11.1	G	5	100
18	*Buchanania lanzan*	4	5.5	1	1.4	G	64	88.2	4	5.8	G	72	100
19	*Butea monosperma*	28	84.9	1	3.0	G	3	8.4	1	4.2	G	33	100
20	*Callicarpa tomentosa*	1	33.3	2	66.6	F	-	-	-	-	-	3	100
21	*Careya arborea*	80	77.1	2	1.9	G	19	18.7	3	2.7	G	104	100
22	*Casearia elliptica*	2	53.6	1	26.8	G	3	74.4	1	14.9	G	4	100
23	*Casearia esculenta*	1	50	-	-	P	1	28	-	-	P	2	100
24	*Casearia graveolens*	1	25	-	-	P	3	69.4	-	-	NEW	4	100

25	*Cassia fistula*	356	70.3	21	4.2	G	128	25.2	1	0.3	G	506	100
26	*Cassine glauca*	-	-	1	50	N	1	50	-	-	P	2	100
27	*Celtis tetrandra*	12	80.0	2	10.6	G	1	6. 7	-	-	P	15	100
28	*Celtis timoriensis*	-	-	1	100	N	-	-	-	-	-	1	100
29	*Cinnamomum sp*	108	99.1	-	-	NEW	1	0.9	-	-	P	109	100
30	*Chionanthus malabarica*	-	-	5	26.1	N	14	69.7	1	4.2	G	20	100
31	*Chloroxylon swietenia*	1	9.23	-	-	P	6	51.3	5	48.7	G	11	100
32	*Chukrasia tabularis*	-	-	2	48	N	1	20	2	40	F	5	100
33	*Cleistanthus patulus*	1	50	-	-	P	1	50	-	-	-	2	100
34	*Cordia macleodii*	-	-	2	100	N	-	-	-	-	-	2	100
35	*Cordia obliqua*	-	-	1	100	N	-	-	-	-	-	1	100
36	*Cordia wallichii*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
37	*Croton oblongifolius*	20	100	-	-	NEW	-	-	-	-	-	20	100
38	*Dalbergia lanceolaria*	1	100	-	-	P	-	-	-	-	-	1	100
39	*Dalbergia latifolia*	16	33.3	5	9.9	G	22	46.3	5	10.4	G	48	100
40	*Deccania pubescens*	-	-	1	100	N	-	-	-	-	-	1	100
41	*Diospyros montana*	8	66.7	4	33.3	G	-	-	-	-	-	12	100
42	*Dolichandrone arcuata*	-	-	-	-	-	-	-	1	100	N	1	100
43	*Ehretia canarensis*	3	188	2	100	G	-	-	-	-	-	2	100
44	*Elaeocarpus tuberculatus*	4	76.9	1	23.0	G	-	-	-	-	-	5	100
45	*Eriolaena quenquelocularis*	-	-	1	100	N	-	-	-	-	-	1	100
46	*Erythrina suberosa*	4	90.9	1	22.7	G	-	-	-	-	-	4	100
47	*Erythrina variegata*	4	85.5	1	21.3	G	1	21.4	-	-	P	5	100
48	*Euodia lunu-ankenda*	1	100	-	-	P	-	-	-	-	-	1	100
49	*Ficus benghalensis*	-	-	1	100	N	-	-	-	-	-	1	100
50	*Ficus hispida*	4	55.6	3	44.4	G	-	-	-	-	-	7	100

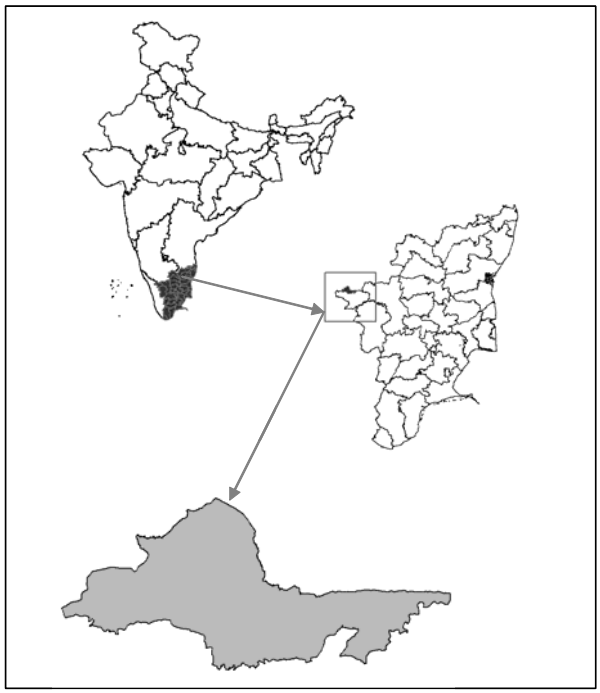
51	*Ficus mysorensis*	1	50	-	-	P	-	-	-	-	-	1	100
52	*Ficus racemosa*	4	66.7	1	16.6	G	1	16.6	-	-	P	6	100
53	*Ficus tsjakela*	1	100	-	-	P	-	-	-	-	-	1	100
54	*Ficus virens*	1	50	-	-	P	1	50	-	-	P	2	100
55	*Firmiana colorata*	2	200	1	100	G	-	-	-	-	-	1	100
56	*Flacourtia montana*	-	-	1	100	N	-	-	-	-	-	1	100
57	*Gardenia gummifera*	4	80.0	1	20.0	G	-	-	-	-	-	5	100
58	*Gardenia latifolia*	1	20	-	-	P	3	55.6	1	20	G	5	100
59	*Givotia rottleriformis*	1	50	-	-	P	-	-	1	28	N	2	100
60	*Glochidion velutinum*	1	100	-	-	P	-	-	-	-	-	1	100
61	*Gmelina arborea*	1	100	-	-	P	-	-	-	-	-	1	100
62	*Grewia tiliifolia*	56	54.3	34	32.5	G	11	10.8	3	2.4	G	103	100
63	*Heterophragma roxburghii*	2	200	1	100	G	-	-	-	-	-	1	100
64	*Holoptelia integrifolia*	1	100	-	-	P	-	-	-	-	-	1	100
65	*Ilex malabarica*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
66	*Kydia calycina*	4	22.0	2	11.0	G	8	45.7	4	21.3	G	18	100
67	*Lagerstroemia microcarpa*	72	48.4	46	31.2	G	22	14.9	8	5.4	G	149	100
68	*Lagerstroemia parviflora*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
69	*Linociera malabarica*	-	-	1	60	N	1	50	-	-	P	2	100
70	*Litsea coriacea*	1	100	-	-	P	-	-	-	-	-	1	100
71	*Litsea deccanensis*	1	100	-	-	P	-	-	-	-	-	1	100
72	*Madhuca indica*	1	50	-	-	P	-	-	1	42	N	2	100
73	*Mallotus intermedius*	-	-	1	100	N	-	-	-	-	-	1	100
74	*Mallotus philippensis*	12	80.0	2	16	G	1	6. 7	-	-	P	15	100
75	*Mallotus tetracoccos*	-	-	1	100	N	1	50	-	-	P	2	100
76	*Mangifera indica*	4	100	-	-	P	-	-	-	-	-	4	100

77	*Meliosma pinnata*	-	-	-	-	-	-	-	1	100	N	1	100
78	*Miliusa tomentosa*	-	-	1	7.0	N	14	97.2	-	-	NEW	14	100
79	*Mitragyna parvifolia*	-	-	-	-	-	3	76.9	1	23.1	G	4	100
80	*Murraya koenigii*	24	100	-	-	NEW	-	-	-	-	-	24	100
81	*Nothopegia beddomei*	-	-	-	-	-	1	100	-	-	P	1	100
82	*Olea dioica*	8	47.2	8	49.5	F	-	-	1	3.3	N	17	100
83	*Ougeinia ougenensis*	4	43.0	3	30.1	G	-	-	3	26.9	N	9	100
84	*Persea macrantha*	-	-	2	100	N	-	-	-	-	-	2	100
85	*Phyllanthus emblica*	8	4.78	4	2.6	G	147	87.9	8	4.6	G	167	100
86	*Phyllanthus indofisheri*	1	7.69	-	-	P	11	85.5	1	4.3	G	13	100
87	*Premna tomentosa*	-	-	-	-	-	-	-	2	100	N	2	100
88	*Pterocarpus marsupium*	-	-	-	-	-	-	-	1	100	N	1	100
89	*Pittosporum floribundum*	-	-	1	100	N	-	-	-	-	-	1	100
90	*Radermachera xylocarpa*	-	-	16	72.0	N	-	-	6	28.0	N	23	100
91	*Santalum album*	-	-	-	-	-	11	62.5	7	37.5	G	18	100
92	*Randia candolleana*	-	-	1	50	N	1	50	-	-	P	2	100
93	*Schefflera venulosa*	-	-	1	100	N	-	-	-	-	-	1	100
94	*Schleichera oleosa*	24	62.0	11	27.9	G	3	7.2	1	2.9	G	39	100
95	*Schrebera swietenioides*	2	16.7	1	10	G	6	46.3	3	27.8	G	12	100
96	*Scolopia crenata*	-	-	1	100	N	-	-	-	-	-	1	100
97	*Shorea roxburghii*	-	-	2	0.2	N	1075	98.7	13	1.2	G	1090	100
98	*Soymida febrifuga*	-	-	-	-	-	6	100	-	-	NEW	6	100
99	*Sterculia guttata*	-	-	1	100	N	-	-	-	-	-	1	100
100	*Sterculia villosa*	-	-	4	100	N	-	-	-	-	-	4	100
101	*Stereospermum angustifolium*	-	-	1	78.2	N	-	-	-	-	-	1	100
102	*Stereospermum personatum*	4	66.7	2	33.3	G	-	-	-	-	-	6	100

