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The Journal of American Science

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(4) Introduction.

(5) Materials and Methods.

(6) Results.

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No.	Titles / Authors	Full Text
1	<p>Composting of Some Dangerous and Toxic Weeds Using <i>Eisenia foetida</i> Avnish Chauhan* and Joshi PC Department of Zoology and Environment Science, Gurkula Kangri University, Harwar, Uttaranchal 249404, India. *Corresponding author: avnishchauhan_in@yahoo.com</p> <p>Abstract: The experiments were conducted to obtain compost from some toxic weeds by using vermicomposting and conventional methods. The weeds used in the experiment were congress grass (<i>Parthenium hysterophorus</i> Linn.), water hyacinth (<i>Eichhornia crassipes</i>) and bhang (<i>Cannabis sativa</i> Linn.). Total six sets of experiments were setup by using above materials. Three of them were test experiments and rests were control experiments. In all the test experiment 50 worms were introduced. The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment having <i>Eisenia foetida</i>. The otherwise toxic weeds used in this experiment are thus converted into compost with higher concentration of nutrients. [Journal of American Science 2010;6(3):1-6]. (ISSN: 1545-1003).</p> <p>Keywords: <i>Parthenium hysterophorus</i> L., <i>Eichhornia crassipes</i>, <i>Cannabis sativa</i> L., <i>Eisenia foetida</i>, cow dung.</p>	Full Text
2	<p>Soil and Water Conservation in Kenya-Operations, Achievements and Challenges of the National Agriculture and Livestock Extension Programme (NALEP) Titus Wambua Mutisya^{1*}, Luo Zejiao¹ and Nenkari Juma² ¹School of Environmental Studies, China University of Geosciences (Wuhan) Lumo Road 388, Wuhan City, 430074 Hubei Province, P.R. China ² Department of Livestock Production, Ministry of Livestock Development. Republic of Kenya tmutisya2003@yahoo.com; mutisya2003@gmail.com</p> <p>Abstract: This paper gives an historical analysis of the soil and water conservation activities in Kenya, introduces the national soil and water conservation project and then gives an insight in to the National Agriculture and Livestock Extension Programme (NALEP), which was designed after several previous projects failed to address the sustainability of such development projects leading to progressive decline in soil fertility and agricultural output. The achievements and challenges faced while implementing the programme activities are also discussed. The</p>	Full Text

	<p>general project information was gathered from the various policy documents, programme documents and workshop reports while the achievements and challenges were drawn as a result of the involvement of two of the authors in the programme activities in 45 focal areas that have been implementing it since inception. The strong stakeholder involvement in all the stages of project development is the basis of the anticipated sustainability. The synergy between the key stakeholders is necessary for a sustainable development programme. Activities which involved the farmers, Government staff, and other development partners were found to be more successful than those that involved only one institution. NALEP framework is worth being replicated in any development project in the country. Scaling-up and replication of the success cases is recommended to improve the general household food security, economic empowerment and environmental conservation. This is the first paper analyzing the soil and water conservation, NALEP and its sustainability measures. The stakeholders could use the information to improve the programme. [Journal of American Science 2010;6(3):7-15]. (ISSN: 1545-1003).</p> <p>Key words: Soil and water conservation, NALEP, sustainability, stakeholders</p>	
3	<p>Helminth Parasites of some Freshwater Fish from River Niger at Illushi, Edo State, Nigeria Onyedineke, Nkechi Esther¹; Obi, Uchechukwu²; Ofoegbu, Pearl Ugochi¹ and Ukogo, Ifeoma¹ ¹Department of Biology, Federal University of Technology, Owerri, Nigeria. ²Department of Zoology, Ambrose Alli University, Ekpoma, Nigeria. nonyedineke@yahoo.com</p> <p>Abstract: Although there are some reports on parasites of fish at different locations on River Niger, there had been no report for Illushi. Parasitological investigation of 71 fish samples belonging to 14 genera from river Niger at Illushi showed a 60.6% prevalence infection and an infection rate of 59.15%. The gills, stomach and sometimes muscles were infected; no parasites were found infecting the liver and eye lens. Nematodes, acanthocephalans, trematodes and cestodes were recovered in decreasing order of abundance. <i>Proteocephalus</i> sp. was found in <i>Ctenopoma kingsleye</i> and was the only parasite infecting <i>Tilapia galilaeus</i>. <i>Diphyllbothrium</i> sp. was only found in the stomach and gills of <i>Chrysichthys nigrodigitatus</i>. <i>Paramphistomum</i> sp. was the only trematode found in the gills of examined fishes. <i>Bucephalus</i> sp was only found in <i>Synodontis eupterus</i> and <i>Distichodus engycephalus</i>. Acanthocephalans were represented by <i>Pomporhynchus</i>, <i>Quadrigidae</i> and <i>Neoechinorhynchus</i>. <i>Neoechinorhynchus</i> was found only on the intestine of <i>Lates niloticus</i>. Parasites were more prevalent in fish of 10 – 30cm standard length. There was no specific trend in parasite prevalence in <i>S. eupterus</i>, <i>S. clarias</i>, <i>C. nigrodigitatus</i> and <i>C. kingsleye</i> as regards the weight classes. The study showed the intestine as the preferred organ for infection, no infection was noticed in the oesophagus. [Journal of American Science 2010;6(3):16-21]. (ISSN: 1545-1003).</p> <p>Key words: helminth parasites, prevalence, freshwater fish, River Niger</p>	Full Text
4	<p>STRUCTURAL AND OPTICAL CHARACTERIZATION OF SPRAY DEPOSITED SnS THIN FILM B.G. Jeyaprakash^{1*}, R. Ashok kumar², K.Kesavan², A. Amalarani¹ 1. Department of Physics, Ponnaiyah Ramajayam College of Engineering and Technology Thanjavur -613 403, TamilNadu, India 2. Department of Physics, PRIST University, Thanjavur – 614 904, Tamilnadu, India *Corresponding author email: bgipabr@yahoo.co.in</p> <p>Abstract: Tin sulfide thin films were prepared on glass substrate by home built microcontroller based spray pyrolysis unit. X-ray diffraction confirmed the nanocrystalline SnS phase formation with preferential orientation along (111) plane. The intensity of XRD peaks increases with the increase of substrate temperature which implies better crystallinity takes place at higher temperature. Scanning electron micrograph of the film revealed the manifestation of nano SnS with size lying in the range of 31 -49nm as the function of substrate temperature. VIS-NIR spectrophotometric measurement showed high transparency of about 87% in the wavelength range 600-1100nm with a direct allowed bandgap lying in the range of 1.30 – 1.40eV as substrate temperature increases. [Journal of American Science 2010;6(3):22-26]. (ISSN: 1545-1003).</p> <p>Key words: Tin sulfide, thin film, spray pyrolysis</p>	Full Text
5	<p>Performance of an Otto engine with volumetric efficiency Rahim Ebrahimi Department of Agriculture Machine Mechanics, Shahrekord University, P.O. Box 115, Shahrekord, Iran Rahim.Ebrahimi@gmail.com</p> <p>Abstract: In this paper, the performance of an Otto engine is evaluated under variable volumetric efficiency.</p>	Full Text

	<p>Finite-time thermodynamics is used to derive the relations between power output and thermal efficiency at different compression ratio and volumetric efficiency for an air-standard Otto cycle. The effect of the volumetric efficiency on the irreversible cycle performance is significant. It was found that the effect of volumetric efficiency on the cycle performance is obvious, and they should be considered in practice cycle analysis. The conclusions of this investigation are of importance when considering the designs of actual Otto engines. [Journal of American Science 2010;6(3):27-31]. (ISSN: 1545-1003).</p> <p>Keywords: Volumetric efficiency; Irreversibility; Analysis; Performance; Otto cycle</p>	
6	<p>Regeneration and Plant Diversity of Natural and Planted Sal (<i>Shorea robusta</i> Gaertn.F.) Forests in the Terai – Bhabhar of Sohagibarwa Wildlife Sanctuary, India</p> <p>D.S. Chauhan, Bhupendra Singh, Shashi Chauhan, C.S. Dhanai & N.P. Todaria Department of Forestry, Post Box No. 59, H. N. B Garhwal University, Srinagar (Garhwal) –246174, Uttarakhand, India Email: dschauhan2008@gmail.com; nptfd@yahoo.com</p> <p>Abstract. We compared regeneration, tree diversity and floristic diversity of natural and planted tropical deciduous Sal (<i>Shorea robusta</i>) forest in Northeastern Uttar Pradesh, India. Species richness (105 and 95 species in natural and planted forests respectively) as well as species evenness was higher in natural forests than in planted forests. Natural forests also had higher mature tree, pole, sapling, and seedling densities compared to planted forest sites. In spite of differences in diversity, natural and planted forests did not differ significantly in species composition and 84 species occurred on both forests. Natural and planted forests did differ in soil moisture%, organic carbon%, available Nitrogen, Phosphorus, Potassium and soil pH. Dominant families in both forests types are Fabaceae (14 species), Mimosaceae, Euphorbiaceae and Moraceae (7 species each) followed by Verbenaceae and Caesalpiniaceae. Tree species dominated the flora (63 %). Of the 196 species found in both sites, 49% species showed good reproductive success, 40% species appeared poor and no seedling & sapling stages. The remaining 11% species were present as seedlings but not as adult individuals. Good quality timber species are not regenerating, with the exception of <i>Shorea robusta</i>, although mortality at seedling stages of this species is high. Our results suggest that the species richness and evenness differed between natural and planted forests and regeneration of some important tree species also varied from natural to planted forests due to differences in microclimate and soil characteristics. Moreover, the good reproductive success of both types of forests indicates the potential of forestry plantations in tropical deciduous forests. This study will help in the formation of effective forest management and conservation strategies. [Journal of American Science 2010;6(3):32-45]. (ISSN: 1545-1003).</p> <p>Key words. <i>Shorea robusta</i>, diversity, regeneration, natural forest, planted forest and density.</p>	Full Text
7	<p>Microstrip Rectangular Patch Antenna Printed on LiTi Ferrite with Perpendicular DC Magnetic Biasing</p> <p>Naveen Kumar Saxena^{1,*} (IEEE Student Member), Nitendar Kumar² and P.K.S. Pourush¹</p> <ol style="list-style-type: none"> 1. Microwave Lab, Department of Physics, Agra College Agra 282002 (U.P) India. Nav3091@rediffmail.com, ppourush@yahoo.co.in 2. Solid State Physics Laboratory, Timarpur, Delhi 110007 India. Nitendar@rediffmail.com <p>Abstract: Characterization of a tunable & switchable microstrip rectangular patch antenna printed on synthesized LiTi ferrite substrate with a normal magnetic bias field is presented. In this paper the concept of switching and tuning are described by magnetostatic and spin waves phenomenon. The DC magnetic biasing generate these both type of waves which response a number of novel magnetic and electrical characteristics including switchable and polarized radiations from a microstrip antenna. In such a case of substituted polycrystalline ferrite antenna due to the DC biasing, most of the power will be converted into mechanical waves and little radiates into air. Under such condition the antenna become switch off, in the sense of effectively absence as radiator. The preparation of ferrite by the solid state reaction technique is also précised with the short description of electric and magnetic properties. [Journal of American Science 2010;6(3):46-51]. (ISSN: 1545-1003).</p> <p>Keywords: Substituted ferrite, microstrip patch antenna, magnetostatic waves, spin waves, X-band frequency range.</p>	Full Text
8	<p>Vitamin E and Curcumin Intervention on Lipid-Peroxidation and Antioxidant Defense System.</p> <p>¹Ali Reza Amani, ²Muhammad Nazrul Hakim Abdullah, ³Mohd Majid B Konting, ⁴Kok Lian Yee ^{1,4}Department of Sport Science, Faculty of educational Studies, University Putra Malaysia</p>	Full Text

	<p>²Department of Biomedical Science, Faculty of Health and Medical, University Putra Malaysia ³Department of Foundations of Education, Faculty of educational Studies, University Putra Malaysia ¹Alireza.daryasar@gmail.com</p> <p>Abstract: The generation of free radical species may represent the negative aspect of exercise. There are a lot of data which have been shown an association between exercise and the increased free radical formation. Living cellular damage may lead human towards hasty aging and variant cancers. It is widely agreed that with increasing consumption of fruits and vegetables, decreased intake of unsaturated fat and moderate exercise will enhance fitness and improved cardiovascular health of the population in most of the developed and near-developed countries. Vitamin E and Curcumin have been known as a strong Antioxidant for prevent of the lipid peroxidation and improve the antioxidant defense system. Curcumin is a phenolic compound presented as a strong anti-oxidative, anti-inflammatory and anti-septic property, widely used in Indian medicine and culinary traditions. Recent investigation has shown that curcumin prevents lipid peroxidation and DNA strand breakage. This review have been shown the effect of the curcumin and vitamin E supplement on the lippid peroxidation and antioxidant defense system specify during the exercise. [Journal of American Science 2010;6(3):52-62]. (ISSN: 1545-1003).</p> <p>Keywords: Vitamin E, Curcumin, Exercise, Antioxidant, Lipid-Proxidation, Free radical</p>	
9	<p>The African Debt Dilemma: An Overview of Magnitude, Causes, Effects and Policy Options Maleshoane Lekomola College of International Business and Management; Shanghai University; Baoshan District, Shang Da Rd #99, Z bldng, Rm Z₁-312, Shanghai 200444, China, Cell: 13764357204 , Tel: +86-21-66131401, Fax: +86-21-66134536 lekomolas@yahoo.co.uk</p> <p>Abstract: This paper attempts to highlight the African debt dilemma. It tries to highlight empirically, the magnitude, causes and effects of African indebtedness that has grown several times between 19970 and 2007. It identifies factors responsible for African's debt to include excessive budget deficits, economic mismanagement, rising real interest rates in industrialized world, global oil shocks and commercial banks' lending practices of the 1970s. The paper concludes with some policy recommendations that are likely to help reduce Africa's huge external debt and its impacts on development; therefore, Africa's debt problem should be a joint effort by all participants. [Journal of American Science 2010;6(3):63-69]. (ISSN: 1545-1003).</p> <p>Keywords: External debt, debt poverty, economic growth and basic transfer</p>	Full Text
10	<p>Regional Development Disparities in Malaysia Mohammad Sharif Krimi, Zulkornain Yusop, Law Siong Hook Department of Economics, Faculty of Economics and Management, University Putra Malaysia, Serdang 43400, Malaysia. sharifkarimi@yahoo.com</p> <p>Abstract: Achieving balanced regional development will remain as one of the key objectives of national development during the development Plans in Malaysia. Therefore this paper analyses regional disparities amongst major states in Malaysia to find out gap and rank of regional development during two development plan (Seventh and Eighth plan). The paper proposes a new methodology that includes TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and Shannon entropy for first time in terms of ranking in this field. The empirical results indicate that in terms of regional balance, little progress was made in reducing development gaps between regions during two plans and Wilayah Persekutuan Kuala Lumpur was the most developed region in 2000 and 2005. On the other hand, Sabah was the least developed region in same period. [Journal of American Science 2010; 6(3):70-78]. (ISSN: 1545-1003).</p> <p>Keywords: TOPSIS, Shannon Entropy, Regional Development, Malaysia</p>	Full Text
11	<p>Effect of Combined Cocoa Pod Ash and NPK Fertilizer on Soil Properties, Nutrient Uptake and Yield of Maize (<i>Zea mays</i>) Dr. Ayeni, L.S. (Ph.D Soil Fertility) University of Agriculture, Department of Soil and Land Management, Abeokuta, Nigeria E-mail: leye_sam@yahoo.com</p> <p>Abstract: Field experiments were conducted in two cropping seasons (March and September, 2007) at two locations to determine the effect of cocoa pod ash (5 and 10 t ha⁻¹) and N 20:10:10 fertilizer (150 and 300 kg ha⁻¹) on soil chemical properties, nutrient uptake and yield of maize in southwest Nigeria. The experiments were sited at Adeyemi College of Education Research Farm, Ondo and Okegun both Alfisol. Ondo soil was sandy clay, deficient in OM, N, P and K while Okegun soil was clay loam, deficient in OM, N and K. The treatments were laid out in randomized complete block design with three replications. Combined cocoa pod ash and NPK 20:10:10 fertilizer significantly (p<0.05) increased soil OM, N, P and K at Ondo and OM, P and K at Okegun than cocoa pod ash and</p>	Full Text

	<p>NPK 20:10:10 fertilizer singly applied. Plant N, P and K were also increased significantly compared with single application of cocoa pod ash and NPK20:10:10 except 300 kg ha⁻¹ at the two locations as well as plant height, grain, stover and dry root yields. At Adeyemi (sandy clay), compared with control, the percentage increase in grain yield were C10F150 (81%), F300 (74.76%), C5F150 (65.71), C10 (47.62%), C5 (38.5%) and F150 (32.28%). For Okegun (clay loam), grain yield significantly increased ($p < 0.05$) by C10F150 (75.85%), F300 (54.36%), C5F150 (42.46%), C10 (8.10%), C5 (19.84%) and F150 (17.06%). Treatment C10F150 gave the highest increases in soil nutrient values and growth parameters of maize. Soil total N, available P and exchangeable K tended to increase as the level of the treatment combinations increased at both locations. Cocoa pod ash combined with reduced level of NPK 20:10:10 was more effective than single application of cocoa pod ash and NPK 20:10:10 fertilizer in both locations. Sandy clay responded to application of cocoa pod ash than clay loam in this experiment. [Journal of American Science 2010;6(3):79-84] (ISSN: 1545 - 1003)</p> <p>Keyword: integration, Fertilizer, maize, soil, nutrient uptake</p>	
12	<p>Seasonal Variations in the Water Chemistry and Benthic Macroinvertebrates of a South Western Lagoon, Lagos, Nigeria</p> <p>*Nkwoji, J. A., Yakub A., Ajani, G. E., Balogun, K. J., Renner, K.O., Igbo, J. K., Ariyo, A. A., Bello, B. O. Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria Email: josephniomr@yahoo.com; Phone: +2348023739253</p> <p>ABSTRACT: The water chemistry and benthic macroinvertebrates of a south-western lagoon, Lagos, Nigeria was studied in July, 2008 and March, 2009 representing wet and dry seasons respectively. The salinity ranged from 0.0 ‰ in the wet season indicating a typical freshwater condition to 32.0 ‰ in the dry season indicating a marine condition. Higher Dissolved Oxygen values were recorded in the wet season than in the dry season. 47.47% of the total organisms was sampled in the wet season while 52.53% was collected in the dry season. Species diversity was also higher in the dry season than the wet season. <i>Tellina nymhalis</i>, <i>Clibanarius africana</i>, and <i>Penaus notialis</i> sampled in the dry season were absent in the wet season. Only one species (<i>Crassostrea gazar</i>) sampled in the wet season was absent in the dry season. There was an indication of a general defaunisation of this lagoon for which reasons including pollution of the lagoon are plausible. [Journal of American Science 2010;6(3):85-92]. (ISSN: 1545-1003)</p> <p>Keywords: Benthic, Macroinvertebrates, Rainfall pattern, Salinity, Defaunisation</p>	Full Text
13	<p>Microbiological Impacts of Produce Water Discharges in Nearshore Shallow Marine Waters Near Chevron's Escravos Tank Farm, Nigeria</p> <p>Dr. Chuma C. Okoro Department of Biological Sciences and Biotechnology, Caleb University, Lagos Nigeria Tel: 08033072754, 01-7430285. e-mail: chuma2k2001@yahoo.com P. O. Box 146, University of Lagos Post Office, Lagos, Nigeria</p> <p>Abstract: A microbiological survey was undertaken in produced water and its receiving environment with the aim of verifying the likely impacts of produced water microbial flora especially the hydrocarbon utilizing types and the sulphate reducing bacteria on the immediate receiving marine near shore shallow environment. The sampling was carried out in two seasons, late wet season and late dry season. The results obtained indicate that produced water from Escravos tank farm had relatively moderate concentrations of hydrocarbon utilizing microorganisms and sulphate reducing bacteria and the concentration of these organisms are much higher at the point of discharge of the produced water including the surface water and the bottom sediment. Bottom sediment samples up to a distance of 500m upstream also showed relatively moderate concentration of hydrocarbon utilizing microorganisms and sulphate reducing bacteria. A distance of 500m downstream showed relatively low concentrations of hydrocarbon utilizing bacteria without any presence of sulphate reducing bacteria. The two seasons under investigation showed similar results. The results obtained indicate that the impacts of produced water microbial flora on the receiving environment is limited to the vicinity of the discharge point of about 100 meters in diameter and also to some extent up to a distance of 500m upstream along the direction of flow of produced water discharges. This assertion is supported by the experimental data which showed considerable accumulation of produced water hydrocarbons in the sediment at the discharge point up to 500m upstream with relatively high concentration of hydrocarbon degrading microorganisms and sulphate reducing bacteria. It is expected that while the hydrocarbon degrading microorganisms plays a beneficial role of degrading and detoxifying abundant produced water hydrocarbons in the sediment and the surface water, Sulfate reducing bacteria might at the same time be playing a detrimental role of oxidizing certain organic compounds or hydrogen and reducing sulphate and other reduced sulphur compounds in</p>	Full Text

	<p>the sediment to hydrogen sulphide, the hydrogen sulphide when released can be very toxic to bacteria, aquatic animals and man. [Journal of American Science 2010;6(3):93-101]. (ISSN: 1545-1003).</p> <p>Keywords: Produced water, Sulphate reducing bacteria, Hydrocarbon utilizing bacteria</p>	
14	<p>Traditional wireless Communication and its Model in South Asian Region DharmaKeerthi Sri Ranjan, G.D. Faculty of Mass Media, SriPalee Campus, University of Colombo, Sri Lanka. Department of Sociology, Wuhan University, Wuhan, 430072 P.R. China. Sri_2007@hotmail.com</p> <p>Abstract: Traditional wireless Communication is encompassed by the new communication technologies and the heterogeneous vision of a culturally diverse society. This speedy diffusion of latest applications of the new media is exploited for the information and entertainments in the rural locales. As a consequence of this the traditional media net work is being affected at an alarming rate in the periphery. The folk cultural tradition has become to tune pop songs and pop songs associated cultural traditions. These associations mainly occur at the economically and socially marginalized people. These modern information identities, based on the science and technology, are experiencing the western cultural denominations. But the traditional wireless communicational patterns were interconnected collectively with the nature oriented human factors. The newly contextualized model (DSR Model*) on the traditional media based on the Ethnographic approach, discusses the traditional wireless communication system, established in the indigenous territory. [Journal of American Science 2010:6(3) 102-108]. (ISSN: 1545-1003).</p> <p>Key Words: Traditional media, Traditional social context, New Model for the traditional media</p>	Full Text
15	<p>Lesser Chamber Effect inside Open Top Chambers Provides Near-Natural Microenvironment for CO₂ Enrichment Studies in an Alpine Region of India Ashish Kumar Chaturvedi,* Pratti Prasad and Mohan Chandra Nautiyal High Altitude Plant Physiology Research Centre, Post Box No. -14, H N B Garhwal University Srinagar Garhwal – 246174, Uttarakhand, India. *ashi_spc@rediffmail.com, ashispc@gmail.com</p> <p>Abstract: Open top chambers (OTCs) were designed and established for the first time in an Indian alpine territory for revealing the effects of realistic elevated carbon dioxide (CO₂) concentrations on growth forms of alpine region of India in natural conditions. Comparison of the microclimatic parameters which affect the growth and physiology of alpine plants was done in three conditions viz. open field, polyhouse and OTCs to trace out the chamber effect inside OTCs. Present communication reveals the efficiency of Open Top Chambers for climate simulation techniques in Indian alpine region. Simple designing and construction of open top chambers make them the most probable method to be used for long-term elevated CO₂ revelation of alpine ecosystems. The operation of the system was satisfactory during the first growing season and repeatability of the gas treatments can be regarded well in this low cost exposure system. [Journal of American Science 2010;6(3):109-117]. (ISSN: 1545-1003)</p> <p>Keywords: Climate change; Open Top Chambers; CO₂ enrichment; Alpine region; Garhwal Himalaya</p>	Full Text
16	<p>Phyllosphere Fungi of <i>Alnus nepalensis</i>, <i>Castanopsis hystris</i> and <i>Schima walichii</i> in a Subtropical Forest of North East India A. Kayini and R.R. Pandey Department of Life Sciences, Manipur University, Canchipur, Imphal – 795 003, India kayinkrich@gmail.com; pandey.rr@rediffmail.com</p> <p>Abstract: A total of 38 epiphytic and endophytic phyllosphere fungi were isolated from living leaves of <i>Alnus nepalensis</i>, <i>Castanopsis hystris</i> and <i>Schima walichii</i> by using a combination of cultural methods i.e. dilution plating, washed disk and surface sterilization, respectively at bimonthly intervals during July, 2008 to May, 2009. <i>Alternaria alternata</i>, <i>Cladosporium cladosporioides</i>, <i>Fusarium oxysporum</i> and <i>Pestalotiopsis</i> sp. were the dominant colonizers of three forest tree leaves. The type of fungal species isolated from different test leaves were found to be influenced by the method of isolation. Some species could be recovered by a particular culture method while others were recovered by two or all three isolation methods. <i>Alternaria raphani</i>, <i>Epicoccum purpurascens</i> and <i>Gliocladium roseum</i> from <i>Alnus nepalensis</i> leaves and <i>Scopulariopsis</i> sp. and <i>Trichoderma harzianum</i> from <i>Castanopsis hystris</i> were the species recovered specifically by washed disk method. Whereas, <i>Gliocladium fimbriatum</i> was isolated only from <i>Schima walichii</i> leaves as endophytic fungi. [Journal of American Science 2010:6(3):118-124]. (ISSN: 1545-1003).</p> <p>Key words: Phyllosphere fungi, epiphytes, endophytes, <i>Alnus nepalensis</i>, <i>Castanopsis hystris</i>, <i>Schima walichii</i></p>	Full Text

17	<p>LAND MANAGEMENT AND ITS PROBLEMS IN NOTSE, SMALL TOWN IN SOUTHERN TOGO Komlan Dela Gake, Jianguo Chen China University of Geosciences, 388 LuMo Road, Wuhan, Hubei 430074, China glanok79@hotmail.com</p> <p>ABSTRACT: Nowadays the analysis of any urban city uses modern techniques such as remote sensing and geographic information system. But in the cities of developing countries this is not often the case, due to lack of means and, on the other hand, lack of political will. The case of Notse, a small town in southern Togo is no exception. Therefore the analysis of the city in this paper will be based on the results of research carried out on the field. However the goal is to reach the constitution of databases that can be used as starting point for the use of the new technologies. Our investigation allowed us to update the problems undermining the development of the town, namely: the lack of reliable data on urban planning, the lack of services and basic facilities to name a few. Further on the assessment will allow us to draw the necessary conclusions and a useful approach to improve the development of the city with new technologies. Consequently, a spatial development plan is proposed to serve as a starting point to a more technological and professional approach of what a 21st century city planning should be. This plan is essentially based on the results of spatial and demographic data analysis. [Journal of American Science 2010;6(3):125-135]. (ISSN: 1545-1003).</p> <p>Keywords: Field work, Geographic Information System, Database constitution, Spatial Development Plan.</p>	Full Text
18	<p>Using Topsis Method with Goal Programming for Best selection of Strategic Plans in BSC Model Javad Dodangeh¹, Rosnah Bt Mohd Yusuff¹, Javad Jassbi² ¹. Department of Mechanical and Manufacturing Engineering, University Putra Malaysia, Malaysia ². Department of Industrial Management, Islamic Azad University, Science & Research Branch, Tehran, Iran jdodangeh@yahoo.com</p> <p>Abstract: Strategic planning is expressly significant for organization's success and competitive advantage making in an increasingly competitive business environment. Implementation of applicable strategies plays an important role for organizations' success. Balanced scorecard is a suitable tool for designing operative strategies. However, one of the balanced scorecard difficulties is the selection in strategic plans' performance. In this issue paper, was demonstrated a model for selection and ranking of strategic plans in Balanced Scorecard using Topsis method Goal Programming model. So first using the view and consensus of organization's managers and experts' opinions, measures of four perspectives and objectives are settled in BSC. And then using experts' opinions and taking the relative importance of decision makers' opinions into consideration, by using Goal Programming model and Topsis method, the implementations of strategic plans are selected in BSC model. The results are revealed that the introduced methods are more reliable and acceptable and the experts were verified the model for selecting of strategic plans in BSC in operation. The initiated methods were used in a study and derived results from it were analyzed from various points of view. In this article Initiative is called strategic plans. [Journal of American Science 2010;6(3):136-142]. (ISSN: 1545-1003).</p> <p>Keywords: Balanced scorecard model, MADM, MODM, Goal Programming, Topsis</p>	Full Text
19	<p>Biodegradation of Produced Water Hydrocarbons by <i>Aspergillus Fumigatus</i> Chuma C. Okoro¹, Olukayode O Amund² ¹ Department of Biological Sciences and Biotechnology, Caleb University, Lagos ² Department of Botany and Microbiology, University of Lagos, Nigeria Tel: 08033072754, 01-7430285. e-mail: chuma2k2001@yahoo.com P. O. Box 146, University of Lagos Post Office, Lagos, Nigeria</p> <p>Abstract: Biodegradation studies of hydrocarbons in untreated produce water from an oil production facility in Nigeria were undertaken over a period of time using pure cultures of <i>Aspergillus fumigatus</i> isolated from the zone of produce water discharge into the receiving sea water. The rate of reduction in some petroleum hydrocarbon fractions such as n-Alkanes, Aromatics, Nitrogen Sulfur and Oxygen (NSO) containing compounds and Polycyclic aromatic hydrocarbons (PAHs) were monitored by means of Gas chromatography and Mass spectrometry using mechanically treated produced water as a reference. Gas chromatographic analysis showed that untreated produced water used in the study had an oil and grease content of 1407mg/l, this includes n-alkanes(608mg/l), Aromatics (13.88mg/l), NSO compounds (12.68mg/l) PAHs(0.833mg/l) and some unidentified greasy components. Upon mechanical treatment, the oil and grease component of produced water was reduced to 44mg/l comprising of n-alkanes (38.40mg/), Aromatics (2.65mg/), NSO compounds(1.78mg/), PAHs (0.0655mg/) and some unidentified greasy component. A pure culture of <i>Aspergillus fumigatus</i> after 120 days of exposure to untreated produce water was able to reduce the hydrocarbons to the following components. n-Alkanes (78.5mg/l), Aromatics(1.58mg/l),</p>	Full Text

	<p>NSO compounds (1.22mg/l) and PAHs (0.0168 mg/l). This result indicate that produce water from Chevron's Escravos tank farm is readily biodegradable and the <i>Aspergillus fumigatus</i> culture used in the study was very effective in degrading the PAHs and NSO components of the hydrocarbon when compared with the conventional mechanical treatment process even though the biodegradation process was very slow. [Journal of American Science 2010;6(3):143-149]. (ISSN: 1545-1003).</p> <p>Keywords: Pure culture, Produce water, Biodegradation, Oil and Grease.</p>	
20	<p>Comparison of the Type of the Web Base Advertising on E-Commerce Improvement Maryam Mazandarani, m93.maryam@yahoo.com</p> <p>Abstract: There are several investigation that have been shown increase the Ecommerce improvements by web base advertising. Recently and specifically after developing on the personal, news, e-shops and web2 websites have been increase interesting to do E-commerce and improve it by the web based advertising. This investigation have been focused on comparison of the two type of the web base advertise on the visitors direction to the targets websites. Result of this investigation have been shown that the picture banner base advertise inside the news content is more effective to direction of the visitors to the targets website. Researcher in this research has been suggested to make the text base advertising in side the content to improve the E-commerce. [Journal of American Science 2010;6(3):150-156]. (ISSN: 1545-1003).</p> <p>Keywords: Bossiness, E-commerce, Website, Web2, PHP Programming</p>	Full Text
21	<p>Contribution of Rice Husk Ash to the Properties of Mortar and Concrete: A Review Alireza Naji Givi ¹, Suraya Abdul Rashid ², Farah Nora A. Aziz ³, Mohamad Amran Mohd Salleh ² ¹. Institute of Advanced Technology, Universiti Putra Malaysia, Malaysia ². Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia ³. Department of Civil Engineering, Faculty of Engineering, Universiti Putra Malaysia, Malaysia ². Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia najigivi@yahoo.com</p> <p>Abstract: In the last decade, the use of supplementary cementing materials has become an integral part of high strength and high performance concrete mix design. These can be natural materials, by-products or industrial wastes, or the ones requiring less energy and time to produce. Some of the commonly used supplementary cementing materials are fly ash, Silica Fume (SF), Ground Granulated Blast Furnace Slag (GGBFS) and Rice Husk Ash (RHA) etc. RHA is a by-product material obtained from the combustion of rice husk which consists of non-crystalline silicon dioxide with high specific surface area and high pozzolanic reactivity. It is used as pozzolanic material in mortar and concrete, and has demonstrated significant influence in improving the mechanical and durability properties of mortar and concrete. This paper presents an overview of the work carried out on the use of RHA as partial replacement of cement in mortar and concrete. Reported properties in this study are the mechanical, durability and fresh properties of mortar/concrete. [Journal of American Science 2010;6(3):157-165]. (ISSN: 1545-1003).</p> <p>Key words: Rice husk ash; concrete; mechanical properties of concrete; durability of concrete</p>	Full Text
22	<p>Quality Models in Software Engineering Literature: An Analytical and Comparative Study Rafa E. Al-Qutaish, PhD Al Ain University of Science and Technology – Abu Dhabi Campus, PO Box: 112612, Abu Dhabi, UAE. rafa@ieec.org</p> <p>Abstract: The quality of the software is critical and essential in different types of organizations. In some types of software, poor quality of the software product in sensitive systems (such as: real-time systems, control systems, etc.) may lead to loss of human life, permanent injury, mission failure, or financial loss. In software engineering literature, there are a number of quality models in which they contain a number of quality characteristics (or factors, as called in some models). These quality characteristics could be used to reflect the quality of the software product from the view of that characteristic. Selecting which one of the quality models to use is a real challenge. In this paper, we will discuss the contents of the following quality models: McCall's quality mode, Boehm's quality model, Dromey's quality model, FURPS quality model and ISO 9126 quality model. In addition, we will focus on a comparison between these quality models, and find the key differences between them. [Journal of American Science 2010; 6(3):166-175]. (ISSN: 1545-1003).</p> <p>Keywords: Software Quality; Quality Models; Quality Engineering; ISO 9126; McCall's Quality Model; Boehm's Quality Model; Dromey's Quality Model; FURPS Quality Model</p>	Full Text
23	Study on the Metal Absorption by two Mosses in Delhi Region (India)	Full Text

	<p>Santosh Kumar Vats, Anjana Singh, Monika Koul and Prem Lal Uniyal Department of Botany, University of Delhi, Delhi- 110007, India Telephone Number- +91-11-27190671, +91-9968279822 (M). uniyalpl@rediffmail.com</p> <p>Abstract: Bryophytes act as precise and sensitive bioindicators as well as bioaccumulators of metal deposition in the environment. Heavy metals are ubiquitous pollutants which are persistent and get transferred from one tropic level to another. Two moss species <i>Physcomitrium cyathicarpum</i> and <i>Barbula constricta</i> growing across different regions of Delhi have been used as indicators of metal. The estimation of important heavy metals like Cr, Co, Cd, Cu, Fe, Hg, Ni and Pb have been carried out in the tissues of both the moss species using atomic absorption spectroscopy, the level being highest for Fe, Ni, Cu and Cr followed by Co, Cd, Pb and Hg. The concentrations of Fe, Co, Cu and Cr was found high in both the species growing in North Delhi region followed by South and West Delhi suggesting the regions with industrial belt, vehicular traffic and heavy industries which release chemical effluents. The low level of metal pollutants was observed in moss specimens collected from Central and East Delhi. Overall, Fe, Cu and Pb are responsible for causing major pollution in the studied sites and the concentration of metals in plant as well as in the substratum was found to be higher in North, South and West Delhi region. Statistical analyses also revealed that correlation exist between the metal content in mosses and degree of pollution in studied sites. [Journal of American Science 2010;6(3):176-181]. (ISSN: 1545-1003).</p> <p>Key words: <i>Accumulation capacity, Heavy metal uptake, Metal ions, Moss, Pollution Monitoring</i></p>	
24	<p>The Cost of Climate Change in Tanzania: Impacts and Adaptations Ceven Shemsanga¹ Anne Nyatichi Omambia¹, Yansheng Gu¹ ¹ School of Environmental Studies, China University of Geosciences, Wuhan 388 Lumo Road, Wuhan, 430074, Hubei Province, P.R. China. 7ceven@gmail.com</p> <p>Abstract: In recent years, Tanzania has witnessed a number of climate related disasters namely, flooding, droughts, widespread crop failures, livestock deaths and intensification of climate sensitive diseases among others. Regular climate discussions in the country have often underestimate crucial problems related to climate change like chronic energy crisis and influx of people to urban areas arguably because of failing agriculture in farming areas. This paper has highlighted the fact that the poor, usually with limited resources and who contribute the least to the causes of climate change are the most affected in many ways. In addition, it gives a detailed account of the issues of climate change in Tanzania and explains the effects of climate variability using examples. The effects of climate change in the country are widespread and significantly interfere with agriculture, while at the same time, reducing the ability of the society to deliver services. Indigenous knowledge such as survival skills and coping mechanisms adopted by different societies in Tanzania, have been discussed in the paper. Such coping mechanisms however are overwhelmed by the impacts of climate change on the people. Different institutions including the government have taken some positive steps towards combating climate change; however the efforts done so far are insufficient. In addition, addressing climate change in Tanzania is hindered with inadequate resources, corruption and poor coordination and implementation of combating measures. Generally current climate variability in the nation is an issue of concern for all future plans and must be addressed. [Journal of American Science 2010; 6(3):182-196]. (ISSN: 1545-1003).</p> <p>Keywords: Climate change, Tanzania, Adaptations, Responses.</p>	Full Text
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Composting of Some Dangerous and Toxic Weeds Using *Eisenia foetida*

Avnish Chauhan* and Joshi PC

Department of Zoology and Environment Science, Gorkula Kangri University, Haridwar, Uttarakhand 249404, India.

*Corresponding author: avnishchauhan_in@yahoo.com

Abstract: The experiments were conducted to obtain compost from some toxic weeds by using vermicomposting and conventional methods. The weeds used in the experiment were congress grass (*Parthenium hysterophorus* Linn.), water hyacinth (*Eichhornia crassipes*) and bhang (*Cannabis sativa* Linn.). Total six sets of experiments were setup by using above materials. Three of them were test experiments and rests were control experiments. In all the test experiment 50 worms were introduced. The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment having *Eisenia foetida*. The otherwise toxic weeds used in this experiment are thus converted into compost with higher concentration of nutrients. [Journal of American Science 2010;6(3):1-6]. (ISSN: 1545-1003).

Keywords: *Parthenium hysterophorus* L., *Eichhornia crassipes*, *Cannabis sativa* L., *Eisenia foetida*, cow dung.

1. Introduction

The practice of Vermiculture is at least a century old but it is now being received worldwide with diverse ecological objectives such as waste management, soil detoxification, regeneration and sustainable agriculture. The growth of industries and ever increasing human population has led to an increased accumulation of waste materials (Joshi and Chauhan, 2006). The use of earthworms as a waste treatment technique is gaining popularity. This method is commonly known as vermicomposting. Vermicompost, a very potential organic input for sustainable agriculture, contains beneficial microorganisms, both major (N, P, K) and micronutrients, enzymes and hormones (Probadhini, 1994). Adding of vermicompost to soil improves the chemical and biological properties of soil and hence improves its fertility (Purakeyastha and Bhatnagar, 1997). Earthworms constitute more than 80% of soil invertebrate population in many ecosystems, especially in the tropical ecosystems (Sinha et al., 2002). In India so far, 509 species, referable to 67 genera and 10 families have been reported (Kale, 1991). Earthworms act in the soil as aerator, grinders, crushers, chemical degraders and biological stimulators. Plants like *Parthenium hysterophorus* Linn. Water hyacinth (*Eichhornia crassipes*) and Bhang (*Cannabis sativa* Linn.) grow as weeds in and around different fields, road sides and forest.

Parthenium hysterophorus L. known as congress grass is a dangerous imported weeds and is poisonous, pernicious, allergic and aggressive and poses a serious threat to human being and livestock. At present it is one of the most troublesome and obnoxious weed of wasteland, forest, pasture, agricultural land and cause nuisance to mankind

(Bakthavathsalam and Geetha, 2004). Water hyacinth tops the list of most dreaded aquatic weeds and now spread to all around the globe. It has successfully resisted all attempts of eradicating it by chemical, biological, mechanical, or hybrid means (Abbasi and Ramasamy, 1999). The origin place of water hyacinth is South America, Venezuela in particular. It has now spread to over 50 countries around the earth. *Cannabis sativa* L. is commonly known as bhang in India. It occurs wild in central Asia and throughout India. It is native of central and western Asia, now naturalized in the sub-Himalayan tract and abundant in wasteland from Punjab State Eastward to Bengal and Bihar state extending southwards. Commonly occurs in waste places along roadside and becomes gregarious along irrigation channels. The fresh plant is not poisonous but becomes poisonous when damaged on drying, heating, smoking and aging of it or its extract and plants parts (Dhiman, 1997). In the present study earthworm species, *Eisenia foetida* is used to decompose these plants.