103	*Stereospermum suaveolens*	-	-	1	100	N	-	-	-	-	-	1	100
104	*Strychnos potatorum*	-	-	-	-	-	-	-	1	100	N	1	100
105	*Syzygium operculatum*	1	50	-	-	P	-	-	1	28	N	2	100
106	*Syzygium cumini*	28	48.6	30	51.3	F	-	-	-	-	-	58	100
107	*Syzygium malabaricum*	-	-	1	100	N	-	-	-	-	-	1	100
108	*Tamarindus indica*	-	-	-	-	-	3	90.9	-	-	NEW	3	100
109	*Tamilnadia uliginosa*	1	1.04	-	-	P	92	95.5	3	2.6	G	96	100
110	*Tectona grandis*	52	22.8	59	25.9	F	36	15.8	81	35.4	F	228	100
111	*Terminalia alata*	20	10.8	35	18.7	F	69	37.5	61	33.0	G	185	100
112	*Terminalia bellirica*	4	61.0	2	30.5	G	-	-	1	8.5	N	7	100
113	*Terminalia paniculata*	4	16.8	3	11.7	G	17	70.2	-	-	NEW	24	100
114	*Toona ciliata*	-	-	1	100	N	-	-	-	-	-	1	100
115	*Trewia nudiflora*	-	-	1	100	N	-	-	-	-	-	1	100
116	*Trichilia connaroides*	1	100	-	-	P	-	-	-	-	-	1	100
117	*Vernonia arborea*	4	100	-	-	NEW	-	-	-	-	-	4	100
118	*Viburnum punctatum*	1	73.8	-	-	P	-	-	1	41.0	N	1	100
119	*Vitex peduncularis*	1	100	-	-	P	-	-	-	-	-	1	100
120	*Vitex altissima*	1	100	-	-	P	-	-	-	-	-	1	100
121	*Xylosma longifolium*	1	100	-	-	-	-	-	-	-	N	1	100
122	*Wendlandia thyrsoidea*	-	-	1	100	N	-	-	-	-	-	1	100
123	*Ziziphus mauritiana*	1	16.4	-	-	P	6	90.9	1	9.1	G	6	100
124	*Ziziphus xylopyrus*	12	9.9	1	0.8	N	100	82.7	8	6.7	G	121	100

- F – Fair regeneration
- G – Good regeneration
- P – Poor regeneration
- N – No regeneration and
- – Absence of young tree / mature tree.

Fig 1. Location map of Mudumalai Wildlife Sanctuary



CONCLUSIONS:

The overall population structure of tree species reveals that mature populations dominate young populations and the fluctuation in population density is related to the anthropogenic factors. The population size of species that lack young trees may decline in the coming years. The forest type (moist deciduous and dry deciduous) which is characterized by abundance of mature tree strata of the species or absence or very low individuals of young type are expected to face local extinction if species conservation are not given priority at the earliest. Moreover, poor regeneration of tree species due to the existing anthropogenic factors endangers the future maintenance of the tree species which pose survival threat to the Flora of Mudumalai Wildlife Sanctuary.

The present study suggests that high level of disturbances such as extraction of trees for timber, forest fire has brought a decline in plant communities. Regeneration is important as it addresses mainstream biodiversity concerns. In areas where protection measures are strictly employed, successful regeneration of natural forests is necessary, and therefore this study was carried out to know the regenerative capacity of natural forests.

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Biodesulfurization of Kerosene by *Desulfobacterium indolicum*

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ABSTRACT: Recalcitrant organosulfur compounds such as Dibenzothiophene (DBT) and its derivatives in real petroleum fractions such as kerosene cannot be removed by convectional hydrodesulfurization (HDS) treatment using metallic catalysts as well as extremes of conditions of high pressure and temperature. The desulfurizing bacterium *Desulfobacterium indolicum* was isolated and subsequently identified by the Department of Botany & Microbiology; University of Lagos, Nigeria exhibited very high desulfurizing ability towards kerosene at 30°C and normal atmospheric pressure. The biodesulfurization of kerosene by *Desulfobacterium indolicum* resulted in reduction of sulfur from 48.68 ppm to 13.76 ppm over a period of 72 hours. Gas chromatography analysis with a pulse flow photoatomic detector revealed that the peaks of Thiophene and 2, 5 - dimethyl Thiophene significantly decreased after biodesulfurization. Therefore, *Desulfobacterium indolicum* could effectively desulfurized kerosene and thus may be a promising biocatalyst for practical biodesulfurization of kerosene. [Nature and Science. 2008;6(4):55-63]. ISSN: 1545-0740.

INTRODUCTION

The problem with fossil fuels is that the combustion products are harmful to the planet. Carbon dioxide emissions have been implicated in global warming. Nitrogen oxides and sulfur oxides emissions have been shown to be responsible for acid rain, which destroys buildings, kills forests and poison lakes. Governments throughout the world have recognized the problems associated with these emissions and moved to reduce them through legislation. Regulations for the sulfur level in diesel oil have become increasingly strict and it is planned to reduce the level to 50 ppm by 2005 in the European Union and Japan. The sulfur content in diesel will probably be less than 10 or 15 ppm (w/w) in the United States and Europe by 2010 (Constants et al, 1994).

The concentration of sulfur in crude oil is typically between 0.05 and 5.0% (by weight), although values as high as 13.95% have been reported (Speight 1981). In general, the distributions of sulfur increase along with the boiling point of the distillate fraction. As a result, the higher the boiling range of the fuel, the higher the sulfur content will tend to be. Upon combustion, the sulfur in fuels can contribute to air pollution in the form of particulate material and acidic gases, such as sulfur dioxide. To reduce sulfur-related air pollution, the level of sulfur in fuels is regulated, and to meet these regulations sulfur must be removed from fuels during the refining process. The availability of low-sulfur crude has decreased over the last decade as a consequence of the increasing reserves of heavy crude (Grossman et al, 2001).

Refineries remove organic sulfur from crude oil-derived fuels by hydrodesulfurization (HDS). HDS is a catalytic process that converts organic sulfur to hydrogen sulfide gas by reacting crude oil fractions with hydrogen at pressures between 1 and 20 MPa and temperatures between 290 and 455 °C, depending upon the feed and level of desulfurization required. Organic sulfur compounds in the lower-boiling fractions of petroleum, e.g., the gasoline range, are mainly thiols, sulfides and thiophene, which are readily removed by HDS. However, middle-distillate fractions, like diesel, kerosene and some fuel oil range, contain significant amounts of benzothiophenes and dibenzothiophenes (DBTs), which are considerably more difficult to remove by HDS (Chang et al, 1998). Among the most refractory of these compounds are DBTs with substitutions adjacent to the sulfur moiety. Compounds of this type are referred to as sterically hindered compounds because the substitutions are believed to sterically hinder access of the sulfur atom to the catalyst surface due to their resistance to HDS; sterically hindered compounds represent a significant barrier to reaching very low sulfur levels in middle and heavy-distillate-range fuels (Kirimura et al, 2003). The high cost and inherent chemical limitations associated with HDS make alternatives to this technology of interest to the petroleum industry. Moreover, current trends toward stricter regulations on the content of sulfur in fuels provide incentive for the continued search for improved desulfurization processes. The hydrogen sulfide produced as a result of HDS is a corrosive gaseous substance, which is stripped from the fossil fuel by known techniques. Elevated or persistent levels of hydrogen sulfide are known to poison (inactivate) the HDS catalyst, thereby complicating the desulfurization of petroleum crude and products that are high in sulfur. Organic sulfur in petroleum fossil fuels is present in a myriad of compounds, some of which are unstable in that they cannot readily be desulfurized or refractory because they do not easily yield to conventional desulfurization treatment by HDS. Increasing the severity of HDS also elicits undesirable effects on fuel quality as other chemical components are reduced at the higher temperatures and pressures needed to achieve low sulfur levels.

MATERIALS AND METHODS

The microorganism *Desulfobacterium indolicum* with the ability to desulfurize oil was isolated from oil contaminated soil by enrichment culture. It was suspended in 9 ml of 0.1M phosphate buffer solution (pH 7.0) and 1 ml of diesel for the biodesulfurization experiment in a 100 ml Erlenmeyer flask (Rhee et al, 1998). The optical density at 510 nm (OD_{510}) was 1.5 the experiment was performed at 30°C with a moderate shaking of 180 rpm. Also, the growth of the sulfur bacterium *Desulfobacterium indolicum* in the experimental tube was monitored as described previously (Chukwu and Nwachukwu, 2005).

Thiophene, 2,5- dimethyl thiophene, benzothiophene and Dibenzothiophene were analyzed using gas chromatography 5890 Hewlett Packard, equipped with a pulse flow photoatomic detector (PFPD).

RESULT AND DISCUSSION

Desulfobacterium indolicum is a motile, oval to rod like, gram negative, non spore forming anaerobic microorganism. Biochemical test has shown that it is capable of utilizing various kinds of sugar as a source of carbon. In the biodesulfurization experiment, the organism was suspended in a sulfur free phosphate medium and the kerosene. It is easier for the organism to utilize carbon in glucose which is in aqueous state in which the organism is also suspended if available than kerosene which is oil. Thus one may conclude that the biodesulfurization of thiophene and 2, 5 - dimethyl thiophene took place via a sulfur-specific degradation pathway.

The GC analysis revealed that the kerosene contained 6.955 mg/l of thiophene and 41.724 mg/l of 2, 5 - dimethyl thiophene. No benzothiophene and dibenzothiophene were found in kerosene. Figures 1 and 2 below show

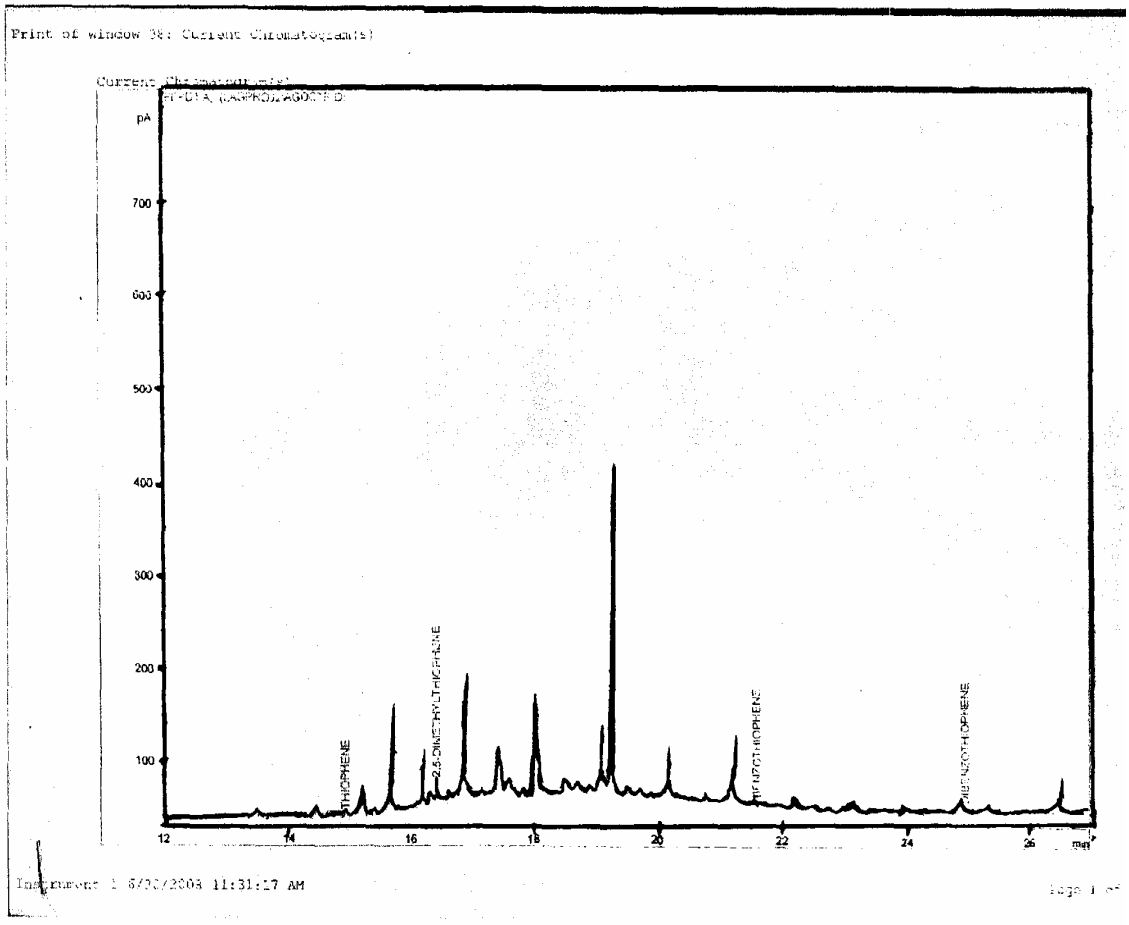

Figure 1: GC-PFPD Chromatograms for Kerosene before Biodesulfurization. the GC-PFPD peaks for all of the sulfur compounds in the kerosene (approximately 48.679 mg/l sulfur initially) before the biodesulfurization by *Desulfobactenum indolicum.* after treatment of the kerosene for 72 hours, all of the peaks significantly decreased. It is important to note that the sulfur compounds with retention times longer than 5 minutes nearly disappeared. Such characteristics of desulfurization by cells of *Desulfobactenum indolicum* are opposite or complimentary to those of hydrodesulfurization, in which sulfur compounds with a shorter residence time are more easily desulfurized (Dzidic with a shorter residence time are more easily desulfurized (Dzidic et al, 1988). Based on these results, cells of *Desulfobacterium indolicum* are considered to have a sufficiently broad substrate specificity to desulfurize major organic sulfur compounds contained in diesel.

Figure 3 below shows the concentration-time profile for the biodesulfurization of benzothiophene. It showed that *Desulfobacterium indolicum* steadily desulfurized the benzothiophene decreasing its concentration to 1.72 mg/l at the end of 72 hours.

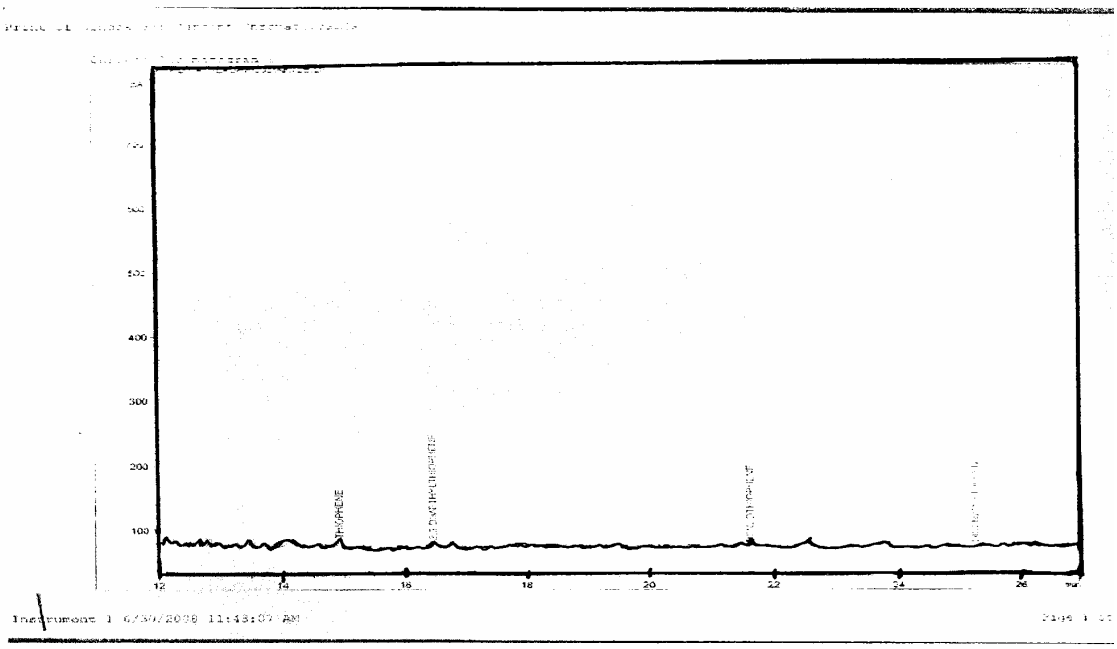

Figure 2: GC-PFPD Chromatograms for Kerosene 72 hours after Biodesulfurization

This is a remarkable feat at a reaction temperature of only 30°C, extremes of reaction conditions would have been employed in hydrodesulfurization to attain the same level of desulfurization.

Similarly, Figure *4* below shows that *Desulfobacterium indolicum* also desulfurized dibenzothiophene steadily reducing its concentration to 31.692 mg/l at the end of 72 hours.