2. Materials and Methods

2.1 Composting materials

The *Parthenium hysterophorus* and *Cannabis sativa* L. were collected from playing ground of B.H.E.L. Haridwar, Uttarakhand, India and water hyacinth was collected from nearby ponds.

2.2 Cow dung

One week old cow dung was used in experiments because fresh cow dung can be dangerous for earthworms due to decomposition process, when generation of heat take place that can kill to earthworms.

2.3 *Eisenia foetida*

Eisenia foetida is one of the best known species for its feeding behavior and were randomly picked from a stock culture maintained in a kitchen garden near residential area.

2.4 Design of Experiment

The present study was carried out during Jun 2005 to Nov 2005. After collecting weeds from different places it was cut into very small pieces and then these small pieces were placed separately in the earthen pits with size 2m×1m×2m. The pits were covered with soil up to 10 cm height. After a period of 20 days all these partially decomposed weeds were collected in separate polythene bags.

The partially decomposed weed material free from soil was collected separately and sun dried for 2 days. The above weed plants material were manually powdered using stone mortar and stored in separate polythene bags. These powdered material shredded to 2-mm sizes before use (Kaushik and Garg, 2004). Reduced particle size of the culture medium tend to be favorable for raising growing worms and also provides more surface area per volume of culture medium, which facilitates microbial activities as well as moisture availability (Bakthavathsalam and Geetha, 2004). By using above weed plants and cow dung, six sets of experiments were set up in plastic containers (50 cm in diameter, depth 16 cm). Three of them were test experiments and rests three were control experiments. In all test experiment 50 young earthworms were introduced. The moisture content was 40-70% throughout the study period and maintained by sprinkling of adequate quantities of water. In first set (1a) of experiment the bedding was prepared by mixing of partially decomposed cow dung with partially decomposed *Parthenium hysterophorus* used in equal amounts (w/w). The control set (1b) of this bedding was without *Eisenia foetida*. In the second set (2a) the bedding was prepared by taking equal amounts of partially decomposed cow dung and partially decomposed water hyacinth. The control set (2b) of this experiment did not have worms. In the third set (3a) of experiment the bedding was same as that of the second set (3b) of experiment but the partially decomposed water hyacinth was replaced by partially decomposed Bhang. The control set of this experiment did not have worms.

2.5 Analytical Procedure

The followings chemical parameters of each bedding materials were analyzed: Organic carbon was determined by the Walkley-Black method (1934). Total Kjeldhal nitrogen (TKN) was determined according to Bremner & Mulvaney

(1982) procedure. Available phosphorus was analyzed by employing Olsen's (1954) method and Potassium was determined by ammonium acetate extractable method (Simard, 1993). All the above nutrients and C/N, C/P ratios were analyzed after every 15 days. In each test experiment offspring's and cocoons were observed after completion of experiment by direct count method.

3. Results & Discussion

The data on Organic carbon, Nitrogen, Phosphorus, Potassium, C/N ratio and C/P ratio of all three test and control experiments are presented in Fig. 1,2,3,4,5 and 6, respectively. However the data on number of earthworms and earthworm's cocoons in the test experiment are given in Fig. 7 and 8, respectively.

The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment set up using earthworms. There was a 20.7%, 26.2% and 23.3% decrease in organic carbon in the first, second and third sets of test experiment respectively. In control, it was 25.6%, 21.5% and 26.4% respectively. The reduction in organic carbon during the first 3-4 months of vermicomposting could be due to the respiratory activity of earthworms and microorganisms (Curry et al., 1995; Edwards and Bohlen, 1996). The increase in organic carbon after 3-4 months was probably due to the addition of earthworms cast, which are rich in organic carbon. There was a 133%, 133% and 149% increase in nitrogen in the first, second and third sets of test experiment respectively. In control, it was 11.8%, 13.3 % and 42% respectively. Bansal & Kapoor (2000) vermicomposting with *Eisenia foetida* of crop residues and cattle dung resulted in significant reduction in C: N ratio and increase in N. There was a 109.2%, 60% and 53% increase in phosphorus in the first, second and third set of test experiment respectively. In control, it was 28.1%, 22.5% and 14.9% respectively. *Eisenia foetida* helps to increase the microbial activity and release the nitrogen, potassium and calcium as suggested by (Edwards, 1995). Anonymous (1992) found higher amount of phosphorus in test experiment than control experiment using earthworm species. There was a 131.2%, 110% and 137.9% increase in potassium of first, second and third sets of test experiment respectively. Decrease in C/N ratio in the first, second and third set of test experiment was 66.3%, 68.3% and 69.2% respectively. Talashilkar et al., (1999) studied changes in chemical properties during composting of organic residues as influenced by earthworm activity. According to them there was a decrease in C: N ratio. The organic carbon is lost as

CO₂ and N contents of compost is decomposed on the initial N present in the waste and extent of decomposition (Crawford, 1983; Gaur & Singh, 1995). Similarly, C/P ratio of test sets decreased by 62.2%, 53.9% and 50.1% in first, second and third sets respectively, while in control the decrease was 42.2%, 36% and 35.9% respectively. Some workers have reported higher content of NPK and micronutrients in vermicompost (Jambhelkar, 1992;

Delgado et al., 1995). The studies clearly indicate that use of worms is highly useful in composting of otherwise toxic plant material. The number of earthworms in each test experiment has increased with time and at 150 days these were 84, 88 and 104 respectively while the numbers of cocoon observed after 150 days was 266, 280 and 289 in test sets 1a, 2a and 3a, respectively.

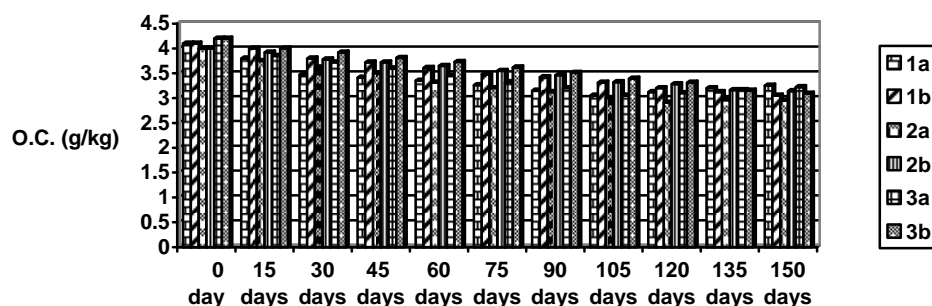


Figure 1. Effects of *Eisenia foetida* inoculation on organic carbon (g/kg) during composting

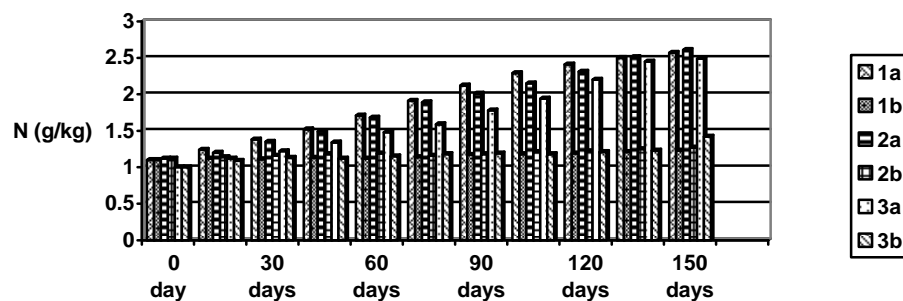


Figure 2. Effects of *Eisenia foetida* inoculation on nitrogen values (g/kg) during composting

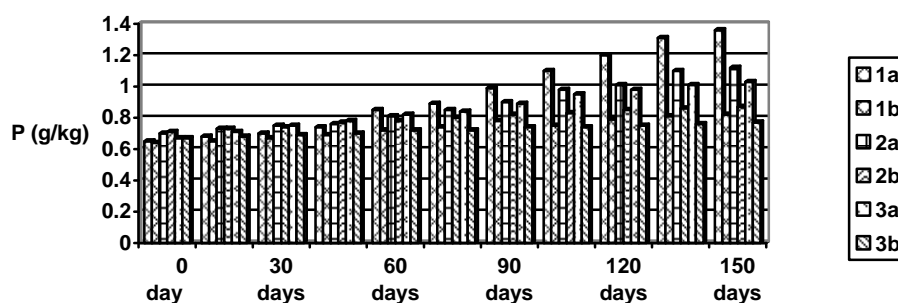


Figure 3. Effects of *Eisenia foetida* inoculation on phosphorus values (g/kg) during composting

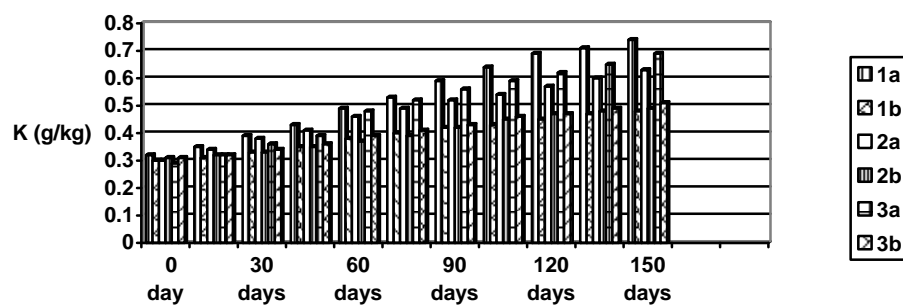


Figure 4. Effects of *Eisenia foetida* inoculation on potassium values (g/kg) during composting

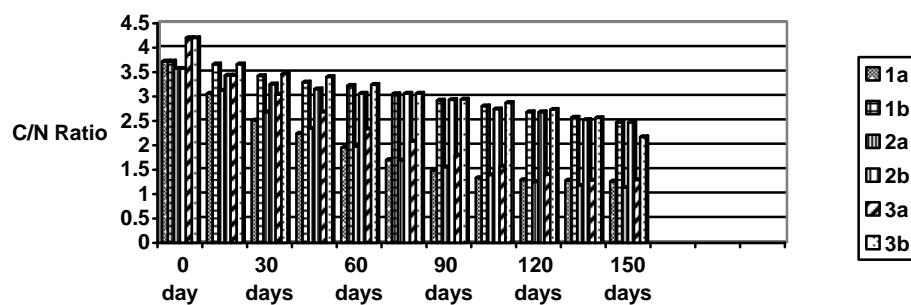


Figure 5. Effects of *Eisenia foetida* inoculation on C/N ratio (g/kg) during composting

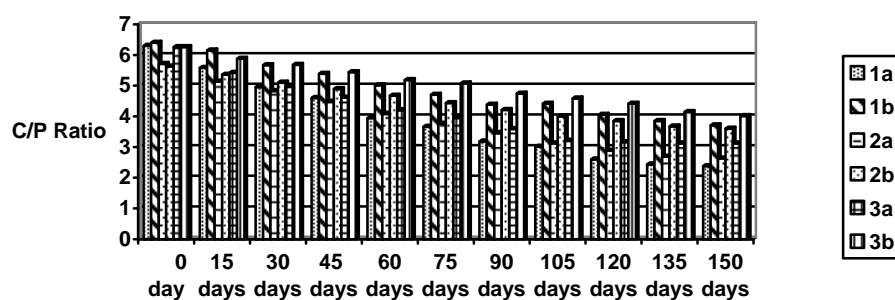


Figure 6. Effects of *Eisenia foetida* inoculation on C/P ratio (g/kg) during composting

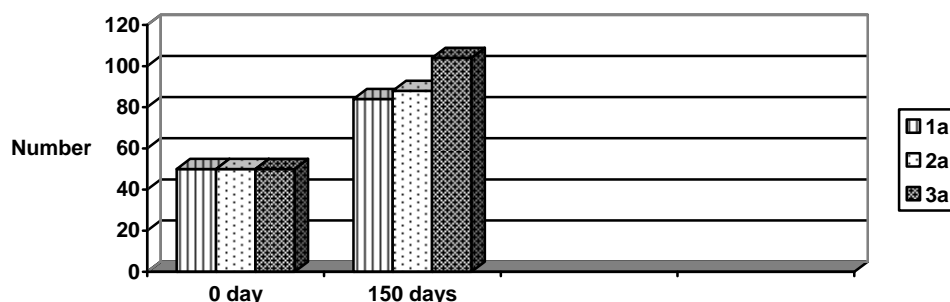


Figure 7. Number of earthworms in the experiments (2), (3) and (4).

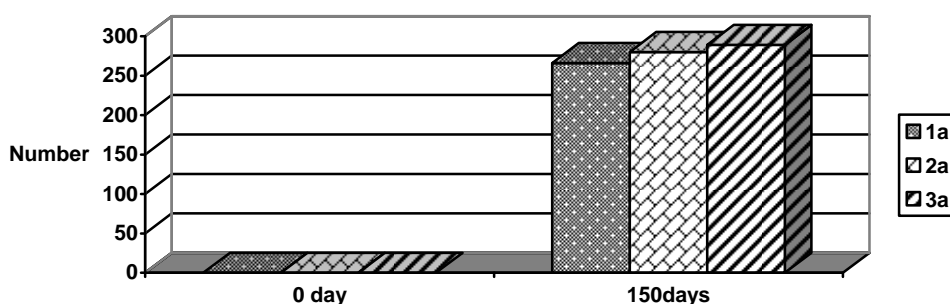


Figure 8. Number of Earthworms Cocoons in The Experiments (2), (3) and (4).

Acknowledgements

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Soil and Water Conservation in Kenya-Operations, Achievements and Challenges of the National Agriculture and Livestock Extension Programme (NALEP)

Titus Wambua Mutisya^{1*}, Luo Zejiao¹ and Nenkari Juma²

¹School of Environmental Studies, China University of Geosciences (Wuhan)
Lumo Road 388, Wuhan City, 430074 Hubei Province, P.R. China.

² Department of Livestock Production, Ministry of Livestock Development. Republic of Kenya.

tmutisya2003@yahoo.com; mutisya2003@gmail.com

Abstract: This paper gives an historical analysis of the soil and water conservation activities in Kenya, introduces the national soil and water conservation project and then gives an insight in to the National Agriculture and Livestock Extension Programme (NALEP), which was designed after several previous projects failed to address the sustainability of such development projects leading to progressive decline in soil fertility and agricultural output. The achievements and challenges faced while implementing the programme activities are also discussed. The general project information was gathered from the various policy documents, programme documents and workshop reports while the achievements and challenges were drawn as a result of the involvement of two of the authors in the programme activities in 45 focal areas that have been implementing it since inception. The strong stakeholder involvement in all the stages of project development is the basis of the anticipated sustainability. The synergy between the key stakeholders is necessary for a sustainable development programme. Activities which involved the farmers, Government staff, and other development partners were found to be more successful than those that involved only one institution. NALEP framework is worth being replicated in any development project in the country. Scaling-up and replication of the success cases is recommended to improve the general household food security, economic empowerment and environmental conservation. This is the first paper analyzing the soil and water conservation, NALEP and its sustainability measures. The stakeholders could use the information to improve the programme. [Journal of American Science 2010;6(3):7-15]. (ISSN: 1545-1003).

Key words: Soil and water conservation, NALEP, sustainability, stakeholders

1.0 Introduction

1.1 Kenya

Kenya is situated on the eastern part of Africa between latitude 4° 40'N, and 4° 30'S and between longitudes 34°E and 41°E. It is boarded by Sudan, Ethiopia and Somali to the northwest, north and east respectively. To the west is Uganda, south Tanzania and southeast is the Indian Ocean

The country covers an area of approximately 582,646 sq. km. comprising 97.8% land and 2.2% water surface. It is divided into 8 provinces and about 244 districts (Ministry of planning and national Development ,2000, 2009).

Total Human Population is estimated at 30 Million (Population census ,1999).The country has a diverse topography, ranging from sea level to the high altitude peaks of Mount (Mt.) Kenya at 5,199 meters above sea level, and other highlands. Climate is influenced by altitude, and annual rainfall amounts

vary much across the country, from less than 200 mm in the arid north to over 2,000 mm on the upper slopes of Mt. Kenya (Sombroek et al,1980, Mati ,2005).

Agriculture is the major economic sector in Kenya, and is the main source of income for some 80 percent of the population, of which 19 percent is in wage employment. It accounts for 52 percent of the national GDP, of which 25 percent is directly and 27 percent is indirectly through linkages with manufacturing, distribution and other service-related sectors. Agriculture accounts for some 40 percent of the total export earnings, 45 percent of the government revenue and 75 percent of the industrial raw materials. There are about 3 million smallholder farm-families in Kenya, of which 80 percent have less than 2 hectares of cropland. Smallholders are responsible for 70 percent of the maize production (staple food for most of the Kenyans), 65 percent of the coffee, over 50 percent of the tea (major export

cash crops), over 70 percent of beef and over 80 percent of milk and other crops (Republic of Kenya

2000; MoA&RD, 2002).

1.2 Soil and Water Conservation in Kenya

1.2.1 History of Kenya's soil and water conservation

Most of the communities in Kenya were herders and gatherers until 1895 when the country was colonized by British who settled in the fertile lands, termed as white highlands. The natives were evicted from their farms to give way to the white settlers who utilized thousands of hectares for large scale agricultural production. This saw the introduction of new crops such as maize, beans, coffee, tea, cotton, tobacco and pyrethrum. Exotic dairy cattle and pigs were also introduced.

Most of the agricultural and soil conservation techniques developed during this period were effective, but the fact that they were based on enforced communal work meant that soil conservation was bitterly resented by the people, yet it was an important activity for sustainable agriculture in the country (Maher, 1937, 1938).

Historically, this may be the first exposure of the native Kenyans to soil conservation activities. It can therefore be stated that the first modern soil and water conservation techniques were imposed on Kenyans through coercion. The natives were not enthusiastic because they were evicted from their land and then enslaved to work for the masters in the same farms. Soil conservation structures were particularly unpopular because they were tiresome to excavate (Thomas et al ,1997, Nandwa et al ,2000). Large tracks of forest land were cleared to give room for large scale crop production and beef cattle ranches.

In the 1950s when the British authorities started to prepare to leave the country due to eminent independence, they sold most of the farms in the white highlands to the new Government which later sold them to native farmers through a native's settlement scheme. The government availed loans to the natives to purchase the farms and start intensive commercial agriculture. Decisions were made at the head office of the Ministry of Agriculture and communicated to the farmers by the extension officers, a typical "top down decision making process". Many farmers training activities were organized and farm inputs were readily available at subsidized costs. Programmes were implemented which involved scheduled regular individual farm visits by the extension staff. The approach was termed as "train and visit" (commonly known as T&V). The approach was therefore "supply driven".

The farmers were expected to implement decisions made for them by the ministry head-quarters

After independence in 1963, the persuasive agricultural services continued, farmers were encouraged to grow food and cash crops. Production of most crops such coffee; tea pyrethrum tobacco was quite high. Food crops such as maize, beans, cowpeas, pigeon peas ground nuts, millet cassava, and fruits were also widely grown. Having associated the soil conservation work with colonialism, farmers either cut down their conservation activities or abandoned them altogether. Consequently the soil erosion problem persisted up to the present moment affecting both the highlands as well as the lowland marginal areas (Barber *et al.*, 1979; National Research Council, 1993).

The human population grew and more natural forests were cleared for agricultural activities. There was no emphasis on environmental issues especially water conservation, soil erosion control or even tree planting in this period. Intensive cultivation, overgrazing and soil erosion led to decrease in soil fertility, crop yields and thus lower household incomes. The agricultural productivity could not be sustained because of lower soil fertility and general environmental deterioration.

Several projects aimed at improving crop and livestock productivity were started and implemented. One of them was the national Soil and Water conservation project

1.2.2 The National Soil and Water Conservation Project (NSWCP)

NSWCP was funded jointly by the Kenya Government and Swedish International Development Agency (SIDA), began in 1974 with an overall objective being "To contribute to food security and to raise the standard of living of the rural population - through suitable conservation practices", it ended in 1994.

The focus of the soil and water conservation project was on improving arable land. It was in the cropped fields where erosion had the most damaging effect on productivity and farmers' income.

The basis of the system was the development of bench terraces over a period of time. The main technique used was "fanya-juu" terracing. This literally means, "do-up" and it referred to the way that soil was thrown up the slope from a ditch to form an earth embankment or bund. Several of these terrace banks were made across a field, on the contour, and over time the land between the bunds

levels off. The field then developed the characteristic "steps" of bench terraces. Soil and rainwater were conserved between the *fanya-juu* bunds (Mati, 2005). The technical objective was two-fold: To keep rainfall where it fell, and to keep soil in the field. The end result was better growing conditions for the crop, both immediately, because of an increase in the amount of moisture available, and in the long term, because the soil was conserved.

Each farm was surveyed to see whether it required a cutoff drain to protect it from surplus rainfall runoff. The cutoff drain was usually designed to hold all the runoff which flowed into it, and therefore it was sometimes known as an "infiltration ditch". The alignment of the terraces was surveyed along the contour using a simple line level. The spacing between the terraces depended on the slope of the land. Apart from terracing, other recommended activities though on a smaller scale, were grass strips along the contour, contour ploughing, simple gully control measures, tree planting, river bank protection and grazing control.

In 1987, the project changed focus to "catchment approach" through farmers groups and agroforestry was incorporated as an activity to enhance the soil and water conservation measures. Farmers were organized into groups in each catchment area. A catchment covered an area extending from the hilltop to the riverbanks and consisted of either one or two villages sharing common hydrological water sheds therefore requiring similar soil conservation measures. Each catchment had a committee and a given number of farmers (approximately 200). Individual farmers undertook soil conservation measures in their farms with regular guidance from the extension officers. Communal activities included wet lands management, river bank protection, communal tree nursery establishment and management, gully erosion control, gabions erection etc.

A "shifting catchment approach" was adopted whereby the project would concentrate activities in one catchment area for one year then shift to another. Catchments were provided with farm tools such as shovels, hoes, pangas (machetes), mattocks, pick axes, crow bars and wheel barrows. They were also provided with free agroforestry tree seeds and seedlings, and polythene tubes. The items were given as demonstration materials and the farmers were expected to appreciate the need for these items and then purchase on their own thereafter. After one year, the catchment committee was expected to continue coordinating soil conservation activities. Regular evaluation of the project was carried out, and the results and recommendations were discussed in

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workshops. The necessary adjustments in the project activities were made after such evaluations.

The project was successful in development of simple extension messages which farmers easily understood, and well conserved farms were a source of pride for the farmers. The staff and farmers were able to effectively use the participatory rural appraisal tools for project activities. They also received specialized training on various aspects of agriculture, soil and water conservation, water harvesting and agroforestry.

However the project was rated as poor because most of the community based activities were not sustainable in absence of free farm tools and inputs. The groups disintegrated and the soil and water conservation, plus the group agroforestry activities collapsed after the end of donor support. The catchment committees also stopped the coordination roles.

While formulating the subsequent development projects, the planners borrowed heavily from the soil and water conservation project and other emerging scenarios as summarized hereunder.

A) The government was no longer the only extension service provider, other service providers included the private service providers such as agrovets, commodity based organizations such as the sugar companies, and even the media (print and electronic). The government employees were also too few to manage to deliver extension services to the increasing number of farmers (Nambiro, 2006).

B) Rural farmers were resource poor and therefore needed to be assisted to get financial resources in a sustainable manner while avoiding free tools and farm inputs. They were mixed farmers, meaning that they had assortment of crops and livestock. It was therefore not feasible for a project to isolate soil and water conservation only and succeed to improve the farmers' welfare.

c) The problems in the rural communities were diverse and there was need for a multi -sectoral approach to solving farmers' problems hence the need to build synergy with other key service providers such as education, social services, health, local government civil society, etc

d) Environmental conservation was multi sectoral, collaboration and networking of many stake holders was therefore a prerequisite for sustainable environmental conservation. It was also not possible to separate the environmental issues, the social equity and the economic development of the community. A compromise among the three Es (Environment, Equity and Economy) was necessary for any rural development programme to succeed and remain sustainable after donor support.

editor@americanscience.org

2.0 National Agriculture and Livestock Extension Programme (NALEP)

2.1. Introduction to NALEP and Focal Area Approach to Extension Services

The programme is jointly funded by the Kenya Government and the Swedish Development Agency (SIDA). It was developed to scale up lessons learnt from the catchment approach to the whole extension system. It was a component of the larger NALEP Implementation Framework designed to implement the National Agricultural Extension Policy (NAEP). It now fits into the National Agricultural Sector Extension Policy (NASEP) under the auspices of the Agricultural Sector Co-ordination Unit (ASCU).

The 5-year NALEP Phase I started in July 2000 and ended in June 2005 after covering 267 divisions in 43 districts in 5 provinces, providing extension services to 100,000 farmers per year through the Focal Area Approach (FAA). NALEP Phase II expanded to cover 70 districts in progression and modified the approach to increase annual coverage to 2,000-6,000 farmers, pastoralists and fisher folk per focal area and bring arid and semi-arid districts on board. NALEP will have a direct outreach of 4 million clients by the end of the 6½ year 2nd Phase which is expected to end in December 2011 (M o A & LD, 2000).

The project uses the shifting focal area approach as explained hereunder.

The basis of NALEP is the focal area. Extension staffs from the Ministry of Agriculture and Livestock development concentrate their support in one focal area each financial year. Each focal area has about 2,000 – 6,000 farmers in each administrative division of the 70 districts in which the project operates. They then shift to a new focal area in the subsequent financial year. The process starts with the focal area selection two years in advance. The extension staff and local stakeholders use some criteria to choose a focal area. The main aim is to select areas where the farmers have not benefited from other development projects before. Available primary and secondary data is used to determine the agricultural production gaps existing in the area which need to be addressed. The stakeholders' inventory is also updated to include new service providers in the selected focal area. The actual extension activities start a few weeks before the beginning of a new financial year (July) with stakeholder mobilization and meeting to elect a stakeholders committee and plan for a Broad based Survey (BBS). The BBS involves the extension staff, rural service providers and the farmers. It encompasses a transect walk across the focal area, then the use of dynamic Participatory Rural Appraisal

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(PRA) techniques to enable the farmer to identify and prioritize their development problems. The BBS culminates with the drawing of a Community Action Plan (CAP) to address the identified problems at community level. For ease of management, the focal area is divided into 4 blocks. A 16 member Focal Area Development Committee (FADC) is democratically elected to coordinate the community activities and link the community with the service providers. Each block is represented in the FADC by 4 farmers. During the BBS, the extension staffs identify viable agricultural enterprises with the potential of improving agricultural yields and therefore boosting household food security and economy. Interested farmers are organized into groups (Common Interest Groups). Throughout the financial year, the extension staffs provide technical and business skills to the farmers and also link the farmers with other service providers. The staffs also arrange cross-site farmers exchange visits. After concentrating in one focal area for the whole financial year, the team then move to the next identified focal area. One extension staff remains to provide technical services while the FADC continues to implement the Community Action Plan

2.2 Project Objectives

The project aims to enhance the contribution of agriculture to social and economic development and poverty alleviation through institutionalization of demand driven and farmer-led extension services, increased effectiveness of pluralistic provision of extension services and increased participation of private sector in providing extension services.

It also aims at empowering the farmers to take charge of Project Cycle Management of extension projects, development of accountability mechanisms and transparency in delivering extension services and also facilitation of commercialization of some of the agricultural extension services.

2.3 NALEP Implementation strategy

In order to achieve the objectives, the project will facilitate the formation of and promote local institutions needed to sustain programme initiatives and activities and support agricultural sector reforms related to the delivery of agricultural research and extension services and strengthen research-extension-farmers' linkages.

NALEP will also facilitate and promote a multi-sectoral approach in the delivery of agriculture and rural development services and collective rural innovations in addressing complex problems. It will also improve monitoring and evaluation of

programme implementation (*Ministry of Agriculture and Livestock Development, 2000*).

2.4 Project pillars

The project is guided by 4 pillars, namely: Participatory/pluralism extension (empowerment of rural communities), demand driven and beneficiary-led extension, professionalism and, teamwork, then transparency and accountability

The above pillars are being used to attain conceptual achievements below:

2.5 NALEP Conceptual achievements

Concept of Stakeholder Forum: NALEP facilitates the formation of and promotes Stakeholder Fora (SHF) at divisional, district and provincial levels. It is a platform for rural communities and all development agencies involved in agriculture and rural development. The stakeholder fora are formed according to NALEP operation procedure (NALEP – OP). A series of meetings are held and a stake holder steering committee is formed with the chairperson being an active farmer in the area of jurisdiction, the secretariat is the agriculture and livestock office while the treasurer is from one of the local Non - Governmental Organization (NGO) or faith based organization. Stakeholder fora have evolved into instruments for community empowerment to take ownership of community projects. Once the stakeholders' fora become institutionalized, they will become instrumental in approving new development projects and regularly assessing the performance of the existing development projects.

Concept of Community mobilization: Through BBS, NALEP helps communities to identify their problems and proposed solutions through flagging out of opportunities that culminate in profitable activities that match with available resources. During the broad based survey, all development partners and Government service providers in the focal area are involved. The product is a CAP that forms the basis for projects formulation and resource mobilization for their implementation. The farming community therefore owns the agricultural development agenda for their focal areas. The community action plan is expected to be a bargaining tool for the focal area development committee to mobilize and access resources and also to assess their rural development progress over time.

Concept of CIGs (Common Interest Groups): NALEP flags out opportunities from which activities that attract the formation of enterprise based groups tailored along commercial lines emerge. These are CIGs that form the bedrock of demand driven and

client-led extension. It is expected that these common interest groups will demand for specific advice from the relevant service providers according to their challenges.

Targeting the poor and the vulnerable: Using Participatory Analysis of Poverty and Livelihood Dynamics tool (PAPOLD), NALEP has been able to identify the very poor, alcoholics, drug addicts, HIV/AIDS affected, widows, child headed households and the old and handicapped and flag out opportunities that derive activities they can afford to implement individually or in groups. This is aimed at reducing the dependency syndrome which is quite common in the rural areas. The groups are also linked to the various institutions that offer help to alleviate their problems

Professionalism and teamwork: NALEP staffs have formed professional groups along respective disciplines at divisional, district and provincial levels. This has increased both horizontal and vertical functional relationships necessary for promoting professionalism and team building. It has provided fora for technical staff and researchers to share acquired ideas and effectively respond to emerging challenges.

Mainstreaming cross-cutting issues: NALEP has formed partnerships with:

KNCHR (Kenya National Commission on Human Rights) on Human Rights Based Approach to development, NEMA (National Environment Management Authority) on environmental management issues, NACADA (National Agency for the Campaign against Drug Abuse) on rehabilitation of abusers of drugs and alcohol. It has also formed partnerships with Legal Resource Foundation (LRF) on paralegal matters that affect farmers and also with HIV/IDS and Gender units in all the ministries.

2.6 The Annual NALEP activity schedule Focal area selection:

Proposal of a focal area is done two years in advance by the Divisional extension team using a set of criteria and later discussed in the divisional Agricultural committee. Stakeholders Mobilization: The divisional and District Agricultural Officers annually update their stakeholders inventory for their respective areas of jurisdiction. All the relevant stakeholders are called for a series of meetings to plan and execute the programme activities. The stakeholders then elect a new committee or confirm the existing one to spearhead the project activities. This is usually done in the month of June.

Community mobilization: This is the most important activity in the programme since it

determines the success or failure of the rest of the activities for the whole year.

The divisional extension team and the local administration hold a series of public meetings in the months of June and July to sensitize the community on the programme activities. At the same time the stakeholders meet to map out the strategy of undertaking the programme activities in the focal area. In the months of August and September, the broad based survey is held. By the end of the survey; a Focal Area Development Committee is democratically elected. A Community Action Plan is drawn. Within the survey period, the staff displays posters showing a menu of available opportunities for farmers to form groups and improve their agricultural production. The farmers register as members of various CIGs

The focal area development committee composed of men women and youth representatives is trained on their role in the programme, group dynamics, resource mobilization, leadership skills etc. The training is done between September and December.

CIG: Each agricultural officer mobilizes a manageable number of common interest groups. The various groups meet and draw their own work plans for the whole year under the guidance of the technical officer. The farmers then implement the agreed activities. It is envisaged that the groups will remain cohesive and form the basis of the programme sustainability and demand- driven, farmer -led extension services.

For the rest of the financial year, all as the individual farmers, CIGs and FADCs implement the agreed activities, the extension staff perform the activities summarized here under.

Individual visits to farmers: There may be some farmers who demand to be visited by the officers to draw farm specific action plans. The local field officer draws a programme to visit the farms that demand such visit. After drawing a sketch of the farm and holding dialogue with the farmer, he/she makes recommendations for various technical officers referred to as “subject matter specialists” to visit and give their recommendations. This is termed as the “Nurse Doctor “model. The divisional office ultimately prescribes an action plan for the farmer to implement. (The technical officer has higher technical training than the field officer).

Follow up: The District and the provincial teams make periodic follow up visits to the focal area to assess the pace of implementation of the programme and offer advice where necessary. The main focus is on the common interest group progress, the community action plan implementation and also the

farm specific action plans (for individual farmer). This makes everyone to take their responsibilities seriously. Corrective measures are taken on those whose performance is below the expected standards while good performers are recognized and motivated in various ways.

Professional group meetings: These are held at the district and provincial levels. Officers in various disciplines of agriculture such as the home economics, farm management, agricultural engineers, livestock production etc, plus their counterparts in the research institutions attend respective meetings. They discuss the technical challenges faced and how best to overcome them. These are usually held just before the common interest groups start their activities so that officers are armed with the necessary information.

Monitoring and evaluation: The activity budgeting allows the implementers and the beneficiaries to evaluate themselves as they implement the activities they set to achieve. The Programme coordinating unit at the head office also carries out monitoring and evaluation. The rolling audit also gives an indicator of the rate of fund utilization versus the achieved target. The programme also has programmed external evaluation done in the middle and at the end of the project. The post project evaluation focuses on the sustainability of the programme.

2.7 Challenges faced by the programme.

The NALEP focal area approach and the use of its pillars, is faced by a few challenges which are mainly operational and beyond the control of the programme implementers due to the multi-sectoral nature of the programme.

Stakeholders’ involvement: The Broad Based Survey is an important tool of bringing together all the relevant service providers and makes the farmers to understand the roles played by each development partner. It also enables the community to draw an all inclusive Community Action Plan (CAP). The process takes up to 21 days. It is not easy to maintain the attendance of all the stakeholders for the whole period since they also have their core activities to achieve. Some stakeholders do not commit themselves to play their role to achieve the community action.

Administrative issues: Staff changes, either due to transfers or natural attrition pose a challenge to the implementation of the programme due to disruption of the cycle of activities after such staff changes.

The bureaucracy in the Government financial cycle and tendering process has led to delay in the

release of funds and other resources to the working units and in the supply of goods and services

Although the programme has facilitated the purchase of computers and internet connections in all the districts and provincial offices, they are not operational due to limited capacity of the telecommunication system in the country. This leads to delay in the processing and transmission of the periodic reports.

Cultural issues: In some communities, a number of social events take priority over development activities. Such events include circumcision ceremonies and burials. For example, circumcision may disrupt agricultural activities for about two months in a year in the areas where it is traditionally performed, while death of a member of the community can lead two to three weeks mourning period, hence causing delay in the development activities.

Some communities still do not allow women to participate in development activities freely. Women are the main implementers of the agricultural and environmental activities. They are however not allowed to take active roles in the participatory rural appraisal and farmers training activities.

Political interference: There has been tremendous fragmentation of the administrative units (Districts) by the political leaders since the start of the programme. This leads to delay in the adjustment of the personnel and financial resources allocations to these units. This process also causes delays in the programme implementation. National presidential and parliamentary elections are held every 5 years. During the electioneering period, most members of the community especially the men and youth dedicate most of their time to political rallies and abandon agricultural activities.

HIV and AIDS: This disease affects the most agriculturally productive part of the rural community. The sick are unable to till their land and the family resources that would have been used to boost agricultural production are diverted to medical care. The other family members are also affected because they have to leave their farming activities to nurse the sick either at home (home based care) or at the hospital wards.

2.8 NALEP Achievements

The programme has heavily boosted the institutional capacity by providing motorcycles and vehicles for the extension staff. Each district has a new vehicle while each division has a new motorcycle purchased for the project work. It has also provided computers and internet connections to all

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the District and Provincial offices for ease of data collection, processing, report compilation and communication.

The programme has improved demand driven extension and bottom up planning. The farmers have been able to identify, plan and implement their activities and demand for specific interventions from the appropriate extension service providers. Common Interest Groups have been formed and implemented enterprise specific activities successfully. The groups have been able to access clean and superior planting materials for bananas, sweet potatoes, ground nuts, beans, tomatoes, potatoes, oil palm and cassava. Group marketing of the crop products has been successfully done. Since the farmers own these CIGs, then their sustainability is highly feasible. Value addition to agricultural products, both for local consumption and marketing has been undertaken by the CIGs. Oil processing especially from simsim and sunflower has been quite a profitable group activity. The growth and marketing of new high value crops such as mushrooms, vanilla and artemisia has been made easier through the CIG approach.

Transparency and accountability has improved at all the levels of programme operation and budgeting process is well organized. The divisional extension team draws their budgets for the programme activities in time (activity budgeting). These budgets are reviewed, amended and adopted at the District management team level after which they are presented at annual National budgeting and planning meeting for further review and adoption. The draft budgets are then sent to all the stations for perusal and report any errors before being sent to the treasury for release of funds. Bottom up planning enables the implementers at the local level to plan and execute the programme smoothly. All the stakeholders especially the farmer (beneficiaries) have access to the budgetary allocations for their respective areas. There are checks and balances at the district level to ensure efficiency in the use of funds. The government auditors regularly audit the programme, and then an external audit firm "pricewaterhouse and coopers" carries out a rolling audit once or twice each financial year. The audit reports are used to make any corrective measures on time to arrest any misused of the resources.

Documented success cases include the KIM tomatoes production group in Western Kenya, and French beans and dairy goats' projects in Eastern Province. All the cases involve collaborative efforts of the farmers groups, agricultural extension officers, Non Governmental Organizations and private service providers.

3.0 Conclusions and Recommendations

Soil and water conservation is a noble idea for sustainable agricultural development and food security for the country. The initial activities were introduced using a wrong approach. It has taken the country more than 50 years, but the activities are still not fully adopted by the rural communities.

Coercion (forceful) and persuasive (supply driven) approaches lead to quick but unsustainable development. Demand driven approach is one way of achieving sustainable development

The strong community and stakeholder involvement in the whole project process is likely to enable the project activities to be sustainable and lead to long term improvement in the rural folk economic welfare.

The local community should be involved in the identification, formulation, implementation and assessment of any development projects in their areas. This way the community will own and sustain the development activities.

In designing any rural development programme, it is necessary to consider sustainability. This can only be achieved if the social Equity, Economic empowerment and Environmental issues are considered on equal footing in geographical and time scale. While exploiting the current natural resources,

it is also important to bear in mind the welfare of the future generations of flora and fauna.

Coordinated activities of several development partners are needed to achieve sustainable development. All the parties involved in the programme should appreciate the challenges and work towards minimizing their effects on the overall performance of the programme. The National Agriculture and Livestock Extension Programme is a model programme that brings all the development partners on board. If well managed, the programme could register even higher level of success.

Other projects funded by local and international organizations should be encouraged to use this model to improve sustainability of their activities.

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Helminth Parasites of some Freshwater Fish from River Niger at Illushi, Edo State, Nigeria

Onyedineke, Nkechi Esther¹; Obi, Uchechukwu²; Ofoegbu, Pearl Ugochi¹ and Ukogo, Ifeoma¹

¹Department of Biology, Federal University of Technology, Owerri, Nigeria.

²Department of Zoology, Ambrose Alli University, Ekpoma, Nigeria.

nonyedineke@yahoo.com

Abstract: Although there are some reports on parasites of fish at different locations on River Niger, there had been no report for Illushi. Parasitological investigation of 71 fish samples belonging to 14 genera from river Niger at Illushi showed a 60.6% prevalence infection and an infection rate of 59.15%. The gills, stomach and sometimes muscles were infected; no parasites were found infecting the liver and eye lens. Nematodes, acanthocephalans, trematodes and cestodes were recovered in decreasing order of abundance. *Proteocephalus* sp. was found in *Ctenopoma kingsleye* and was the only parasite infecting *Tilapia galilaeus*. *Diphyllbothrium* sp. was only found in the stomach and gills of *Chrysichthys nigrodigitatus*. *Paramphistomum* sp. was the only trematode found in the gills of examined fishes. *Bucephalus* sp was only found in *Synodontis eupterus* and *Distichodus engycephalus*. Acanthocephalans were represented by *Pomporhynchus*, *Quadrigidae* and *Neoechinorhynchus*. *Neoechinorhynchus* was found only on the intestine of *Lates niloticus*. Parasites were more prevalent in fish of 10 – 30cm standard length. There was no specific trend in parasite prevalence in *S. eupterus*, *S. clarias*, *C. nigrodigitatus* and *C. kingsleye* as regards the weight classes. The study showed the intestine as the preferred organ for infection, no infection was noticed in the oesophagus. [Journal of American Science 2010;6(3):16-21]. (ISSN: 1545-1003).