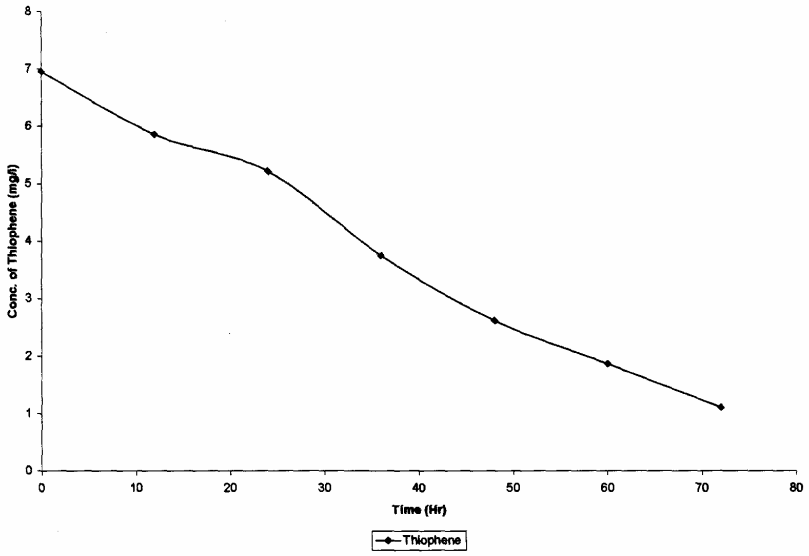

Figure 3: The Concentration-Time Profile of Thiophene Biodesulfurization by *Desulfobacterium indolicum*

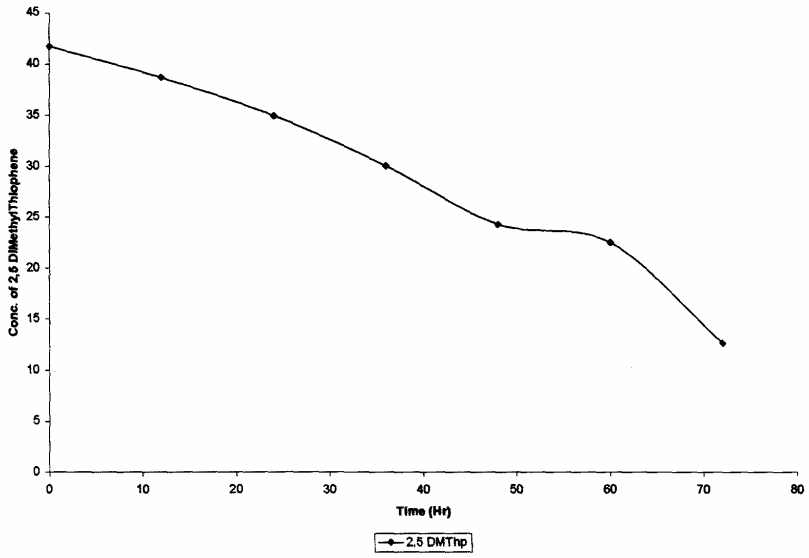

Figure 4: The Concentration-Time Profile of 2, 5 – Dimethyl Thiophene Biodesulfurization by *Desulfobacterium indolicum*

From the viewpoint of a practical process, biodesulfurization at ambient temperature and pressure of kerosene containing various types of thiophene derivative is advantageous, since cooling treatment of the oil to ambient temperature would be unnecessary.

Figures 3 and 4 above show the concentration-time of biodesulfurization of thiophene and 2, 5 - dimethyl thiophene in kerosene. It was observed that at all times, the percentage of thiophene desulfurized is higher than 2, 5 - dimethyl thiophene. This is expected because the methyl substituents at positions 2 and 5 would constitute a steric hindrance to the organism from reaching the sulfur atom in the thiophene ring. At the end of 72 hours, 84% of thiophene has been desulfurized while 70% of 2, 5 - dimethyl thiophene was desulfurized. This is shown in figure 5 below.

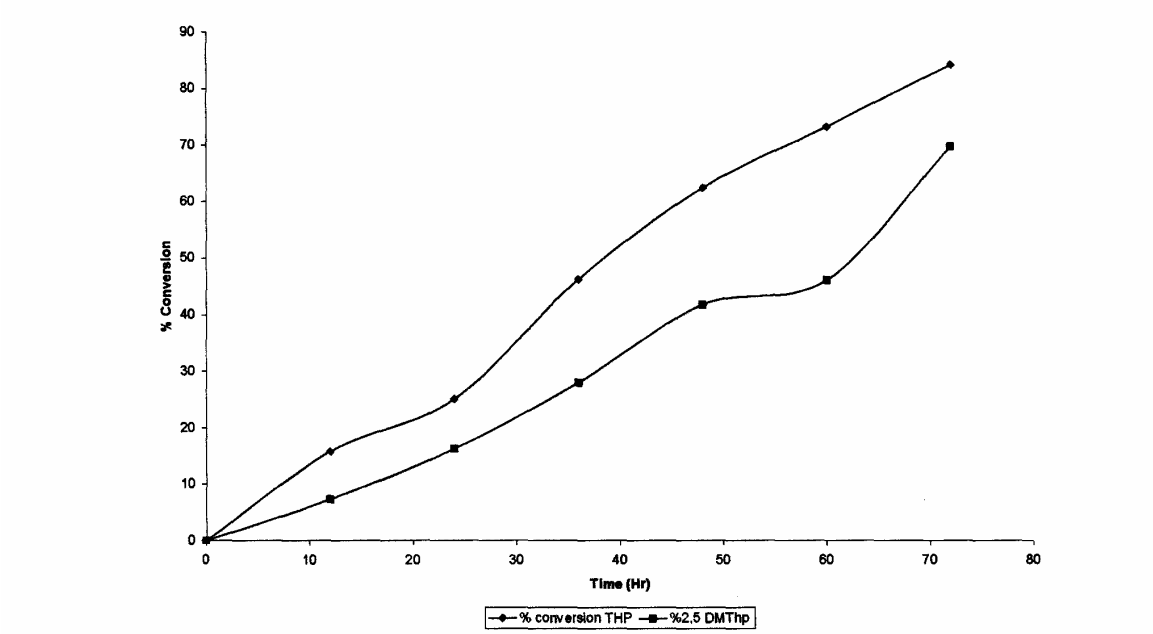

Figure 5: The Percentage Desulfurization -Time Profile of Thiophene & 2, 5 - Dimethyl Thiophene Biodesulfurization by *Desulfobacterium indolicum* The population density of *Desulfobacterium indolicum* is increasing as biodesulfurization of kerosene progresses. The Log™ of the population of the cells of A versus time is shown in figure 6 below.

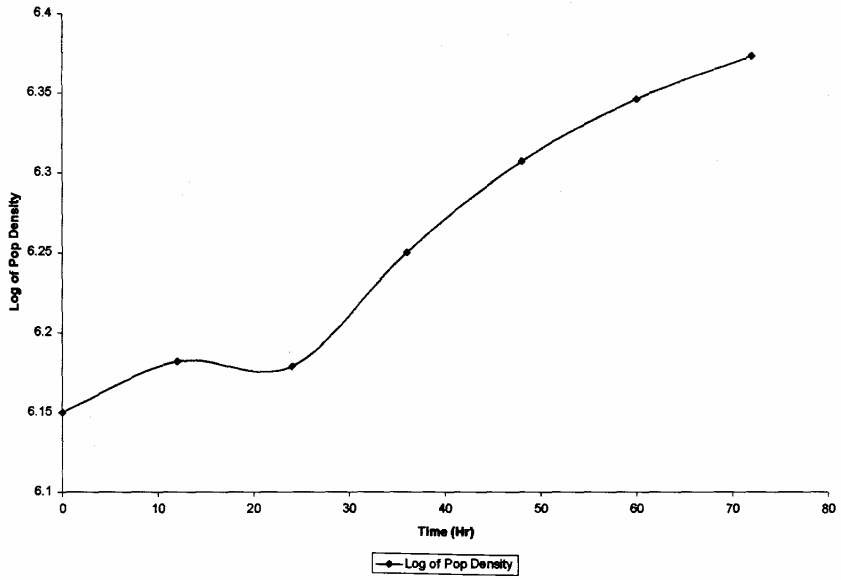

Figure 6: The Log_{10} of the population of the cells of *Desulfobacterium indolicum* -Time Profile

The population of the cells of *Desulfobacterium indolicum* increases steadily as biodesulfurization of kerosene progresses, showing that the cells use the sulfur in the fuel for metabolism leading to both growth and increase in population.

Goswami et al, (1991) in their work mentioned that two different biological mechanisms are known for the degradation of water-insoluble hydrocarbons and aromatic compounds. The first involves the case in which the microorganisms use emulsifiers to overcome poor solubility of hydrocarbons and aromatic compounds, whilst the other is to increase cell surface hydrophobicity so that adherent capacity to the hydrocarbon is enhanced. According to them, in many cases, microorganisms use both mechanisms with one mechanism acting dominantly. The dominant mechanism can be easily figured out by centrifugation of the cell broth after cultivation using hydrocarbons or oils. If the increase of cell surface hydrophobicity were the dominant mechanism, most of the cells would exist in the interface of aqueous and oil phase after centrifugation. Most of the cells would be in the bottom of the aqueous phase in the opposite case. In this work, the cells of *Desulfobacterium indolicum* were observed at the interface of the aqueous and oil phase.

The first step in the biodesulfurization of these molecules is the transfer of the molecules from the oil to the cells. It appears that these molecules are transferred directly from the oil into the cells. Many microorganisms have been shown to metabolize many insoluble molecules in this fashion. The PASHs appear to partition to the water before being brought into the cell. The enzyme responsible for the first two oxidations are to reflect the reaction it catalyzes and has been coded DszC. It catalyzes the oxidation by transferring an electron from flavin mononucleotide (FMNH2) to the organosulfur (the thiophene and 2,5- dimethyl thiophene) to produce FMN an oxidized (FMNH2) and sulfoxides of thiophene and 2,5- dimethyl thiophene and also the oxidation of sulfoxides by transferring an electron from flavin mononucleotide (FMNH2) to produce FMN an oxidized (FMNH2) and the corresponding sulfones.

The first cleavage of the C-S bonds is catalyzed by sulfone Monooxygenase (FMN hfc XO2 oxidoreductase); DszA codes this enzyme. It Transfers another electron from FMNH2 to XO2. Where X is the organosulfur.

The production of sulfite & subsequently sutfate and an intact hydrocarbon molecule is the last reaction in the pathway. This is catalyzed by a desulfinase coded by the DszB gene and leads to the release of the sulfur as sulfite and the production of the corresponding hydroxyl phenyl.

In nature, the cell has achieved its goal. It has the sulfur it needs to grow. The sulfite can be reduced to sulfide and incorporated into sulfur-containing amino acids and vitamins necessary for growth.

It is worthy of note that this study focused on real fuel rather than modeled media of organosulfur compounds. This implies that the organism can survive in the fuel till it removes all the sulfur in it.

In conclusion, it has been confirmed that A could effectively desulfurize organosulfur compounds, thiophene and 2, 5 - dimethyl thiophene through a sulfur-specific degradation pathway with the selective cleavage of C-S bonds at ambient temperature and pressure conditions. Therefore, *Desulfobacterium indolicum* may be a useful desulfurizing biocatalyst possessing broad substrate specificity toward organosutfur compounds.

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Peroxisome proliferator-activated receptor

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Abstract: The peroxisome proliferator-activated receptors (PPARs) belong to the nuclear hormone receptor superfamily. All PPARs heterodimerize with the retinoid X receptor (RXR) and bind to specific regions on the DNA of target genes. The discovery of PPARγ as a target of multimodal insulin sensitizers has attracted remarkable scientific interest and had a great impact on the pharmaceutical industry. This article gives a review for the PPAR. [Nature and Science. 2008;6(4):64-70]. ISSN: 1545-0740.

Keywords: peroxisome proliferator-activated receptor (PPAR); protein; phiology

Introduction

Peroxisome proliferator-activated receptors (PPARs) are members of the nuclear hormone receptor superfamily of ligand-activated transcription factors that are related to retinoid, steroid, and thyroid hormone receptors (Esposito et al. 2006). Three types of PPARs have been identified: α (alpha), γ (gamma), and β/δ (beta/delta): α (expressed in liver, kidney, heart, muscle, adipose tissue); β/δ (expressed in many tissues but markedly in brain, adipose tissue) γ (through alternative splicing is expressed in three forms: γ1 - expressed in virtually all tissues, including heart, muscle, colon, kidney, pancreas, and spleen γ2 - expressed mainly in adipose tissue, γ3 - expressed in macrophages, large intestine, white adipose tissue) (Sridhar 2003).

Discovery of peroxisome proliferator-activated receptor

PPARs were originally identified in Xenopus frogs as receptors that induce the proliferation of peroxisomes in cells. The first PPAR (PPARα) was discovered during the search of a molecular target for a group of agents then referred to as peroxisome proliferators, as they increased peroxisomal numbers in rodent liver tissue, apart from improving insulin sensitivity. After PPARδ was identified in humans in 1992, it turned out to be closely-related to the PPARβ previously described during the same year in other animals. The name PPARδ is generally used in the US, whereas the use of the PPARβ denomination has remained in Europe where this receptor was initially discovered in Xenopus. These agents, pharmacologically related to the fibrates were discovered in the early 1980s. When it turned out that PPARs played a much more versatile role in biology, the agents were in turn termed PPAR ligands. The best-known PPAR ligands are the thiazolidinediones (Krey et al. 1997). (http://en.wikipedia.org/wiki/Peroxisome_proliferator-activated_receptor).

PPAR γ is the subject of intense investigation as a target for drugs against diabetes, atherosclerosis and cancer. For this reason there is considerable interest in the spectrum of compounds that bind this receptor. The binding of this fatty acid to the receptor increases its fluorescence and causes a shift in the UV spectrum. This spectral shift is reversible by competition with other known ligands for PPARγ. This report represents the first direct demonstration of a fatty acid binding to PPARγ (Palmer and Wolf 1998). In Kasuga's study, 3-(4-Alkoxyphenyl)propanoic acid derivatives were prepared as candidate PPAR α/δ/γ pan agonists, based on our previous SAR studies directed toward the development of subtype-selective PPAR agonists. The steric bulkiness of substituents introduced at the distal benzene ring had an important influence on PPAR activity. The finding that a 4-adamantyl derivative exhibited not only PPARα/δ activity but also significant PPARγ activity prompted us to search for structurally novel phenylpropanoic acid derivatives with more potent adipocyte differentiation activity than the well-known PPARγ agonist, rosiglitazone, as well as well-balanced PPARα and PPARδ agonistic activities (Kasuga et al. 2008). The PPAR γ is one of the ligand-activated transcription factors in the nuclear hormone receptor superfamily and

a pivotal regulator of glucose and lipid homeostasis. The discovery of PPARγ as a target of multimodal insulin sensitizers, represented by thiazolidinediones (TZDs), has attracted remarkable scientific interest and had a great impact on the pharmaceutical industry. With the clinical success of the PPARγ agonists, pioglitazone (Actos) and rosiglitazone (Avandia), development of novel and potent insulin-sensitizing agents with diverse clinical profiles has been accelerated (Cho and Momose 2008). The physiological role of PPARδ may be an indicator for switching from glucose metabolism to fatty acid metabolism (Takahashi et al. 2006).

Structure of Peroxisome proliferator-activated receptor

Like other nuclear receptors, PPARs are modular in structure and contain the following functional domains: (A/B) N-terminal region; (C) DBD (DNA-binding domain); (D) flexible hinge region; (E) LBD (ligand binding domain); (F) C-terminal region. The DBD contains two zinc finger motifs, which bind to specific sequences of DNA known as hormone response elements when the receptor is activated. The LBD has an extensive secondary structure consisting of 13 α helices and a β sheet. Natural and synthetic ligands bind to the LBD, either activating or repressing the receptor (Yee et al. 1997) (http://en.wikipedia.org/wiki/Peroxisome_proliferator-activated_receptor).

The PPARs belong to the nuclear hormone receptor superfamily. To date, three different PPAR isotypes, namely PPARα, -δ, and -γ, have been identified in vertebrates and have distinct patterns of tissue distribution. Like all nuclear receptors, the human PPARγ (hPPARγ) is characterized by a modular structure composed of an N-terminal A/B domain, a DNA-binding domain with two zinc fingers (C domain), a D domain, and a C-terminal ligand-binding domain (E/F domain). Human PPARγ exists in two protein isoforms, hPPARγ(1) and -γ(2), with different lengths of the N-terminal. The hPPARγ(2) isoform is predominantly expressed in adipose tissue, whereas hPPAR-γ(1) is relatively widely expressed. Human PPARγ plays a critical physiological role as a central transcriptional regulator of both adipogenic and lipogenic programs. Its transcriptional activity is induced by the binding of endogenous and synthetic lipophilic ligands, which has led to the determination of many roles for PPAR-γ in pathological states such as type 2 diabetes, atherosclerosis, inflammation, and cancer. Of the synthetic ligands, the thiazolidinedione class of insulin-sensitizing drugs (ciglitazone, pioglitazone, troglitazone, rosiglitazone) is employed clinically in patients with type 2 diabetes (Zieleniak et al. 2008). The structure of the complex with the S-enantiomer reveals a new region of the PPARγ-LBD never sampled before by other ligands (Montanari et al. 2008).