Key words: helminth parasites, prevalence, freshwater fish, River Niger.

1. Introduction.

Parasites in fish have been a great concern since they often produce disease condition in fish thereby increasing their susceptibility to other diseases, causing nutritive devaluation of fish and fish loss.

Various studies have been done on parasites of fish from different Nigerian water bodies (Onwuliri and Mgbemena, 1987; Anosike *et al.*, 1992; Ezenwaji and Ilozumba, 1992; Aken'ova, 1999; Auta *et al.*, 1999; Okaka, 1999; Emere, 2000; Ibiwoye *et al.*, 2000, 2004; Olurin and Somorin, 2006, Olofintoye, 2006 and Akinsanya *et al.*, 2007) but none on the parasite burden of fish in Niger river at Illushi. Investigations on the helminth fish parasites of fish from River Niger at Shagunu and Kainji reservoir include those of Awachie (1965) and Ukoli (1965) respectively.

This study is designed to ascertain the diversity and extent of parasitic infection in fish from River Niger at Illushi, Edo State, Nigeria.

2. Materials and Methods

Fishes used for the study were bought from same fisherman operating with gill nets and cast nets along the river Nigeria at Illushi, Edo State located within longitude 6° 30' to 6° 40'E and latitude 6° 34' to 6° 47' N. The fish samples were kept in plastic coolers containing river water and ice blocks before being transported to the laboratory. In the laboratory the fishes were identified to species level using keys provided by

Holden and Reed (1972) and Lowe-Mc Connel (1972). Fish standard length (SL – from the snout to the base of the caudal peduncle) were determined with a meter rule while body weight (BW) was determined using a weighing balance.

The gills, muscles, intestine, stomach and oesophagus of the fish were examined for parasites. Parasites recovered from each site were properly washed, fixed in alcohol-formol- acetic acid according to Olurin and Somorin (2006) and site of infection noted. Identification of parasites was carried out according to Yamaguti (1958, 1959, 1961 and 1963).

3. Results

Seventy-one fish samples belonging to 14 genera were subjected to parasitologic investigation. Forty-three fish were infected with hundred and fourteen parasites. The prevalence of parasitic infection was 60.6%.

Parasites recovered were Nematodes, Acanthocephalans, Cestodes and Trematodes in decreasing order of abundance. The incidence of infestation by nematodes and cestodes were 57.96% and 2.54% respectively. The gills, stomach and sometimes muscles were infected; no parasites were found infecting the liver and eye lens.

The only parasites recovered from *Tilapia galilaeus* was a cestode – *Proteocephalus* sp. which was also found in *Ctenopoma kingsleye*. *Diphyllbothrium* sp.

was only found in the stomach and gills of *Chrysichthys nigrodigitatus*.

Nematodes occurred mostly in the stomach and intestines of fish examined but were also found in the

gills of *Synodontis eupterus* and *Alestes nurse* (Table 1 & 2).

Table 1. Host Specificity of parasite types

Taxonomic Group	Parasites	Fish species															
		<i>Synodontis eupterus</i>	<i>Synodontis clarias</i>	<i>Chrysichthys nigrodigitatus</i>	<i>Clarias gariepinus</i>	<i>Bagrus bayad</i>	<i>Ctenopoma kingsleye</i>	<i>Tilapia galilaeus</i>	<i>Tilapia zilli</i>	<i>Alestes nurse</i>	<i>Citharinus citharius</i>	<i>Hydrocynus vitatus</i>	<i>Mormyrus rume</i>	<i>Labeo senegalensis</i>	<i>Labeo cubie</i>	<i>Distichodus aegycephalus</i>	<i>Lates niloticus</i>
Nematoda	<i>Procammellanus</i>	+	+	+	+	-	-	+	+	+	+	+	+	-	-	+	-
	<i>Camellanus</i>	+	+	+	+	-	-	+	+	+	-	-	-	-	+	-	-
	<i>Gnathostoma</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Trematoda	<i>Paramphistomum</i>	+	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-
	<i>Clinostomum</i>	+	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-
	<i>Bucephalus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Acanthocephala	<i>Pomporhynchus</i>	+	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-
	<i>Quadrigyidae</i>	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Neoechinorhynchus</i>	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	+
Cestoda	<i>Diphyllbothrium</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Proteocephalus</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-

Table 2. The occurrence of parasites in fish examined (S=stomach, I=intestine, G=gill)

Fish species	Nematoda			Trematoda			Acanthocephala			Cestoda			Total
	S	I	G	S	I	G	S	I	G	S	I	G	
<i>Synodontis eupterus</i>	18	35	3	2	0	0	12	8	0	0	0	0	78
<i>Synodontis clarias</i>	17	2	0	0	0	1	0	25	0	0	0	0	45
<i>Chrysichthys nigrodigitatus</i>	10	14	0	0	0	0	5	27	0	1	0	1	58
<i>Clarias gariepinus</i>	11	0	0	0	0	0	0	0	0	0	0	0	11
<i>Ctenopoma kingsleye</i>	13	0	0	2	0	0	0	13	0	0	6	0	34
<i>Tilapia galilaeus</i>	2	0	0	0	0	0	0	0	0	0	0	0	1
<i>Tilapia zilli</i>	1	3	0	0	0	0	0	0	0	0	0	0	4
<i>Alestes nurse</i>	0	5	5	0	0	0	0	0	0	0	0	0	10
<i>Citharinus citarius</i>	3	0	0	0	2	0	0	0	0	0	0	0	5
<i>Hydrocynus vitatus</i>	5	0	0	0	0	0	0	0	0	0	0	0	5
<i>Mormyrus rume</i>	0	3	0	0	0	0	0	0	0	0	0	0	3
<i>Labeo cubie</i>	4	6	0	0	0	0	0	8	0	0	0	0	18
<i>Distichodus aegycephalus</i>	30	0	0	0	0	0	0	13	0	0	0	0	43
<i>Lates niloticus</i>	0	0	0	0	0	0	0	3	0	0	0	0	3
Total	114	68	8	4	2	1	17	97	0	1	6	1	318

Few trematodes were recovered from fish examined. The trematode *Paramphistomum* sp was found in the gills of *Synodontis clarias*. *Bucephalus* sp was only found in *S. eupterus* and *Distichodus aegycephalus*.

Pomporhynchus, *Quadrigyidae* and *Neoechinorhynchus* were the Acanthocephala recovered from the fish examined.

Table 1 and 2 shows the host and organ specificity of parasites respectively.

Table 3: Prevalence (%) of Helminth infection in fish species collected in relation to their standard length.

Standard Length (cm)	<i>S. eupterus</i>			<i>S. clarias</i>			<i>C. nigrodigitatus</i>			<i>C. gariepinus</i>		
	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered
10 – 13.9	4 (33.3)	3 (25)	44 (56.4)	(0.0)	(0.0)	(0.0)	3 (16.7)	1 (5.6)	1 (1.7)	(0.0)	(0.0)	(0.0)
14 – 17.9	6 (50)	4(33.3)	16 (20.5)	1 (33.3)	1 (33.3)	3 (6.7)	4 (22.2)	2 (11.1)	2 (3.5)	(0.0)	(0.0)	(0.0)
18 – 21.9	2 (16.7)	2 (16.7)	18 (23.1)	(0.0)	(0.0)	(0.0)	6 (33.3)	4 (22.2)	19 (32.8)	(0.0)	(0.0)	(0.0)
22 – 25.9	(0.0)	(0.0)	(0.0)	1 (33.30)	1 (33.3)	25 (53.3)	4 (22.2)	2 (11.1)	23 (39.7)	(0.0)	(0.0)	(0.0)
26 – 29.9	(0.0)	(0.0)	(0.0)	1 (33.3)	1 (33.3)	17 (37.8)	1 (5.6)	1 (5.6)	13 (22.4)	1(100)	1 (100)	11(100)
Total	12(100)	9(75.0)	78 (100)	3 (100)	3 (100)	45 (100)	18 (100)	10(55.6)	58 (100)	1 (100)	1 (100)	11 (100)
Standard Length (cm)	<i>D. engycephalus</i>			<i>C. citharius</i>			<i>T. galilaeus</i>			<i>T. zilli</i>		
	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered
10 – 13.9	1 (100)	1 (100)	43 (100)	(0.0)	(0.0)	(0.0)	2 (50.0)	(0.0)	(0.0)	1(100)	(0.0)	(0.0)
14 – 17.9	(0.0)	(0.00)	(0.0)	(0.0)	(0.0)	(0.0)	2 (50.0)	1 (25.0)	1 (100)	3 (75.0)	2 (50.0)	4(100)
18 – 21.9	(0.0)	(0.0)	(0.0)	3(100)	2 (66.7)	5(100)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
22 – 25.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	1 (100)	1 (100)	43 (100)	3(100)	2 (66.7)	5(100)	4(100)	1 (25.0)	1 (100)	4 (100)	2 (50.0)	4 (100)
Standard Length (cm)	<i>C. kingsleye</i>			<i>A. nurse</i>			<i>L. coubie</i>					
	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered
10 – 13.9	(0.0)	(0.0)	(0.0)	3 (75.0)	2 (50.0)	5 (50.0)	1(10.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
14 – 17.9	1 (33.3)	1 (33.3)	13 (38.2)	(0.0)	(0.0)	(0.0)	8 (80.0)	3 (30.0)	6 (33.3)	(0.0)	(0.0)	(0.0)
18 – 21.9	(0.0)	(0.0)	(0.0)	1 (25.0)	1 (25.0)	5 (50.0)	1 (10.0)	1 (10.0)	12 (66.7)	(0.0)	(0.0)	(0.0)
22 – 25.9	1 (33.3)	1 (33.3)	7 (20.6)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
26 – 29.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
30 – 33.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
34 – 37.9	1 (33.3)	1 (33.3)	14 (41.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	3(100)	3(100)	34 (100)	4 (100)	3 (75.0)	10 (100)	10 (100)	4(40.0)	18 (100)			

Table 4. Prevalence (%) of Helminth infection in fish species collected in relation to their body weight

Body weight (g)	<i>S. eupterus</i>			<i>S. clarias</i>			<i>C. nigrodigitatus</i>			<i>C. gariepinus</i>		
	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered
0 – 10.9	1 (8.3)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	2 (11.1)	1 (5.6)	1 (1.7)	(0.0)	(0.0)	(0.0)
11 – 20.9	2 (16.7)	2 (16.7)	38 (48.7)	(0.0)	(0.0)	(0.0)	4 (22.2)	2 (11.1)	2 (3.4)	(0.0)	(0.0)	(0.0)
21 – 30.9	5 (41.7)	3 (25.0)	18 (23.1)	1(50.0)	1(50.0)	3(6.7)	1 (5.6)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
31 – 40.9	1 (8.3)	1 (8.3)	6 (7.7)	(0.0)	(0.0)	(0.0)	8 (44.4)	6 (33.3)	53 (91.4)	1 (100)	1 (100)	11(100)
41 – 50.9	3 (25.0)		16 (20.5)	1 (50.0)	1 (50.0)	42 (93.3)	3 (16.7)	1 (5.6)	2 (3.4)	(0.0)	(0.0)	(0.0)
51 – 60.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	12(100)	9(75.0)	78 (100)	2 (100)	2 (100)	45 (100)	18 (100)	10(55.6)	58 (100)	1 (100)	1 (100)	11 (100)

Body weight (g)	<i>D. engycephalus</i>			<i>C. citharius</i>			<i>T. galilaeus</i>			<i>T. zilli</i>		
	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered
0 – 10.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
11 – 20.9	1 (100)	1 (100)	43 (100)	(0.0)	(0.0)	(0.0)	1(25.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
21 – 30.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	2 (50.0)	1 (25.0)	1 (100)	1(25.0)	(0.0)	(0.0)
31 – 40.9	(0.0)	(0.0)	(0.0)	1(33.3)	1(33.3)	4(80.0)	1(25.0)	(0.0)	(0.0)	3 (75.0)	2 (50.0)	4(100)
41 – 50.9	(0.0)	(0.0)	(0.0)	1(33.3)	1(33.3)	1(20.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
51 – 60.9	(0.0)	(0.0)	(0.0)	1(33.3)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	1 (100)	1 (100)	43 (100)	3(100)	2 (66.7)	5(100)	4(100)	1 (25.0)	1 (100)	4 (100)	2 (50.0)	4 (100)

Body weight (g)	<i>C. kingsleye</i>			<i>A. nurse</i>			<i>L. coubie</i>		
	No (%) of fish Examined	No(%) of fish infected	Total No (%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered	No (%) of fish Examined	No(%) of fish infected	Total No(%) of parasites recovered
0 – 10.9	(0.0)	(0.0)	(0.0)	3 (75.0)	2 (50.0)	5 (50.0)	1(10.0)	(0.0)	(0.0)
11 – 20.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	2 (20.0)	(0.0)	(0.0)
21 – 30.9	1(33.3)	1(33.3)	7(20.6)	(0.0)	(0.0)	(0.0)	7 (70.0)	4(40.0)	18 (100)
31 – 40.9	1 (33.3)	1 (33.3)	13 (38.2)	1(25.0)	1(25.0)	5(50.0)	(0.0)	(0.0)	(0.0)
41 – 50.9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
51 – 60.9	1(33.3)	1(33.3)	14(41.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	3(100)	3(100)	34 (100)	4 (100)	3 (75.0)	10 (100)	10 (100)	4(40.0)	18 (100)

The cestodes were found parasitizing the stomach, intestine and gills only in *Chrysichthys nigrodigitatus*, *Ctenopoma kingsleye* and *Tilapia galilaeus*.

Procamellanus was mostly found infecting the stomach and intestine of *Hydrocynus vitatus* and *Mormyrus rume* while *Neoechinorhynchus* as the only parasites found in the intestine of *Lates niloticus*. *Procamalanus* species was the most prevalent.

The percentage infection of the fish genera is presented in Table 3.

Parasites were most prevalent in fish of 10 to 30cm standard length. In *C. kingsleye* parasites were most prevalent in fish of 14- 17cm and 34 to 37.9cm standard length.

There was no specific trend in parasite prevalence in *S. eupterus*, *S. clarias*, *C. nigrodigitatus* and *C. kingsleye* as regards the weight classes.

The largest numbers of parasites isolated were nematodes.

Organ specificity of parasite infection showed the intestine as the preferred organ while none was found in the oesophagus (Table 4).

3. Discussion

The study showed a high infection rate (59.15%) in all fish genera examined. This is unlike the low infection rate reported elsewhere (13.6% in Imo River, Ugwuozor, 1987). The high infection rate in these fishes could be attributed to the sanitary condition of the place, the location of the river from living place, number and class of people visiting the river and their purpose. Number of nematodes isolated was higher than cestodes, trematodes and acanthocephalans. Nematodes are known to occur in body cavities or found penetrating subcutaneous tissues. Host specificity of nematodes was variable which agrees with the findings of Akinsanya et al., (2007).

Ukoli (1965) and Olurin and Somorin (2006) recovered *Clinostomum* sp. from the intestines of tilapia fishes, in this study, *Clinostomum* was found parasitizing non-cichlids such as *Synodontis eupterus*, *Ctenopoma kingsleye*, *Clarias* sp. and *Citharinus* sp. Kabata (1985), reported that *Clinostomum* when ingested with poorly cooked fish is capable of producing laryngopharyngitis which is an unpleasant inflammatory condition in man.

Most Acanthocephalans were found in the intestine of fish which agrees with the findings of Awachie (1965) and Olurin & Somorin (2006) in fishes from Kainji Lake and Owa stream respectively.

High number of parasites was found in the intestines could be associated with the fact that most digestion activity takes place in the intestine resulting in the release of parasite ova/cysts in food particles. Few parasites were found on the gills could be as a result of the continuous movement of water current over the gills which may not encourage establishment and survival of parasites there.

The length classes within the range of 10 -29.9cm recorded the highest prevalence of infection. This might be attributed to low level of immunity in smaller sized fish.

Only *C. nigrodigitatus* fish of 31 – 39.9g body weight recorded the highest prevalence of parasitic infection. This might be attributed to random selection.

This agrees with the finding of Olorin & Somorin (2006) regarding *T. mariae* in Owa stream which had increased parasite load with increased weight. Increase in weight also increases fish susceptibility to parasitization.

Past studies on parasitic infection of fishes from River Niger by Ukoli (1965) and Onyia (1970) reported *Diplodiscus* species *Macroodus*, *Dactylogyrus*, *Gyrodactylus*, *Nephrocephalus* and *Rhabdinorynchus* species as the major causes of parasitic infection. None of these parasites was recovered in the present study; it could be that they could not survive in this part of the river Niger

River Niger at Illushi has high parasitic load as exhibited by the high rate of infection on the fishes examined as such adequate measures should be put in place to prevent these parasites from spreading.

Correspondence to:

Onyedineke, N. E.

Department of Biology

Federal University of Technology

Owerri, Nigeria.

Email: nonyedineke@yahoo.com

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STRUCTURAL AND OPTICAL CHARACTERIZATION OF SPRAY DEPOSITED SnS THIN FILM

B.G. Jeyaprakash^{1*}, R. Ashok kumar², K.Kesavan², A. Amalarani¹

1. Department of Physics, Ponnaiyah Ramajayam College of Engineering and Technology
Thanjavur -613 403, TamilNadu, India
2. Department of Physics, PRIST University, Thanjavur – 614 904, Tamilnadu, India

*Corresponding author email: bgjpabr@yahoo.co.in

Abstract: Tin sulfide thin films were prepared on glass substrate by home built microcontroller based spray pyrolysis unit. X-ray diffraction confirmed the nanocrystalline SnS phase formation with preferential orientation along (111) plane. The intensity of XRD peaks increases with the increase of substrate temperature which implies better crystallinity takes place at higher temperature. Scanning electron micrograph of the film revealed the manifestation of nano SnS with size lying in the range of 31 -49nm as the function of substrate temperature. VIS-NIR spectrophotometric measurement showed high transparency of about 87% in the wavelength range 600-1100nm with a direct allowed bandgap lying in the range of 1.30 – 1.40eV as substrate temperature increases. [Journal of American Science 2010;6(3):22-26]. (ISSN: 1545-1003).

Key words: Tin sulfide, thin film, spray pyrolysis

1. Introduction

Semiconducting metal chalcogenides are used as sensor, polarizers and thermoelectric cooling materials [Lindgren *et al* 2002]. Among many semiconducting metal chalcogenides, tin sulfides have attracted extensive interest due to its photoconductivity properties for solar energy conversion. Tin sulfide exists in variety of phases such as SnS, Sn₂S₃, Sn₃S₄ and SnS₂ due to bonding characteristics of tin and sulfur [Jiang *et al* 1998]. Also it has both p and n-type conduction with a direct band gap of 1.3eV and an indirect bandgap of 1.0eV [Valiukonis *et al* 1986; Engelken *et al* 1987]. Several methods such as Electrodeposition [Zainal *et al* 2005], SILAR [Biswajit *et al* 2008], Spray pyrolysis [Khelia *et al* 2000; Thangaraju *et al* 2000] and Co-evaporation [Cifuentes *et al* 2006] have been studied for preparing tin sulfide thin film. For the past few years thin film nanomaterials based devices are fabricated due to its unique physical and chemical properties which differs from its bulk and enhancing device performance. There are numerous methods for preparing thin film nanomaterials. These methods can be broadly classified into Vapour deposition and Solution deposition method. Each method has its own characteristics merits and demerits in producing homogeneous and defect free thin film nanomaterials and new preparation methods are being evolved to produce controlled size and shape

of desired morphology. Spray pyrolysis technique [Chopra *et al* 1982] has been used for several decades in glass industry and in solar cell production to deposit electrically conducting electrodes. The quality and properties of the films depends largely on substrate temperature, precursor solution concentration, atomization type and substrate [Chamberlin *et al* 1966; Patil 1999; Chen *et al* 1996]. In the present work the effect of substrate temperature towards the x-ray diffraction, optical energy band gap and surface morphology of the films on glass substrate was studied.

2. Experimental

Thin film prepared by conventional spray pyrolysis has disadvantages due to i) non-uniformity of film with larger grain size due to uncontrollable spray droplet size ii) wastage of solution i.e. the low ratio of atoms effectively deposited to those supplied iii) low deposition rate. Several workers have made improvement in the spray efficiency. In corona spray the transport of aerosol droplets towards the substrate have been achieved by a control and 80% efficiency is achieved in this method [Siefert 1984]. The films formed in the present spray unit shown in figure 1(a) have good surface uniformity with controlled droplet size. The unit consists of (i) specially designed spray generator shown in figure 1(b) is made up of 50 ml capacity glass vessel having carrier gas nozzle of

0.76mm diameter and an inverted funnel type nozzle of 1mm diameter. By Bernoulli's action solution spray will take place through this nozzle when air flows through the carrier gas nozzle and a fine mist is produced at the barrier which is allowed to deposit on the pre heated glass substrate. (ii) substrate heater with thermostat coupled with K-type thermocouple (iii) microcontroller based timer for spraying precursor solution and (iv) compact air compressor of flow rate 20Lpm with pressure regulator and (v) exhaust system. Solution wastage is reduced and 90% of the precursor solution is used for deposition. By controlling the carrier gas pressure the grain size of the material in the film can be controlled. This helps for the production of nanomaterials thin films.

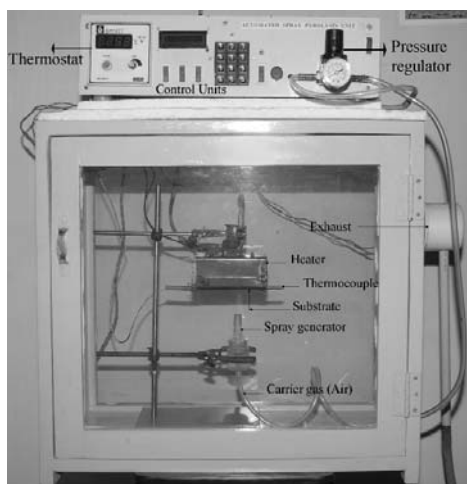


Figure-1(a). Microcontroller based home built automated spray pyrolysis unit

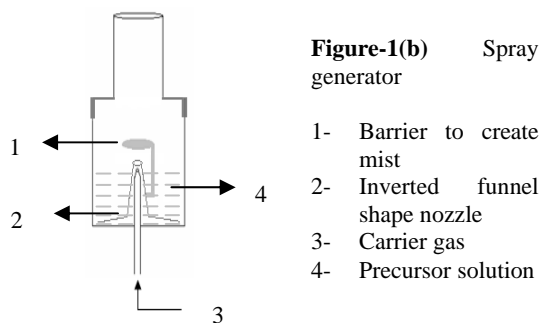


Figure-1(b) Spray generator

To prepare tin sulfide thin film a precursor solution is prepared by dissolving the salts of Stannous Chloride ($\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$) of 0.01M and Thiourea ($\text{CS}(\text{NH}_2)_2$) of 0.01 M in deionised water. Few drops (~0.5 ml) of concentrated HCl is added to get clear solution. The aqueous solution was then sprayed as a

fine mist containing the reactant molecules on the preheated glass substrate of kept at 20°C . Compressed dry air at a pressure of $2\text{Kg}/\text{Cm}^2$ from an air compressor via an air filter-cum regulator was used as the carrier gas and spray rate of the solution inside the bulb was maintained at 3ml / min. Successive spraying was done, ie solution is sprayed for 30 sec and left off for 15 sec. Similarly films were prepared at 250°C and 300°C without changing other parameters.

Film thickness was estimated by weighing method and verified with cross sectional view of SEM image. X-ray diffraction (XRD) studies were carried out using PANalytical X-ray diffractometer (Model X'per PRO). Ni-filtered $\text{CuK}\alpha$ radiation ($\lambda = 1.5148\text{\AA}$) was employed with generator setting of 30mA and 40 kV. Continuous scanning was applied with a scanning speed of $10^\circ/\text{min}$. A range of 2θ from 20° to 80° was scanned from a fixed slit type, so that all possible diffraction peaks could be detected. X-ray line broadening technique is adopted to determine grain size of the film. Surface morphology of the films was investigated by using HITACHI Scanning Electron Microscope (Model S-3000H) with an accelerating potential of 18 kV. Prior to imaging, the films were sputtered with thin gold film to enhance the emission of secondary electron for better imaging.

Optical absorbance and transmission measurements for the film were carried out using computer controlled single beam Elico Spectrophotometer (Model SL159) with uncoated glass as reference. The experimental accuracy for absorbance is ± 0.005 Abs and of wavelength is ± 0.5 nm.

3. Results and Discussion

3.1. X-ray diffraction Studies

Figure (2) shows the XRD pattern of obtained tin sulfide film at different substrate temperature. It is seen that as temperature increased the peaks intensity found to increases indicating better crystallinity. All reflections can be indexed to pure orthorhombic SnS phase as compared with standard JCPDS card no. 39-354 with no impurities peaks such as elemental tin, sulfur and other tin sulphide phases, indicating the formation of single phase SnS. It is found the optimum temperature to obtain uniform well adherent SnS film is at 300°C . Above which lesser deposition occurs due to vapourization of droplet when reaches nearer to substrate. Lower temperature leads to powdery films. The observed XRD lines are broadened in their shape.

These may due to instrumental and specimen effects. In the present work instrumental broadening is corrected by using a standard defect free silicon sample. Specimen broadening arises due to small crystalline (grain) size and strain (lattice distortion). Both grain size and strain effects are interconnected in the line broadening of peaks, which makes it difficult to separate. Many approaches exist for the evaluation and separation of size and strain parameters from the occurring line broadening. Williamson-Hall technique [Williamson *et al* 1953] is adopted in the present work where grain size D and micro strain ε is related as

$$\frac{\beta_c \cos \theta}{\lambda} = \frac{1}{D} + \varepsilon \left(\frac{\sin \theta}{\lambda} \right)$$

β_c is the instrumental effect corrected full width at half maximum of the peak measured in radian, θ the diffraction angle and λ is the wavelength of X-ray. The slope of the plot between $\beta_c \cos \theta / \lambda$ and $\sin \theta / \lambda$ gives micro strain and the inverse of intercept on y-axis give grain size value. Figure (3) shows the variation of grain size and strain of SnS thin film prepared at different substrate temperature. It shows grain size increases from 31nm to 48nm as substrate temperature increases but strain value decreases from 1.9×10^{-4} to 0.8×10^{-4} .

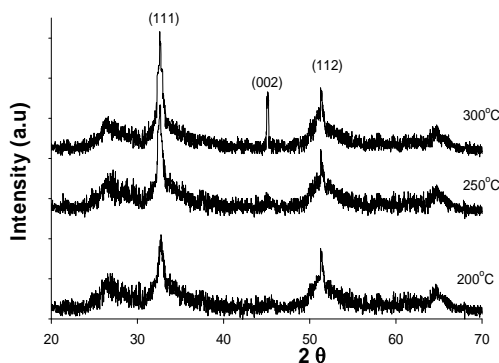


Figure-2. XRD pattern of SnS thin film prepared at different temperature

3.2. Surface Morphology Studies

Figure 4(a) shows the surface micrograph of film prepared at 300°C which consists of spherical shape grains. This structure repeats throughout the materials with closely packed to each other indicating good adhesiveness of film with the substrate. The grains size seen is comparable with that calculated value from x-ray diffraction studies. Film prepared at 200°C shown in figure 4(b) shows discontinuous in nature. This is

believed that at low temperature the droplet splashes onto the substrate with lesser decomposition which leads to porous and less adhesive of film which is observed visually.

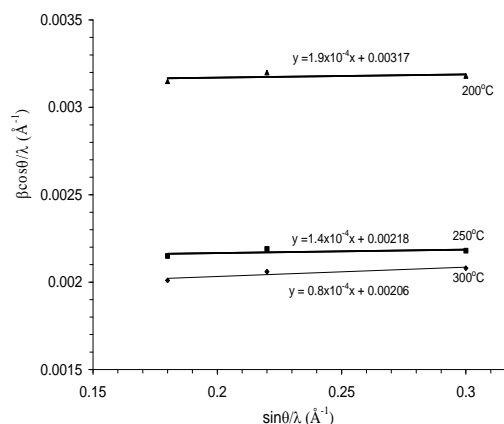


Figure-3. Williamson-Hall plot to determine grain size and strain of SnS film prepared at different temperature

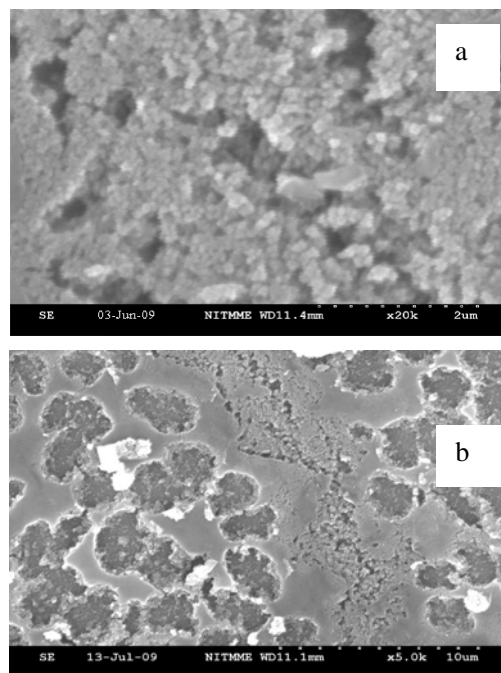


Figure-4. Scanning Electron Micrograph of SnS film prepared at a) 300°C and b) 200°C

3.3. Optical Studies

Optical absorption measurements were carried out in the wavelength region 380 to 1100nm. Figure (5) shows transmittance of film prepared at 300°C. It indicates a smooth increase and almost saturate at

600nm to 85% of transmittance. This smooth increase is due to high crystalline nature of the prepared film.

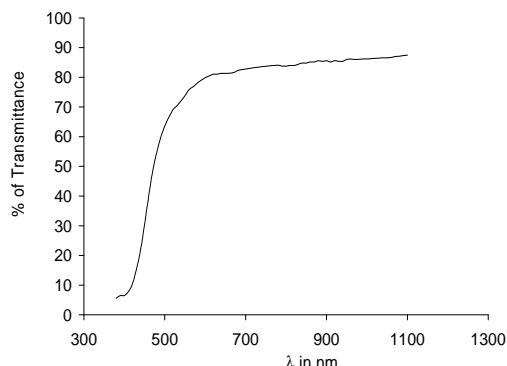


Figure-5. Transmittance spectra of SnS thin film prepared at different temperature

The absorption coefficient α is calculated from Lambert's law ($\alpha = (2.303 A) / t$). Where 'A' is optical absorbance and 't' is the film thickness. Optical band gap E_g and absorption coefficient is related as

$$(\alpha h\nu)^{1/p} = A(h\nu - E_g)$$

Where A is a constant, exponent p is the transition probability. For $p = 1/2$ the transition is direct and allowed, $p=2$ indirect and allowed and $p = 3/2$ for direct forbidden. To determine direct allowed band gap a graph between $(\alpha h\nu)^2$ and $h\nu$ is plotted and the straight portion of the graph is extrapolated to energy axis to give E_g . From figure (6) the bandgap decreases from 1.40 to 1.30 eV with increase in substrate temperature. This is due to lesser grain size and quantum confinement [Brus 1984] at lower temperature.

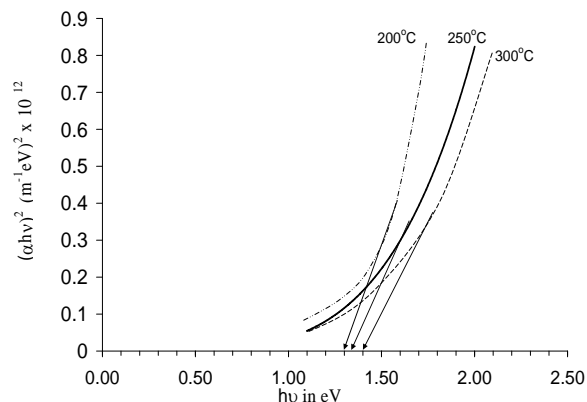


Figure-6. Bandgap variation of SnS film at different temperature

4. Conclusion

In summary, microcontroller based home built spray pyrolysis method was used to prepare tin sulfide thin film on glass substrate from the precursor solution containing salts of stannous chloride and thiourea. X-ray diffraction pattern indicates the formation of single phase SnS crystalline material. SEM study shows that the film has spherical shape grains and closely packed together. Optical studies reveal that the film has direct allowed transition with band gap of 1.35 eV. It is concluded that to obtain uniform well adherent of spherical grain crystalline SnS film the substrate temperature is fixed to 300°C.

Correspondence to:

Dr. B.G. Jeyaprakash

Department of Physics

Ponnaiyah Ramajayam College of Engineering and Technology, Thanjavur-613 403, Tamilnadu, INDIA

Telephone: +91-431-2770145

Cellular phone: 0098654-21411

Email: bgjpabr@yahoo.co.in

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10/29/2009

Performance of an Otto engine with volumetric efficiency

Rahim Ebrahimi¹, Davood Ghanbarian¹, Mahmoud Reza Tadayon²

¹. Department of Agriculture Machine Mechanics, Shahrekord University, P.O. Box 115, Shahrekord, Iran

² Department of Agronomy and plant breeding, Shahrekord University, P.O. Box 115, Shahrekord, Iran

Rahim.Ebrahimi@gmail.com

Abstract: In this paper, the performance of an Otto engine is evaluated under variable volumetric efficiency. Finite-time thermodynamics is used to derive the relations between power output and thermal efficiency at different compression ratio and volumetric efficiency for an air-standard Otto cycle. The effect of the volumetric efficiency on the irreversible cycle performance is significant. It was found that the effect of volumetric efficiency on the cycle performance is obvious, and they should be considered in practice cycle analysis. The conclusions of this investigation are of importance when considering the designs of actual Otto engines. [Journal of American Science 2010;6(3):27-31]. (ISSN: 1545-1003).

Keywords: Volumetric efficiency; Irreversibility; Analysis; Performance; Otto cycle

Nomenclature

B	constants related to heat transfer
c_p	specific heat at constant pressure
c_v	specific heat at constant volume
f_{mep}	friction mean effective pressure
Q_{in}	heat added to the working fluid
Q_{out}	heat rejected by the working fluid
Q_{LHV}	lower heating value of the fuel
R_{air}	air constant of the working fluid
\dot{m}_f	mass flow rate of the fuel
\dot{m}_t	mass flow rate of the air–fuel mixture
m_a/m_f	air–fuel ratio
N	engine speed
r_c	compression ratio
T	temperature
P_{out}	power output of the cycle
V	volume of the gas in the cylinder

Greek symbols

η_c	compression efficiency
η_{com}	combustion efficiency
η_e	expansion efficiency
η_{th}	thermal efficiency of the cycle
η_v	volumetric efficiency
γ	specific heat ratio
ρ_{air}	inlet air density
ϕ	equivalence ratio

Subscripts

1, 2, 3, 4	state points
S	stoichiometric condition

1. Introduction

A study of gas cycles as the models of internal combustion engines is useful for illustrating some of the important parameters influencing engine performance. In the last two decades, by using finite time thermodynamics theory, many optimization studies based on various performance criteria have been carried out for endoreversible and irreversible heat engine models [Ge et al., 2008; Ebrahimi, 2009a]. Lior and Rudy (1988) conducted an availability analysis of an ideal Otto cycle with instantaneous burning of the fuel. Orlov and Berry (1993) deduced the power and efficiency upper limits for internal-combustion engines. They derived the maximum work or power and the corresponding efficiency bounds. Angulo-Brown et al. (1996) examined the performance of an irreversible air-standard Otto cycle by taking into account the finite-time evolution of the cycle's compression and power strokes and gathering the global losses in a dissipation term represented by a friction force linear with the piston mean velocity. Chen et al. (1998) derived the relations between the net power and the efficiency of the Otto-cycle with heat-transfer loss. Fischer and Hoffman (2004) concluded that a quantitative simulation of an Otto-engine's behavior can be accurately achieved by a simple Novikov model with heat leaks. Ozsoysal (2006) gave the valid ranges of the heat transfer loss parameters of the Otto and diesel cycles with consideration of the heat loss as a percentage of the fuel's energy. Rocha-Matinez et al. (2006) presented a simplified irreversible Otto-cycle model with fluctuations in the

combustion heat. Parlak and Sahin (2006) defined the internal irreversibility by using entropy production and analyzed the effect of the internal irreversibility on the performance of the irreversible reciprocating heat engine cycle. Abu-Nada et al. (2007) studied on thermodynamic analysis of spark ignition engine. They implemented a theoretical model of Otto cycle, with a working fluid consisting of various gas mixtures. Ge et al., (2008) analyzed the performance of an air standard Otto cycle. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Ebrahimi (2010a, 2010b, 2010c) determined the characteristics of power and efficiency for Otto cycle with engine speed, equivalence ratio and combustion efficiency.

As can be seen in the relevant literature, the investigation of the effect of volumetric efficiency on performance of Otto cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of the volumetric efficiency on performance of air standard Otto cycle.