Amri et al detected the primary sequence of human PPAR in 1995. According to Amri's study, exposure of preadipocytes to long chain fatty acids induces expression of several gene markers of adipocyte differentiation. The cDNA had the characteristics and ligand-binding domains of nuclear hormone receptors and encoded a 440 amino acid protein related to PPARs, PPAR. The deduced protein sequence was 88% homologous to that of hNUC I, isolated from human osteosarcoma cells. The human PPAR primary sequence is following (Amri et al. 1995):

1 meqpqeetpe areeekeeva mgdgapelng gpehtlpsss cadlsqnssp sslldqlqmg
61 cdgasggsln mecrvcgdka sgfhygvhac egckgffrrt irmkleyekc drickiqkkn
121 rnkcqycrfq kclalgmshn airfgrmpea ekrklvaglt asegcqhnpq ladlkafskh
181 iynaylknfn mtkkkarsil tgksshnapf vihdietlwq aekglvwkql vnglppynei
241 svhvfyrcqs ttvetvrelt efaknipnfs slflndqvtl lkygvheaif amlasivnkd
301 gllvangsgf vtheflrslr kpfsdiiepk fefavkfnal elddsdlalf iaaiilcgdr
361 pglmnvpqve aiqdtilral efhlqvnhpd sqylfpkllq kmadlrqlvt ehaqmmqwlk
421 ktesetllhp llqeiykdmy

Studied by Sher et al in 1993, the human PPAR was cloned from a human liver cDNA library. The cDNA exhibited 85% and 91% DNA and deduced amino acid sequence identity with mouse PPAR (mPPAR), respectively. The hPPAR gene was mapped on human chromosome 22 slightly telomeric to a linkage group of six genes and genetic markers that are located in the general region 22q12-q13.1. Cotransfection assays of mouse Hepa 1 cells were used to roughly compare the ability of hPPAR- and mPPAR-expressed cDNAs to trans-activate the acyl CoA oxidase (ACO) PPAR response element located 5' upstream to the minimal thymidine kinase promoter driving the expression of the chloramphenicol acetyl transferase (CAT) reporter gene. Both receptors elicited a response with the prototypical peroxisome proliferators nafenopin, clofibrate, and WY-14,643. Moreover, using cotransfection assays in which the

CAT reporter plasmid contained the CYP4 A6 gene response element rather than the ACO element, it was shown that hPPAR is capable of very efficiently trans-activating a second PPAR response element. These results indicate that the PPAR is present in humans in a form that is functional and can trans-activate response elements derived from two different genes, the rat ACO and the rabbit CYP4A6. The primary sequence of 468 amino acids of human PPAR detected by Sher et al in 1993 is as the following (Sher et al. 1993):

1 mvdtesplcp lspleagdle splseeflqe mgniqeisqs igedssgsfg fteyqylgsc
61 pgsdgsvitd tlspasspss vtypvvpgsv despsgalni ecricgdkas gyhygvhace
121 gckgffrrti rlklvydkcd rsckiqkknr nkcqycrfhk clsvgmshna irfgrmprse
181 kaklkaeilt cehdiedset adlkslakri yeaylknfnm nkvkarvils gkasnnppfv
241 ihdmetlcma ektlvaklva ngiqnkevev rifhccqcts vetvteltef akaipafanl
301 dlndqvtllk ygvyeaifam lssvmnkdgm lvaygngfit reflkslrkp fcdimepkfd
361 famkfnalel ddsdislfva aiiccgdrpg llnvghiekm qegivhvlrl hlqsnhpddi
421 flfpkllqkm adlrqlvteh aqlvqiikkt esdaalhpll qeiyrdmy

The human PPAR gene encodes a component of SCF complexes, which are composed of this protein, cullin 1, a ring-box protein, and one member of the F-box family of proteins. This protein binds directly to the F-box motif found in F-box proteins. SCF complexes are involved in the regulated ubiquitination of specific protein substrates, which targets them for degradation by the proteosome. Specific F-box proteins recognize different target protein(s), and many specific SCF substrates have been identified including regulators of cell cycle progression and development. Studies have also characterized the protein as an RNA polymerase II elongation factor. Alternative splicing of this gene results in two transcript variants. A related pseudogene has been identified on chromosome 7. Transcript Variant: This variant (2) utilizes an alternate splice site in the 3' coding region, compared to variant 1. This results in a frameshift and slightly longer protein (isoform b), compared to isoform a. The human PPAR gene sequence is as the following (Chen et al. 1995):

1 agccgcgatg tgacgccgcg cgccccgggg tcctcggcgc ctgcgccctc tcctataaag
61 cagacgccgc gccgcgctgc gacgctgtag tggcttcgtc ttcggttttt ctcttccttc
121 gctaacgcct cccggctctc gtcagcctcc cgccggccgt ctccttaaca ccgaacacca
181 tgccttcaat taagttgcag agttctgatg gagagatatt tgaagttgat gtggaaattg
241 ccaaacaatc tgtgactatt aagaccatgt tggaagattt gggaatggat gatgaaggag
301 atgatgaccc agttcctcta ccaaatgtga atgcagcaat attaaaaaag gtcattcagt
361 ggtgcaccca ccacaaggat gaccctcctc ctcctgaaga tgatgagaac aaagaaaagc
421 gaacagatga tatccctgtt tgggaccaag aattcctgaa agttgaccaa ggaacacttt
481 ttgaactcat tctggctgca aactacttag acatcaaagg tttgcttgat gttacatgca
541 agactgttgc caatatgatc aaggggaaaa ctcctgagga gattcgcaag accttcaata
601 tcaaaaatga ctttactgaa gaggaggaag cccaggtacg caaagagaac cagtggtgtg
661 aagagaagtg aaatgttgtg cctgacactg taacactgta aggattgttc caaatactag
721 ttgcactgct ctgtttataa ttgttaatat tagacaaaca gtagacaaat gcagcagcaa
781 gtcaattgta ttagcagaat attgtcctca ttgcatgtgt agtttgagca cagatcccaa
841 accttacggc caagtttctt ctagtatgat ggaaagtttc ttttttcttt gctctgaata
901 aaactgaact gtgggttctc tataagtggc attttgggct ttccctcttt tttgtaaagc
961 aatgtctgcc tagtttattg tccagttaac tttagtgacc ttttaaaagt tggcattgta
1021 aataaaacaa cttgcaaaaa agttttctgg aatagaatta acaaaatatt atctttattc
1081 atgagttgga aactggaaaa aggcttcttg aagtaaatgt tctgagtgga gctactagga
1141 tgtcttccag cctcctgcag tcaaggagta ccactgtatt gattagcctg tatgtagcag
1201 ggctcccttc attgcatctg aggacttgtt ttctttttct ttatttttaa tcctcttagt
1261 tttaaatata ttgcctagag actcagttac tacccagttt gtggtttttt gggagaaatg
1321 taactggaca gttagctttt caattaaaaa gacacttaac ccatgtggga tgtcatcttt
1381 ttataattag tgttcccatg tggagaaaat tattcacact acttgcatgt aaagaataat
1441 ttaactttta acattaaaat atgtggtaaa acccagaaag catccatcat gaatgcaaga
1501 tactttcaat aaaaagtaag ttatatagta ggtagttaag tttgcttttg tggacttaaa
1561 tgtgtctctt cacttaaatg ggttgaatgt gtatatattt gttcagcttg aaaagactta
1621 gtttatatcc tagctcactg gaggctgctg acataaccat aacttctgtc ccttctaatt

1681 gtcatttata tgcctaactg gagctagtac tttaattctt aacacaaaat tactctgcca
1741 ttgtttccag cttccctcct acaatagaat gaagtttttt tgatggcttg agatggctca
1801 caaattttga ttttttttttc ttccttgtgc tccctttttt tctccttgct tttccagtta
1861 acatctatat tcacatgtaa tcttgttttc tcttcacatt cactgagttg ttcaggctca
1921 gatcatccct tgacagtagt ttgccttcat ctcacctttc atttgtccca aattcacctt
1981 atttaataaa gtcccatatg ttgtctcact taaaaaaaaa aaaaaaaa

Physiological function of Peroxisome proliferator-activated receptor

All PPARs heterodimerize with the retinoid X receptor (RXR) and bind to specific regions on the DNA of target genes. These DNA sequences are termed PPREs (peroxisome proliferator hormone response elements). The DNA consensus sequence is AGGTCAXAGGTCA, with X being a random nucleotide. In general, this sequence occurs in the promotor region of a gene, and, when the PPAR binds its ligand, transcription of target genes is increased or decreased, depending on the gene. The RXR also forms a heterodimer with a number of other receptors (e.g., vitamin D and thyroid hormone) (Raingeard et al. 2009).

The function of PPARs is modified by the precise shape of their ligand-binding domain (see below) induced by ligand binding and by a number of coactivator and corepressor proteins, the presence of which can stimulate or inhibit receptor function, respectively (Zieleniak et al. 2008).