2. Cycle model

An air-standard Otto cycle model is shown in figure 1. Process $1 \rightarrow 2s$ is a reversible adiabatic compression, while process $1 \rightarrow 2$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real compression process. The heat addition is an isochoric process $2 \rightarrow 3$. Process $3 \rightarrow 4s$ is a reversible adiabatic expansion, while $3 \rightarrow 4$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real expansion process. The heat rejection is an isochoric process $4 \rightarrow 1$. From the constant volume process $2 \rightarrow 3$, the heat added to the working fluid is

$$Q_{in} = \dot{m}_i c_v (T_3 - T_2) \quad (1)$$

The total energy of the fuel per second input into the engine can be given by: (Heywood, 1988)

$$Q_{fuel} = \eta_{com} \dot{m}_f Q_{LHV} \quad (2)$$

The heat loss through the cylinder wall is given in the following linear expression (Chen et al., 2008, Ebrahimi, 2009b)

$$Q_{ht} = \dot{m}_i B (T_2 + T_3) \quad (3)$$

Since the total energy of the delivered fuel Q_{fuel} is assumed to be the sum of the heat added to the working fluid Q_{in} and the heat leakage Q_{ht} ,

$$Q_{in} = Q_{fuel} - Q_{ht} = \eta_{com} \dot{m}_f Q_{LHV} - \dot{m}_i B (T_2 + T_3) \quad (4)$$

The intake system -the air filter, carburetor, and throttle plate, intake manifold, intake port, intake

valve- restricts the amount of air which an engine of given displacement can induct. The parameter used to measure the effectiveness of an engine's induction process is the volumetric efficiency. It is defined as the volume flow rate of air into the intake system divided by the rate at which volume is displaced by the piston:

$$\eta_v = \frac{2\dot{m}_a}{\rho_{air} V_d N} \quad (5)$$

The relations between η_v and \dot{m}_f , between

η_v and \dot{m}_i are defined as (Heywood, 1988):

$$\dot{m}_f = \frac{\eta_v \rho_{air} V_d N \phi}{2(m_a/m_f)_s} \quad (6)$$

and

$$\dot{m}_i = \frac{\eta_v \rho_{air} V_d N}{2} \left(1 + \frac{\phi}{(m_a/m_f)_s} \right) \quad (7)$$

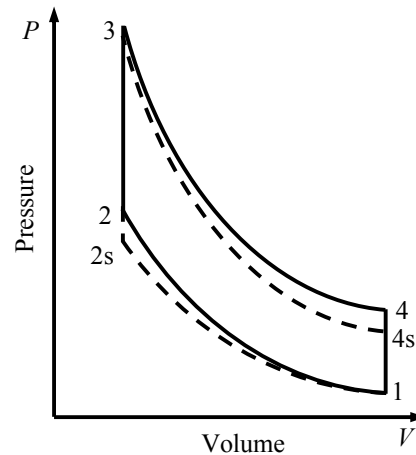


Figure 1. $P-V$ diagram for the air standard Otto cycle

The compression ratio, r_c , is defined as:

$$r_c = V_1/V_2 \quad (8)$$

For the processes $1 \rightarrow 2s$ and $3 \rightarrow 4s$, one has

$$T_{2s} = T_1 r_c^{\gamma-1} \quad (9)$$

$$T_{4s} = T_3 r_c^{1-\gamma} \quad (10)$$

For the two reversible adiabatic processes $1 \rightarrow 2s$ and $3 \rightarrow 4s$, the compression and expansion efficiencies can be defined as (Chen, 2004, Ebrahimi, 2010c):

$$\eta_c = (T_{2s} - T_1)/(T_2 - T_1) \quad (11)$$

$$\eta_e = (T_4 - T_3)/(T_{4s} - T_3) \quad (12)$$

Substituting equation (11) into equation (9) yields:

$$T_2 = \frac{T_1 (r_c^{\gamma-1} + \eta_c - 1)}{\eta_c} \quad (13)$$

Combining equations(1) , (4), (6) and (13) gives:

$$T_3 = \frac{\eta_c \eta_{com} Q_{LHV} \phi (m_a/m_f)_s \left[1 + \phi / (m_a/m_f)_s \right] + T_1 (r_c^{\gamma-1} + \eta_c - 1) (R_{air}/(\gamma-1) - B)}{\eta_c (R_{air}/(\gamma-1) + B)} \quad (14)$$

Substituting equations (10) and (14) into equation (12) yields:

$$T_4 = \left[\frac{\eta_c \eta_{com} Q_{LHV} \phi (m_a/m_f)_s \left[1 + \phi / (m_a/m_f)_s \right] + T_1 (r_c^{\gamma-1} + \eta_c - 1) (R_{air}/(\gamma-1) - B)}{\eta_c (R_{air}/(\gamma-1) + B)} \right] \times (\eta_e r_c^{1-\gamma} - \eta_e + 1) \quad (15)$$

The data of total motored friction mean effective pressure for several four stroke cycle, four cylinder spark ignition engines between 845 and 2000 cm^3 displacement, at wide open throttle, as a function of engine speed (Abd Alla, 2002) are well correlated by an equation of the form:

$$fmep = 97 + 0.9N + 0.18N^2 \quad (16)$$

Therefore, the lost power due to friction is

$$p_{fri} = \frac{fmep V_d N}{2} = \quad (17)$$

$$V_d N (45.5 + 0.45N + 0.09N^2)$$

Assuming an ideal, non-reacting gas with specific heat, the net actual power output of the Otto cycle engine can be written as:

$$P_{otto} = Q_{in} - Q_{out} - p_{fri} = \frac{\eta_v \rho_{air} V_d N R_{air}}{2(\gamma-1)} \left(1 + \frac{\phi}{(m_a/m_f)_s} \right) \times \left[T_1 \left(1 - \frac{r_c^{\gamma-1} + \eta_c - 1}{\eta_c} \right) - \frac{\eta_c \eta_{com} Q_{LHV} \phi (m_a/m_f)_s \left[1 + \phi / (m_a/m_f)_s \right] + T_1 (r_c^{\gamma-1} + \eta_c - 1) (R_{air}/(\gamma-1) - B)}{\eta_c (R_{air}/(\gamma-1) + B)} \right] - (\eta_e r_c^{1-\gamma} + \eta_e) \quad (18)$$

$$V_d N (45.5 + 0.45N + 0.09N^2)$$

The thermal efficiency of the Otto cycle engine is expressed by

$$\eta_{th} = P_{otto} / Q_{in} \quad (19)$$

where Q_{in} is:

$$Q_{in} = \dot{m}_t c_v (T_3 - T_2) = \frac{\eta_v \rho_{air} V_d N R_{air}}{2\eta_c (\gamma-1)} \left(1 + \frac{\phi}{(m_a/m_f)_s} \right) \times \left(\frac{\eta_c \eta_{com} Q_{LHV} \phi (m_a/m_f)_s \left[1 + \phi / (m_a/m_f)_s \right] + T_1 (r_c^{\gamma-1} + \eta_c - 1) (R_{air}/(\gamma-1) - B)}{R_{air}/(\gamma-1) + B} - T_1 (r_c^{\gamma-1} + \eta_c - 1) \right) \quad (20)$$

Notice that both power and efficiency are convex functions of the compression ratio.

3. Numerical examples and discussions

As it can be clearly seen from Eqs. (18) and (19), the thermal efficiency and the power output of the Otto cycle are dependent on the volumetric efficiency. In order to illustrate the effect of this parameter, the relations between the power output and the compression ratio, between the thermal efficiency and the compression ratio, and the optimal relation between power output and the efficiency of the cycles presented in figures 2–4. The values of the constants and the parameters used in this example are summarized in Table 1.

Table 1. Constants and parameters used in the numerical example [Heywood, 1988; Ebrahimi, 2009b; Chen et al., 2008; Ge et al., 2008]

bore×stroke	76.7×78 mm
constant related to heat transfer	0.71 kJ kg ⁻¹ K ⁻¹
lower heating value of the fuel	44000 kJ kg ⁻¹
air–fuel ratio at stoichiometric conditions	0.0685
engine speed	3000 rpm
compression ratio	1 → 70
intake temperature	300 K
compression efficiency	0.97
expansion efficiency	0.97
combustion efficiency	100%
volumetric efficiency	60 → 100%
specific heat ratio	1.4
equivalence ratio	1

Figures 2-4 show the effect of the volumetric efficiency on the cycle performance with heat resistance, internal irreversibility and friction losses. From these figures, it can be found that the volumetric efficiency plays important roles on the performance of the Otto engine. It is clearly seen that the effects of volumetric efficiency on the performance of the cycle is related to compression

ratio. They reflect the performance characteristics of a real irreversible Otto cycle engine. The power output versus compression ratio characteristic and the thermal efficiency versus compression ratio characteristic are approximately parabolic like curves. It should be noted that the heat added and the heat rejected by the working fluid increase as the volumetric efficiency increases. It can also be seen that the curves of power output versus thermal efficiency are loop shaped as is common to almost all real heat engines (Ebrahimi, 2009b).

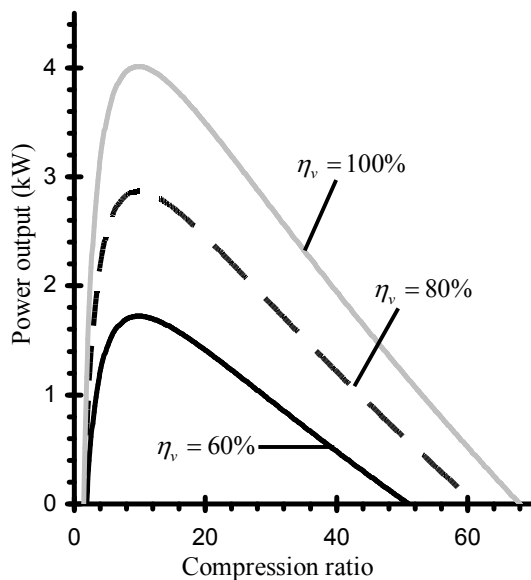


Figure 2. Effect of volumetric efficiency on the variation of the power output with compression ratio

Referring to Figs. 2 and 3, it can be concluded that, throughout the compression ratio range, the power output and thermal efficiency increase with the increasing volumetric efficiency. This can be attributed to the fact that the difference between heat added and heat rejected increase with the increasing volumetric efficiency. This is consistent with the practical working volumetric efficiency of spark ignition engines (Heywood, 1988). From these figures, it can be resulted that the maximum power output and the maximum thermal efficiency increase about 69.6% and 31% when volumetric efficiency increases 40%. The results also revealed that the optimal compression ratio corresponding to maximum thermal efficiency point and the working range of the cycle increase as the volumetric efficiency increases. In other words, the optimal compression ratio corresponding to maximum thermal efficiency point and the working range of the cycle increase about 25% and 25.1% when volumetric efficiency increases 40%. While the optimal compression ratio corresponding to

maximum power output point remains constant with the increasing volumetric efficiency.

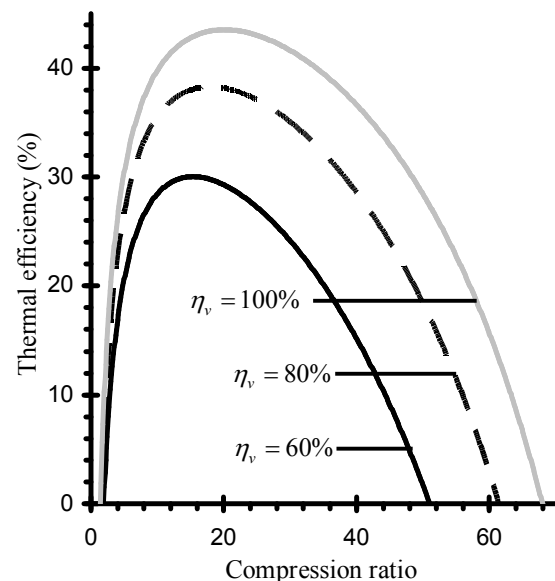


Figure 3. Effect of volumetric efficiency on the variation of the thermal efficiency with compression ratio

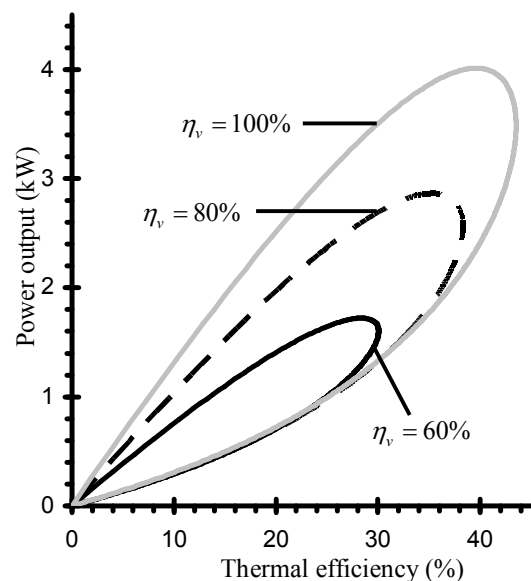


Figure 4. Effect of volumetric efficiency on the variation of the power output with thermal efficiency

Referring to Fig. 4, it can be seen that the power output at maximum thermal efficiency and the thermal efficiency at maximum power output improve when the volumetric efficiency increased. In other words, the power output at maximum thermal efficiency and the thermal efficiency at maximum power output increase about 54.3% and 28.7% when volumetric efficiency increases 40%.

4-Conclusion

In this paper, the effects of volumetric efficiency on the performance of an Otto cycle during the finite time are investigated. The general conclusions drawn from the results of this work are as follows:

- Throughout the compression ratio range, the power output and thermal efficiency increase with the increasing volumetric efficiency.
- The optimal compression ratio corresponding to maximum thermal efficiency point and the working range of the cycle increase as the volumetric efficiency increases. While the optimal compression ratio corresponding to maximum power output point remains constant with the increasing volumetric efficiency.
- The power output at maximum thermal efficiency and the thermal efficiency at maximum power output improve when the volumetric efficiency increased.

The results of this investigation are of importance when considering the designs of actual Otto engines.

Correspondence to:

Rahim Ebrahimi

Department of Agriculture Machine Mechanics
Shahrekord University, PO Box 115, Shahrekord,
Iran

Tel/Fax: 0098-381-4424412

Email: Rahim.Ebrahimi@gmail.com

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Regeneration and Plant Diversity of Natural and Planted Sal (*Shorea robusta* Gaertn.F.) Forests in the Terai – Bhabhar of Sohagibarwa Wildlife Sanctuary, India

D.S. Chauhan, Bhupendra Singh, Shashi Chauhan, C.S. Dhanai & N.P. Todaria

Department of Forestry, Post Box No. 59, H. N. B Garhwal University (Central University), Srinagar (Garhwal) –246174, Uttarakhand, India, e-mail: dschauhan2008@gmail.com; nptfd@yahoo.com

Abstract. We compared regeneration, tree diversity and floristic diversity of natural and planted tropical deciduous Sal (*Shorea robusta*) forest in Northeastern Uttar Pradesh, India. Species richness (105 and 95 species in natural and planted forests respectively) as well as species evenness was higher in natural forests than in planted forests. Natural forests also had higher mature tree, pole, sapling, and seedling densities compared to planted forest sites. In spite of differences in diversity, natural and planted forests did not differ significantly in species composition and 84 species occurred on both forests. Natural and planted forests did differ in soil moisture%, organic carbon%, available Nitrogen, Phosphorus, Potassium and soil pH. Dominant families in both forests types are Fabaceae (14 species), Mimosaceae, Euphorbiaceae and Moraceae (7 species each) followed by Verbenaceae and Caesalpiniaceae. Tree species dominated the flora (63 %). Of the 196 species found in both sites, 49% species showed good reproductive success, 40% species appeared poor and no seedling & sapling stages. The remaining 11% species were present as seedlings but not as adult individuals. Good quality timber species are not regenerating, with the exception of *Shorea robusta*, although mortality at seedling stages of this species is high. Our results suggest that the species richness and evenness differed between natural and planted forests and regeneration of some important tree species also varied from natural to planted forests due to differences in microclimate and soil characteristics. Moreover, the good reproductive success of both types of forests indicates the potential of forestry plantations in tropical deciduous forests. This study will help in the formation of effective forest management and conservation strategies. [Journal of American Science 2010;6(3):32-45]. (ISSN: 1545-1003).

Key words. *Shorea robusta*, diversity, regeneration, natural forest, planted forest and density.

Introduction

The species composition of forests depends on the regeneration of species composing the forest in space and time. Several types of disturbances affect the abundance and composition of seedlings in the forest understory (Benitez-Malvido 1998). An increasing interest in the development and management of mixed plantations, uneven-aged stands and natural forests has given rise to the need to understand the regenerative process that ensure maintenance of the community structure and ecosystem stability (Moravie *et al.* 1997). As floristic and structural composition change, the competitive relationship of species may change with corresponding changes in opportunities for regeneration (Barker & Kirkpatrick 1994).

The diversity of Sohagibarwa Wildlife Sanctuary is of prime importance because of its interesting flora and fauna. In the sanctuary, 75% of the area covered by Sal (*Shorea robusta*) is either natural or planted forests (Manikant 1994). More than half of the remaining forest in the Terai-Bhabhar of U.P. is dominated naturally by *Shorea robusta* Gaertn. f. (Dipterocarpaceae, locally called “Sal”). The Terai Sal forest is highly valuable timber species both commercial and subsistence

purposes and also important for livestock nutrition, animal bedding & compost and biologically diversity (Glimour and Fisher, 1991; Webb and Sah, 2003). Although timber production is key component to sustainable management of sal forests, whether by industry or communities (Sah, 2000b). Plantation is considered to hold potential for timber production and in some cases site amelioration (Jackson, 1994).

Some studies on Indian Sal communities are available (Gupta & Shukla 1991, Panday & Shukla 1999, 2001) and have compared the *taungya* plantation with natural forest stand in Darjeeling Himalaya with greater emphasis on the alteration of landscape, loss of species and recovery of the system (Uma Shankar 2001) and in Nepal Terai Sal forests have been studied by Webb & Shah 2002; Rautiainen & Suoheimo 1997; Matherma 1991. The present study is an attempt to compare the regeneration, diversity and other community attributes in natural and planted Sal forest in the Terai-Bhabhar forest of Sohagibarwa Wildlife Sanctuary Forest Division (U.P.), India. We wished to examine how species diversity, tree regeneration and soil parameters differed in planted forests vs. natural forests. We hypothesized that regeneration

differ in natural and planted forests and natural regeneration of existing species in planted forests. Such information may be useful for formulating conservation strategies for this wildlife Sanctuary and this hypothesis will provide important community-level information on natural and planted sal forest and its diversity. This information will be help full to the species which diversity and regeneration were high could be considered for afforestation programme in future and to conserve the biological diversity in the sanctuary.

Methods

Study area: We carried out our study in the Sohagibarwa Wildlife Sanctuary, which is located in the Maharajganj district of Uttar Pradesh, India. The Indo-Nepal border constitutes the northern boundary of the WLS. It is located between 27° 05' & 27° 25'N latitudes and 83° 20' & 84° 10' E longitudes and at 95 m above mean sea level. The forest belts adjacent to foothills of Central Himalaya fall under Terai region (foot hills of sub-mountain Himalaya are mainly composed of silt and clay soil transported by rivers), the major part of which covers forested zone of Northeastern U.P. under Sohagibarwa Forest Division (Management and administrative unit of forest area). The area of Sanctuary is 428 km² (42,820 ha) (Manikant 1994). These forests boast some of the finest stands of Sal in this bio-geographic zone (Rodgers & Panwar 1988). This division comprises seven ranges- Lachhimipur, North Chauk, South Chauk, Madhualia, Nichlaur, Pakri and Sohagibarwa.

The forest cover is generally dominated by plantations of Sal (*Shorea robusta*) followed by Teak (*Tectona grandis*), Jamun (*Syzygium cumini*) and Khair (*Acacia catechu*). There are few stands of fast growing tree species such as *Trewia nudiflora*, *Albizia lebbek*, *Bauhinia* spp. *Terminalia tomentosa*, *T. arjuna* and a few others. The climate is seasonal and subtropical. The average annual rainfall is about 1814 mm, 87% of which occurs during the wet summer (April to June) or monsoon season (July to September). During the relatively dry period of about 8 months, i.e. January-June and November-December the monthly rainfall is less than 100 mm. The soil is old gangetic alluvium, texture is sandy loam and the soil p^H is neutral (Panday & Shukla 2001). The area falls under the Terai – Bhabar biogeographic subdivision of upper Gangetic plain (7A) following the biogeographic classification of Rodgers & Panwar (1988). Sanctuary forests is characterized by following forest types (i) Group 2 - Tropical semi evergreen forest, sub group (ii) Group 3 - Tropical moist deciduous forest (iii) Group 4 - Tropical littoral and swamp

forest (iv) Group 5 - Tropical dry deciduous forest (Champion & Seth's 1968). The present study was concentrated only sal dominated three types forests i.e Group 2,3 and 5.

Sal had been planted in the Sanctuary mostly using the *taungya* system. Sal plantation continued to become established between 1933 to 1994 using the *taungya* system. However, clear felling was not carried out after 1993-94 in this area. Under early working plans, old Sal forests were clear felled and Teak was planted through *taungya* system. In this system, *Syzygium cumini*, *Terminalia tomentosa*, *T. arjuna* and other species have also been planted (Ahassan 1984, Manikant 1994). Mixed species plantation comprising of *Tectona grandis*, *Dalbergia sissoo*, *Acacia catechu*, *Trewia nudiflora*, *Kydia calycina*, *Syzygium cumini* and *Terminalia* spp. etc. were established as early as in 1944-45 to 1953-54 (Ahassan 1984). In the years 1984-85 to 1991-92, gap planting (*Syzygium cumini* and *Terminalia tomentosa*) was carried out in grass free areas (Manikant 1994).

Field inventory: We conducted our studies during 2001-2002 at seven forest sites under above mentioned forest types. At each site, we surveyed both natural and planted forests using a stratified random sampling technique. About 1% of the area in each site was sampled. Within each forest, we sampled 0.2 ha plots (50m x 40m = 2000 m²) for a total of 326 sample plots (215 natural + 111 planted forests). Within each sample plot, we surveyed nested in 2000 m², 20 quadrats (10 x 10m = 100 m²) for mature trees and poles (young tree of 2 to 13 m. height and 10 to 30 cm dbh) (density of all stems and size) and 80 quadrats (5 x 5 m = 25 m²) for shrub, sapling and seedlings (density and identity) nested in 2000 m². We define mature trees as stems > 30 cm dbh and >13 m height, poles as individuals >10 cm to < 30 cm dbh and > 2 to < 13 m height, sapling are individuals of > 1 cm to < 10 cm dbh and > 0.5 m to < 2 m height and seedling > 1 cm collar diameter and upto 0.5 m height. All sampled plants were counted and analyzed in each sample plot. The species sampled in the four layers of vegetation were classified into the following four growth forms: upper storey tree, under storey tree, shrub and climber.

The canopy cover of the trees was measured directly in the field by spherical densiometer. Soil p^H and soil moisture were measured by the Kelway soil acidity and moisture meter (No. 221175, Ben Meadows Company, USA) directly in the field. In each forest inventory plot, four soil samples were for analyzed for Soil p^H. However, soil samples were collected only at every second species inventory plots on the Sanctuary sites. The samples

were taken using an auger with a diameter of five cm. The samples representing topsoil were taken 0-20 cm beneath the ground surface and those representing subsoil were taken 20 – 50 cm beneath the ground. The soil samples were analyzed in the laboratory of the Forestry Department of HNB Garhwal University, Srinagar (Garhwal) and GB Pant Himalayan Institute & Development unit Srinagar (Garhwal), Uttarakhand, India. Available Nitrogen, Phosphorus, Potassium and Organic carbon were determined in the laboratory using the standard method of "Tropical Soil Biology and Fertility" (TSBF) (Anderson & Ingram, 1993).

Data analysis: Frequency, density, basal area, and importance value index (IVI) were determined for each species following Mueller – Dombois & Ellenberg (1974).

The diversity indices were calculated are richness, Shannon's diversity index (H'), Simpson's index (λ), evenness index (P) and Hill diversity index (N_1, N_2 ; i.e the number of dominating species). The data were analyzed statistically. In all comparison between tree and seedling density between natural and planted forest sites the t-test was used. A multivariate regression model of species richness and six explanatory variables such as soil characters in 326 plots in natural and planted forest sites were used. Linear regression analysis of seedling density vs adult density among all the

plots was also made. Multiple regression analysis is widely used and considered one of the most efficient parametric tests (Hader & Grandage, 1958).

Results

Floristic composition, species richness and diversity: We found one hundred eighteen species in our plots (50 upperstorey trees, 24 understorey trees, 36 shrubs and 8 climbers); with 105 species in natural forest and 94 in planted forest (Table 1) however, 84 species were found common to both types of forests.

The best-represented families in both forests were Fabaceae (14 species 12% of the total number of species), Mimosaceae, Euphorbiaceae and Moraceae (7 species each), Verbenaceae and Caesalpiniaceae (6 species each), Rubiaceae (5 species), Combretaceae and Tiliaceae (4 species each). Fabaceae constituted 12% of the total number of species, followed by Mimosaceae, Euphorbiaceae and Moraceae with 6%, respectively. Species diversity as well as richness was higher in natural forests than in planted forest (Table 1). Similarly, the Hill diversity index was relatively higher in natural forest (Table 1). Species evenness (Pielou index) had relatively higher values in planted forests than in natural forests.

Table 1. Regeneration, soil parameters (mean \pm S.D.), tree structure and diversity Indices of Sohagibarwa Wildlife Sanctuary.

Parameters	Natural forests	Planted forests
No. of plots	215.0	111.0
Tree density ha ⁻¹	136.4 \pm 42.0	107.4 \pm 30.6
Pole density ha ⁻¹	114.1 \pm 37.2	61.3 \pm 20.8
Sapling density ha ⁻¹	158.7 \pm 32.3	116.6 \pm 13.0
Seedling density ha ⁻¹	496.0 \pm 163.0	276.0 \pm 80.6
Species richness	105.0	94.0
No. of genera	81.0	74.0
No. of Families	49.0	47.0
Population density	23,522	15,275
Diversity index		
Shannon (H')	3.53	3.26
Simpson (C)	0.212	0.174
Evenness (E_i)	0.0346	0.0354
Hill diversity index		
N0	105.0	94.0
N1	29.75	28.83
N2	4.72	5.75
Canopy cover %	50-60	30-40
Soil moisture %	37.2 \pm 1.5	26.3 \pm 11.8
Soil organic Carbon %	2.2 \pm 0.3	1.5 \pm 0.3
Soil pH	7.2 \pm 0.1	6.8 \pm 0.1
Available Soil Nitrogen kg ha ⁻¹	209.2 \pm 18.3	170.0 \pm 18.3
Available Soil Phosphorus kg ha ⁻¹	10.7 \pm 2.3	8.4 \pm 1.3
Available Soil Potassium kg ha ⁻¹	331.0 \pm 21.4	294.5 \pm 21.6

Stand structure, density, basal area and soil characteristics: Tree density and average pole density significantly differed ($P < 0.05$) between natural and planted forests. Sapling density was not significantly different in natural and planted forests, while seedling density significantly differed ($P < 0.05$) in natural and planted forests (Table 1). Total population densities of natural and planted forests were 23,522 and 15,275 individuals, respectively, in all the studied areas. Average canopy cover ranged from 50-60% in natural forest and 30-40.5% in planted forests. The soil moisture %, organic carbon %, soil p^H , available Nitrogen, Phosphorus and Potassium, however, were slight higher in natural forests than in planted forests in Sohagibarwa Wildlife Sanctuary (Table 1).

Upperstorey tree density: In natural forest tree species was found higher (23.40 %) as compared to the planted forests. The mature as pole density was 45.72 % higher in natural forest as compared to the planted forest. Similarly, sapling and seedling densities were also higher (41.68 %) in natural forest as compared to planted forests. In natural forests, the genera *Terminalia* (4 spp.), *Ficus* (3 spp.), *Syzygium*, *Lagerstroemia* *Albizia* and *Acacia* were represented by two species each and remaining 32 genera by one species each in natural forest (Table 2). Whereas, *Terminalia* (3 species), *Acacia*, *Ficus* and *Syzygium* were represented by two species each and remaining 27 genera by one species each in planted forests (Table 2). Density of *Shorea robusta* (Dipterocarpaceae) in mature and pole strata was highest as compared to other tree species while lowest tree density was recorded for *Terminalia chebula* in natural forests. However, *Tectona grandis* (Verbenaceae) and *Shorea robusta* density for mature tree and pole was highest in planted forests. While minimum mature tree and pole density was recorded for *Alangium salvifolium* in planted forests (Table 2). Sapling and seedling density of *Shorea robusta* was also recorded highest in natural forests, whereas, lowest sapling and seedling density was recorded for *Ficus religiosa*. In planted forests, maximum sapling and seedling density was recorded again for *Shorea robusta*, while minimum density was observed for *Streblus asper* (Table 2).

Understorey tree density: In understory tree species number of tree were higher (26.08 %) in natural forest as compared to the planted forests. The mature and pole densities were maximum (49.95 %) in natural forest compared to the planted forest. Similarly sapling and seedling density was highest in natural forest which was 36.34 % greater

than planted forest. The genera *Bauhinia* and *Ficus* had three species each; *Bridelia* and *Miliusa* (two species each) and rest 13 genera were represented by one species each in natural forests. Whereas, in planted forests *Ficus* (3 species), *Bridelia*, *Cassia* and *Miliusa*, (Two species each) and 8 other genera were represented by one species each (Table 2). *Mallotus philippensis* (Euphorbiaceae) was highest in mature tree and pole density in natural forests and lowest density was recorded for *Bauhinia recemosa*. While maximum mature tree and pole density was also recorded for *Bauhinia recemosa* in planted forests but minimum density was recorded for *Casearia graveolens* (Table 2). In sapling and seedling strata, highest density was recorded for *Bridelia retusa* and lowest density for *Ficus palmata* in natural forests. Whereas, maximum sapling and seedling density was observed for *Mallotus philippensis* and minimum density was recorded for *Casearia graveolens* in planted forests (Table 2).

Shrub and climber density: The shrub species that are characterized by short stature, armed, including annual or biannual herbs with spiny structures (thorns and prickles) and climbers included species that were shade- loving, are mentioned in table 2 only in sapling and seedling categories. The shrub species was 23.53 % greater in planted forest than natural forest. A total seedling and sapling density was higher (20.48 %) in natural forests as compared to the planted forests. In natural forests, the genera *Desmodium* and *Moghania* were represented by three species each, *Grewia* and *Smilax* by two species each and by 16 other genera with one species each. Whereas, in planted forests genera *Desmodium* was represented by 4 species *Moghania* by 3 species, *Grewia*, *Smilax* and *Trumfetta* by 2 species each and rest of 21 genera were represented by one species each (Table 2). The highest density was recorded for *Helictres iosra* in both types of forests and lowest density was recorded for *Leea sambussina* in natural forests. The number of climber species was also highest (12.5 %) in natural forest as compared to the planted forest. The total climber density was higher in natural forest which was 45.78 % greater than planted forest. In natural and planted forests all the genera were represented by one species each (Table 2). The highest density for *Lachrocarpus fruntasens* and lowest density was recorded for *Gloriosa superba* in natural forests. Whereas, maximum density was recorded for *Clerodendrum viscosum* and minimum density for *Gloriosa superba* in planted forests (Table 2).

Table 2. Floristic composition and density (Seedling, Sapling, Pole and Mature trees ha⁻¹) (Mean± S.D.) in Natural and Planted forests of Sohagiberwa Wildlife Sanctuary.

Species	Family	Mature tree and Pole density ha ⁻¹		Sapling and seedling Density ha ⁻¹	
		Natural forest	Planted forest	Natural forest	Planted forest
Upperstorey Trees					
<i>Acacia catechu</i>	Mimosaceae	145.22±40.20	14.50±4.50	217.38±27.12	48.75±25.13
<i>Acacia nilotica</i>	Mimosaceae	16.00±6.25	26.14±10.12	9.67±1.50	0.00
<i>Adina cordifolia</i>	Rubiaceae	139.25±27.52	41.10±15.36	200.2±94.19	49.35±13.03
<i>Aegle marmelos</i>	Rutaceae	85.15±29.51	0.00	58.86±20.98	0.00
<i>Alangium salvifolium</i>	Alangiaceae	185.15±78.26	12.67±0.94	0.00	17.00±5.00
<i>Albizzia lebbek</i>	Mimosaceae	58.50±8.50	0.00	0.00	0.00
<i>Albizzia procera</i>	Mimosaceae	18.00±9.25	0.00	0.00	0.00
<i>Anthocephalus cadamba</i>	Rubiaceae	90.00±42.16	170.00±81.85	0.00	0.00
<i>Bombax ceiba</i>	Bombaceae	66.67±34.09	35.25±16.53	0.00	20.00±1.25
<i>Buchanania lanzan</i>	Anacardiaceae	0.00	15.00±4.53	0.00	0.00
<i>Butea monosperma</i>	Fabaceae	49.33±23.12	0.00	0.00	0.00
<i>Celtis tetrandra</i>	Ulmaceae	132.50±17.50	21.80±5.25	250.0±65.46	109.00±33.66
<i>Cordia dichotoma</i>	Ehretiaceae	79.00±21.00	55.60±7.11	0.00	21.50±12.05
<i>Dalbergia sissoo</i>	Fabaceae	91.43±8.29	206.50±66.50	0.00	0.00
<i>Dillenia pentagyna</i>	Dilleniaceae	54.67±33.08	35.00±17.52	0.00	0.00
<i>Diospyros tomentosa</i>	Ebenaceae	0.00	120.67±18.50	79.00±16.05	180.37±57.15
<i>Ehretia laevis</i>	Ehretiaceae	77.00±40.77	53.73±7.41	616.00±51.14	0.00
<i>Ficus glomerata</i>	Moraceae	51.58±16.35	109.33±27.04	0.00	35.00±15.00
<i>Ficus ramphii</i>	Moraceae	75.20±24.72	29.00±7.12	0.00	37.50±15.19
<i>Ficus religiosa</i>	Moraceae	63.50±3.50	0.00	5.71±1.25	0.00
<i>Gamelina arborea</i>	Verbenaceae	83.33±37.14	0.00	0.00	0.00
<i>Garuga pinnata</i>	Burseraceae	190.50±70.50	0.00	0.00	30.50±3.50
<i>Grewia subinaequalis</i>	Tiliaceae	0.00	0.00	487.75±184.4	46.67±15.06
<i>Holarrhena antidysenterica</i>	Apocynaceae	0.00	0.00	569.20±48.72	330.45±97.84
<i>Holopteta integrifolia</i>	Ulmaceae	75.40±24.92	75.77±36.83	141.50±58.50	78.00±35.84
<i>Kydia clycina</i>	Malvaceae	55.00±27.00	0.00	0.00	0.00
<i>Lagerstroemia parviflora</i>	Lythraceae	134.83±34.41	74.50±26.47	14.78±9.05	170.00±62.31.00
<i>Lagerstroemia speciosa</i>	Lythraceae	29.00±16.58	0.00	0.00	0.00
<i>Lannea cormendelica</i>	Anacardiaceae	111.86±50.85	0.00	0.00	0.00
<i>Madhuca indica</i>	Sapotaceae	52.50±22.69	0.00	0.00	150.00±45.0
<i>Mitragyna parviflora</i>	Rubiaceae	86.80±46.48	0.00	97.00±18.92	91.58±10.50

<i>Ougeinia oojeinensis</i>	Fabaceae	27.00±12.03	67.1±8.12	93.50±51.62	18.00±6.00
<i>Pongamia pinnata</i>	Fabaceae	41.25±14.81	0.00	0.00	80.00±21.25
<i>Pterocarpus marsupium</i>	Fabaceae	25.00±12.42	0.00	0.00	0.00
<i>Drypetes roxburghii</i>	Euphorbiaceae	22.25±10.78	75.50±45.50	140.00±43.20	17.25±4.76
<i>Schleichera oleosa</i>	Sapindaceae	167.00±77.04	0.00	329.6±127.73	191.8±150.73
<i>Semecarpus anacardium</i>	Anacardiaceae	109.00±27.03	40.00±29.25	0.00	0.00
<i>Shorea robusta</i>	Depterocarpaceae	328.56±41.73	242.08±20.60	1045.44±514.77	785.45± 419.98
<i>Stereospermum suaveolens</i>	Bignoaceae	59.00±6.98	0.00	0.00	0.00
<i>Streblus asper</i>	Moraceae	141.50±58.50	32.00±8.116	88.25±15.64	12.0±4.00
<i>Syzygium cerasoides</i>	Myrtaceae	100.00±35.00	233.50±16.56	0.00	0.00
<i>Syzygium cumini</i>	Myrtaceae	271.69±85.94	43.43±18.18	693.0±150.38	420.42±97.66
<i>Tectona grandis</i>	Verbenaceae	135.25±58.49	259.08±88.47	64.00±10.42	208.62±66.1
<i>Terminalia arjuna</i>	Combretaceae	87.60±15.87	0.00	0.00	17.50±5.50
<i>Terminalia bellirica</i>	Combretaceae	28.12±6.12	30.25±11.25	0.00	0.00
<i>Terminalia chebula</i>	Combretaceae	14.00±2.45	0.00	0.00	0.00
<i>Terminalia tomentosa</i>	Combretaceae	140.71±61.05	67.75±16.10	53.50±20.62	0.00
<i>Toona ciliate</i>	Meliaceae	36.25±15.26	23.28±11.26	56.25±29.56	0.00
<i>Trewia nudiflora</i>	Euphorbiaceae	59.27±33.36	66.00±43.12	119.79±36.27	0.00
Understorey Trees					
<i>Antidesma ghaesembilla</i>	Euphorbiaceae	15.14±8.13	0.00	0.00	0.00
<i>Barringtonia acutangula</i>	Lecythidaceae	0.00	9.50±2.29	49.15±16.25	75.00±33.94
<i>Bauhinia malabarica</i>	Caesalpiniaceae	72.00±42.74	52.50±19.20	0.00	0.00
<i>Bauhinia recemosa</i>	Caesalpiniaceae	13.14±6.12	148.40±34.74	0.00	36.00±8.00
<i>Bauhinia purpurea</i>	Caesalpiniaceae	14.28±8.04	0.00	0.00	0.00
<i>Bridelia retusa</i>	Euphorbiaceae	87.80±12.72	79.83±32.50	619.01±79.25	36.00±24.00
<i>Bridelia stipularis</i>	Euphorbiaceae	18.37±6.12	0.00	241.3±37.79	80.00±20.00
<i>Caesalpinia crista</i>	Caesalpiniaceae	0.00	0.00	26.42±14.12	19.00±2.00
<i>Casearia graveolens</i>	Flacourtiaceae	0.00	6.33±2.05	34.00±9.33	13.00±4.32
<i>Cassia fistula</i>	Caesalpiniaceae	31.00±17.12	0.00	375.5±70.38	152.78±20.56
<i>Cassia siamea</i>	Caesalpiniaceae	0.00	0.00	0.00	111.25±34.36
<i>Ficus hipsida</i>	Moraceae	0.00	0.00	40.00±16.25	37.50±15.19
<i>Ficus lacon</i>	Moraceae	123.67±12.69	17.00±8.69	0.00	0.00
<i>Ficus palmate</i>	Moraceae	0.00	16.00±1.12	9.43±2.45	0.00
<i>Litsea glutinosa</i>	Lauraceae	28.50±17.50	0.00	312.50±75.89	60.00±35.00

<i>Leucaenea luecocephala</i>	Mimosaceae	33.67±16.54	0.00	0.00	0.00
<i>Mallotus philippensis</i>	Euphorbiaceae	321.43±191.33	102.30±23.22	422.5±33.53	581.4±267.27
<i>Miliusa tomentosa</i>	Anonaceae	55.67±4.12	64.00±13.95	334.33±70.25	75.80±26.32
<i>Miliusa velutina</i>	Anonaceae	0.00	0.00	112.00±64.19	470.00±215.
<i>Phyllanthus emblica</i>	Euphorbiaceae	20.25±12.05	0.00	0.00	0.00
<i>Pithecellium dulce</i>	Mimosaceae	32.25±18.91	0.00	0.00	0.00
<i>Pygmaeoperma herbecea</i>	Verbenaceae	120±67.93	0.00	0.00	0.00
<i>Randia dumetorum</i>	Rubiaceae	0.00	11.00±2.12	186.67±18.01	31.67±8.22
<i>Salix tetrasperma</i>	Sailiceaea	25.40±5.00	0.00	0.00	0.00
Shrubs					
<i>Ardisia solanacea</i>	Myrinaceae	0.00	0.00	513.0±192.25	306.13±79.12
<i>Asparagus racemosa</i>	Liliaceae	0.00	0.00	170.00±81.85	36.00±17.00
<i>Ageratum conyzoides</i>	Asteraceae	0.00	0.00	0.00	17.86±3.07
<i>Aristolochia spp.</i>	Aristolochiaceae	0.00	0.00	14.12±6.12	16.50±5.30
<i>Berleria prioitis</i>	Acanthaceae	0.00	0.00	0.00	208.00±41.5
<i>Calamus tennis</i>	Arecaceae	0.00	0.00	254.18±93.69	50.25±14.77
<i>Callicarpa macrophylla</i>	Verbenaceae	0.00	0.00	215.01±34.88	92.98±32.32
<i>Calotropis procera</i>	Asclepiadaceae	0.00	0.00	0.00	45.00±39.10
<i>Carissa spinarum</i>	Apocynaceae	0.00	0.00	213.00±13.94	39.50±11.29
<i>Colebrookea oppositifolia</i>	Lamiaceae		0.00	287.57±190.28	0.00
<i>Curculigo orchioides</i>	Ammarillidaceae	0.00	0.00	0.00	77.67±11.50
<i>Desmodium gangeticum</i>	Fabaceae	0.00	0.00	60.14±19.26	31.50±10.50
<i>Desmodium heterocarpon</i>	Fabaceae	0.00	0.00	21.00±8.52	16.00±6.00
<i>Desmodium latifolium</i>	Fabaceae	0.00	0.00	220.00±10.92	130.00±50.50
<i>Desmodium pulchellum</i>	Fabaceae	0.00	0.00	0.00	104.00±32.00
<i>Glycosmis pentaphylla</i>	Rutaceae	0.00	0.00	698.6±189.67	242.6±49.81
<i>Grewia hirsute</i>	Tiliaceae	0.00	0.00	212.50±96.89	14.50±2.50
<i>Grewia tiliaefolia</i>	Tiliaceae	0.00	0.00	44.12±19.12	44.00±23.00
<i>Helicteres iosra</i>	Sterculiaceae	0.00	0.00	791.0±191.50	1371.0±711.5
<i>Hymenodictyon spp.</i>	Rubiaceae	0.00	0.00	434.2±273.46	25.50±10.50
<i>Indigofera cassioides</i>	Fabaceae	30.00±10.00	64.50±17.50	400.0±212.13	104.00±12.00
<i>Lantana camara</i>	Verbenaceae	0.00	0.00	0.00	1191.00±89.5
<i>Leea sambussina</i>	Tamaricaceae	0.00	0.00	10.00±6.25	11.00±2.00
<i>Moghania chappar</i>	Fabaceae	0.00	0.00	374.0±160.02	158.8±29.51

<i>Moghania lineate</i>	Fabaceae	0.00	0.00	20.00±11.26	29.50±2.50
<i>Moghania prostrate</i>	Fabaceae	0.00	0.00	618.0±181.33	60.00±10.0
<i>Murraya koenigii</i>	Rutaceae	0.00	0.00	384.56±56.8	114.75±64.97
<i>Rawolifia serpentine</i>	Apocynaceae	0.00	0.00	0.00	188.67±8.09
<i>Rosa invducrata</i>	Rosaceae	0.00	0.00	0.00	28.83±12.73
<i>Smilax macrophylla</i>	Smilacaceae	0.00	0.00	652.1±162.15	221.50±21.50
<i>Smilax prolifera</i>	Smilacaceae	0.00	0.00	185.33±84.98	27.50±4.50
<i>Tamarix dioice</i>	Tamaricaceae	0.00	0.00	194.33±95.87	0.00
<i>Tiliacora acuminata</i>	Menispermaceae	0.00	0.00	274.64±52.32	148.68±47.76
<i>Triumfetta pentandra</i>	Tiliaceae	0.00	0.00	0.00	10.5±01.50
<i>Triumfetta rhomboidea</i>	Tiliaceae	0.00	0.00	0.00	332.25±113.5
<i>Ziziphus mauritina</i>	Rhamnaceae	0.00	0.00	296.00±26.70	473.8±237.67
Climbers					
<i>Abrus precatorius</i>	Fabaceae	0.00	0.00	250±91.25	0.00
<i>Acacia concinna</i>	Mimosaceae	0.00	0.00	45.60±15.29	250.00±91.25
<i>Bauhinia vahlii</i>	Caesalpiniaceae	0.00	0.00	319.2±169.26	84.73±25.04
<i>Clerodendrum viscosum</i>	Verbenaceae	0.00	0.00	810.4±110.33	699.0±62.10
<i>Gloriosa superba</i>	Liliaceaea	0.00	0.00	33.14±6.12	43.00±17.19
<i>Lchnocarpus frutesens</i>	Apocynaceae	0.00	0.00	811.0±201.85	136.50±20.50
<i>Milletia auriculata</i>	Fabaceae	0.00	0.00	57.00±11.26	112.67±43.39
<i>Tinospora cordifolia</i>	Menispermaceae	0.00	0.00	211.5±114.04	50.00±28.12

Regeneration: In natural forests eight new species were regenerating in sapling and seedling stages including two upperstorey tree species (*Grewia subinaequalis* and *Holarrhena antidysenterica*) and six understorey tree species (*Barringtonia accutangula*, *Caesalpinia crista*, *Casearia graveolens*, *Ficus hipsida*, *Ficus plamata* and *Randia dumetorum*). Similarly, in planted forests, fifteen new species were also regenerating in sapling and seedling stages including eight upperstorey tree species (*Grewia subinaequalis*, *Cordia dichotoma*, *Holarrhena antidysenterica*, *Madhuca indica*, *Mitragyna parviflora* *Pongamia pinnata*, *Schleichera oleosa* and *Terminalia arjuna*) and seven understorey tree species (*Bridelia stipularia*, *Caesalpinia crista*, *Cassia fistula*, *Cassia siamea*, *Ficus hipsida*, *Litsea glutinosa* and *Milium velutina*). Of all 105 species in natural forest, 46% species was found in all three stages i.e. seedlings, sapling and mature tree and 45% species appeared poor & no seedling and sapling stages. The remaining 9% species seems to be either reappearing or immigrating in natural forests. In planted forests, out of total 91 species, 52% species was found seedling, sapling and mature stages and 32% species showed poor & no seedling and sapling stages and remaining 16 % seems to be either reappearing or immigrating.

The multiple regression data computed between few important tree species, tree and seedling density and six explanatory variables (soil moisture, soil organic carbon, soil pH, N.P & K) for natural and planted forests are given in table 3 and 4. The multiple regression models revealed significant impact of soil characteristics on tree and seedling density in natural forest (Table 3). The value of F-ratio is significant at 1% for *Bauhinia malabarica*, *Cassia fistula*, *Garuga pinnata*, *Holoptelea integrifolia*, *Lannea cormendelica*, *Milium tomentosa*, *Drypetes roxburghii*, *Shorea robusta*, *Schleichera oleosa*, *Streblus asper*, *Terminalia arjuna* and *T. tomentosa* trees densities and *Bridelia retusa*, *Celtis tetrandra*, *Cassia fistula*, *Diospyros tomentosa*, *Lagerstroemia parviflora*, *Randia dumetorum*, *Syzygium cumini* and *Tectona grandis* seedlings densities. It shows that the systematic variation is considerably more than should be explained by chance. The multiple regression models revealed significant impact of soil characteristics on tree and seedling density in planted forest also (Table 4). The value of F-ratio is significant at 1% for *Adina cordifolia*, *Bauhinia malabarica*, *Bridelia retusa*, *Mallotus philippensis*, *Terminalia tomentosa* trees densities and *Bauhinia recemosa*, *Garuga pinnata*, *Litsea glutinosa*,

Streblus asper, *Syzygium cumini*, *Tectona grandis* seedling densities.

Discussion

The flora of Sohagibarwa Wildlife Sanctuary forest is characterized by overwhelming dominance of the tree species (74 tree species including understorey) as compared to shrub and climbers. Of all individuals, 63% belong to trees. The dominance of upperstorey and understorey species appears to be the characteristic features of dry deciduous forests (Seetharam *et al.* 2000). The Sanctuary forest appears unusually rich in number of tree species compared to other Indian dry deciduous forest (Gupta & Shukla 1991) with 105 and 94 species in natural and planted forests across all the study sites. Generally tropical deciduous forests generally are remarkably consistent in their taxonomic composition (Uma Shankar 2001) with Leguminosae the most specious family followed by Bignoniaceae (Gentry 1995). This trend seems somewhat different for Indian deciduous forests wherein the Leguminosae is a dominant family (Sukumar *et al.* 1997, Uma Shankar 2001), followed by Euphorbiaceae and not Bignoniaceae. Besides these, Moraceae, Verbenaceae, Rubiaceae, Tiliaceae and Combretaceae were the next, in that order, in the present study.

The total number of species under four categories: upperstorey tree, understorey tree, shrub and climber were significantly higher in the natural forests. The species richness was recorded greater in natural forests than natural Terai Sal forest of Nepal (Webb & Sah 2003), Central Himalayan forests (Singh & Singh 1992), deciduous forest in the Western Ghats (Sukumar *et al.* 1997). Shannon's diversity index (H') was higher in the study area (3.26 for planted forests and 3.53 for natural forests) than the 1.58- 3.53 index value recorded for Old Sal plantations in Gorakhpur (Panday & Shukla 1999, Shukla & Panday 2000), 2.65 - 2.94 for Western Ghats (Arunachalam 2002) and a tropical dry evergreen forest (2.28) in Southern India (Parthasarathy & Sethi 1997). This also indicates that the Sal forests in Eastern Himalaya are more or less similar to the present study sites in terms of species richness, but less diverse than the present study sites in terms of different life forms. It is perhaps due to rich transported soil of Terai – Bhabhar. Historically Terai – Bhabhar forest area is mainly composed of gangetic alluvium with a succession of beds of sands and loam of varying depth (Champion & Seth's 1968). The surface soil in the low alluvium is very recent, but that in the high alluvium is mostly loamy sand varying in depth

Table 3. Regression equations for the tree species under study using parameters such as Soil Moisture, Soil Organic Carbon, p^H , Nitrogen, Phosphorus and Potassium with tree and seedling density in Natural Forest of SBWLS. No. of soil sample was 215.

Species		Regression equation coefficients		
		Intercept (SE)	R ² (adjusted r ²)	F ratio (significance level)
<i>Acacia catechu</i>	Tree	955.088 (477.606)	0.022 (-0.035)	0.386 (0.886)
	Seedling	165.918 (67.475)	0.037 (0.015)	1.347 (0.238)
<i>Adina cordifolia</i>	Tree	-6.480 (77.301)	0.028 (-0.001)	0.999 (0.427)
	Seedling	-27.269 (229.65)	0.047 (0.019)	1.715 (0.119)
<i>Alangium salvifolium</i>	Tree	372.686 (215.979)	0.046 (0.019)	1.681 (0.127)
<i>Anthocephalus cadamba</i>	Tree	70.413 (107.402)	0.210 (-0.007)	0.744 (0.615)
<i>Bauhinia racemosa</i>	Tree	10.918 (8.033)	0.023 (-0.005)	0.817 (0.557)
<i>Bauhinia malabarica</i>	Tree	-43.791 (61.234)	0.229 (0.207)	10.322 (5.280)
<i>Bridelia retusa</i>	Tree	152.935 (94.165)	0.031 (0.003)	1.098 (0.364)
	Seedling	-357.195 (430.308)	0.297 (0.276)	14.661 (0.000)
<i>Celtis tetrandra</i>	Tree	164.686 (47.895)	0.044 (0.016)	1.576 (0.156)
	Seedling	304.128 (118.937)	0.087 (0.060)	3.286 (0.004)
<i>Cassia fistula</i>	Tree	112.91 (33.725)	0.111 (0.086)	4.360 (0.000)
	Seedling	-142.373 (193.403)	0.195 (0.172)	8.419 (0.000)
<i>Dalbergia sissoo</i>	Tree	50.844 (73.851)	0.018 (-0.011)	0.628 (0.707)
<i>Diospyros tomentosa</i>	Seedling	266.787 (64.206)	0.098 (0.073)	3.789 (0.001)
<i>Ficus lacon</i>	Tree	83.531 (37.963)	0.019 (-0.009)	0.669 (0.674)
<i>Garuga pinnata</i>	Tree	-7.069 (122.255)	0.085 (0.059)	3.238 (0.004)
<i>Holoptelea integrifolia</i>	Tree	-11.009 (60.170)	0.137 (0.112)	5.504 (0.000)
	Seedling	96.761 (113.49)	0.048 (0.021)	1.752 (0.110)
<i>Lagerstroemia parviflora</i>	Tree	261.465 (120.927)	0.034 (0.006)	1.211 (0.302)
	Seedling	57.889 (22.940)	0.229 (0.208)	10.340 (5.080)
<i>Lannea cormendelica</i>	Tree	200.248 (91.820)	0.099 (0.073)	3.804 (0.001)
<i>Litsea glutinosa</i>	Tree	34.010 (31.256)	0.047 (0.020)	1.728 (0.115)
	Seedling	433.589 (172.707)	0.017 (-0.011)	0.615 (0.718)
<i>Milusa tomentosa</i>	Tree	139.493 (37.776)	0.171 (0.147)	7.178 (0.000)
	Seedling	499.341 (76.098)	0.015 (-0.013)	0.543 (0.775)
<i>Milusa velutina</i>	Seedling	56.500 (137.58)	0.009 (-0.019)	0.327 (0.921)
<i>Mallotus philippensis</i>	Tree	608.206 (274.709)	0.013 (-0.015)	0.462 (0.835)
<i>Drypetes roxburghii</i>	Tree	7.764 (26.62)	0.191 (0.168)	8.179 (5.950)
	Seedling	114.387 (78.016)	0.018 (-0.011)	0.621 (0.713)
<i>Randia dumetorum</i>	Seedling	702.551 (165.297)	0.107 (0.081)	4.144 (0.000)
<i>Shorea robusta</i>	Tree	510.765 (179.489)	0.132 (0.107)	5.282 (4.33)
	Seedling	2946.011 (1212.5)	0.049 (0.022)	1.816 (0.097)
<i>Schleichera oleosa</i>	Tree	18.364 (178.73)	0.104 (0.078)	4.013 (0.001)
<i>Streblus asper</i>	Tree	244.796 (74.965)	0.139 (0.115)	5.631 (1.940)
	Seedling	160.709 (57.627)	0.0127 (-0.016)	0.447 (0.846)
<i>Syzygium cumini</i>	Tree	366.423 (82.606)	0.045 (0.017)	1.636 (0.138)
	Seedling	306.971 (390.418)	0.199 (0.176)	8.616 (2.240)
<i>Tectona grandis</i>	Tree	183.165 (85.309)	0.022 (-0.006)	0.795 (0.575)
	Seedling	-70.718 (45.283)	0.082 (0.055)	3.093 (0.006)
<i>Trewia nudiflora</i>	Tree	166.335 (83.088)	0.077 (0.051)	2.914 (0.009)
	Seedling	22.082 (92.965)	0.026 (-0.002)	0.942 (0.465)
<i>Terminalia arjuna</i>	Tree	75.176 (70.515)	0.302 (0.282)	15.013 (2.970)
<i>Terminalia tomentosa</i>	Tree	186.417 (135.516)	0.321 (0.302)	16.416 (1.850)
	Seedling	77.375 (26.859)	0.044 (0.017)	1.607 (0.147)

Table 4. Regression equations for the tree species under study using parameters such as Soil Moisture, Soil Organic Carbon, p^H , Nitrogen, Phosphorus and Potassium with tree and seedling density in planted Forest of SBWLS. No. soil sample was 111.

Species		Regression equation coefficients		
		Intercept (SE)	R^2 (adjusted r^2)	F ratio (significance level)
<i>Acacia catechu</i>	Tree	22.198 (8.390)	0.104 (0.052)	2.023 (0.069)
	Seedling	44.633 (45.89)	0.026 (-0.029)	0.479 (0.822)
<i>Adina cordifolia</i>	Tree	158.573 (36.134)	0.296 (0.256)	7.297 (0.000)
	Seedling	212.339 (50.241)	0.119 (0.068)	2.349 (0.036)
<i>Alangium salvifolium</i>	Tree	-0.147 (9.000)	0.059 (0.005)	1.098 (0.368)
	Seedling	-7.290 (14.287)	0.048 (-0.007)	0.876 (0.515)
<i>Anthocephalus cadamba</i>	Tree	204.522 (83.970)	0.116 (0.065)	2.278 (0.041)
<i>Bauhinia racemosa</i>	Tree	317.178 (84.138)	0.069 (0.016)	1.295 (0.266)
	Seedling	93.852 (20.738)	0.217 (0.172)	4.815 (0.000)
<i>Bauhinia malabarica</i>	Tree	85.708 (32.791)	0.197 (0.150)	4.242 (0.000)
<i>Bridelia retusa</i>	Tree	83.266 (34.532)	0.151 (0.102)	3.074 (0.008)
	Seedling	50.782 (35.82)	0.047 (-0.008)	0.846 (0.537)
<i>Celtis tetrandra</i>	Tree	10.217 (16.977)	0.061 (0.007)	1.130 (0.349)
	Seedling	133.300 (77.964)	0.080 (0.027)	1.514 (0.180)
<i>Cassia fistula</i>	Seedling	13.768 (58.961)	0.028 (-0.027)	0.514 (0.796)
<i>Dalbergia sissoo</i>	Tree	67.873 (114.033)	0.030 (-0.026)	0.539 (0.777)
<i>Diospyros tomentosa</i>	Tree	30.154 (41.762)	0.032 (-0.023)	0.576 (0.748)
	seedling	139.95 (100.731)	0.036 (-0.019)	0.657 (0.684)
<i>Ficus lacon</i>	Tree	6.833 (13.611)	0.062 (0.007)	1.142 (0.343)
<i>Garuga pinnata</i>	Seedling	49.331 (11.409)	0.163 (0.114)	3.380 (0.004)
<i>Holoptelea integrifolia</i>	Tree	52.799 (45.640)	0.088 (0.036)	1.677 (0.133)
	Seedling	87.697 (35.849)	0.063 (0.008)	1.161 (0.332)
<i>Lagerstroemia parviflora</i>	Tree	21.710 (43.849)	0.137 (0.087)	2.760 (0.015)
	Seedling	229.270 (52.808)	0.105 (0.054)	2.043 (0.066)
<i>Litsea glutinosa</i>	Seedling	-133.173 (50.336)	0.249 (0.205)	5.744 (0.000)
<i>Milusa tomentosa</i>	Tree	72.799 (34.095)	0.062 (0.008)	1.150 (0.338)
	Seedling	93.054 (36.775)	0.035 (-0.019)	0.641 (0.697)
<i>Milusa velutina</i>	Seedling	955.088 (477.606)	0.022 (-0.034)	0.386 (0.886)
<i>Mallotus philippensis</i>	Tree	-30.126 (50.667)	0.258 (0.215)	6.042 (0.000)
	Seedling	551.823 (313.431)	0.046 (-0.009)	0.830 (0.549)
<i>Drypetes roxburghii</i>	Tree	17.884 (62.528)	0.022 (-0.34)	0.393 (0.882)
	Seedling	3.577 (13.978)	0.069 (0.16)	1.30 (0.263)
<i>Shorea robusta</i>	Tree	329.111 (125.744)	0.118 (0.067)	2.322 (0.038)
	Seedling	847.796 (125.359)	0.123 (0.073)	2.436 (0.030)
<i>Schleichera oleosa</i>	Seedling	-436.061 (206.872)	0.1117 (0.066)	2.297(0.040)
<i>Streblus asper</i>	Tree	19.496 (20.237)	0.118 (0.067)	2.311 (0.039)
	Seedling	-19.338 (9.792)	0.230 (0.186)	5.188 (0.000)
<i>Syzygium cumini</i>	Tree	61.096 (29.789)	0.045 (-0.010)	0.813 (0.563)
	Seedling	158.149 (214.376)	0.191 (0.144)	4.079 (0.001)
<i>Tectona grandis</i>	Tree	106.255 (134.659)	0.118 (0.067)	2.312 (0.039)
	Seedling	-70.707 (77.994)	0.246 (0.202)	5.645 (0.000)
<i>Trewia nudiflora</i>	Tree	88.207 (43.120)	0.019 (-0.038)	0.033 (0.919)
<i>Terminalia arjuna</i>	Seedling	18.613 (12.461)	0.079 (0.026)	1.496 (0.187)
<i>Terminalia tomentosa</i>	Tree	2.221 (41.659)	0.164 (0.116)	3.395 (0.004)

and composition (Champion & Seth's 1968). However, these comparisons convey limited meaning since the sample area is variable across studies sites and forest are mostly restricted to the protected area network.

Simpson's index for tropical Sal forests plantation in Gorakhpur ranged between 0.042-0.211 (Shukala & Panday 2000). In the present study, the Simpson value of 0.212 for natural forest and 0.174 for planted forest. The Pielou's evenness indices were 0.03460 and 0.354 for natural and planted forests respectively, which were (Table 1) lower than 0.9 on an average reported for Western Ghats (Arunachalam 2002) indicating low dominance and a more or less regular distribution of plant species in the study sites. Hill diversity numbers were relatively low in planted forests and significant variation could be observed between the two study areas, while in Western Ghats no significant variation was observed (Arunachalam 2002). A similarity in species richness and diversity indices is reflected in 84 species common in both sites, the similarity index indicating less variation in the species composition. This could also be attributed to no major variations among soil type and available soil nutrients between natural and planted forests of present study sites. There were slight variations in the soil moisture, pH, organic carbon, nitrogen, potassium and phosphorus among both types of forests.

It has been recorded that regeneration of tree species is affected by fire (Sukumar *et al.* 1997, Murthy *et al.* 2002), grazing, light, canopy density, soil moisture, soil nutrients and anthropogenic pressure (Teketay 1997, Cierjacks & Hensen 2004, Shrestha *et al.* 2007, Sagar & Singh 2005, Mishra *et al.* 2004). In general, regeneration of species is also affected by natural phenomena such as light gaps (Teketay 1997). In our study, planted forest sites showed low species density and diversity and high light penetration but no significant variation among soil characteristics (Table 1) as compared to the natural forest sites. The tree density and seedling density in natural forest are significantly influenced by soil characteristics as revealed by multiple regression models.

A few ecological studies (Sukumar *et al.* 1997, Murthy *et al.* 2002, Teketay 1997, Cierjacks & Hensen 2004, Shrestha *et al.* 2007, Sagar & Singh 2005, Mishra *et al.* 2004) have determined how regeneration of specific species relate to fire, grazing, light, canopy density, soil moisture, soil nutrients and anthropogenic disturbance. The species richness and seedling and sapling density of the natural forest sites were significantly higher compared to planted forests. In natural forest sites, two tree species, *Shorea robusta* and *Syzygium cumini*, were regenerating well with greater density in seedling and sapling populations. Sal forests have two important associated species

everywhere *Syzygium cumini* and *Mallotus philippensis*. The study area is a Sal dominated natural forests and Sal is one of the most important timber species in India. *Syzygium cumini* is an important fruit resource for herbivores within the protected area. *Tectona grandis* had higher seedling and sapling densities in planted forests. The greater number of saplings in the stands indicates the composition of future vegetation (Swaine & Hall 1988). According to Jones *et al.* (1994), seedling layers differ in composition from their respective overstories. Regeneration of species is dependent on internal community processes and exogenic disturbance (Barker & Kirpatrick 1994). Seedlings of three dominant overstorey species (*Shorea robusta*, *Syzygium cumini* and *Mallotus philippensis*) were found in most of the study plots, while for some other dominant species such as *Ailanthus excelsa*, *Streblus asper* and *Cordia dichotoma* seedling and sampling were not recorded in the study plots. The lack of juveniles of some of the primary species has also been reported from the rain forest of Khade, Ghana (Swain & Hall 1988). The low grade timber species, such as *Ehretia leavis* and *Syzygium cumini*; shrub species, such as *Helicteres iosra*, *Gylcosmis pentaphylla*; and climbers such as *Ichnocarpus frutesens*, *Clerodendrum visosum* were regenerating well.

The planted forest is still in the evolving stage. Some of the natural species such as *Grewia subinaequalis*, *Lagerstroemia parviflora*, *Miliusa tomentosa*, *Shorea robusta*, *Syzygium cumini*, and *Mallotus philippensis* were regenerating in the planted forests as well. Similar findings were also reported by other workers indicating that natural species have regenerated automatically under the plantations (Shah 1992). Interestingly, some natural species have been found regenerating automatically in planted forest thereby indicating that good management prescription has been carried out. This is an indication that protection carried by the Sanctuary authority has been enhancing the natural species regeneration in plantations.

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Correspondence to:

Dr. D.S. Chauhan
Senior Lecturer
Department of Forestry, H.N.B. Garhwal University,
Post Box-59, Srinagar Garhwal, 246 174
Uttarakhand India
Telephone -91-1346267529
Cellular Phone 91-9412949549
Email: dschauhan2008@gmail.com

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Dr. D.S. Chauhan is Senior Lecturer in the Department of Forestry. He has been actively involved in research and teaching of undergraduate and post graduate students of Forestry. Dr. Chauhan has supervised 10 students leading to M.Sc. thesis and 03 students leading to PhD. Degree. He has contributed more than 30 research papers in International and National Journal of repute and edited books. He has been published as co-edited book "Concepts in Forestry Research" (IBD Publishing, Dehradun). Presently he is Principal Investigator of a major research project on "Regeneration and plant diversity status along disturbance gradient on Oak natural forests in Garhwal Himalaya" funded by MoEF, Govt. of India, New Delhi and Co-PI of three other research project in the Department. He is also associated as Consultant with a group of interdisciplinary experts for consultancy research project in EIA & EMP of various river valley projects in Uttarakhand. His field of specialization is Natural Resource Management, Forest Ecology & Biodiversity. His other research interest includes RS & GIS, forest regeneration and Agroforestry.

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Microstrip Rectangular Patch Antenna Printed on LiTi Ferrite with Perpendicular DC Magnetic Biasing

Naveen Kumar Saxena^{1,*} (IEEE Student Member), Nitendar Kumar² and P.K.S. Pourush¹

1. Microwave Lab, Department of Physics, Agra College Agra 282002 (U.P) India.

Nav3091@rediffmail.com, ppourush@yahoo.co.in

2. Solid State Physics Laboratory, Timarpur, Delhi 110007 India.

Nitendar@rediffmail.com

Abstract: Characterization of a tunable & switchable microstrip rectangular patch antenna printed on synthesized LiTi ferrite substrate with a normal magnetic bias field is presented. In this paper the concept of switching and tuning has been described by magnetostatic and spin waves phenomenon. The DC magnetic biasing generate these both type of waves which response a number of novel magnetic and electrical characteristics including switchable and polarized radiations from a microstrip antenna. In such a case of substituted polycrystalline ferrite antenna due to the DC biasing, most of the power will be converted into mechanical waves and little radiates into air. Under such condition the antenna become switch off, in the sense of effectively absence as radiator. The preparation of ferrite by the solid state reaction technique is also précised with the short description of electric and magnetic properties. [Journal of American Science 2010;6(3):46-51]. (ISSN: 1545-1003).

Index Terms: Substituted ferrite, microstrip patch antenna, magnetostatic waves, spin waves, X-band frequency range.

List of Symbols

f_r	= resonant frequency
h	= height of substrate
λ	= wavelength
a_i	= inter-atomic space
s	= side length of rectangular patch
β_x, β_y	= progressive phase excitation difference along x and y direction respectively
d_x, d_y	= element separation along x and y direction respectively
α	= attenuation constant
β	= phase constant
β_0	= propagation constant in vacuum
ϵ_r	= dielectric constant
μ_{eff}	= effective permeability
μ, κ	= permeability tensor components of μ_{eff}
T	= relaxation time
H_0	= applied bias field
ΔH	= magnetic resonance width of ferrite
ω	= angular frequency of incident e-m-waves
ω_0	= external magnetic field angular frequency
ω_m	= internal magnetic field angular frequency
ω_{ex}	= internal magnetic field angular frequency due to exchange forces
μ'	= real part of permeability
μ''	= dissipative part of permeability
χ'	= real part of susceptibility
χ''	= dissipative part of susceptibility
$4\pi M_s$	= saturation magnetization
γ	= gyromagnetic ratio (2.8 MHz / Oe.)

1. Introduction

In the present era of high frequency communication, ferrite is one of the important magnetic materials which are used as in both types single and polycrystalline. Some novel characteristics of polycrystalline ferrite over normal dielectric material make it very useful in microwave antenna applications. Different types of polycrystalline ferrites have their specific advantages as Li substituted ferrites has high dielectric constant, low sintering temperature etc. than other substituted ferrites. The reason for using ferrite materials in microstrip structures is that the applied magnetic field changes the permeability and thus the electrical properties of material, which in turn changes the antenna properties. The significance of this is that it is possible to change the antenna characteristics through the DC magnetic field applied externally (Pozar et al., 1993, 1992, 1988; Fukusako et al., 1998).

Beam steering, gain and bandwidth enhancement, RCS control, surface wave reduction, switchable and electronic tunability are some of the unique and inherent features of ferrite based microstrip antennas and arrays, which have been discussed by numbers of investigators for the C-band and S-band but not for the X-band (Dixit et al., 2000; Batchelor et al., 1997; Ufimtsev et al., 2000; Horsfield et al., 2000).

In the present paper, the concept of tunable antenna with the magnetostatic and spin wave has

been developed by rectangular patch printed on LiTi ferrite substrate in the X band.

2. Theory

The geometry of antenna is shown in fig. 1. The patch of length 'L' and width 'W' printed on LiTi ferrite substrate of thickness 'h'. The dielectric constant and saturation magnetization ($4\pi M_s$) of substrate is 16 and 2200 Gauss respectively. There are many feeding techniques available but due to the brittleness of substrate stripline feeding is preferred.

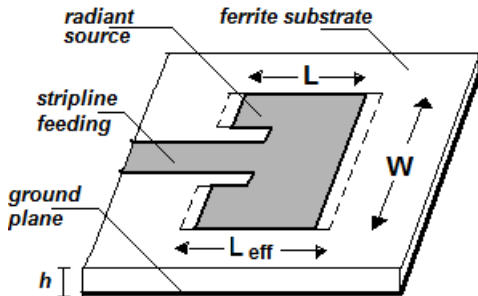


Figure 1. Geometry of microstrip rectangular patch antenna.

Consider a plane wave propagating in the perpendicular direction of slab with a magnetic bias field applied longitudinally. As a result of elasticity of the spin (magnetic) system, oscillations (precession) of the magnetic moments with the frequency of exciting force can exist and they are in resonance for the frequency equal to $\mu_0 \gamma H_i$, where H_i is the internal field in the magnetic material. If these oscillations are excited in limited region of the ferrite sample, then due to elasticity of this system they will propagate with a defined velocity in the sample. This propagating disturbance represents magnetostatic and spin waves. These waves are generated when external magnetic field applied perpendicular to the magnetic vector of EM waves. MSW propagate perpendicularly on both sides to the EM wave's propagation [Lax et al, 1962].

If we consider the infinite medium plane wave solution of the equations of motion including the spin wave "exchange" term and neglecting losses then the dispersion relation for ω as a function of k , for the biquadratic equation (4) is given by:

$$\omega^2 = \frac{\frac{k^2}{4\mu} + (\omega_r + \omega_M)^2 \pm \left\{ \left[\frac{k^2}{4\mu} + (\omega_r + \omega_M)^2 \right]^2 - 4(\omega_r^2 + \omega_M \omega_r) \frac{k^2}{4\mu} \right\}^{1/2}}{2} \quad (1)$$

If we plot the dispersion relation (5) then we got-

a curve between frequency (ω) and propagation constant (k) for a particular value of external magnetic field (H_0). The value of propagation constant (k) becomes zero twice at which the frequency known as cutoff frequency which is due to the generation of three types of waves: quasi TEM, Magnetostatic and Spin waves. Spin wave excitation is the result of exchange forces between atoms. Magnetostatic waves are of two types (1) Surface MSW (2) Volume MSW (Lax et al, 1962; Kabos et al, 1994; Sodha et al, 1981).

A. Surface MSW

Surface magnetostatic waves are the most common and well investigated class of magnetostatic waves. These waves propagate in ferromagnetic materials magnetized in the layer plane perpendicularly to the direction of the magnetic field. The classical dispersion equations first published by Damon and Eshbach in 1961, so that these wave also known as Damon-Eshbach waves. The dispersion relation of surface MSW with spin wave exchange term, given as follows:

$$\omega^2 = \omega_H (\omega_H + \omega_r) + \frac{\omega_M^2}{2(1 + \tanh^{-1}(kt))} \quad (2)$$

Surface MSW band limits:

$$\mu_0 \gamma \sqrt{H(H + M_0)} \leq \omega \leq \mu_0 \gamma H \left(H + \frac{M_0}{2} \right) \quad (3)$$

Surface MSW in metal coated ferrite:

$$\omega \leq \mu_0 \gamma (H + M_0) \quad (4)$$

B. Volume MSW

These types of waves generally produce dominantly in the layered structure perpendicular to surface MSW propagation or magnetized layer. The dispersion relation of volume MSW with spin wave exchange term, given as follows:

$$\omega^2 = \omega_r \left[\omega_r + \frac{\omega_M}{1 + \left(\frac{\pi M}{kt} \right)^2} \right] \quad (5)$$

Volume MSW band limits:

$$\mu_0 \gamma H \leq \omega \leq \mu_0 \gamma \sqrt{H(H + M_0)} \quad (6)$$

3. Synthesis Of Substrate

LiTi ferrite synthesized from the basic components of lithium ferrites. The ingredients required for the preparation of these ferrites have

been calculated on the basis of chemical formula. A small amount of Mn^{3+} ion has been also incorporated in the basic composition in order to suppress the formation of Fe^{2+} ions in the ferrites and to influence magnetostriction being a Jahn Teller ion (Uitert et al., 1956; Kishan et al, 1985). In order to avoid Lithia at high temperature of sintering, Bi_2O_3 (0.25 wt %) has been added as sintering aid (Randhawa et al, 2007). Analytical grade chemicals have been used for the preparation of the material. The stoichiometric ratio of the chemicals has been thoroughly mixed in a polypropylene jar containing the zirconium balls and distilled water has been used as a mixing agent. The presintering of the mixed powder has been carried out at $\sim 750^\circ C$ in a box furnace and soaking time was kept 4 hours. The sieved material has been pressed in disk (antenna substrate) and toroidal shapes with the help of suitable dies and using hydraulic pressing technique at pressure of 10 ton/cm^2 . The substrates and toroidals have been finally sintered at $1050^\circ C$ for four hours. The heating and cooling cycle of the samples has been carried out in the air atmosphere of furnace. The sintered samples so obtained have been subjected to cutting, grinding, polishing etc, in order to get specific size and shape.

The single-phase spinel nature of the samples has been confirmed by X-ray diffraction (XRD) patterns obtained by using Cu- K_α radiation. The microstructure studies of the sample have been carried out by scanning electron microscopy (SEM). Vibrating Sample Magnetometer (VSM) has been used to determine the magnetic properties of the samples. For dielectric measurements, rectangular pellets of size $25 \text{ mm} \times 13 \text{ mm} \times 7 \text{ mm}$ have been used. The dielectric measurements have been performed from 8 to 12 GHz by a VNA E8263B Agilent Technology impedance analyzer. The value of the real part of dielectric constant (ϵ') of the ferrite samples has been calculated using formula $\epsilon' = Ct/\epsilon_0 A$ where ' ϵ_0 ' is the permittivity of free space $= 8.854 \times 10^{-12} \text{ F/m}$, 'C' is the capacitance of specimen, 't' is the thickness of specimen and 'A' is the area of sample in square meter. The density measurement has been done by a small experiment based on Archimedes' principle. Remanence and Coercive Force have been measured by B-H loop setup applied to coiled toroid sample at 50 Hz.

The Curie temperature for the LiTi ferrite samples has been determined by using a simple experimental setup based on gravity effect in the laboratory. The ferrite specimen has been made to attach itself to a bar magnet through a mild steel rod due to the magnetic attraction and combination was suspended inside the furnace. A chromel-alumel thermocouple has been attached with the sample holder to read the temperature of the specimen. As

the temperature of the system was increased, at a particular temperature the specimen loses its spontaneous magnetization and becomes paramagnetic. This temperature is known as Curie temperature. At this temperature specimen falls downward due to gravity. The electrical and magnetic properties of LiTi ferrite substrate have been experimentally calculated in laboratory which is listed in table 1.

Table1. The electrical and magnetic properties of LiTi ferrite substrate

LiTi Ferrite Characteristics	Values
Magnetic Saturation ($4\pi M_s$)	2200 Gauss
Curie Temperature (T_c)	500 K
Density (ρ)	4.21 grams/cm ³
Remanence	0.90
Coercivity	1.50
Dielectric Constant (ϵ)	17.5
Resonance Line Width (ΔH)	370 Oersteds
Loss Tangent ($\tan \delta$)	< 0.0005

4. Simulation And Characterization

The dispersion curve for the material has been plotted and shown in fig. 2. It is clear from the curve that when ferrite substrate is magnetized the propagation constant (k) varies with frequency and the initial linear part of the curve represents quasi TEM wave excitation which is of very small order (10^{-100}) in comparison of scale (10^8). The rest part of the curve represents MSW and Spin wave excitation. Spin wave excitation is the result of exchange forces between atoms.

According to Fig. 2 the absorbing power due to the MSW generation is in a particular limit. This particular limit depends upon the thickness of substrate, Resonance Line Width (ΔH) and external magnetic field orientation. Here obtained results are simulated and are in close agreement with results available in the literature.

The dimension of patch is calculated by following equations:

$$W = \frac{\epsilon}{2f \sqrt{\epsilon_{\text{eff}}}} \quad (7)$$

$$L = \frac{\epsilon}{2f \sqrt{\frac{(\epsilon_{\text{eff}} + 1)}{2}}} - 2\Delta l \quad (8)$$

where

$$\left[\Delta l = 0.412 h \frac{(\epsilon_{reff} + 0.9)(a/h + 0.264)}{(\epsilon_{reff} - 0.258)(a/h + 0.8)} \right]$$

$$L_{eff} = L + 2\Delta l$$

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left(\frac{10h}{a} \right)^{-1/2}$$

These equations are based on Transmission Line model. Symbol a, b, h, is the width, length and thickness of the patch respectively. To obtain good performance, there are many feeding methods, such as CPW in the ground feeding microstrip antenna, and CPW with stub patch feeding slot antenna (Bahl et al, 1980; Balanis et al, 1982).

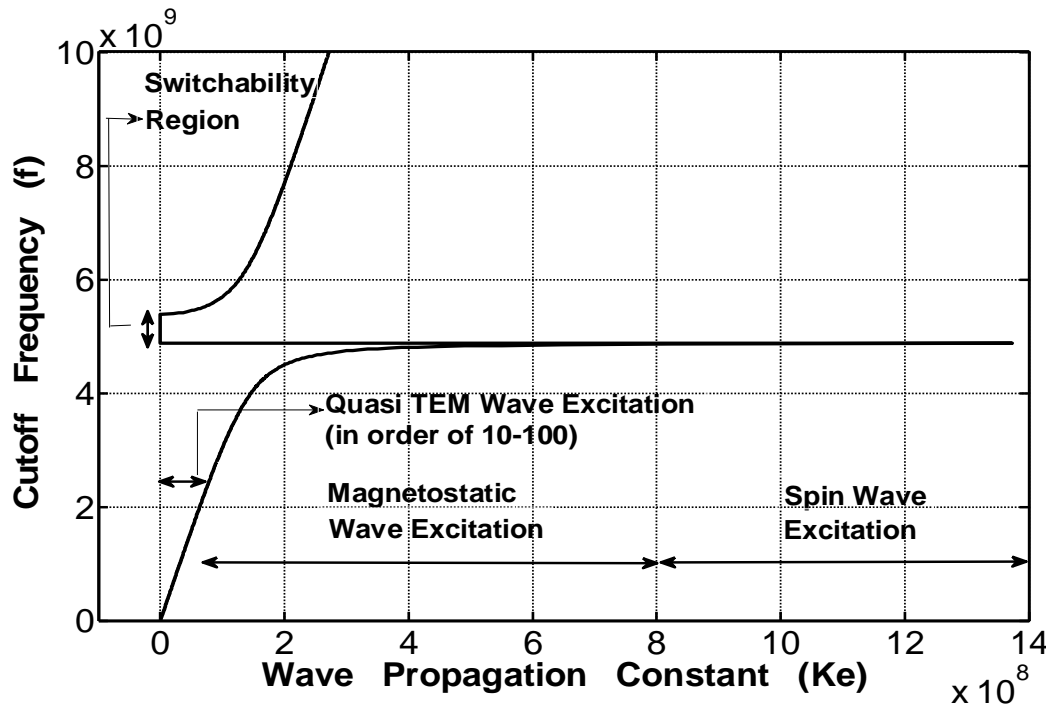


Figure 2. Dispersion curve (f vs. K) for plane wave propagation perpendicular to biasing field.

Thus the far zone expressions for rectangular patch microstrip antenna are obtained as follow:

$$E_\theta = 0 \text{ and } E_\phi = -2jV_0 W k F(\theta, \phi) \quad (9)$$

where V_0 = voltage across the patch.

$$F(\theta, \phi) = \frac{\sin\left(\frac{kh}{2} \sin\theta \cos\phi\right)}{\frac{kh}{2} \sin\theta \cos\phi} \times \frac{\sin\left(\frac{kW}{2} \cos\theta\right)}{\frac{kW}{2} \cos\theta} \sin\theta$$

and

$$k_{\pm} = \omega^2 \epsilon \mu_0 \frac{(\omega_r + \omega_M)^2 - \omega^2}{\omega_r^2 + \omega_r \omega_M + \omega^2}$$

The polarization of antenna radiation can be decided by the propagation constant k as shown in table 2. The parameters related to patch characterization are calculated for biased and unbiased ferrite substrate, listed in table 3. By the help of these parameters and mathematical software (Mathworks MatLab 7.1), the radiation patterns are plotted in fig. 3 & 4 for E-plane and H-plane respectively for this geometry. These curves show a comparison between unbiased and biased substituted polycrystalline ferrite substrate patch antenna.

The total field pattern $R(\theta, \phi)$ is generally obtained from the relation [9-11]:

$$R(\theta, \phi) = |E_{\theta}|^2 + |E_{\phi}|^2 \quad (10)$$

The value of $R(\theta, \phi)$ is computed for a case taking source frequency $f=10$ GHz, $k = k_+$, $\epsilon_r = 16$, $h = 0.165$ cm, $s = 0.2104$ cm and loss tangent = 0.0005. For the array element separation

$d_x = d_y = \lambda/2$ cm and progressive phase excitation is $\beta_x = \beta_y = 0$.

Table 2. Antenna's polarization function based on the propagation of magnetostatic and spin waves.

Extraordinary Wave Propagation with Propagation Constant	Antenna Function
Negative k	Off
Positive k_+	Radiate with RHCP
Positive k_-	Radiate with LHCP

Table 3. Comparison of Antenna's parameters for Unbiased and biased case.

Parameters	Unbiased	Biased
Total Impedance (Z_{in})	32.54 ohms	83.52 ohms
Quality Factor (Q)	~7 %	~7 %
Bandwidth (BW)	~3 dB	~3 dB
Directivity Gain (D)	3.5	7.6
Radiation Power (P_r)	7.7 mW	3.0 mW
Efficiency	49 %	49 %

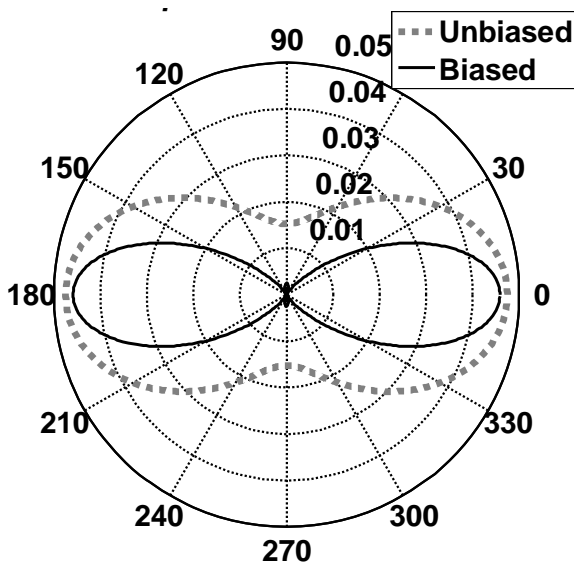


Figure 3. Comparison of E-plane pattern of rectangular patch microstrip antenna with RHCP for unbiased case and biased case.