Endogenous ligands for the PPARs include free fatty acids and eicosanoids. PPARγ is activated by PGJ_2 (a prostaglandin). In contrast, PPARα is activated by leukotriene B_4 (Yu and Reddy 2007; Zieleniak et al. 2008) (http://en.wikipedia.org/wiki/Peroxisome_proliferator-activated_receptor).

Human PPARγ plays a critical physiological role as a central transcriptional regulator of both adipogenic and lipogenic programs. Its transcriptional activity is induced by the binding of endogenous and synthetic lipophilic ligands, which has led to the determination of many roles for PPARγ in pathological states such as type 2 diabetes, atherosclerosis, inflammation, and cancer (Zieleniak et al. 2008).

PPARγ is a nuclear receptor that is known to have a tumour suppressor role in cancer. PPARγ also acts as a receptor for polyunsaturated fatty acids, including omega-3 and 6 (Yasui et al. 2005; Yasui et al. 2006).

Medical applications of Peroxisome proliferator-activated receptor

The reproductive function of PPARδ was first revealed in the uterus at the implantation site. Since then, PPARδ and its ligand have been discovered in all reproductive tissues, including the gametes and the preimplantation embryos. PPARδ in preimplantation embryos is normally activated by oviduct-derived PPARδ ligand. PPARδ activation is associated with an increase in embryonic cell proliferation and a decrease in programmed cell death (apoptosis). On the other hand, the role of PPARδ and its ligand in gamete formation and function is less well understood (Huang 2008). Lee et al have applied the fluorescent differential method and the PPARα-null mouse model for the rapid isolation of expression tags of PPARα target genes that are involved in the action of peroxisome proliferators and in the regulation of lipid homeostasis under energy deprivation. Identification of a wide spectrum of PPARα target genes will provide new insights into the diverse cellular pathways regulated by these receptor, and this information will be critical for understanding the complicated biological interactions among members of the PPARα target genes. With the recent technological advancement, a newer method, such as DNA microarray, has emerged in the identification of differential gene expressions. This new DNA microarray method, in conjunction with the differential display method, is the first important step toward understanding the molecular mechanisms of gene interactions in any biological systems and can speed up the search for differential gene expressions (Lee et al. 2002).

Discussion

The prevalence of type 2 diabetes continues to expand worldwide. Increased body mass index (BMI), preexisting glucose and insulin abnormalities, physical inactivity, and parental diabetes appear to be acknowledged risk factors for the development of new diabetes. In 1997, the American Diabetes Association (ADA) adopted new criteria for the detection of diabetes by establishing a single fasting blood glucose of at least 126 mg/dL (7 mmol/L) for the diagnosis of overt diabetes and glucose levels of 110 to 125 mg/dL (6.1 to 6.9 mmol/L) for impaired fasting glucose. People who develop type 2 diabetes usually pass through the phases of excessive adipogenesis, nuclear peroxisome proliferator–activated receptor (PPAR) modulation, insulin resistance, hyperinsulinemia, pancreatic ß-cell stress and damage leading to a

progressive decrease in insulin secretion, and impaired glucose postprandial and fasting levels. Fasting glucose is presumed to remain normal as long as insulin hypersecretion can compensate for insulin resistance. The profound metabolic (specifically glucose and fatty acids) abnormalities associated with the impaired fasting glucose phase lead to further disturbance of insulin sensitization and secretion. These mechanisms contribute to the conversion of the impaired fasting glucose phase to overt diabetes. PPAR-γ is activated by fibric acids (eg, bezafibrate) and form heterodimers with the 9-cis retinoic acid receptor. These heterodimers bind to peroxisome proliferator response elements, which are located in numerous gene promoters and increase the level of the expression of mRNAs encoded by PPAR-γ target genes (Tenenbaum et al. 2004).

Activation of PPARα by clofibrate has recently been shown to cause upregulation of the high-affinity carnitine transporter novel organic cation transporter (OCTN) 2 in small intestine. This strongly suggests that PPARα activation in response to clofibrate treatment improves the absorption of carnitine from the diet. The administration of clofibrate to rats increases carnitine absorption in small intestine which is probably due to the observed upregulation of OCTN2 mediated by activation of PPARα (Ringseis et al. 2008). PPARγ activation by rosiglitazone attenuates mitochondrial dysfunction in mutant huntingtin-expressing striatal cells, and this could be an important therapeutic avenue to ameliorate the mitochondrial dysfunction that occurs in Huntington disease (Quintanilla et al. 2008). PPAR-γ ligands constitute important insulin sensitizers that have already been used for the treatment of human metabolic disorders, exerting also pleiotropic effects on inflammatory related diseases and cancer. Ischemia-reperfusion injury that is mainly associated with organ transplantation constitutes a serious complication with a great relevance in clinical practice. PPAR-γ ligands seem to represent potential therapeutic agents in the aim to reduce or even prevent injury associated with ischemia-reperfusion (Giaginis et al. 2008). PPARγ is expressed in a variety of immune cells as well as in numerous leukemias and lymphomas. Understanding the diverse properties of PPARγ ligands is crucial for the development of new therapeutic approaches for hematological malignancies (Garcia-Bates et al. 2008). Rosiglitazone, a drug that has an excellent safety profile, may offer a well tolerated systemic treatment option for atopic dermatitis. However, its role should be further assessed in controlled trials to establish its efficacy and safety in this disease (Behshad et al. 2008).

Melanomacrophages, cells of the immune system in fish, show strong expression of both PPARα and PPARβ whereas PPARγ expression is almost restricted to this cell type suggest a significant role of PPAR-mediated regulation of cell function in melanomacrophages (Ibabe et al. 2004). By their diverse biological effects on cell proliferation and differentiation in the skin, PPAR agonists or antagonists may offer interesting opportunities for the treatment of various skin disorders characterized by inflammation, cell hyperproliferation, and aberrant differentiation (Di-Poi et al. 2004).

Of the synthetic ligands, the thiazolidinedione class of insulin-sensitizing drugs (ciglitazone, pioglitazone, troglitazone, rosiglitazone) is employed clinically in patients with type 2 diabetes (Zieleniak et al. 2008).

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Estimation of dry Mass of epiphytic lichens in a temperate forest of Garhwal Himalaya, India

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ABSTRACT: The dry mass of epiphytic lichens of two common *Quercus semecarpifolia* and *Rhododendron arboreum* tree from the moist temperate forest of Chopta-Tunganath region of Garhwal Himalaya District Rudraprayag has been discussed. Out of three d. b. h. classes' trees (diameter at breast height), d. b. h. 1-30cm and 30-60cm has found maximum mass of epiphytic lichens. [Nature and Science. 2008;6(4):71-75]. ISSN: 1545-0740.

Keywords: Lichen biomass, *Quercus semecarpifolia*, Garhwal Himalaya

INTRODUCTION

According to the concept of Esseen & Renhorn (1998), high biomass of epiphytic lichens is a characteristic feature of many old- growth forest ecosystems in temperate and boreal areas. Various workers like Pike (1978), Boucher & Nash (1990), Knops et al. (1991, 1996) and Esseen et al. (1996) epiphytic lichens are abundant, they may play an important role in the nutrient cycling in forest ecosystem. In the temperate regions of the Garhwal Himalaya lichen collection is a common practice among the villagers and the trivial to collect the lichens together with tree twigs, as oak trees especially *Quercus semecarpifolia* (Kharsu oak). The precipitation peculiar to the high altitudes raise the atmospheric humidity; the frequency of clouds in summer as well as the snow amount in winter are water reservoirs favouring the development of lichen flora. As a result, this superior band of wood vegetation includes the great number of lichen species. The great richness of *Usnea* and fewer *Ramalina* genera represented by aerophile species.

The present paper, enumerates the dry mass of major epiphytic lichens was only for five major lichen taxa of the Chopta area of the Garhwal Himalaya viz. *Usnea, Everniastrum, Parmotrema, Cetrariopsis* and *Ramalina.* Because these five lichen taxa are commercially exploiting in some high altitude area of Uttarakhand state. In order to collect lichens from the trees it is not allowed because of the lichens are very slow grower plants, these are pioneer plants in all the epiphytes, if the lichens are extracted from any plant species, the other epiphytes like orchids, mosses and angiosperms can be effected and unable to re-sprout. Kumar (2008) study showed only the ground or fallen lichen collection should be possible.

In order to improve the socio-economic standard of the people of Uttarahkand, it may also be necessary to increase and improve the botanical resources of the area. Depletion of lichen population is a matter of concern from conservation standpoint because of several reasons; being unique symbiotic

organisms they contribute to biodiversity; they are ecologically important as food, shelter and nesting materials for a variety of wild animals (Mc Cune and Geiser 1997).