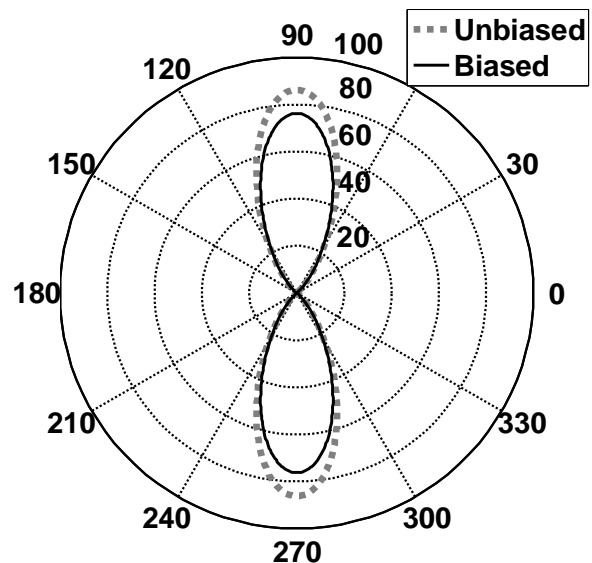


Figure 4. Comparison of H-plane pattern of rectangular patch microstrip antenna with RHCP for unbiased case and biased case.

Conclusions

The integration of ferrite technology into microstrip printed circuit antenna has numerous advantages and potential applications. In this paper we have synthesized LiTi polycrystalline ferrite substrate using SSRT as a substrate for microstrip rectangular patch antenna at 10 GHz. of microwave frequency range. The parameters used for the study of biased ferrite substrate are saturation magnetization ($4\pi M_s$) = 2200 Gauss and bias field H_0 = 1750 Oe. While, for unbiased ferrite substrate bias field become H_0 = 0 Oe. The radiation patterns and antenna's characteristics are calculated and reported in fig. 3, 4 and table 1, 2, 3 respectively.

It is evident from the dispersion effect on ferrite material that there should be a propagating and

non-propagating region for an antenna. There is a frequency range bounded by limits, namely cutoff limit or resonance limit. In this where H_{eff} is negative, the extraordinary wave is highly attenuating and therefore the antenna is effectively off as radiator. Some salient features of this array geometry are summarized as follow:

1. Comparison shows that on biasing, the radiation patterns becomes directive in nature. Directiveness can be observed by the comparison of E-plane pattern as shown in figure 3.
2. It is evident from the dispersion curve that, for the given parameters, the cut-off limit is between 5 GHz. to 5.5 GHz. and tunable resonant region

lies, except of the cutoff region. This property of antenna shows its switchable and tunable capability which can be varied as per requirement.

3. When the antenna became biased with DC magnetic field the parameters show that the directivity gain is increased but the radiation power is decreased accordingly. Measurement also shows the increasing of total impedance in the case of external DC biasing.
4. The size of patch is reduced considerable 35% comparable when designed on Quartz substrate. This reduction would certainly have a wide use in creating a miniaturization of an antenna system which has a potential application in space and cellular communication.

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Correspondence to:

Naveen Kumar Saxena (*IEEE Student Member*)
Microwave Lab, Department of Physics
Agra College Agra, 282002 (U.P) India.
Cellular Phone: 919411083091
Email: Nav3091@rediffmail.com

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Vitamin E and Curcumin Intervention on Lipid-Peroxidation and Antioxidant Defense System

¹A.R Amani, ²M.N. Somchit, ³M.M. B Konting, ⁴Kok L Y

^{1,3,4}Department of Sport Science, Faculty of Educational Studies, Universiti Putra Malaysia

²Department of Biomedical Science, Faculty of Health and Medical, Universiti Putra Malaysia
nazrul.hakim@gmail.com , Alireza.daryasar@gmail.com¹

Abstract: The generation of free radical species may represent the negative aspect of exercise. There are a lot of data which have been shown an association between exercise and the increased free radical formation. Living cellular damage may lead human towards hasty aging and variant cancers. It is widely agreed that with increasing consumption of fruits and vegetables, decreased intake of unsaturated fat and moderate exercise will enhance fitness and improved cardiovascular health of the population in most of the developed and near-developed countries. Vitamin E and Curcumin have been known as a strong Antioxidant for prevent of the lipid peroxidation and improve the antioxidant defense system. Curcumin is a phenolic compound presented as a strong anti-oxidative, anti-inflammatory and anti-septic property, widely used in Indian medicine and culinary traditions. Recent investigation has shown that curcumin prevents lipid peroxidation and DNA strand breakage. This review have been shown the effect of the curcumin and vitamin E supplement on the lippid peroxidation and antioxidant defense system specify during the exercise. [Journal of American Science 2010;6(3):52-62]. (ISSN: 1545-1003).

Keywords: Vitamin E, Curcumin, Exercise, Antioxidant, Lipid-Proxidation, Free radical

1. Introduction: It is widely agreed that with increasing consumption of fruits and vegetables, decreased intake of unsaturated fat and moderate exercise, will enhance fitness and improved cardiovascular health of the population in most of the developed and near-developed countries(Lloyd et al., 1998). Fruits, vegetables and grains are rich of antioxidant because they contain ascorbate, tocopherols, tocotrienols, flavonoids, other phenols and carotenoids (Stangeland et al., 2008). An antioxidant is a molecule capable of slowing or preventing the oxidation of other molecules. Oxidation is a chemical reaction that transfer electron from a substance to an oxidizing agent. Oxidation reaction can produce free radicals. Antioxidant terminates the chain of the reaction by removing free radicals and inhibits other oxidation reaction by oxidizing themselves. The balance between free radicals formation and antioxidant activity is called oxidative stress. When the oxidative stress is unbalanced in favor for free radicals, such as acute and chronic exercises, damage occurs to many cellular membranes such as

the hearth and skeletal muscles (Jenkinson et al., 1999).

2. Methodology. The current studies has been focused on Curcumin intervention as an herbal antioxidant on lipid-peroxidation during the exercise. PubMed and SPORT Discus databases were searched from 1982 to 2009 using the terms Curcumin, Vitamin E, Curcumin and Exercise, Vitamin E and Exercise and Lipid Peroxidation. Related studies were located by reviewing the reference lists of the articles identified through the computer database search. There are many studies of the effects of Curcumin supplementation in lipid Peroxidation among human and animal subject. Some limitation in muscle sampling among the human people was the cause to do research in antioxidant among rats and other animal that are closely respond similar with human.

Free radicals and antioxidant enzymes have been implicated as important factors in fitness and for the battle of some diseases such as diverse cancer,

diabetes and cardiovascular diseases in recent century. It has been demonstrated that antioxidant enzymes can prevent living cells' membrane from damage and lipid peroxidation where free radicals may cause damage to the cellular agent. Researchers showed that the increase of free radicals is the result of the increased oxygen utilization. Physical exercise associated with oxidative damage is dependent on the type and intensity of exercises. However, some investigations have demonstrated that by endurance training improved the antioxidant defense system as well as oxidative capacity in the skeletal muscles (Powers et al., 1999; Terblanche, 1999). Metabolic rates as a result of exercise may increase oxygen consumption (VO_2 max) up to 20 times over steady state. Evidences have shown that aerobic exercise generated reactive oxygen species such as superoxide radical (O_2^-), hydroxyl radical ($\cdot\text{OH}$), perhydroxyl radical (HO_2^\cdot) and Conjugated peroxy radical which are capable of damaging living cellular and caused inflammation (Alessio & Goldfarb, 1988; Liu et al., 2000). The benefits of using supplementary antioxidant to prevent reactive oxygen species (ROS) appear in large investigations. Curcumin is a phenolic compound present as a strong anti-oxidative, anti-inflammatory and anti-septic property, widely used in Indian medicine and culinary traditions. Recent investigation has shown that curcumin prevents lipid peroxidation and DNA strand breakage (James S. Wright, 2002). The presumption of whether the combined effect from both the exercise and curcumin would yield more antioxidant activity or free radicals damage and muscle lipid peroxidation remain controversial. The only research which has tested antioxidant and exercise have provided contradictory conclusion. In the research, they used vitamin E as an antioxidant supplement (Viitala et al., 2004).

2.1 Free Radicals and Oxidative Stress: Any chemical species which has an unpaired electron or an odd number of electrons may be labeled as free radicals. Free radicals are the very high reactive molecular that seek to combine with other molecular to react and make their way to unpaired electron molecules (McBride & Kraemer, 1999). The term free radical has been around for over 40 years. However, this term may have many meanings according to the variety of specific researches. In general free radical is an atom or group of atoms with an unpaired electron in the outer orbits. Some of the free radicals such as melanin are not chemically reactive, but this is not true for most of the biological-relevant oxygen free radicals. The unpaired electron is usually extremely

exchangeable, which is the chemical and physical reason for the reactivity of radical species (Urban Wiklund, 2009). The level of the free radicals' reactivity depends on their life span or the survival of the radical species. Some radicals exist only for a fraction of seconds before they participated in a chemical reaction. Some radicals which have obtained an extremely low energy level, are therefore referred to as the stable radicals (Sawyer, 1988). Normally millions of free radicals are continually created in our physiology to carry on the metabolic activity of the body. They are essential to life, we need them, and they fight infections. Our cells boost up these free radicals to kill the germs when we are infected with *bacteria*, *fungus*, and *parasites*. Oxygen is known to be a free radical; it is highly unstable. Oxygen is a life saver but if one is to be given 100% oxygen, it is highly toxic. Why does oxygen become toxic? It is a molecule which consists of two atoms of oxygen, and when they are combined, they balance out each other. But if it is unstable, and if the two atoms are separated, they became two free radicals. But free radicals are not limited only of oxygen. Any molecules, any atoms in the body can become a free radical, and when it does, it will try to balance itself by picking up an electron from a neighboring molecule which in turn will become a free radical and this vicious cycle will continue until it is checked and controlled. If it is not controlled, damage will occur in different parts of the body (Sharma, 1993). There are many environmental and biochemical factors which hinder the production of free radicals such as metabolism, pollution, radiation, cigarette smoke and herbicides. However, free radicals can be produced by several mechanisms. Dissolution of the cells, hemolytic fission and electron transfer in the mitochondria are the few most important ways to produce free radicals (Cheeseman & Slater, 1993). It has been nearly 50 years since Denham Harman suggested that free radicals produced during aerobic respiration caused cumulative oxygen damage, resulting in aging and death. Oxygen is an essential molecule for all aerobic forms. Hence, Oxygen is indispensable for all cells for chemistry energy production (ATP). It is often transformed into a highly reactive form: reactive oxygen species (ROS), which is very toxic for all cells and can damage the molecular membrane (Haddad, 2002), (Figure 1).

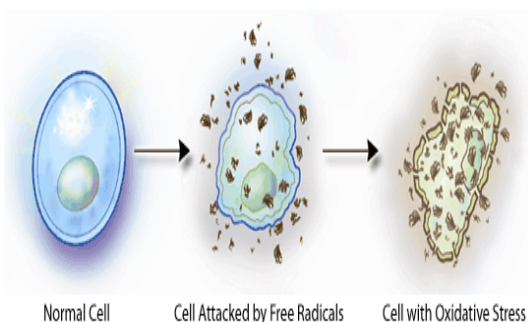


Figure 1. Free Radicals And Oxidative Stress

In chemistry, radicals (often referred to as free radicals) are atoms, molecules or ions with unpaired electrons on otherwise open shell configuration. These unpaired electrons are usually highly reactive, whereby radicals are likely to take part in chemical reactions (Figure 1).

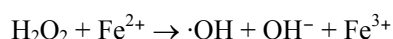


Figure 2. Free Radicals Formation Mechanisms

The most important free radicals in our bodies are the radical derivatives of oxygen better known as reactive oxygen species (Cheeseman & Slater, 1993). These include oxygen in its triplet state (3O_2) or singlet state ($^1\text{O}_2$), superoxide anion ($\text{O}_2^{\cdot-}$), hydroxyl radical ($\cdot\text{OH}$), nitric oxide ($\text{NO}\cdot$), peroxynitrite ($\text{ONOO}\cdot$), hypochlorous acid (HOCl), hydrogen peroxide (H_2O_2), alkoxyl radical ($\text{LO}\cdot$), and the peroxy radical ($\text{LO}_2\cdot$). Another than that, there is the carbon-centered free radical ($\text{CCl}_3\cdot$) which arises from the attack of an oxidizing radical at an organic molecule. Hydrogen centered radical is a result from an attack of the H atom ($\text{H}\cdot$). Another form is the sulfur-centered radical produced from the oxidation of glutathione which resulted in the thiyl radical ($\text{R-S}\cdot$). A nitrogen-centered radical also exists for example the phenyl diazine radical. Under normal condition (at rest), the antioxidant defense system within the body can easily handle free radicals that are produced. During times of increased oxygen flux (i.e. exercise), free radicals production may ultimately exceed removal resulted in lipid peroxidation. Free radicals have been implicated to play a role in the etiology of cardiovascular disease, cancer, Alzheimer's disease, and Parkinson's disease. Although it is worthy of a discussion, these conditions are not the focus of the current literature reviews (Valko et al., 2007).

Table 1 . Biologically Significant Free radical

Reactive Oxygen Species	
$\text{O}_2^{\cdot-}$	Superoxide radical
$\cdot\text{OH}$	Hydroxyl radical
$\text{ROO}\cdot$	Peroxy radical
H_2O_2	Hydrogen peroxide
$^1\text{O}_2$	Singlet oxygen
$\text{NO}\cdot$	Nitric oxide
ONOO^-	Peroxynitrite
HOCl	Hypochlorous acid

2.2 Lipid-Proxidation: Free radicals may attack many components of a cell such as the polyunsaturated fatty acid (PUFA), deoxyribonucleic acid (DNA) and proteins. The damage of the lipid membrane is called lipid peroxidation. Lipid peroxidation is a process related to free radicals whereby in this process, free radicals got hold of electrons from the lipid such as the cellular membrane. This process often affects the polyunsaturated fatty acid (figure 2), because they contain multiple double bands in between which lie the methylene- CH_2 groups that contain the reactive oxygen. In the cellular membrane, the oxidative stress is the by-product of the free radicals oxygen (Viitala et al., 2004). Lipid peroxidation is the most popular biomarker of the oxidative stress. There are three steps in lipid peroxidation as in the following:

- First step is the initiation: the initiation is the step where the fatty acid radical is produced. In this step, a reactive oxygen species or (ROS) such as OH^- is combined with a hydrogen atom to make water and a fatty acid radical.
- Second step of the lipid peroxidation is called the propagation. In this step, the fatty acid radical which is the by-product of the first step, is a set of very unstable molecules where it reacts readily with oxygen to create the peroxy-fatty acid radical.
- Radical Reaction stops when two radicals react and produce a non-radical species. This happens when the concentration of radical species is high enough to enable two radicals to react together and produce a non-radical species.

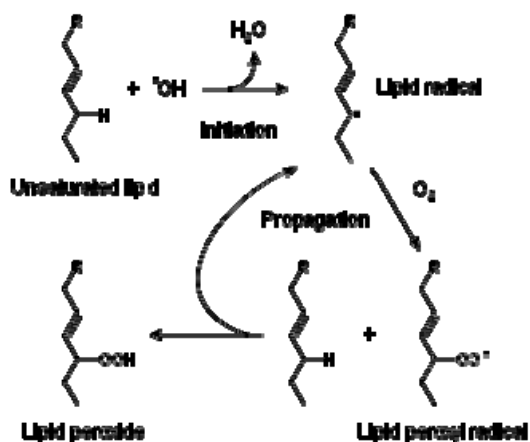


Figure 3. Mechanism of Lipid-Peroxidation

Malonaldehyde (MDA), thiobarbituric acid reactive substance (TBARS), lipid hydroperoxides (LH), and 4-hydroxyalkenals (4-HNE) are the example of lipid peroxidation by-products which have been used as biomarker of lipid peroxidation level. Many investigations have shown that MDA, TBARS, LH and 4-HNE are directly linked to increase the rates of lipid peroxidation (LaMonte et al., 2000).

2.3 Antioxidant Properties of Curcumin. An antioxidant molecule can prevent the oxidation of other molecules. Oxidation is a chemical reaction that transfers an electron from a molecule to an oxidizing agent. Oxidation reaction can produce free radicals which caused cellular damage. Antioxidants terminate this chain reaction by removing the free radical species and inhibit other oxidation reactions by oxidized themselves (LaMonte et al., 2000). There are two major antioxidant defense systems to protect our bodies against the reactive oxygen species and cellular damage, which are the enzymatic and non-enzymatic antioxidants. The non-enzymatic system includes the glutathione, uric acid, vitamin C, and vitamin E. Antioxidant enzymes are also produced by our bodies which include catalase, superoxide dismutase, and glutathione peroxidase (Szymonik-Lesiuk et al., 2003). These two type of antioxidant systems are working together to ameliorate any harmful effects of oxidant in the cell. Both of the enzymatic and non-enzymatic antioxidants detoxify ROS in the intracellular and extracellular environments (LaMonte et al., 2000). To provide maximum intracellular protection, these scavenger agents are strategically located in the cells.

2.4 Curcumin: is a yellow agent from curcuma longa (figure 2-7 to 2-10). It is a major component of turmeric and is commonly used as spice and food coloring component in some countries especially in India and the Middle East area. Three decades of

researches show that curcumin is a component with anti-inflammatory, antitumor and antioxidant properties. The first chemical characterization of curcumin was obtained in 1910, with the molecular formula of $\text{C}_{21}\text{H}_{20}\text{O}_6$. The antioxidant mechanism of curcumin has recently been the focus of free-radical chemists and biologists. Curcumin is the main biologically active phytochemical (of chemical reactions resulting from the influence of light or radiation) compound of Turmeric (Fahey & Talalay, 1999). More than one billion people consume curcumin regularly in their daily diet. Curcumin has long been used in some Eastern medicine and also used for protection against cancer and cardiovascular disease nowadays (Menon & Sudheer, 2007).

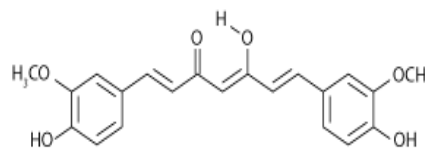


Figure 4. Curcumin Molecule Structure

Curcumin keeps the heart healthy by preventing a plaque build-up in the arteries, which can lead to atherosclerosis. In one study, participants who take 500 milligrams of curcumin each day significantly have their cholesterol levels reduced in simply 10 days. Preliminary research indicates that curcumin may also help lower blood pressure and prevent blood clots (Martin -2003).



Figure 5. Turmeric Rhizome

Numerous research teams provide evidence that curcumin contributes to the inhibition of tumour formation and is promoted as the inhibition of cancer. This compound is also known to decrease and block the progression of tumours. Azuine et al. described curcumin as inhibit tumor.

Most of the antioxidants have either a phenolic functional group or a B-diketone group. Curcumin is

a unique antioxidant which has a variety of functional groups including the carbon-carbon double bond, B-diketone group and phenyl rings that contain varying amounts of hydroxyl and methoxy substituents (James S. Wright, 2002). Recently, many studies on the health benefits associated with curcumin have been reported. In the present study, an attempt has been made to test individual curcuminoids, such as curcumin, bisdemethoxycurcumin and demethoxycurcumin, for their antioxidant activities with the *in vitro* model systems. Water and fat-soluble extracts of turmeric and its curcumin components exhibit strong antioxidant activities, compared to vitamins C and E. A study has showed curcumin to be eight times more powerful than vitamin E in the case of preventing lipid peroxidation (Majeed, 1999).

2.5 Vitamin E is referred to a related compound (tocopherols) which have hydroxylated aromatic rings and isoprenoid side chain. The hydrophilic molecule is the major lipid soluble antioxidant in the membranes of living cells and it protects cells against lipid peroxidation by acting directly with a variety of oxygen reactive radicals, containing single oxygen, lipid peroxidation products and superoxide radicals to form relatively harmlessly with tocopherol radical to regenerate reduced tocopherol (Rumsey et al., 1999).

2.6 effects of training on the antioxidant defense system

As the number of studies which investigate the impact of exercise on oxidative stress increased, researchers speculate that regular exercise training induced an adaptive response in the antioxidant defense system. Consequently, this enhances the protection against reactive oxygen species (ROS) and decrease the accumulation of oxidative damage in living cells. Exercise volume is related to the blood antioxidants and antioxidant enzymes. Some of the other investigations show that specific evidence of exercise induces oxidative stress due to the lack of mitochondrial to generate free radicals. This is because these reactive oxygen species are very short-lived and also difficult to measure directly (Di Meo & Venditti, 2001). Reactive oxygen species (ROS) can be generated through different pathways and from different forms of exercise and training. The balance between the production of reactive oxygen species and the capacity of the antioxidant defense system determines the extent of oxidative stress within the system. Jackson (1994) suggested that the title of exercise is an umbrella term. Since there are different forms of exercise, oxidative stress induced by exercise must be considered based on the type of exercise performed.

During aerobic exercise, there is an increased need for the production of adenosine three phosphate (ATP) in the muscle cells. This production occurs through the reduction of molecular oxygen in the mitochondria. With the increased aerobic metabolism, this provides an increase in the electron flux among the mitochondrial electron transport chain. The increased oxygen metabolism will increase the formation of oxygen radical through the mitochondrial respiratory chain. In addition, if the exercise has a high mechanical impact, there may be destruction of erythrocytes, which could release iron into the circulation. Myoglobin may also be released into the circulation if there is any damage to the skeletal muscle. The production of Hydroxyl radical can be stimulated by these free iron ions by catalyzing the "Fenton reaction" ((Halliwell & Gutteridge, 1985)).

In studies which deal with vitamin C supplement in humans, the doses have varied considerably. Alessio et al. (1997) used acute (1 and 7 days) (1.0 g/day) vitamin C supplement and did not observe a reduction in oxidative stress induced by exercise. Conversely, a higher dose of (3.0 g/day) vitamin C supplement for two weeks was shown to be able to reduce plasma protein carbonyls (Bryer & Goldfarb, 2006). Goldfarb and Patrick (2005) reported that both 500 mg and 1 gm of vitamin C that were given two weeks prior to exercise could attenuate the oxidative stress induced by exercise as indicated by the reduction of protein carbonyls. The results showed reduction was dependent on the doses given. Interestingly, there were no changes with the glutathione status during the exercise or the treatment. Muscle soreness and oxidative stress had both been reported to be reduced with high doses of vitamin C supplement following an eccentric exercise (Kaminski et al., 1992; Bryer and Goldfarb, 2006). It seems that higher doses of vitamin C supplement create beneficial effects when dealing with oxidative stress induced by exercise. The role of vitamin C supplement has not been studied in myocardium where oxidative stress is induced by exercise.

There are a lot of interests in the effects of antioxidant supplement both in terms of promoting performance and also preventing tissues damage, which occur during exercise, particularly for those who undertake irregular and strenuous activity.

The states of Cellular prooxidant are defined as the increased concentrations of active oxygen, organic peroxides, and radicals. A prooxidant state may be induced by environmental factors, such as by chemicals and irradiation, as well as physiological factors, for example, under the condition of physical exercise. The effects of Prooxidant from the various factors of biological systems are most commonly

estimated by the degree of consequent lipid peroxidation. However, it is not clear whether the products of lipid peroxidation is a cause or a consequence of diseases(Esterbauer et al., 1992).

2.7 Mechanisms and the peroxide-removing antioxidant system.

To assess the peroxidation process, the products of lipid peroxidation will be analyzed. Thus, conjugated dienes arises as an early event of reactions to lipid peroxidation. Several end products of lipid peroxidation(Uotila et al., 1993), such as aldehydes, react readily with thiobarbituric acid (TBA) and is defined as thiobarbituric acid reactive material (TBARM). Fluorescent chromolipids are inactive compounds formed by the reactions of aldehydes with free amino groups. Reactive oxygen species (ROS) are of biological molecules such as lipids, proteins and DNA. Antioxidant molecules prevent and/or inhibit these harmful reactions(Erel, 2004).

In 1978, Dillard et al. were the first to demonstrate that physical exercise could lead to an increase of lipid peroxidation. They observed a 1.8-fold increase in the exhaled pentane level, a possible by-product of oxidative lipid damage, after 60 minutes of cycling at 25–75% of $\dot{V}O_2\text{max}$. Since then, increased bodies of evidence have been accumulated to support the hypothesis that physical exercise has the potential to increase the production of free radicals which lead to oxidative stress. To measure the production of free radicals directly is difficult, primarily because of the short life-span of this species. The use of free radicals' spin traps could increase this life-span and there have been recent studies demonstrated that the blood removed from an individual who does exercise has an enhanced ability to trap free radicals when assayed by *ex vivo*(Powers et al., 1994).

They reported that Long Evans male rats, who do exercise, have increased lipid peroxidation, as measured by the used of TBARS. Since then, studies have been carried out on humans to evaluate whether exercise increases oxidative stress. While many studies supported Davies' findings, at the same time many refuted of them also(Bor et al., 2003; White et al., 2008).

The generation of Reactive radical oxygen species (ROS) increases with the aerobic endurance stress. The major source of ROS is thought to be the mitochondria of active muscles, but free radicals are also produced by red blood cells or during inflammatory response. When the antioxidant system is not adapted to excessive production of ROS, oxidative stress initiates. ROS are potent to

induce various cellular damage affecting lipids, proteins and nucleic acids. The imbalance between oxidants and antioxidants will affect the normal function of immune cells. In order to prevent exercise-induced oxidative stress, the organism is well equipped with antioxidant defense systems including enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GSH-Px), and non-enzymatic substances such as reduced glutathione (GSH) and vitamins A, C, E, and selenium that act in synergy. Vitamin E is considered the most important lipid-soluble exogenous antioxidant in humans. Vitamin E serves as an antioxidant directly by scavenging aqueous peroxyl radicals and indirectly by regenerating reduced vitamin E(Bonithon-Kopp et al., 1997).

Packer (1991) suggested that there was an increased requirement for vitamin E during endurance training. There may be a number of sources of this oxidative stress, including the production of mitochondrial superoxide, ischaemia-reperfusion mechanisms and auto-oxidation of catecholamines. Severe or prolonged exercise could overwhelm antioxidant defences, which included vitamins E and C and thiol antioxidants where both were interlinked in an antioxidant network, as well as the antioxidant enzymes (Packer, 1997).

The Emory's researchers found that people who had participated in an aerobic exercise program for a year actually had greater rate of LDL oxidation than a similar group who did not exercise (Shern-Brewer et al., 1998).

In an investigation by Afzalpour et al. (2008), they examined the effect of moderate and vigorous aerobic exercise with the serum oxidized low density lipoprotein (ox-LDL) levels and total antioxidant capacity (TAC) in trained and untrained health subjects. In this investigation, they found out that serum ox-LDL and TAC were not affected by exercising, and concluded that there was a positive correlation between $\dot{V}O_2\text{max}$ and total antioxidant capacity (TAC) whereas there was a negative correlation between TAC and LDL-C as well as TC. Afzalpour (2008) suggested that physical training could improve the antioxidant defense systems(Afzalpour et al., 2008).

Rafael et al. (2007) investigated the effects of aerobic exercise training on the activities and mRNA level of catalase (CAT), glutathione peroxidase (GPX), Cu-Zn superoxide dismutase and manganese superoxide dismutase (Mn-SOD), the TBARS contents and the activities of xanthine oxidase (XO), in the soleus muscle of young and aged rats. In this investigation, it was shown that the activity and mRNA level of antioxidant enzyme had markedly increased in the soleus muscle along with

aging. An increase of all antioxidant activities except for the Cu-ZN superoxide dismutase were found in the young rats with induced exercise training. In this group, Xanthine oxidase (XO) also did not change. TBARS which is the by-product of lipid peroxidation had increased in the soleus muscle of young rats involved with the training. The activity level of catalase (CAT), glutathione peroxidase (GPX) and Cu-Zn superoxide dismutase did not change on the soleus muscle of aged rats with exercise training while activities of Mn-SOD and XO increased (40%) and (27%) respectively. TBARS in aged rats with training had increased by (80%). This investigation showed that lipid peroxidation level increased with training in both aged and young rats by exercise training (Lambertucci et al., 2007).

The influence of vitamin C as a parameter for the blood oxidative stress in basketball players in response to maximal exercise was investigated by Cholewa et al. (2007). This investigation showed that there were significant effects of vitamin E supplement in the serum of vitamin C concentration and that there was no effect as in the 21 days of vitamin C intake at the blood antioxidant system as well as the MDA (Lipid peroxidation products) and $VO_2\text{max}$ as an aerobic capacity. This investigation also showed that exercise did not change the SOD enzymes, GPx, CAT, GR and GSH activities but changes could be seen in vitamin C and MDA concentration. The final of this research showed that vitamin C has no effect at the blood antioxidant status and $VO_2\text{max}$ in basketball players. (Cholewa et al., 2008)

Mustafa Gul (2003) and his colleagues investigated the effects of endurance training and acute exhaustive exercise of the antioxidant defense mechanism in rats' hearts. In this investigation they used the male rats with 8-weeks of treadmill training. The Malondialdehyde level in the heart tissues was not affected by acute exhaustive exercise for both trained and untrained rats. In both acute exercise and trained groups, the activities of the glutathione reductase and glutathione peroxidase enzymes decreased while the activity of catalase was not affected. Additionally in this investigation, the activities of the total and non-enzymatic superoxide scavenger were not affected. The activity of Superoxide dismutase decreased with acute exercise in untrained rats. The result of this investigation showed that a rat's heart has sufficient capacity of antioxidant enzyme to cope with exercise-induced oxidative stress and adaptive changes in antioxidant enzymes due to the limited endurance exercise (Williams et al., 2007).

Alessio and Goldfarb (1988) had examined lipid peroxidation and scavenger enzymes during

exercise: adaptive response to training. In this study, it was shown that the training program which contained the endurance exercise caused a 64% increase of oxidative capacity in the leg muscle. With the sedentary exercise group, there was an increase during lipid peroxidation in the liver and white muscle. The endurance group of rats did not have any increase of the lipid peroxidation after exercise. In this investigation, it also showed that the activity of catalase (CAT) was higher in both red and white muscles after exercise for trained rats. Acute and chronic exercise was not affected by superoxide dismutase (SOD) in both acute and chronic group of rats. This investigation showed that endurance training could reduce lipid peroxidation indicated by malondialdehyde (MDA) in the rats (Alessio & Goldfarb, 1988).

Dietary intakes of polyunsaturated fatty acids and the indices of oxidative stress in human volunteers were investigated by Jenkinson et al. (1999). In this investigation, Jenkinson and his colleagues used human subjects in their investigation. A significant increase in the whole blood of oxidised glutathione where there was an index of oxidative stress had been found after consumption of high polyunsaturated fatty acids (PUFA) diet. The investigation also showed that TBARS as an index of lipid peroxidation was increased using the high PUFA and decreased by consuming the low PUFA diet. Superoxide dismutase and total cholesterol decreased after consumption of the low PUFA diet. In this investigation they suggested that the increase of vitamin E intake was required when PUFA diet increased (Jenkinson et al., 1999).

The effects of antioxidant vitamin supplement at the resistance of exercise which induced lipid peroxidation in trained and untrained participants were investigated by Viitala et al. (2004). At the end of this investigation, there was no any significant difference between placebo and vitamin E supplement in trained and untrained rats. All of the rats in this study had been selected equally in term of the blood's vitamin E level and the percentage of body fat (Viitala et al., 2004).

Other than that, Wright (2002) investigated the prediction of antioxidant activity for curcumin and curcuminoids. Curcuminoids which included curcumin and other related molecules were strong antioxidant with medical effects. The curcumin structure had multiple function groups including β -diketon. Carbon-carbon double bond and phenyl ring contained varying amount of hydroxyl and methoxy substituent. The site of the activity and reaction mechanism of the curcumin, responsible for the antioxidant effects were controversial (J. S. Wright, 2002).

The effects of dietary vitamin E, C and soybean oil supplement of the activities of antioxidant enzyme in the liver and muscles of rats were investigated by Shireen et al. (2008). In this study, they examined the effects of elevated levels of dietary vitamin E, C and the combination of vitamin E and vitamin C (E & C) combined with soybean oil of the activities of antioxidant enzymes important for the protection against lipid peroxidation in male rats. At the end of this research, it was showed that the combination of Vitamin C and vitamin E as well as separate daily supplement for 28 days increased catalase (CAT), glutathione peroxidase (GPx) and glutathione reductase (GR) activities in liver, pectoralis major and sartorius muscles. These enzymes increased significantly in rats fed with the diet which included vitamin C, E separately, and the combination of vitamin C and Vitamin E with the exception of superoxide dismutase (SOD), which showed no alteration. However this investigation showed that the combination of vitamin E and C enhanced the activities of antioxidant enzymes more significantly and also showed that the role of vitamin C and vitamin E and their combination to reduce the risk of chronic diseases and cells damage related to oxidative stress(Shireen et al., 2008).

Davis and his colleagues investigated the effects of curcumin on inflammation and the recovery performance of running as in the downhill running of mice. At the end of this research, it was showed that Downhill running decreased both treadmill running time in term of fatigue (48h and 72h) and voluntary activity (24h) ($P<0.05$), where curcumin feedings offset these effects on the running performance. Downhill running was also associated with an increase of inflammatory cytokines (24h and 48h) and creatine kinase (24h) ($P<0.05$) that were blunted by curcumin feedings. These results supported the hypothesis that curcumin could reduce inflammation and offset some of the performance deficits associated with eccentric exercise-induced muscle damage (Davis et al., 2007).

Bryant et al. (2003) had investigated the effects of vitamin E and vitamin C supplement either individually or combined on the exercise-induced

lipid peroxidation in trained cyclists. They used seven trained male cyclists who (at the age of 22.3 \pm 2 years) participated in four separate supplementary phases. The results of this investigation showed that the treatment of vitamin E alone was more effective than vitamin C. MDA level of pre-exercise in the plasma during the vitamin E trial and MDA level of pre-exercise with placebo was 2.94 \pm 0.54 and 4.81 \pm 0.65 micromol per ml respectively. The plasma MDA level following the exercise in the vitamin group was lower than the placebo group. At the end of this research, it could be seen that 400IU/day of vitamin E reduced membrane damage more effectively than vitamin C but it did not enhance performance (Bryant et al., 2003).

3. Conclusion There are a lot of data which show that free radicals and reactive oxygen species increased cardiovascular risks and also increased damage done on the membrane of living cells. Curcumin and Vitamin E are as The strong antioxidant supplement which are decreases the lipid peroxidation and improves total antioxidant capacity in the human and animal body. Also have been shown that acute and chronic exercise training would increase the oxygen reactive concentration in the body. However for long term, regular endurance training improved the total antioxidant capacity. According to the last investigation, we can predicate that exercise will improve antioxidant defense system and increase lipid peroxidation in cells' membranes more significantly. This investigation will examine the affects of both supplementary curcumin and exercise on the antioxidant defence system and lipid peroxidation.

Corresponding Author:

AliReza Amani
University Putra Malaysia
43400, Serdang, Selangor, Malaysia
Alireza.daryasar@gmail.com

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Regional Development Disparities in Malaysia

Mohammad Sharif Krimi, Zulkornain Yusop, Law Siong Hook

Department of Economics, Faculty of Economics and Management, University Putra Malaysia,
Serdang 43400, Malaysia.

sharifkarimi@yahoo.com

Abstract: Achieving balanced regional development will remain as one of the key objectives of national development during the development Plans in Malaysia. Therefore this paper analyses regional disparities amongst major states in Malaysia to find out gap and rank of regional development during two development plan (Seventh and Eighth plan). The paper proposes a new methodology that includes TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and Shannon entropy for first time in terms of ranking in this field. The empirical results indicate that in terms of regional balance, little progress was made in reducing development gaps between regions during two plans and Wilayah Persekutuan Kuala Lumpur was the most developed region in 2000 and 2005. On the other hand, Sabah was the least developed region in same period. [Journal of American Science 2010; 6(3):70-78]. (ISSN: 1545-1003).

Keywords: TOPSIS, Shannon Entropy, Regional Development, Malaysia

1. Introduction

Regional Disparities or imbalance refers to a situation where per capita income, standard of living, consumption situation, industrial and agriculture and infrastructure development are not uniform in different parts of a given region. Regional Disparities are a global phenomenon. The problems of regional disparities in the level of economic development are almost universal. Its extent may differ in different countries. Most of the countries of the world are experiencing the problem of regional disparities. The problem is not a new phenomenon. Even during the earlier periods also there were difference in the level of economic development both in the advanced countries of the Europe and developing countries of Asia and Africa. But due to the lack of statistical measures these imbalances didn't attract notice. However, in recent years they have received a lot of attention because of their adverse implications for balanced economic development.

Growth pole dynamics and inverted-U hypothesis sustain that regional inequalities within developing countries will be eventually reduced through factor mobility. Neoclassical growth theory highlights the mobility of supply side factors, in particular capital stock, technical change and labor, as the reason for the eventual reduction of such disparities. On the other hand the opposing theories, in particular dependency and structural change theories, postulate that regional inequality is an inevitable outcome of capital accumulation and profit

maximization. Therefore the goal of this study is to survey regional disparities in Malaysia.

Malaysia is an independent nation state, a parliamentary constitutional monarchy, with a federal government structure. The country, one of 10 nations (plus Timor-Leste) in South- East Asia, comprises thirteen states spread across two major regions separated by the South China Sea (Peninsular Malaysia and East Malaysia on the island of Borneo), and three Federal Territories—Kuala Lumpur, established in 1974; Labuan, established in 1984; and Putrajaya, established in 2001. Peninsular Malaysia and East Malaysia had a common background of British colonial administration, though this administration began at different times in different states (Malaysia, Economic Planning Unit (2005). Malaysia has an abundance of natural resources, providing the basis for its key wealth-creating industries. These include rubber, tin, timber, oil palm, and petroleum and natural gas. The various states of Peninsular Malaya, including four Federated Malay States, five Unfederated Malay States, Pulau Pinang, and Melaka, transferred peacefully from colonial rule to independence as the Federation of Malaya in 1957. Subsequently, the Federation of Malaya joined with Sarawak, Sabah, and Singapore in 1963 to form the Federation of Malaysia. Following the separation of Singapore from the Federation in 1965, the present nation of Malaysia was in place. The colonial heritage included a multi-ethnic, multicultural, and multireligious society, resulting from the inflow of Chinese over a long period (to both Peninsular

Malaysia and East Malaysia) and a more targeted inflow of Indians to Peninsular Malaysia as rubber estate workers (Leete, 1996).

Malaysia was still sharply differentiated in terms of economic activity in 1970. The Bumiputera were more concentrated in rural areas in smallholder agriculture, but were also represented in government, the police, and the armed forces; the Indians were still heavily concentrated in the plantation sector, as well as in railways and government utilities; while the Chinese dominated trade and commerce. The states located in Borneo—Sabah and Sarawak—are very large, making up 60 per cent of Malaysia's total land area but only 18 per cent of its population. Clearly, issues of isolated populations, while not totally absent in Peninsular Malaysia, are more pressing in these states, and strengthening the transportation network, as well as bringing basic services to small communities, has been a major preoccupation of their development activities. The colonial heritage also included a relatively prosperous economy based mainly on rubber cultivation and tin mining, along with the more traditional smallholder production of rubber, rice, vegetables and fruits, and small-scale fishing. There was a good transportation network in Peninsular Malaysia, including railways and macadamized roads, though not so advanced in East Malaysia, where the road network was embryonic and river transportation remained very important. In comparison with many other neighboring countries, the education system was relatively well developed, and well functioning national and state civil services were in place.

Malaysia is a resource-rich country and these resources have provided the foundation for much of the economy's growth. Moreover, successive governments have provided an appropriate legal framework and stable democratic political setting for the economy to take full advantage of its rich natural and human resources. Medium-term economic planning in Malaysia has been effected through a series of five-year plans, and the country's relatively high-quality public administration has allowed for effective implementation of its development policies and programmes. During the Eighth Plan period, all states recorded economic growth and increase in the mean monthly household income. The quality of life also improved in the rural and urban areas. However, in terms of regional balance, little progress was made in reducing development gaps between regions, states as well as

rural and urban areas. Achieving balanced regional development will remain as one of the key objectives of national development during the Ninth Plan. Measures will be undertaken to reduce disparities in development between regions and states as well as between rural and urban areas. In this regard, the development of transborder areas between states will be emphasized while the development of existing growth centers within states will be intensified. Emphasis will also be given to develop rural growth centers and urban conurbations by generating income-creating activities and improving the quality of life. Malaysia's development planning foresees the country becoming a fully developed nation by 2020. For achieve this purpose it should be need survey disparities among all stat in Malaysia. Therefore the aim of this research is to determinant disparities among all stat in Malaysia according to economical, social and cultural Indicators during seventh Malaysia Plan (1996–2000) and Eighth Malaysia Plan (2001–5).

Table1: Overview of Malaysia's Development planning Framework.

1960-70	1971-90	1991-2000	2000-2010
Pre-NEP	New Economic Policy (NEP)	National Development Policy (NDP)	National Vision Policy (NVP)
First Malaysian Plan(1966-70)	Second Malaysia plan(1971-5) Third Malaysia Plan(1976-80) Fourth Malaysia Plan(1981-5) Fifth Malaysia Plan(1986-90)	Sixth Malaysia Plan(1991-5) Seventh Malaysia Plan(1996-2000)	Eighth Malaysia Plan(2001-5)

Source: Malaysia, Economic Planning Unit (2006)

2. Regional Development during Seventh and Eighth Plan

During the Seventh Plan period, the major thrusts of regional development were to achieve balance in social and economic development across regions and states and to raise the standard of living and quality of life of the people. In this regard, the economic structure of the less developed states were diversified with larger contributions from manufacturing and services sectors. In addition, the increase in private sector investments further stimulated economic activities within the context of the Eastern Corridor development strategy. The expansion of social and physical infrastructure contributed towards better living standards and progress was also made in the Growth Triangles cooperation through the implementation of several joint-venture projects.

During the Eighth Plan period, the focus of regional development was to raise the standard of

living and quality of life as well as attain balanced social and economic development across regions and states. All states recorded economic growth and as a result of which the standard of living in rural and urban areas improved. Nevertheless, development gaps between states and rural-urban disparities widened during the period. Gross Domestic product .the central region accounted for 41.1 per cent of the national GDP in 2005 with manufacturing and services sectors as major contributors. Meanwhile, the eastern region which is agriculture-based, Accounted for only 11.5 per cent of the national GDP. In terms of states, Selangor accounted for the largest share of the national GDP at 23.0 per cent in 2005 with the manufacturing and services sectors accounting for 53.5 per cent and 41.2 per cent, respectively (Malaysia, Economic Planning Unit, 2006).

Growth of Gross Domestic Product: In terms of the average growth rate of GDP in constant prices, the central region and southern region as well as Sarawak recorded growth rates higher than the national average of 4.5 per cent during the Plan period, as shown in Table 17-2. The eastern region recorded the lowest GDP growth rate of 3.5 per cent per annum. The GDP growth by state indicated that Selangor registered the fastest growth followed by Johor and Pulau Pinang, while Kelantan recorded the lowest growth.

Household Income and Incidence of Poverty: The average mean monthly household income increased from RM2,472 in 1999 to RM3,249 in 2004, growing at 5.6 per cent per annum. The highest mean monthly income was recorded in Selangor at RM5,175 while Kelantan recorded the lowest at RM1,829 in 2004. However, the income gap between the state with the lowest income and the state with the highest income narrowed from 1: 3.12 in 1999 to 1: 2.83 in 2004. All states except Wilayah Persekutuan Kuala Lumpur recorded a decline in the incidence of poverty in 2004, based on the new poverty line income. The incidence of poverty remained high in the less developed states of Sabah, Terengganu and Kelantan (Malaysia, Economic Planning Unit, 2006).

The development gaps between states are also reflected in the attractiveness to new manufacturing investment in certain states. During the Plan period, the direction of investment was skewed towards the more developed states. Selangor, Johor, Pulau Pinang and Melaka remained as the major choices of location for both domestic and foreign investment due to the availability of adequate and good infrastructure, proximity to air and sea hubs, financial centers and support services. A total of 4,807 manufacturing projects was approved with a

proposed capital investment of RM132.4 billion of which RM73.6 billion or 55.6 per cent were intended for these four states. Among the less developed states, Sarawak was the exception as it ranked third after Selangor and Johor in terms of new manufacturing investment approved during the period. Meanwhile, Perlis and Kelantan attracted the least investment at RM83.0 million and RM474.9 million (Malaysia, Economic Planning Unit, 2006).

3. Theoretical Basis for Regional Development

A number of the multitudinous theories and concepts of development that have been put forward in the past hundred years have significantly shaped regional development thinking. The following sections discuss these theoretical trajectories in terms of their basic concepts or perspectives and how the same have translated into policies and strategies in regional development. Richardson (1973) explains the claim of neoclassical economics that regional disparities in terms of supply and demand of factors of production (labor, capital, technology) or commodities will even out inevitably given the sufficient increase in the accessibility between regions and consequently by the mobility of these production factors and commodities. According to the theory, regional imbalances in supply and demand manifest themselves in differences in prices of these factors of production and commodities.

Hirschman (1957) and Perroux (1964) have been considered the forerunners of the trickle down or the center down paradigm, which had been the basis for the development of the growth center approach. The concept largely mirrors the view of neoclassical economics. Stohr (1981) in succinct terms, explained that the trickle down paradigm purports that “development can start only in a relatively few dynamic sectors and geographic locations from where it is expected to spread to the remaining sectors and geographical areas of a country”. The trickle down process starts from a high level (from worldwide or national demand, or from world or national innovation centers) filtering down and outward to national and regional units through various mechanisms: urban hierarchy, multi-plant business organizations and large-scale government organizations.

3.1 The Theories of Growth Pole Centers

As originally presented in the mid-1950s and onward by French economist Francois Perroux, growth pole theory was a largely abstract conceptualization. The theory implied the idea of a complex of industries, mutually linked by functional relations and dominated by a propulsive industry (the so-called *industrie motrice*), the latter being the

engine of the development dynamic, thanks to its intrinsic capacity to innovate and stimulate economic growth as well as to nurture the formation of other economic activities and industries (the so-called industries *mues*, or ‘mute industries’).

Conceptually, Perroux premised his theory upon a neo-Schumpeterian understanding of the mechanics of development within capitalist economies. Development proceeds, in Schumpeter’s view, by the direct and the indirect effects of innovations which are able to take an economy away from a stationary equilibrium (both sectoral and spatial). This means that the newer and more efficient industries in which innovations take place grow at a faster pace compared to the older and more static industries. Regional economic development, therefore, implies cumulative sectoral and spatial differentiation in impact and thus deviates from a stationary conception of equilibrium growth. Building on this conceptual argumentation, which had many points of convergence with subsequent theories of unbalanced and cumulative growth (notably those of leading economists and planners such as Albert Hirschmann, Gunnar Myrdal, and John Friedmann), Perroux thought that in order to act as a pole the propulsive industry should satisfy the three criteria of: (1) large size, (2) a potential of economic leadership, and (3) a rate of growth faster than that of the local and regional economy in which it becomes embedded. The existence of these conditions allowed the deployment of a mechanic of polarization, which in Perroux’s view could take place in two specific respects: first, the leading firm can make anticipation of demand, both correct and incorrect, affecting smaller firms; second, the effects of the leading firm is able to change the balance of factor inputs in other firms.

4. Literature Review

There are a few studies about regional disparities. The rest of those researches are analyses regional disparities amongst various states based on HDI (Human Development Index), Economic and socio-economic indicators with a simple models such as Normalize and weighted mathematical method as follow:

Riskin (1988) observes that substantial disparities between Chinese provinces in the 1950s became much more serious with industrialization. He states that the leadership opted for the diversion of investment resources to the more backward provinces and consequently “...relative convergence of provincial industrialization occurred from the start of the First Five Year Plan [1953-57] with less industrialized provinces growing at higher proportional rates than more industrialized ones.”

(Page 227). Nevertheless, he argues that the regional disparities in terms of rural poverty remained high. Fedorov (2002) highlights the growing regional inequalities in Russia in the 1990s. Referring to recent studies on regional disparities in Russia he states that “Virtually all authors agree that the transition period has been characterised by rapidly growing economic inequality among Russia’s regions...” Vanderpry-Orgle (2002) after citing a number of studies on the growing regional disparities in Ghana, discusses the growing trends in spatial inequalities and polarization in Ghana during the period of stabilization and structural adjustment programmes – late 1980s to late 1990s. This study concludes that regional inequality increased during the first stages of reform period, followed by a short period of decline before resuming its increasing trend for the rest of the period to 1999.

Wei and Kim (2002) shown that the increasing regional inequality is widely considered to be the reason for the existing regional problems in China and an obstacle to its stability and development. In this study of inter-county inequality in Jiangsu province of China they conclude that for the period of 1950-95.

Noorbakhsh (2003) analyzed regional disparities amongst major states in India to find out if they are on a convergence or further divergence course. The analysis is extended to the evolution of disparities amongst the states with respect to a larger set of socio-economic indicators especially HDI. A number of regional composite indices are constructed from the selected indicators and tested for their validity.

In case of regional development disparities in Malaysia, there is just one study by Economic planning Unit in 2006 that used of the Development Composite Index (DCI), based on 16 indicators include social and economic index. This study used of a simple method (Normalizes method) for ranking states in Malaysia the result shows that Wilayah Persekutuan Kuala Lumpur ranked the highest DCI followed by Pulau Pinang, Melaka and Selangor.

5. Data

The data for this study consist of observations from a number of different sources on 15 indicators in 14 states in Malaysia during 2000-2005, also indicators are include economically, social, cultural, education and health indexes as follow:

Table 2: Data and Sources

DATA	SOURCE
Mean Monthly Household Income(RM)	Economic Planning Unit
Incidence of Poverty (%)	Economic Planning Unit
Urbanisation Rate(%)	Economic Planning Unit
Unemployment rate(%)	Economic Planning Unit
GDP Per Capita(RM)	Economic Planning Unit
Road Density	Economic Planning Unit
Production Capacity of water supply (mld)	Economic Planning Unit
Net enrolment rate in primary education.	Malaysian Educational Statistics
Proportion of pupils starting grade 1 who reach grade 5	Malaysian Educational Statistics
Literacy rate of 15-24(%)	Malaysian Educational Statistics
Under five mortality rate (per 1,000 live births)	Ministry of Health
Death rate associated with malaria	Ministry of Health
Death rate associated with tuberculosis.	Ministry of Health
Proportion of population with sustainable access to improved water source, rural	Ministry of Health
Unemployment rate of 15 - 24 year olds	Economic Planning Unit

6. Methodology

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), developed by Hwang and Yoon (1981), was based on the concept that the selected best alternative should have the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution in a geometrical (Euclidean) sense. In other words, the ideal alternative has the best level for all attributes considered, whereas the negative ideal is the one with

all the worst attributes value. A TOPSIS solution is defined as the alternative that is simultaneously farthest from the negative-ideal and closest to the ideal alternative. The TOPSIS has two main advantages: its mathematical simplicity and very large flexibility in the definition of the choice set. When solving real-life problems, or representing real world phenomena, linguistic variable usually appears to be an important output of the process (Hsu et al, 2009). The fuzzy set theory has been applied to the field of management science; however, it is scarcely used in the field of Economics. Thus, this study includes a fuzzy multiple-criteria decision-making process provides a coherent process for incorporating subjective views into an explicit decision process. Due to verified success and robustness in different decision situations (Cheng, 1996; Deng et al., 2000), the entropy method is suggested for accomplishing the task. This task is efficiently achieved by applying Shannon's entropy concept, which basically considers decision matrix contents as a specific source of information emitted through criteria to the decision maker. Entropy based method in turn computes unbiased relative criteria weights, and enable the final step – an application of the TOPSIS multi-criteria method to rank scenarios appropriately. Obtained ranking is considered the final result of proposed methodology (Shannon and Weaver, 1947), the TOPSIS method evaluates the following decision matrix (Kandakoglu et al, 2009):

$$P = \begin{matrix} & \begin{matrix} C_1 & C_2 & C_3 & \dots & C_n \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} x_{11} & x_{12} & x_{13} & \dots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \dots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \dots & x_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \dots & x_{mn} \end{bmatrix} \end{matrix}$$

Where A_i is the i th alternative, C_j is the j th criterion, and x_{ij} is the performance measure of the i th alternative in terms of the j th criterion. Then the TOPSIS method consists of the following steps (which are adaptations of the corresponding steps of the ELECTRE method).

Step 1: Calculate the weights of the evaluation criteria. To find the relative normalized weight of each criterion, this task is efficiently achieved by applying Shannon's entropy concept, which basically considers decision matrix contents as a specific source of information emitted through criteria to the decision matrix. Entropy based method in turn

computes unbiased relative criteria weights, and enable the final step – an application of the TOPSIS multi-criteria method to rank scenarios appropriately.

Obtained ranking is considered the final result of proposed methodology. Entropy is generally understood as a measure of uncertainty in the information. By considering scores of alternatives as specific emitters of information about importance of each criterion, entropy approach enables measuring that source and determining the relative weights of criteria (W_1, W_2, \dots, W_n) in rather simple and straightforward manner. By additive normalization (1) of each column in matrix p a new matrix is derived containing relative scores of alternatives across criteria.

$$P_{ij} = X_{ij} \left[\sum_{j=1}^n X_{ij} \right]^{-1}, \quad i=1,2,\dots,m \quad (1)$$

The information contained in matrix X can be considered as 'emission power' of each criterion C_j ($j=1,2,\dots,n$), and used to compute an entropy value e_j :

$$E_j = -k \sum_{i=1}^m (P_{ij} \ln P_{ij}) \quad j=1,2,\dots,n \quad (2)$$

Constant $k=1/\ln(n*m)$ is used to guarantee that $0 \leq e_j \leq 1$. Degree of divergence d_j of average intrinsic information contained in each criterion is calculated as:

$$d_j = 1 - E_j \quad j=1,2,\dots,n \quad (3)$$

If d_j is considered as specific measure of inherent contrast intensity of the criterion C_j , final relative weights for all criteria can be obtained by simple additive normalization:

$$W_j = d_j \left[\sum_{j=1}^n d_j \right]^{-1} \quad j=1,2,\dots,n \quad (4)$$

Because the criteria weights are obtained directly from the decision matrix, which means independently of the DM, this qualifies the entropy method as unbiased ('objective') evaluation procedure and the same may be adopted as valid for the result obtained – criteria weights (W_1, W_2, \dots, W_n).

Step 2: Construct the normalized decision matrix. This step converts the various attribute dimensions into no dimensional attributes. An

element r_{ij} of the normalized decision matrix R is calculated as follows:

$$R_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}^2}, \quad i=1,2,\dots,m; \quad j=1,2,\dots,n \quad (5)$$

$$\text{Where } N = [R_{ij}]_{m \times n} \quad (6)$$

Step 3: Calculate the weighted normalized decision matrix (V). The weighted normalized value v_{ij} is calculated as:

$$V_{ij} = w_j r_{ij}, \quad i=1,2,\dots,m; j=1,2,\dots,n \quad (7)$$

$$\text{Where } V = [v_{ij}]_{m \times n} \quad (8)$$

Step 4: Identify the positive ideal solution and negative ideal solution.

$$\begin{aligned} A^* &= \{V_1^*, V_2^*, \dots, V_n^*\} = \\ &\{(\max_j v_{ij} \mid i \in I'), (\min_j v_{ij} \mid i \in I'')\} \\ \bar{A} &= \{\bar{V}_1, \bar{V}_2, \dots, \bar{V}_n\} = \\ &\{(\min_j v_{ij} \mid i \in I'), (\max_j v_{ij} \mid i \in I'')\} \end{aligned}$$

Where I' is associated with benefit criteria and I'' is associated with cost criteria.

Step 5: Calculate the separation measure. In this step the concept of the n-dimensional Euclidean distance is used to measure the separation distances of each alternative to the ideal solution and negative-ideal solution. The corresponding formulas are:

$$S_i^* = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^*)^2}, \quad i=1, 2, \dots, m \quad (9)$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, \quad i=1, 2, \dots, m \quad (10)$$

Step 6: Calculate the relative closeness to the ideal solution. The relative closeness of the alternative A_i with respect to A^* is defines as:

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-}, \quad i=1, 2, \dots, m \quad (11)$$

Where $0 \leq C_i^* \leq 1$ that is, an alternative i is closer to A^* as C_i^* approaches to 1.

Step 7: Rank the preference order. Choose an alternative with maximum C_i^* or rank alternatives according to C_i^* in descending order.

3	Selangor	0.66531	0.665194
4	Melaka	0.596663	0.596218
5	Negeri Sembilan	0.549142	0.548594
6	Kedah	0.532712	0.532133
7	Perak	0.504573	0.504129
8	Perlis	0.499811	0.499086
9	Johor	0.49444	0.49453
10	Terengganu	0.45114	0.450614
11	Kelantan	0.445555	0.444759
12	Sarawak	0.438568	0.438233
13	Pahang	0.427402	0.427127
14	Sabah	0.171592	0.172037

7. Result

The result of TOPSIS and Shannon Entropy method for ranking regional development in Malaysia is shown in Tables 3 and figure 2 Based on the Development Index (DI), during two development plan (Seventh and Eighth) all states recorded economic growth and increase in the mean monthly household income. The quality of life also improved in the rural and urban areas. However, in terms of regional balance, a little progress was made in reducing development gaps between regions and states. Which comprises Wilayah Persekutuan Kuala Lumpur, Melaka, Negeri Sembilan and Selangor was the most developed region in 2000 and 2005. Sabah, Sarawak and the states in the eastern region which comprises Kelantan, Pahang and Terengganu were the least developed regions. Wilayah Persekutuan Kuala Lumpur ranked the highest DI followed by Pulau Pinang, Selangor and Melaka indicating a higher level of economic activity and quality of life in 2000 and 2005, as shown in Table 3. The states of Sabah, Pahang and Sarawak remained at the lower end. Besides DI, there is a big development gaps according to DI between regions and states were identified, while DI index for Wilayah Persekutuan in 2005 is around 0.905136 this amount for Sabah is 0.171592, that shows a big development gap between this two regions. On the other hand, during seventh and Eighth development plan development index (DI) and gap between all state were remained same that means this two development could not reducing development gaps between regions.

Table 3: Ranking of State Development in Malaysia (2000-2005).

Rank	State	DI 2000	DI 2005
1	WilayahPersekutuan Kuala Lumpur	0.905136	0.904869
2	Pulau Pinang	0.666958	0.666725

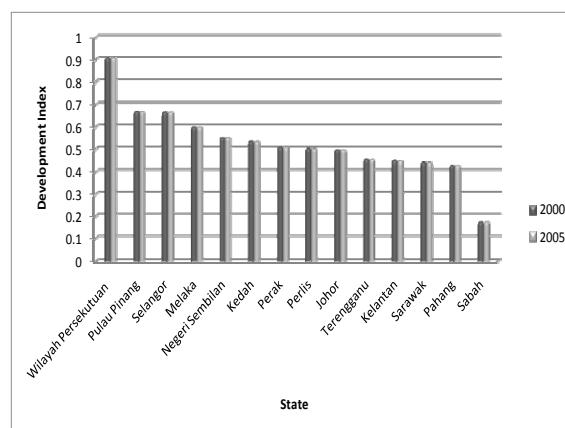


Figure1: Regional Development Disparities in Malaysia (2000-2005)

8. Conclusions and Policy implications

During the Eighth Plan period, efforts were undertaken to promote balanced regional development. Despite all states recording economic growth, the development gaps between regions, states and rural-urban areas remained wide. During the next plans, measures will be undertaken to accelerate the development of less developed states, particularly in northern Peninsular Malaysia, the Eastern Corridor, Sabah and Sarawak to attain regional balance and reduce development gaps. The main objective of balanced development during the Future Plan period will be to narrow development gaps between regions, states as well as between rural and urban areas. Measures will be undertaken to reduce disparities in terms of per capita income and household income, incidence of poverty in the less developed states and disparities in terms of infrastructure and utilities, between the states in the Peninsular and between the Peninsular, Sabah and Sarawak.

It is hoped that this attempt at providing a new technique of regional development measuring

and suggesting a research agenda will help jumpstart more studies that will fill such gaps.

Corresponding Author:

Mohammad Sharif Karimi,
Department of Economics,
Faculty of Economics and Management, University
Putra Malaysia,
Serdang 43400, Malaysia.
E-mail: sharifkarimi@yahoo.com

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Effect of Combined Cocoa Pod Ash and NPK Fertilizer on Soil Properties, Nutrient Uptake and Yield of Maize (*Zea mays*)

Dr. Ayeni, L.S. (Ph.D. Soil Science)

University of Agriculture, Department of Soil and Land Management, Abeokuta, Nigeria

E-mail: leye_sam@yahoo.com

Abstract: Field experiments were conducted in two cropping seasons (March and September, 2007) at two locations to determine the effect of cocoa pod ash (5 and 10 t ha⁻¹) and NPK 20:10:10 fertilizer (150 and 300 kg ha⁻¹) on soil chemical properties, nutrient uptake and yield of maize in southwest Nigeria. The experiments were sited at Adeyemi College of Education Research Farm, Ondo and Okegun both Alfisol. Ondo soil was sandy clay, deficient in OM, N, P and K while Okegun soil was clay loam, deficient in OM, N and K. The treatments were laid out in randomized complete block design with three replications. Combined cocoa pod ash and NPK 20:10:10 fertilizer significantly ($p < 0.05$) increased soil OM, N, P and K at Ondo and OM, P and K at Okegun than cocoa pod ash and NPK 20:10:10 fertilizer singly applied. Plant N, P and K were also increased significantly compared with single application of cocoa pod ash and NPK 20:10:10 except 300 kg ha⁻¹ at the two locations as well as plant height, grain, stover and dry root yields. At Adeyemi (sandy clay), compared with control, the percentage increase in grain yield were C10F150 (81%), F300 (74.76%), C5F150 (65.71%), C10 (47.62%), C5 (38.5%) and F150 (32.28%). For Okegun (clay loam), grain yield significantly increased ($p < 0.05$) by C10F150 (75.85%), F300 (54.36%), C5F150 (42.46%), C10 (8.10%), C5 (19.84%) and F150 (17.06%). Treatment C10F150 gave the highest increases in soil nutrient values and growth parameters of maize. Soil total N, available P and exchangeable K tended to increase as the level of the treatment combinations increased at both locations. Cocoa pod ash combined with reduced level of NPK 20:10:10 was more effective than single application of cocoa pod ash and NPK 20:10:10 fertilizer in both locations. Sandy clay responded to application of cocoa pod ash than clay loam in this experiment. [Journal of American Science 2010;6(3):79-84] (ISSN: 1545 - 1003)

Keyword: micronutrients, Fertilizer, macronutrients, soil, nutrient uptake, soil type

Introduction

In tropical countries, high cost, scarcity, nutrient imbalance and soil acidity are problems associated with the use of mineral fertilizer while bulkiness, low nutrient quality and late mineralization were the bottleneck to the sole use of organic manures for crop production. Some studies confirmed that combined application of organic manures and mineral fertilizers gave superior effects in terms of balanced plant nutrition and improved soil fertility (Uyovbisere and Elemo, 2000, Ayeni, 2008). Other advantages of using combined application of organic and inorganic fertilizers, is that, it reduces the need for mineral fertilizer and aids time mineralization of nutrients from organic manures.

Cocoa pod husk and its ash have not been adequately studied in plant nutrition. Ayeni *et al.*, (2008a) found that cocoa pod ash contained plant nutrients as N, P, K Ca, Mg and micronutrients and is good for tomato production (Odedina *et al.*, 2003). About 800,000 tones of cocoa pod husk are generated annually in Nigeria and often wasted (Egunjobi, 1976). It is advised that the husk be burnt into ash as a method of farm sanitation and for the control of black pod disease. The husk left on the farm harbours the fungus (*phytophthora palmivora*) which is the causal organism of black pod disease. Moyin Jesu (2003)

after extensive literature search noted scarcity of report on use of cocoa husk in plant nutrition. Egunjobi (1976) found that ground cocoa husk applied to soil increased maize yield by 124%, and also increased uptake of P, K, and Mg. In the studies by Ajayi *et al.*, (2007a, 2007b), it was found that cocoa pod husk ash increased growth and nutrient uptake by Kola seedlings and soil P, K, Ca and Mg, compared with NPK fertilizer, cocoa pod ash, at 2, 4, 6, 8 and 10 t ha⁻¹ increased root N, P, K, Ca, and Mg which increased with level of ash. Ojeniyi *et al.*, (2002) investigated the effect of animal manure amended cocoa pod husk on tomato. Amended husk significantly increased growth and yield of tomato, trail yield was increased by 397%.

This work studied the comparative effect of cocoa pod ash, NPK 20: 10: 10 and their combinations on soil chemical properties, nutrient uptake and yield of maize in sandy clay and clay loam of southwest Nigeria where cocoa pod is found in abundance.

Materials and methods

Soil Analysis

Before the commencement of experiment, surface (0 – 20 cm) soil samples were collected at the site of the experiment using auger, bulked, air –dried and 2mm – sieved for analysis. Samples were also

collected over each treatment plot. Analysis was done as described by Carter (1993). Organic matter (OM) was determined using wet dichromate method, total N by Kjeldahl method, available P by molybdenum blue colorimetry. Exchangeable K, Ca and Mg were extracted using ammonium acetate, K was read on flame photometer and Ca and Mg on atomic absorption spectrophotometer. Soil analysis were also carried out after the conduct of the experiment

Field experiment

Field experiments were conducted concurrently in March, 2007 and repeated in September 2007 at Adeyemi College of Education Research farm, Ondo (sandy clay) and clay loam soil of Okegun 30 km away from Ondo both Alfisol (07°C 05N and 04E 55N) in the rain forest zone of southwest Nigeria. Ondo site was cultivated to maize, yam and cassava with application of various types of mineral fertilizer for many years. Okegun soil has also been cropped with various crops with no history of the use of mineral fertilizers on the soil. The lands at both sites were manually cleared in February 2005 and heaps were made 75cm apart. There were seven manurial treatments involving a control (no treatment), NPK 20:10:10 at 300 kg ha⁻¹ (F300), 150 kg ha⁻¹ NPK20: 10:10 fertilizer (F150), cocoa pod ash at 5 t ha⁻¹ (C5), cocoa pod ash at 10 t ha⁻¹ (C10), 5 t ha⁻¹ cocoa pod ash combined with 150 kg ha⁻¹ NPK 20:10:10 fertilizer (C5F150), 10 t ha⁻¹ cocoa pod ash combined with 150 kg ha⁻¹ NPK20:10:10 fertilizer (C10F150). The seven treatments were replicated three times on single stand of maize at 75 x 30 cm given a total population of 70 plants per plot of the 21 plots, each plot being 16m². Cocoa pod ash, NPK 20:0:10 and their combinations were applied in ring form and covered with soil to avoid evaporation at two weeks after planting. Three weeding were done with hoe at two weeks interval.

Ash and leaf analysis

The nutrient composition of cocoa husk ash was determined. With the exception of nitrogen (N), the determination of other nutrients was done using wet digestion method based on 25 – 5 – 5 ml of HNO₃ – H₂SO₄ – HClO₄ acids (AOAC, 1990). The methods used in soil were also used to analyze P, K, Ca and Mg. Total N was determined with Microkjeldahl method.

Leaf samples collected from maize plants at 50% flowering were oven dried for 24 hrs at 70°C, milled and analyzed as described by Tel and Hagarty (1984). Nutrients determination was carried out as done in cocoa pod ash.

Growth and Yield Data

At harvest (90 days after planting), five plants were uprooted per plot to determine height, stover and root dry matter. Roots were separated from the shoot. The plants were air – dried at 65 °C to constant weight to determine shoot and root dry matter yield. 40 maize plants were randomly selected from the middle row and harvested. Cobs were air – dried, shelled and grain yield determined at 12% moisture content. Grain yield per hectare were calculated. In September 2007 (second cropping season), the experiment was repeated and done as carried out in the first experiment.

Statistical analysis

The Duncan Multiple Range Test was used to compare the mean data at 5% level.

Result and Discussion

The soil physical and chemical properties used for the conduct of the experiment are shown in table1. The nutrient critical level recommended for optimum production of maize in southwest Nigeria are organic matter (OM) 3%, total N 0.15%, available P 8 – 10 g kg⁻¹, exchangeable K, Ca and Mg are 0.20, 20 and 0.26 Cmol kg⁻¹ respectively (Sobulo and Osiname, 1987, Adepetu *et al.*, 1979, Agboola and Unamena, 1989). This indicates that soil in Ondo was deficient in OM, N, P and K while the soil use for the experiment at Okegun was adequate in P and fairly adequate in total N. The two soils were adequate in Ca and Mg. The soil at Okegun was higher in nutrient values than Ondo.

Table 2 presents data on nutrient composition of cocoa pod ash used in the conduct of the experiment. Cocoa pod ash had high K and Ca with low N and P. The low N might be as a result of volatilization during the burning process. The C/N ratio (13) is conducive enough for early mineralization of nutrients especially N for maize uptake. This is in line with the previous work of Odedina *et al.*, 2003 and Ayeni *et al.*, 2008b that cocoa pod ash contained N, P, K, Ca and Mg. Sobamiwa and Longe (1994) showed that cocoa pod ash contains N, P, K, Ca, Mg and micronutrients.

Table 1: Initial soil physical and chemical properties

Nutrient	Okegun	Ondo
pH (1:1 H ₂ O)	6.02	6.39
OM %	2.49	2.23
Total N %	0.14	0.10
Available P mg kg ⁻¹	8.89	5.96
Exchangeable K	0.12	0.15
Exchangeable Ca	2.35	3.38
Exchangeable Mg	0.36	0.30
Sand %	44	73
Silt	23	9
Clay	33	18
Textural class	clay loam	sandy clay

Table 2: Nutrient composition of cocoa pod ash (%)

Nutrient	values
Organic carbon	12.10
N	0.99
C/N ratio	13.00
Total P	2.50
K	12.36
Ca	3.40
Mg	0.76

Table 3 presents data on the effect of cocoa pod ash, NPK 10:10:10 fertilizer and their combinations on soil chemical properties after maize harvest in the two locations. Cocoa pod ash applied at 10 t ha⁻¹ (C10), cocoa pod ash combined with NPK fertilizer rates (C5F150, C10F150) and F300 significantly ($p < 0.05$) increased soil OM, N and P in both locations. Compare with control, cocoa pod ash rates (C5, C10) and its combinations with NPK fertilizer significantly ($p < 0.05$) increased exchangeable Mg at Ondo and Okegun while only Ondo had significant effect on Ca at all rates. Treatment C5 had higher OM, N and P than C10 while C10 increased OM, N and P than C5 in Okegun. The increase in OM, N and P as the level of cocoa pod ash was increased at Okegun might be as result of its texture which enhanced absorption of nutrients. The improved soil nutrient contents due to application of ash is consistent with the report of Ayeni *et al.*, 2008b that application of wood ash increased soil OM, N, P, K, Ca as well as leaf N and

P in the experiment conducted to show the effect of wood ash and sawdust ash on raising cocoa seedlings in the nursery. Ajayi *et al.*, 2007a) also found that cocoa pod ash increased soil nutrients in the experiment performed to show the effect of cocoa husk ash in raising kola seedlings. The effectiveness of combined cocoa pod ash and NPK fertilizer over single application of cocoa pod ash and NPK 20:10:10 fertilizer might be that the materials complement each other in nutrient release for nutrient uptake. Cocoa pod ash (C5, C10) supplied higher Ca than NPK 20:10:10 fertilizer rates (F150, F300). Their values also tended to increase with the levels of cocoa pod ash in the two locations. The increases in Ca and Mg contents are attributable by cocoa pod ash. This confirmed the positive effect of ash on cationic nutrients. The higher Ca and Mg treated with C5F150 and C10F150 than F150 and F300 were therefore derived from the cocoa pod ash as indicated in the percentage composition of cocoa pod ash (Table 2).

Table 3: Effect of cocoa pod ash, poultry manure, NPK fertilizer and their combinations on soil chemical properties

Treatment	OM %		N %		P mg kg ⁻¹		K		Ca cmol kg ⁻¹		Mg	
	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun
Control	1.07	1.21	0.02	0.09	4.16	5.62	0.17	0.19	1.00	2.11	0.33	0.47
F300	2.18	2.26	0.11	0.12	9.45	10.22	0.20	0.23	1.10	2.13	0.34	0.46
F150	1.09	2.00	0.04	0.12	4.41	7.11	0.18	0.20	1.10	2.10	0.36	0.46
C5	2.46	2.12	0.1	0.11	9.14	1973	0.29	0.22	3.02	3.32	1.50	1.00
C5F150	2.95	3.76	0.16	0.14	12.00	19.04	0.31	0.25	2.30	3.02	1.00	1.50
C10	2.43	3.25	0.12	0.15	9.03	19.49	0.36	0.23	3.84	3.00	1.62	1.15
C10F150	3.10	3.48	0.18	0.17	17.17	20.98	0.39	0.26	2.00	2.00	1.10	1.20
LSD(0.05)	0.51	0.59	0.04	0.06	3.00	4.14	0.12	0.02	0.94	1.00	0.59	0.48

at Ondo and Okegun

Table 4 presents data on tissue N, P and K of maize in Ondo and Okegun respectively. The data are the mean for the two experiments in each location (early and late seasons). Treatment C10F150 gave the highest N and K in the two locations. F300 recorded highest P in Okegun while C10F150 had highest P in Ondo. Cocoa pod ash combined with NPK 20:10:10 fertilizer at all levels had higher N, P and K than C5, F150 and control in both locations. The value of C/N ratio of cocoa pod ash is conducive for rapid degradation and dissolution of ash as earlier stated. Hence, it is expected that the nutrients in the ash would easily be released for maize uptake. Brady and Weil (1999) recommended 2.5 – 3.5, 0.20 - .050, and 1.5 – 3% as critical levels for N, P and K plant uptake respectively. Based on this recommendation, cocoa pod ash, NPK fertilizer applied individually and cocoa pod ash combined with NPK fertilizer at two levels had adequate plant N, P and K except control at the two locations. Treatments C10F150 and C5F150 had higher plant N than the recommended level at Okegun site. Also, treatments F300, C5, C5F150, C10 and C10F150 had K above the critical level at

the two locations. The excesses might cause nutrient imbalances in other nutrients such as Ca, Mg and micronutrients that were not investigated in this experiment.

Table 5 shows data on maize height, grain yield, stover and root matter yields as affected by cocoa pod ash, NPK 20:10:10 fertilizer and their combinations. Treatment C10F150 had the tallest maize plant and grain yield, stover and root matter in the two locations. The mean increases in grain yield in the two locations followed the same trend C10F150 > F300 > C5F150 > C10 > C5 > F150 > control. The percent increases in grain yield at Ondo were higher than Okegun despite the fact that Okegun mean grain yields were higher than Ondo. This might be as a result of lower initial soil status of Ondo soil than Okegun which resulted in higher utilization of nutrients derived from the treatments applied. Also, the significance increases ($p < 0.05$) in yields of all the treatments compared with control attest to the ability of these treatments in supplying plant nutrients.

Table 4: Effect of cocoa pod ash, NPK 20:10:10 and their combinations on N, P and K uptake at Ondo and Okegun (%)

Treatments	N		P		K	
	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun
Control	1.14	1.18	0.14	0.29	1.24	1.26
F300	3.44	3.54	0.47	0.50	3.48	4.33
F150	1.42	2.66	0.26	0.32	1.48	3.29
C5	2.75	2.60	0.30	0.38	3.62	3.61
C5F150	3.38	3.62	0.41	0.46	4.60	4.42
C10	2.70	2.91	0.40	0.46	4.77	4.19
C10F150	3.49	3.80	0.49	0.49	5.01	4.99
LSD 0.05	0.14	0.19	0.03	0.07	1.02	0.18

Table 5: Effect of cocoa pod ash, NPK 20:10:10 fertilizer and their combinations on agronomic parameters of maize at Ondo and Okegun

Treatment	Height cm		grain yield t ha ⁻¹		% grain yield		stover yield t ha ⁻¹		root dry matter t ha ⁻¹	
	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun	Ondo	Okegun
Control	99.45	142.12	2.10	2.52	0	0	3.74	3.59	1.04	1.28
F300	69.00	170.01	3.67	3.90	75.	55	5.45	5.50	1.53	1.46
F150	103.33	166.15	2.78	2.95	32	17	2.92	4.21	1.32	1.30
C5	118.00	167.67	2.91	3.02	39	20	3.96	5.13	1.41	1.44
C5F150	163.11	173.00	3.45	3.59	66	43	5.22	5.46	1.49	1.49
C10	162.00	169.67	3.10	3.48	48	38	5.17	6.19	1.42	1.46
C10F150	172.67	179.00	3.81	4.38	81	79	5.36	6.78	1.48	2.07
LSD 0.05	12.43	14.42	0.56	0.59	-	-	1.59	1.44	0.47	0.61

In this experiment, yield appears dictated by plant nutrient uptake as the maize plants with highest N, P and K had the highest plant height and yields. The finding that C10F150, F300 and C5F150 gave highest increase in plant height, grain yield, stover yield and root dry matter can be related to the finding that the treatments mostly increased the N, P and K contents of maize tissue which are the most essential nutrients need by maize to complete growth and reproductive cycle.

Conclusion

Application of cocoa pod ash, NPK 20:10:10 fertilizer and their combinations increased soil organic matter and major nutrients, tissue N, P and K status as well as agronomic parameters of maize. Combined cocoa pod ash with reduced level of NPK 20:10:10 fertilizer is found to be more effective source of plant nutrients than the single application of cocoa pod ash and NPK 20:10:10 fertilizer. Treatment C10F150 gave the highest increases in soil nutrient values and growth parameters of maize. The sandy clay soil supplied more plant nutrients derived from cocoa pod ash than clay loam in this experiment.

Dr. Ayeni, L.S (Ph.D. Soil Science)

University of Agriculture, Department of Soil and Land Management, PMB 2240, Abeokuta, Ogun State, Nigeria

E-mail: leye_sam@yahoo.com

Mobile Phone No : 08032142663

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Seasonal Variations in the Water Chemistry and Benthic Macroinvertebrates of a South Western Lagoon, Lagos, Nigeria

*Nkwoji, J. A., Yakub A., Ajani, G. E., Balogun, K. J., Renner, K.O.,
Igbo, J. K., Ariyo, A. A., Bello, B. O.

Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria

Email: josephniomr@yahoo.com; Phone: +2348023739253

ABSTRACT: The water chemistry and benthic macroinvertebrates of a south-western lagoon, Lagos, Nigeria was studied in July, 2008 and March, 2009 representing wet and dry seasons respectively. The salinity ranged from 0.0 ‰ in the wet season indicating a typical freshwater condition to 32.0 ‰ in the dry season indicating a marine condition. Higher Dissolved Oxygen values were recorded in the wet season than in the dry season. 47.47% of the total organisms was sampled in the wet season while 52.53% was collected in the dry season. Species diversity was also higher in the dry season than the wet season. *Tellina nymphalis*, *Clibanarius africana*, and *Penaus notialis* sampled in the dry season were absent in the wet season. Only one species (*Crassostrea gazar*) sampled in the wet season was absent in the dry season. There was an indication of a general defaunisation of this lagoon for which reasons including pollution of the lagoon are plausible. [Journal of American Science 2010;6(3):85-92]. (ISSN: 1545-1003)

Keywords: Benthic, Macroinvertebrates, Rainfall pattern, Salinity, Defaunisation.

INTRODUCTION

Benthic macroinvertebrates are animals without backbone that live on or in the sediment of the water body or attached to rocks or debris at the bottom. The minimum size is 0.55mm in diameter. They include crustaceans, molluscs, aquatic worms and larval forms of aquatic insects. They are important in the aquatic ecosystem because they form part of the aquatic food chain. They are also used to assess water quality and as pollution indicators.

Biological communities have been seen as effective tools for assessing organic pollution. Macroinvertebrate animals are easy to monitor, because they can be sampled quantitatively and also respond to man-made disturbance (Otway et al, 1996).

According to Pearson & Rosenberg (1978), organic enrichment of sediments due to sewage and other organic contaminants may result in a series of non-linear changes in the abundance, biomass and diversity of benthic organisms, in both spatial and temporal patterns.

Early works on the benthic macroinvertebrates of the Lagos lagoon were on genus *Pachymelania* (Oyenekan, 1979), *Iphigenia*

truncata (Yoloye, 1977; Oyenekan & Bolufawi, 1986), and (Oyenekan, 1988). Ajao and Fagade (1990b) worked on the seasonal and spatial distribution of the population of benthic macroinvertebrate, *Capitella capitata* in Lagos lagoon and recorded that the abundance of this organism was influenced by the type and organic content of the sediment as well as the sediment metals and hydrocarbon content.

Edokpayi and Nkwoji (2007) worked on the physico-chemical and macrobenthic invertebrate characteristics of a sewage dumpsite along the bank of Lagos lagoon and recorded a relatively high abundance of the polychaete family Nereidae in the station closest to the sewage dump.

In determining ecological changes in the tropics, temperature may not be as significant as rainfall (Webb 1960; Nwankwo 2004b). Rainfall distributive pattern has great impact on both the chemistry of the water of the lagoon as well as the population dynamics of the fauna and flora of the lagoon (Onyema et al, 2009).