METERIALS AND METHODS

The Chopta region lies between and 30° 30'-30° 42' N latitude and 79°-79° 30' E longitude in the Garhwal Himalaya is dominated by *Quercus semecarpifolia* trees associated with *Rhododendron* spp, *Taxus baccata*, *Abies pindrow*, *Aser* spp. and *Cotoneaster* shrub. The dry mass estimation of major lichens from the area on *Quercus semecarpifolia* and *Rhododendron arboreum* trees made between 2500m - 3500m above mean sea level. We have identified two purely *Q. semecarpifolia* forest at southeast aspect (open canopied forest) and northwest aspect (closed canopied forest) of the study area. At presents lichen exploitation has band in the study area due to the area comes under the Kedarnath Wild Life Sanctuary area (KWLS). The study has been carried out during June to September 2006. To assessing the mass of major epiphytic lichens vegetation on three dbh classes trees, we have developed a appropriate methodology. Before collecting the epiphytic lichen mass, we have provided a reconnaissance survey to collecting the information on traditional method of lichen harvesting from some high altitude villages of district Chamoli.

A. Traditional Method of Lichen Harvesting

The method has been traditionally followed by lichen collectors of Deval and Tharali block of Chamoli district of Uttrakhand. In these areas lichens collected by the villagers or lichen collectors of Ratgawn, Bursol, Dungari, Man, Kolpuri, Mundoli, Vaan, Kuling, Baak and Ghes village. This area comes under the Badrinath forest division. These areas falls within the Garhwal Himalaya region and the forests are dominated with *Quercus semecarpifolia* (brown oak) and these areas lies between 2000m to 3000m altitudes in west Pinder range of Tharali Tehsil. Brown oak trees of the area harbors luxuriant growth of epiphytic lichens. The collectors collects these plants from the forests and sold it in the local market at Tharali, Deval and Narayanbagar. Some villagers also sold it at Kerabagar and Vaan village of the area.

Villagers of Ratgawn region, approximately 250 collectors collects these plants from the forests in every day in its peak season of collection especially for fallen lichen collection from March to May; there is a major cause of lichen fall due to heavy snow fall in the high altitude areas of the forest. The traditional method of lichen collection is locally called ‘Makku Tipan’. Lichen extracts from standing trees through climbing on tree parts (as trunk, branch and twigs) and lichen removed from bark through hands, and for large tree or long branches, a traditional method has followed and used a iron knife tied on a log and then applied it for lichens extraction from the trees. If this kind of technique has not possible, then they cuts the tree parts and after fall down the branch or twigs and extract lichens. Some time the Nepalese are also collects lichens from the forest, they stay there for a month and they harm the trees during the lichen extraction and they also cuts the branches of the trees and extract lichens for sale and wood for fuel or cooking.

B. Sampling of Epiphytic Lichen Thallus

To assessing dry mass of epiphytic lichens, we have collected fifteen (15) individuals of each major lichen taxa from the forest and calculated their dry mass (sun dry mass) for each selected lichen taxa.

C. Sampling of Phorophytes

On the basis of availability of tree species (phorophytes) in both the aspect of the forest, lichen rich habitat and to convenience of the study (as easy to climbing for lichen species counting on tree parts) at both the forest (open canopied as well as closed canopied forests), the trees of *Q. semecarpifolia* and *R. arboreum* categorized into three dbh classes as 1-30cm, 31-60cm and 61-90cm. Three replicates of each dbh class of each phorophyte have randomly selected in both the forests.

D. Counting of Major Epiphytic Lichens on Selected Phorophytes and Estimation of their Dry Mass

We have just counts the number of individuals of each major epiphytic lichen taxa on tree trunk, three randomly selected branches (including lichens on the sub branches and on twigs) of selected trees of each dbh class. The lichen dry mass calculated with the help of following formula-

i. Lichen dry mass on trunk = Total number of individuals of each major epiphytic lichen on trunk X estimated dry mass of each major lichen taxa.

ii. Lichen dry mass on a branch = Sum of individuals of each lichen taxa on all randomly selected branches of the tree X estimated dry mass of each lichen taxa / total number of randomly selected branches.

iii. Lichen dry mass on the total branches of the tree = lichen dry mass on a branch X total number of branches of the selected tree.

iv. Total dry mass of lichens on the tree (phorophyte) = lichen dry mass on tree trunk + lichen dry mass on all branches of the phorophyte.

RESULTS

The maximum dry mass of epiphytic lichen of *Usnea* species represented by 11mg followed of 6mg *Ramalina* species and 5mg of *Parmotrema* species. Two species of lichens i.e. *Everniastrum* and *Cetrariopsis* have found equal dry mass. The youngest Q. *semecarpifolia* trees dbh 1-30cm provided 329.16(±112.2) g. lichen d.w/tree, at south east aspect, and it was greater about 588.46(±454.93) g. lichen d. w. /tree *Q. semecarpifolia* at north west aspect of the forest The *Q. semecarpifolia* tree dbh 31-60cm recorded 598.56(±317.31) g. lichens d. w. /tree (south east) and 496.86(±349.87) g. lichen d. w. /tree (north west). Similarly for tree dbh 61-90 cm, the lichen dry mass was found on the phorophyte as 753.7(±53.51) g. lichen d. w. /tree at south east and only 189.13(±83.62) g. lichen d. w. at north west aspect of the forest.

Lichen mass on the second phorophye *Rhododendron arboreum* was found very poor as campared to *Q. semecarpifolia*, due to type of bark, shape and size of the tree. In case of *R. arboreum* the highest dry

mass of lichens was recorded on trees dbh 61-90cm dbh was 72.76(±35.67) g. lichen d. w. /tree at north west aspect and it was lesser 21.4 (±13.21) g. lichen d. w. /tree at south east aspect of the forest.

DISCUSSIONS

The lichen mass was situated in the Chopta area on *Quercus semecarpifolia* and *Rhododendron arboreum*, species trees at southeast and northwest aspect. The major lichen taxa exhibited on individual pattern of vertical distribution. The lichen mass depends on tree cover, size & shape of tree, age of tree, and climate of the region. The Quercus *semecarpifolia* is an excellent phorophyte to providing much lichen mass due to dome shaped canopy.

In both the cases the phorophytes *Q. semecarpifolia* and *R. arboreum*, more than 70% mass of major epiphytic lichens was contributed by the canopy twigs and remaining 30% lichen mass contributed by tree branches and trunk or bole at both the aspect of the forest.

The youngest trees of *Q. semecarpifolia* have found as good lichen mass due to the age trees and smoothness in the trunk bark and absence of growth of other epiphytes, and in case of sapling (dbh1-30cm), all the parts of the saplings (including trunk, branches and twigs) were contributed for lichen mass. In case of increasing diameter (dbh>31cm), the twigs also provided good lichen mass as compared to tree branch and trunk or bole.

The Usneaceae family is represented in about more than 60% at southeast aspect and 58.26% lichen dry mass at northwest aspect of the forest. The Parmeliaceae family also represents 26.19% and 25.54% lichen dry mass at southeast and North West aspect. In both the forests Ramaliniaceae family is represents as very poor contribution about 2% in open and 3% in closed canopied forest.

In open canopied forest (southeast aspect) and closed canopied forest (northwest forest) the fruticose lichens provided 46.4% and 26.84% dry mass of lichens, this contribution is grater than dry mass of foliose lichens as 27.94% and 27.36% dry mass of lichens.

According to Degelius (1978) the lichens began to colonize oak twigs in Europe at about five years. Stone (1989) reported that branches of *Quercus garryna* upto twenty year old show growth of many foliose and fruticose lichens. Similar to the studies it was observed that on mature *Quercus semecarpifolia, Q. floribunda,* and *Q. leucotrichophora* trees in and around the study area attainment of the climax stage was exhibited by dominance of foliose and fruticose lichens represented by *Ramalina* and *Usnea* species. Dudgeon (1923) mentioned six stages of succession on epiphytic lichens of *Quercus leucotrichophora*. The crustose lichen stage, begining with numerous little patches of crusts as pioneers on the bark of branches that were 3-4 year old, of which two species frequency wise represent about 75% of the total vegetation. Foliose and fruticose lichens appear simultaneously but become somewhat conspicuous, 3-4 years old *Usnea barbata* (=*Usnea complanata*: Mull. Arg.Mot.) was a prominent member. This stage under favourable condition takes about 9-12 years to achieve its full development. The later stage of succession is taken over by mosses, fern and flowering plant. By this time the twig become thick branches. In the present investigation it was observed that on young tree trunk and twigs of *Quercus semecarpifolia,* Q. *floribunda,*

Q. leucotrichophora and *Rhododendron arboreum*, there is dominance of crustose lichens while mature tree twigs bear luxuriant growth of foliose and fruticose lichens. Du Rietz (1945) attempted to correlate certain tree species with dominance of epiphytic lichens and termed them as **Lichen Rich-Bark** species and **Lichen Poor-Bark** species. *Quercus semecarpifolia* is **Lichen Rich-Bark** trees while a *Rhododendron arboreum tree is* **Lichen Poor-Bark** species.

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