This present study seeks to investigate the impact of seasons on the water chemistry and benthic macroinvertebrates assemblage in this lagoon.

DESCRIPTION OF THE STUDY SITE

Lagos lagoon is a major part of the barrier-lagoon complex of the Nigerian coastal zone. The barrier-lagoon complex extends eastwards for about 200km from the Nigerian-Benin Republic border to the western limit of the transgressive mud coast. The morphology has been described in terms of coastal dynamics and drainage and largely affected by the long shore current actions (Ibe, 1988).

The lagoon is located between latitude $6^{\circ} 26' N$ and $6^{\circ} 38' N$ longitude $3^{\circ} 23' E$ and $3^{\circ} 43' E$.

It covers an area of about 208 km² (FAO, 1969). It is generally between 0.5 – 2m deep in most parts with a maximum of about 5m in the main lagoon and 25m in some dredged parts of the Lagos Harbour. The tidal range is only about 0.3m – 1.3m. The interconnecting creeks are also very shallow and are sites of active silting and deposition of mud. The lagoon sediments range between mud, sandy mud, muddy sand, and sand (Ajao and Fagade, 1991) and has a defined salinity gradient, linked with the rainfall pattern extending inland westwards and eastwards (Nwankwo and Akinsoji, 1992).

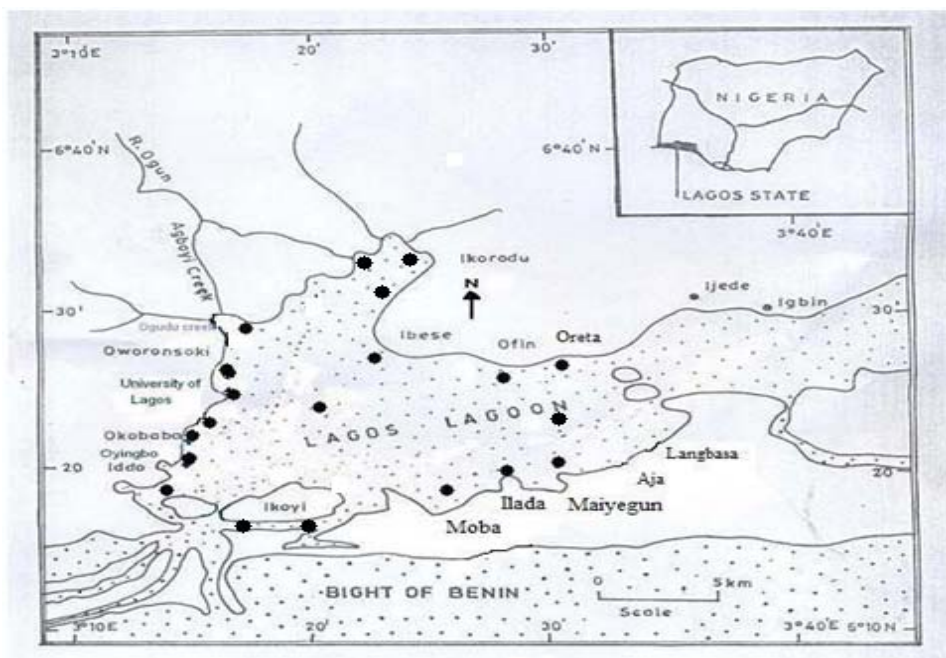


Figure 1: Map of the study area showing the sampling sites

Station	Location	N-coordinates	E-coordinates
1.	Queen's Drive	N06 ⁰ 27.040'	E003 ⁰ 26.648'
2.	Park view	N06 ⁰ 27.337'	E003 ⁰ 27.092'
3.	Moba	N 06 ⁰ 27.724'	E 003 ⁰ 28.269'
4.	Ikate	N 06 ⁰ 28.228'	E 003 ⁰ 28.988'
5.	Itedo	N 06 ⁰ 27.476'	E 033 ⁰ 29.284'
6.	Off Itedo	N 06 ⁰ 29.315'	E 003 ⁰ 30.021'
7.	Oreta	N 06 ⁰ 31.954'	E 003 ⁰ 30.664'
8.	Ofin	N 06 ⁰ 32.309'	E 003 ⁰ 30.003'
9.	Ibese	N 06 ⁰ 32.116'	E 003 ⁰ 29.534'
10.	Nichemtex	N 06 ⁰ 34.731'	E 003 ⁰ 28.557'
11.	Ikorodu port	N 06 ⁰ 36.032'	E 003 ⁰ 28.835'
12.	Majedun	N 06 ⁰ 36.383'	E 003 ⁰ 28.398'
13.	Iddo	N06 ⁰ 28.032'	E003 ⁰ 23.024'
14.	Makoko	N06 ⁰ 29.252'	E003 ⁰ 23.492'
15.	Abule Agege	N06 ⁰ 30.197'	E003 ⁰ 23.558'
16.	Ogudu	N06 ⁰ 33.494'	E003 ⁰ 24.145'

Collection and Analysis of Samples

Data on rainfall distributive pattern were obtained from the Federal Meteorological Department Oshodi, Lagos, Nigeria and the measurement was in mm. Surface water samples were collected with a 1dm³ water sampler and stored in 1litre water bottles and analysed in the laboratory for pH, conductivity, salinity and turbidity using a multi-meter water checker (Horiba U-10). Separate water samples were collected in 250ml dissolved oxygen bottles at each station for dissolved oxygen estimation using iodometric Winkler's method. Air and surface water temperature were measured *in situ* using mercury-in-glass thermometers.

Benthic samples were collected with the use of Van-veen grab. The sediment samples collected were sieved through 0.5mm aperture size sieve. The materials retained in the 0.5mm sieve were then preserved in 5% formalin. Sorting was done to get the clean samples of the benthic organisms.

The sorted macro benthic fauna were identified to species level where possible. They were counted and numbers recorded. Identification was done after Edmund (1978), Yankson and Kendall (2001), Olaniyan, (1968), and Schneider (1990).

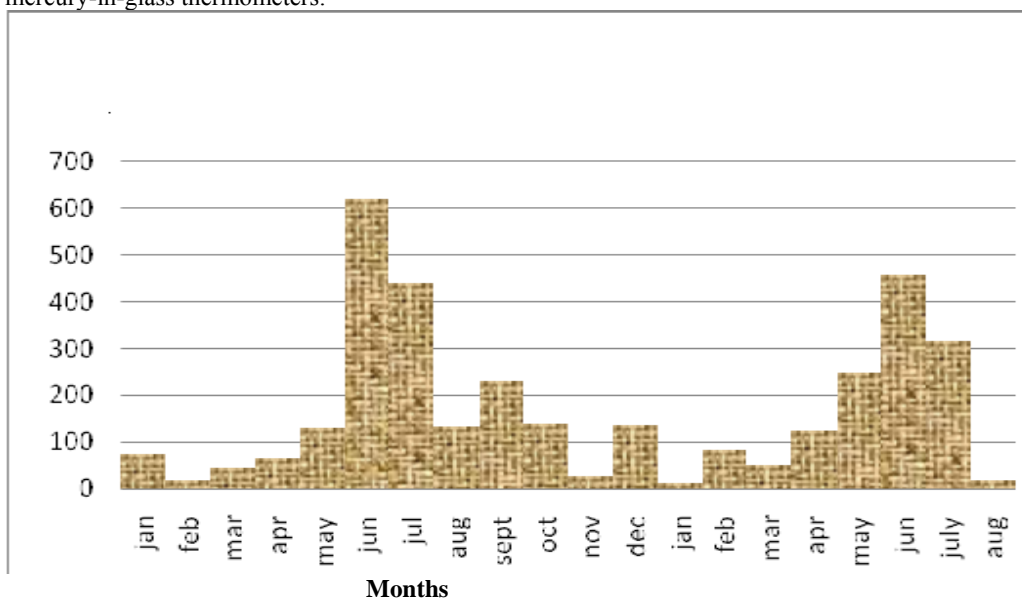


Figure 2: Rainfall (mm) distribution Jan. 2008-Aug. 2009

Community Structure Analysis

Species Richness Index (d)

The Species richness index (d) according to Margalef (1951) was used to evaluate the community structure. The equation below was applied and results were recorded to two decimal places.

$$d = (S - 1) / \log_e N$$

Where:

d = Species richness index

S = Number of species in a population

N = Total number of individuals in S species.

Shannon and Wiener diversity index (H)

Shannon and Wiener (1949) diversity index

(H) given by the equation:

$$H_s = \sum P_i \ln P_i$$

Where

H_s = Diversity Index

i = Counts denoting the *i*th species ranging from 1 – n

P_i = Proportion that the *i*th species represents in terms of numbers of individuals with respect to the total number of individuals in the sampling space as whole.

RESULTS

Water chemistry

Highest salinity recorded for the wet season was 3.10 ‰ in Iddo sampling station. Most stations sampled in the wet season recorded a zero salinity indicating a freshwater condition. The dry season generally recorded high salinity with the highest value (32.0 ‰) recorded in Iddo sampling station. The highest pH value (9.1) for the period of study was recorded in the wet season at Ikate sampling station while the lowest value (6.56) was observed in the dry season at Ofin sampling station. Conductivity values were generally lower in the wet season than in the dry season. There were no significant differences in the values of both the air and water temperatures between the wet season and the dry season ($P < 0.05$). The Dissolved Oxygen recorded for

both wet and dry seasons at all the stations (except Makoko and Ogudu mouth in the dry season) were above the WHO standard (Table

1). Seasonal variations salinity, conductivity, turbidity and dissolved oxygen in the stations are presented in Figures 3-6.

Table 1: Physico-Chemical Parameters of the Water Samples

		Queen's Drive	Park view	Moba	Ikate	Itedo	Off Itedo	Oreta	Ofin	Ibese	Nichmtex	Ikorodu port	Majidun	Iddo	Makoko	Abule Agege	Ogudu Mouth
Air Temp. (°C)	WS	28.0	27.2	26.0	28.0	30.0	30.0	30.0	30.0	30.5	30.0	30.0	31.0	28.0	28.5	28.0	29.0
	DS	28.5	28.0	29.0	29.5	30.0	29.5	29.5	29.0	30.5	30.5	30.0	30.5	29.0	29.0	28.5	29.0
H ₂ O Temp. (°C)	WS	29	29	28	28	28.9	29	29	29	29.5	28	28	28	28	26.5	27	26
	DS	28.0	27.0	28.5	28.5	29.0	29.5	29.0	29.0	29.0	28.5	29.5	29.5	28.0	28.0	27.5	28.5
pH	WS	9.1	8.9	9.0	9.1	8.9	8.8	9.2	8.9	9.0	9.0	8.8	9.1	8.10	7.96	7.69	7.81
	DS	8.08	8.02	8.10	7.90	7.48	6.75	6.76	6.73	7.50	6.60	6.56	6.71	8.01	7.80	7.79	7.49
Conductivity (mS cm^{-1})	WS	0.84	1.0	0.64	0.67	0.61	0.12	0.19	0.3	0.24	0.54	0.18	0.61	5.84	1.10	0.39	0.17
	DS	46.0	46.5	45.8	34.7	32.2	32.5	29.0	29.0	28.9	22.4	19.5	19.8	49.1	41.4	39.5	11.6
Turbidity (NTU)	WS	78	366	126	108	208	226	86	386	248	256	346	276	133	72.0	51.0	229.0
	DS	10	10	10	10	147	135	10	100	101	107	109	10.0	57.0	72.0	51.0	129.0
Salinity (‰)	WS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.5	1.10	0.00
	DS	29.9	30.5	29.8	22.0	20.0	20.4	17.8	17.9	17.8	13.4	11.4	11.7	32.0	26.5	25.0	6.60
D.O (mg l^{-1})	WS	11.2	13.6	18.4	15.6	12.0	11.2	12.4	12.4	13.2	9.6	10.4	8.4	8.0	5.2	8.4	8.8
	DS	8.00	13.2	10.0	14.8	7.20	11.6	8.40	10.4	12.8	9.2	8.0	5.6	3.10	3.50	4.40	3.90

WS= Wet Season

DS= Dry Season

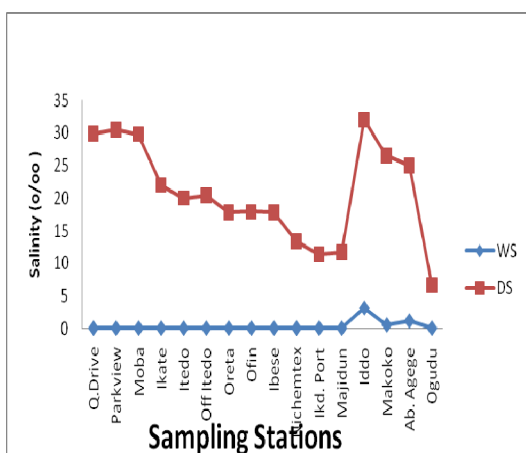


Figure 3: Seasonal Variations in Salinity/Station

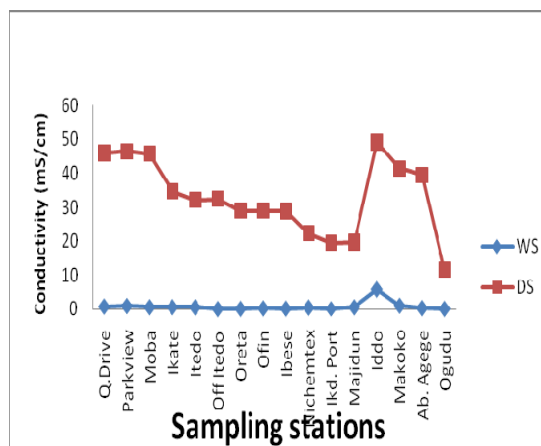


Figure 4: Seasonal Variations in Conductivity/Station

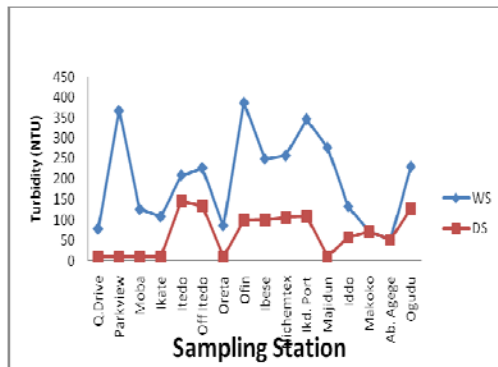


Figure 5: Seasonal Variations in Turbidity/Station

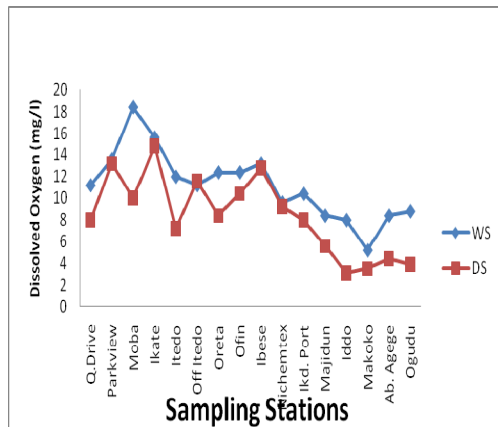


Figure 6: Seasonal Variations in D.O./Station

Population Dynamics of the Benthic Macroinvertebrates

A total of 788 individuals were sampled in the wet season accounting for 47.47% of total individuals sampled during the period of study. 872 individuals were sampled in the dry season which accounts for 52.53% of the total individuals sampled. More species were recorded in the dry season than in the wet season during the period of study. *Tellina nymphalis*, *Clibanarius africanus*, and *Peneaus notialis* sampled in the dry season were absent in all the station during the wet season. On the other hand, only *Crassostrea gazar* sampled in the wet season was absent in all the stations in the dry season.

The highest number of individuals (505) sampled in the wet season during the period of study was collected in Ofin sampling station accounting for 64.09% of the total individuals collected in the wet season during the period of study. In the dry season samples, the highest number of individuals (351) was collected in Oreta sampling station accounting for 40.25% of the total individuals collected during the period of study (Table 2). Figure 3 shows variations in total number of individuals collected in the sampling stations for the two seasons.

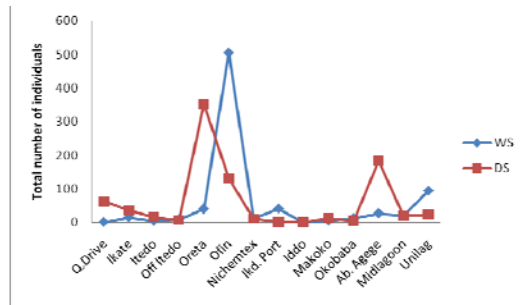
Table 2: Numerical Abundance and Occurrence of the Benthic Macroinvertebrates

		Q. Drive	Ikate	Itedo	Off Itedo	Oreta	Ofin	Ibese	Nichmetex	Ik.d. Port	Majidun	Iddo I	Iddo IV	Makoko	Okobaba	Ab Agege	Midagoon	Ogudu	Unilag ft	Total
<i>Mytilus edulis</i>	WS			1			2										17			20
	DS	1				11						1							2	15
<i>Aloides trigona</i>	WS	—	1	—	—	6	85	1	2	27	—	—	—	—	—	—	—	—	1	123
	DS	—	—	—	1	101	2	—	—	2	—	—	—	—	—	—	—	—	—	106
<i>I. truncate</i>	WS	—	—	—	—	21	65	—	2	3	—	—	—	—	—	3	3	—	—	97
	DS	55	—	—	4	119	2	—	2	—	1	—	—	—	—	—	2	—	5	190
<i>Tympanotonus sp</i>	WS	—	—	—	—	6	2	—	2	2	—	—	—	5	9	4	—	—	25	55
	DS	—	—	16	—	1	—	—	1	—	1	—	—	11	1	—	7	—	8	46
<i>P. aurita</i>	WS	—	13	3	1	5	273	1	6	4	—	—	—	—	2	6	—	—	58	372
	DS	1	26	—	—	12	45	—	4	—	2	—	—	—	2	176	6	1	—	275
<i>Neritina glabrata</i>	WS	1	1	—	—	—	18	—	1	4	—	1	—	—	—	12	—	—	—	37
	DS	—	5	1	—	102	69	—	4	—	—	—	—	2	2	7	3	—	7	202
<i>Neritina senegalensis</i>	WS	—	—	—	—	2	60	—	—	—	—	—	—	—	—	—	—	—	4	66
	DS	—	—	—	—	—	14	—	—	—	—	—	—	—	—	—	—	—	—	14
<i>Nereis sp</i>	WS	—	—	—	6	—	—	—	—	1	—	—	—	—	1	—	—	—	2	10

	DS	4	–	–	–	1	–	–	–	–	–	–	–	–	–	2	–	–	7
<i>Capitella Capitata</i>	WS	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	4	6
	DS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	2
<i>Crassostrea gazar</i>	WS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	2
	DS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0
<i>Tellina nymphalis</i>	WS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0
	DS	1	1	–	2	4	–	–	–	–	–	–	1	–	–	–	–	–	9
<i>Clibanarius Africana</i>	WS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0
	DS	1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
<i>Penaus notialis</i>	WS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0
	DS	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
No. of Species	WS	1	3	2	3	5	7	1	5	6	0	1	0	1	3	5	2	0	6
	DS	6	6	2	3	8	5	1	4	1	3	1	1	2	3	2	6	1	5
No. of Indiv.	WS	1	15	4	9	40	505	1	13	41	0	1	0	5	12	27	20	0	94
	DS	63	36	17	7	351	132	1	11	2	4	1	1	13	5	183	21	1	23

WS= Wet Season

DS= Dry Season



Stations

collected /Sampling stations

Figure 7: Seasonal variations in total number of individuals

Species Diversity and Richness Indices

The species diversity and richness indices of the study areas for the period of study are presented in Table 3.

The highest value of 1.60 for species diversity index was recorded in the dry season at Midlagoon sampling station while the highest for species richness (Margalef's index) was also recorded in dry season and at the same sampling station. The highest number of individuals (505) sampled throughout the period of study was recorded in Ofin sampling station in the wet season (Table 3).

Table 3: Species Diversity and Richness Indices

Bio-indices		Queens Drive	Ikate	Iredo	Off Iredo	Oreta	Ofin	Nichehtex	Ik. Port	Iddo	Makoko	Okobaba	Ab Agege	Midlagoon	Unilag
Total species diversity (S)	WS	1	3	2	3	5	7	5	6	1	1	3	5	2	6
	DS	6	6	2	3	8	5	4	1	1	2	3	2	6	5
Total Species abundance (N)	WS	1	15	4	9	40	505	13	41	1	5	12	27	20	94
	DS	63	36	17	7	351	132	11	2	1	13	5	183	21	23
Shannon-Wiener Index (Hs)	WS	0	0.49	0.56	0.85	1.32	1.31	1.41	1.16	0	0	0.72	1.41	0.42	1.05
	DS	0.56	0.91	0.22	0.96	1.39	1.07	1.26	0	0	0.43	1.05	0.16	1.60	1.41
Margalef's Index (d)	WS	-	0.74	0.72	0.91	1.08	0.96	1.56	1.34	-	0	0.80	1.21	0.33	1.10
	DS	1.21	1.11	0.35	1.03	1.19	0.82	1.25	0	-	0.39	1.24	0.19	1.64	1.28

DISCUSSION

Monthly rainfall volumes observed before, during and after the period of study is typical of a

bi-modal rainfall distributive pattern recorded by earlier authors (Chukwu 2002; Nwankwo *et al.* 2003; Edokpayi and Nkwoji 2007; Onyema, *et al.* 2009). The results of the air and water temperatures for all the stations during the period of study showed that temperature differences in the two seasons are highly negligible. This result agrees with earlier studies (Webb, 1960; Nwankwo, 2004; Edokpayi and Nkwoji, 2007) that temperature is not a major factor in tropical aquatic ecosystem. There were profound differences in the salinity values between the two seasons. According to Onyema, *et al.* (2009), the rainfall distributive pattern has great impact on the chemistry of the water of the lagoon. This impact is mostly expressed in the salinity values. This is because the rain water is a fresh water which when added to the lagoon water, greatly reduces the salinity.

The strong positive correlation in the values of salinity and conductivity recorded in this study as seen in Figures 3 & 4 is in agreement with studies carried out earlier in the lagoon (Ogunwenmo and Osuala, 2004; Edokpayi and Nkwoji, 2007; Onyema and Nkwoji, 2009). Conductivity and salinity have been previously reported as associated factors (Onyema and Nwankwo 2009). The water samples were more turbid in the wet season than in the dry season at all the stations during the period of study. The particulate matters brought into the lagoon by surface run-off and flood must have been responsible for the high turbidity recorded in the wet season.

Dissolved oxygen was also higher in the wet season and positively correlated with turbidity. Onyema *et al.* (2009) had attributed high level of dissolved oxygen to the perturbation of water and this was prevalent in the wet season. A higher level of dissolved oxygen recorded during the wet season could also be linked to floodwater dilution and reduced resident time of the polluted water. Low dissolved oxygen was however recorded in the dry season at the western industrialised parts of the lagoon. According to Nwankwo and Akinsoji (1989) the Lagos lagoon is under intense pressure from pollution such as untreated sewage, sawdust, petrochemical materials, detergent and industrial effluents.

The composition, abundance and distribution of the benthic macroinvertebrates in the study area for the two seasons are presented in Table 2. In the wet season samples, 10 taxa were identified from a total of 788 individuals collected. This accounts for 76.9% and 47.47% of the total taxa and individuals respectively, collected during the period of study. For the dry season samples, 12

taxa were identified from a total of 872 individuals collected accounting for 92.3% and 52.53% of the total taxa and individuals respectively, collected during the period of study. The number of species and individuals sampled in the dry season was higher than in the wet season. *Tellina nymphalis*, *Clibanarius africana*, and *Penaus notialis* sampled in the dry season were absent in the wet season. Only one species (*Crassostrea gazar*) sampled in the wet season was absent in the dry season.

The macrobenthic abundance and composition were low and the more dominant taxonomic groups were molluscs. There is an observable low diversity and low abundance of the benthic macro invertebrates in the sampling area. Some species such as *Dosinia isocardia*, *Tagellus angulata*, *Tellina nymphalus*, reported by earlier workers (Oyenekan, 1979, Ajao & Fagade, 1990 and Brown, 1991) in the lagoon were missing in this study.

Only one individual each of the bivalve *Aloidis trigona* was recorded in the western axis of the lagoon in the wet season. This agrees with similar observations by Ajao and Fagade (1990), that this benthic fauna was virtually absent from the western industrialised parts of Lagos lagoon which received a complex mixture of domestic and industrial wastes.

There is an observable overall low diversity of benthic macroinvertebrates in the study area. Both Margalef's species richness (d) and Shannon-Weaver diversity index (H) were highest in the dry season. These values 1.64 and 1.60 respectively, were indicative of very low species richness and diversity of the study area. The sampling station with the highest value for both species richness and diversity (Midlagoon) is removed from land when compared with the other sampling stations and hence relatively shielded from land based stressors.

The macrobenthic abundance and composition at the study stations were low. This could be attributed to some ecological imbalance arising from alterations of some important factors governing the abundance and distribution of the benthic communities. Such factors include water quality, immediate substrates for occupation and food availability (Dance and Hynes, 1980). Therefore, it appears that the low macrobenthic invertebrate community abundance, composition and diversity may have been greatly affected by stress imposed by land based pollutants (Chukwu and Nwankwo, 2003). There is an indication of a general defaunisation of the lagoon for which

reasons including pollution of the lagoon are plausible.

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Microbiological Impacts of Produce Water Discharges in Nearshore Shallow Marine Waters Near Chevron's Escravos Tank Farm, Nigeria

Dr. Chuma C. Okoro

Department of Biological Sciences and Biotechnology

Caleb University, Lagos Nigeria

Tel: 08033072754, 01-7430285

e-mail: chuma2k2001@yahoo.com

P. O. Box 146, University of Lagos Post Office, Lagos, Nigeria

Abstract: A microbiological survey was undertaken in produced water and its receiving environment with the aim of verifying the likely impacts of produced water microbial flora especially the hydrocarbon utilizing types and the sulphate reducing bacteria on the immediate receiving marine near shore shallow environment. The sampling was carried out in two seasons, late wet season and late dry season. The results obtained indicate that produced water from Escravos tank farm had relatively moderate concentrations of hydrocarbon utilizing microorganisms and sulphate reducing bacteria and the concentration of these organisms were much higher at the point of discharge of the produced water including the surface water and the bottom sediment. Bottom sediment samples up to a distance of 500m upstream also showed relatively moderate concentration of hydrocarbon utilizing microorganisms and sulphate reducing bacteria. A distance of 500m downstream showed relatively low concentrations of hydrocarbon utilizing bacteria without any presence of sulphate reducing bacteria. The two seasons under investigation showed similar results. The results obtained indicate that the impacts of produced water microbial flora on the receiving environment is limited to the vicinity of the discharge point of about 100 meters in diameter and also to some extent up to a distance of 500m upstream along the direction of flow of produced water discharges. This assertion is supported by the experimental data which showed considerable accumulation of produced water hydrocarbons in the sediment at the discharge point up to 500m upstream with relatively high concentration of hydrocarbon degrading microorganisms and sulphate reducing bacteria. It is expected that while the hydrocarbon degrading microorganisms plays a beneficial role of degrading and detoxifying abundant produced water hydrocarbons in the sediment and the surface water, Sulfate reducing bacteria might at the same time be playing a detrimental role of oxidizing certain organic compounds or hydrogen and reducing sulphate and other reduced sulphur compounds in the sediment to hydrogen sulphide, the hydrogen sulphide when released can be very toxic to bacteria, aquatic animals and man. [Journal of American Science 2010;6(3):93-101]. (ISSN: 1545-1003).

Keywords: Produced water, Sulphate reducing bacteria, Hydrocarbon utilizing bacteria

1. Introduction:

Produced water is defined as the water (brine) brought up from the hydrocarbon bearing strata during the extraction of oil and or Gas and this may include; Formation water, Injection water, small volumes of condensed water and trace amount of treatment chemicals (Ayes and Parker, 2001). Produced water is by far the largest volume bi-product of waste stream associated with oil and gas production and its properties and volumes vary considerably depending on the geographical location of the field, the geological formation with which the produced water has been in contact for thousands of years and the type of hydrocarbon product being produced (Ayes and Parker, 2001).

The characteristics features of produced water such as microbial load, salinity, density, trace metals and organic content can vary widely between fields and even within the same field, same goes with the receiving environment and the biological impacts of the discharge on the

immediate environment will depend on whether the discharge is on a shallow near shore environment or in an open sea. In an open sea, the level of dilution and mixing is very high and as such the impact of the discharged produced water may not be significant but in a shallow near shore environment where the level of dilution and mixing is low, it is expected that the impact of the discharged produced water on the immediate environment will be significant.

The study is focused on the microbiological impacts of produced water discharges on the immediate near shore environment and the target microorganisms are the hydrocarbon degrading organisms and sulphate reducing bacteria which seems to be indigenous to produced water. Population densities of microorganisms in produced waters are usually not very high, total bacterial counts can reach up to 10^5 - 10^6 millilitres by direct microscopic count (Maggot, 2005). These low population densities indicate that produced

waters constitute a nutrient limiting environment. A major cause for concern is the presence of sulphate reducing bacteria (SRB) in produced water. A great variety of SRBs have been isolated from produced water in various oil fields around the world (Birkeland, 2005). SRB species such as *Archaeoglobus fulgidus*, *Desulfacinium infernum*, *Desulfobacter vibrioformis*, *Desulfomicrobium sp*, *Thermodesulfobacterium* have been isolated from the North sea oil fields (Birkeland, 2005), From the Russian oil fields, *Desulfotomaculum kuznetsorri* and *Desulfotomaculum nigrificans* have been isolated while *Desulfovibrio bastinii* and *Desulfovibrio gabonensis* have been isolated from Congo and Gabon offshore oil fields (Birkeland, 2005). In Nigeria, significant concentrations of unidentified sulphate reducing bacteria have been isolated from produced water effluents from Chevron's Escravos tank farm (Okoro, 1999). These discoveries indicate that oil fields may be the natural habitats of sulphate reducing bacteria.

Sulphate reducing bacteria are strict anaerobes that perform anaerobic respiration by oxidizing certain organic compounds or hydrogen and reducing sulphate and other reduced sulphur compounds to hydrogen sulphide, the hydrogen sulphide when released is very toxic to bacteria, aquatic animals and man (Atlas, 1984). Apart from liberation of hydrogen sulphide, sulphate reducing bacteria have been known to be responsible for corrosion of iron and steel in form of storage tanks, pipelines and pumps (Atlas, 1984).

A significant concentration of hydrocarbon utilizing microorganisms have also been isolated from produced water, and the studies conducted thereafter showed that produced water is easily biodegradable (Okoro, 1999., Okoro and Amund, 2002., and Okoro, 2008), the presence of hydrocarbon degrading bacteria in produced water therefore can be of immense benefit to the receiving environment especially in the degradation of recalcitrant organic compounds in the receiving environment (Munn, 2004).

The aims and objectives of the present study therefore is to isolate the indigenous microbial flora of produced water and the receiving shallow near shore environment where the produced water is being discharged with more emphasis on the hydrocarbon utilizing bacteria and sulphate reducing bacteria and also to further investigate the relationship between the indigenous microbial flora of the discharged produced water and that of the receiving environment up to a distance of 500m downstream and upstream from the discharge point with the aim of knowing how much the indigenous microbial flora of the produced water have impacted on the receiving environment.

2.0 Materials and Methods:

Physicochemical Analysis of Water and Sediment samples:

The pH of the water and sediment samples were measured with a portable water proof pH meter (Jenway, 3150, USA), Temperature was measured using portable thermometer (Hanana, H1-93510, USA). Salinity was measured as Chloride using the Argentometric method as earlier described in (Eaton et al, 1995). Per sulphate digestion method was used to estimate Phosphorus (Eaton et al, 1995).

The method used in the estimation of Barium, Sulphate and Nitrate was as described in CNL (1995). The appropriate powder pillows for Barium, Nitrate and Sulphate were added to 25 ml. Of the water sample and 1g of the sediment sample as the case may be. The wave length of the colorimeter was adjusted to 500nm using blank solution, the sample was introduced to the colorimeter and the concentration recorded accordingly.

Carbonate, Bicarbonate and COD were also determined as described in Eaton et al, 1995. Ammonia Nitrogen was determined by titrimetric method while TDS and TSS were determined by gravimetric method as described in Eaton et al, 1995.

Determination of Biological Oxygen Demand

BOD bottles were filled with appropriate dilutions of the samples (50ml) and the initial dissolved oxygen was measured. The BOD bottles with samples were sealed to exclude air followed by incubation at 20°C for 5 days after which the BOD was computed from the difference between the initial and the final dissolved oxygen (Eaton et al, 1995)

Detection of heavy metals: Heavy metals were detected using the Atomic absorption Spectrophotometer (Perkin Elmer 5100PC, England) after sample preparation and digestion as previously described (Eaton et al, 1995).

Detection of Sulphate reducing bacteria:

Sulphate reducing bacteria were estimated using using sulphate reducing bacteria test kit (Rapid check 11) which was prepared and packaged by Strategic diagnostics Industries Inc. As described in CNL, 1995. The SRB test kit contains a set of reagents which was mixed with 1ml. Of the sample and incubated for 10mins at room temperature under anaerobic condition. The colour of the membrane of the test kit was compared with the standard colour in the colour card to determine the SRB concentration.

Enumeration of Hydrocarbon Utilizing Microorganisms:

Hydrocarbon utilizing microbial counts were obtained by plating out at low dilutions 10^{-1} – 10^{-3} of samples on mineral salt medium of Mills *et al* (1978). The composition of the medium is as follows in (g/L): NaCl (10), $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (0.42), KCl (0.29), KH_2PO_4 (0.83), Na_2HPO_4 (1.25), NaNO_3 (0.42), Agar bacteriological (15), distilled water (1000 ml), and pH (7.2). The medium was autoclaved at 1.1 kg/cm^2 for 15 mins. The inoculated mineral agar plates were then inverted over sterile membrane filters moistened with crude oil (Escravos light) and held in the lid of the petri dishes. The dishes were wrapped round with a masking tape so as to increase the vapour pressure within the Petri dishes while the plates were incubated at 29°C for 6 days after which the growth of hydrocarbon degrading microorganisms were observed and counted. For fungal plates, 0.1g of Penicillin was added to 250ml mineral salt medium to inhibit bacterial growth.

Solvent extraction of Residual Oil

One gram of the sample or 25mls as the case may be was introduced into a separating funnel containing 50mls of Methylene chloride, this was followed by vigorous shaking for 10mins and filtration using Watman no.1 filter paper as described previously described (Eaton *et al*, 1995) and the filtrate was collected in a clean conical flask.

Gas Chromatography of Oils

Degraded oil were analyzed by Gas chromatography using Hewlett Packard 5890 series 11 Gas chromatograph equipped with single flame ionization detector (FID) fitted with Perkin Elmer Nelson analog digital converter (900 series) and a Compaq deskpro computer. A J and W scientific DB-1 capillary column of 15 m length and an internal diameter of 0.32 mm wide bore of 1micron film thickness were used. A temperature program of $50\text{--}305^\circ\text{C}$ increasing at 3.5°C per minute for 27.15min was employed. Hydrogen with a flow rate of 2ml per min was used as a carrier gas while the flow rate of air was 400ml per min. The detector temperature was 325°C while the injection port temperature was 305°C . 1 ml of the residual oil extract was dissolved in methylene chloride at the ratio of 1:1 and a sample volume of $0.2 \mu\text{l}$ was injected into the GC. Total hydrocarbon was measured as oil and grease in ppm.

Identification of Hydrocarbon Degrading Microorganisms:

The growth and morphology of bacterial isolates in minimal salts medium and on nutrient agar plates were noted with regards to the

following characteristics; Form, Pigmentation, Texture, Color and Elevation. Fungal cultures were stained with Methylene blue and observed under a microscope (x40) and each fungal culture was identified based on its morphological characteristics. Bacterial cultures were stained using grams staining procedure and proper identification was done using a computerized BBL Enterotube identification test kits, manufactured by Becton Dickson Microbiology systems Inc. USA.

3.0 Results:

Physico-Chemical Properties of Produced water and the associated receiving marine environment

The Physicochemical properties of produced water and the receiving marine environment during the late dry and rainy season's survey are shown in tables 1 and 2 respectively. Both the produced water and the receiving marine environment have a moderate alkaline pH during the late dry season but the late rainy season's survey showed a slightly neutral pH for produced water and a slightly acidic pH for the receiving marine environment. Considerable concentrations of oil and grease were present in the discharged produced water and also within the area of about 100m circumference where produced water is being discharged. Among the heavy metals analyzed, only lead and chromium showed considerable presence in both the produced water and the receiving marine environment. The temperature of the produced water and the point of discharge is relatively higher than that of the marine environment.

Relative Population Densities of Microorganisms found in the produced water and the receiving marine environment

The relative population densities of microorganisms found in the produced water and the receiving marine environment during the two seasons under investigation are shown in tables 3 and 4 respectively. The total heterotrophic and hydrocarbon utilizing microbial counts were highest in the bottom sediment samples at the point of discharge of produced water. Upstream surface water and bottom sediment samples also showed higher microbial counts than the downstream counterparts. Considerable concentration of SRB were present in produced water, surface water and bottom sediment at the point of discharge but the concentrations were more in the bottom sediment samples. Upstream bottom sediment samples also showed considerable concentrations of sulfate reducing bacteria while those of downstream did not.

Table 1: Chemical Composition of Produced Water and the Receiving Environment at Escravos (late dry season)

	Treated Produced Water	Receiving Water at Discharge Point	Bottom Sediment at Discharge Point	500M Upstream from Discharge Point (SW)	500M Upstream from discharge point (BS)	500M Downstream from discharge point (SW)	500M Downstream From discharge point (BS)
pH	8.34	8	8.40	7.30	7.80	7.40	7.60
Temp.(^o C)	65	48	42	38	36	32	32
Co ₃ (mg/L)	14.16	0.00	64.40	0.00	23.60	0.00	14.40
HCO ₃ (mg/L)	1894	405	2640	65.70	1480.50	69	1325
COD(mg/L)	1110	240	1820	200	1480	300	1250
BOD ₅ (mg/L)	640	230	1260	60	820	70	540
DO(mg/L)	1	3	0.56	4	0.65	3	1.50
Mg(mg/L)	0.37	451	625	590	0.68	27	0.34
SO ₄ (mg/L)	12	450	550	1300	220	1425	140
Ba(mg/L)	16	8	16	46	0	0	0.30
NO ₃ (mg/L)	3.98	0.33	1.68	35	0.50	0.00	0.48
NH ₃ (mg/L)	3.25	1.84	2.40	1.96	1.60	1.96	3.20
Salinity(Cl)mg/L	5105	11012	9650	10612	8560	10211	9480
TSS (mg/L)	58	585	28	172	32	178	28
TDS (mg/L)	11492	16484	25230	17860	13200	16260	9200
OIL AND GREASE (mg/L)	44	22	36	0	14	0	16
Ca (mg/L)	68	250	330	279	0	268	0.046
P (mg/L)	1.14	0.20	0.62	0	1.56	0	1.26
Cd (mg/L)	0.06	0.03	1.20	0.04	0	0.04	0
Cr (mg/L)	0.10	0.04	0.82	0.12	0.48	0.12	0
Cu (mg/L)	0	0.03	0.08	0	0.16	0	0.28
Pb (mg/L)	0.15	0.19	0.93	0.12	0.82	0.12	0
K (mg/L)	54	17.6	23.40	298	96.40	246	48.40
Zn (mg/L)	0	0	0.55	0.02	0	0.01	0.056

1. SW = Surface water, BS= Bottom sediment. TDS=Total dissolved solids, TSS= Total suspended solids .

2. GPS BEARINGS: Discharge point: 04 22 12 E, 06 09 15 N, 500M UPSTREAM: 04 47 30 E, 06 23 00 N, 500M DOWNSTREAM: 04 39 30 E, 06 23 10 N.

Hydrocarbon Utilizing Microorganisms Isolated from Produce water and the receiving marine environment

Various groups of hydrocarbon utilizing microorganisms, especially Bacteria and Fungi which were isolated from the produced water and the receiving marine environment during the two

seasons under investigation are shown in table 5. It was observed that some of the microorganisms found in the produced water were also present in the receiving marine environment. The bacterial flora of produce water was dominated by *Pseudomonas sp.* during the two seasons under investigation the *Aspergillus sp.* dominated the Fungal flora.

Table 2: Chemical Composition of Produce Water and the Receiving Environment at Escravos (late wet season)

	Treated Produced Water	Receiving Water at Discharge Point	Bottom Sediment at Discharge Point	500M Upstream from Discharge Point (SW)	500M Upstream from discharge point (BS)	500M Downstream from discharge point (SW)	500M Downstream From discharge point (BS)
pH	7.9	7.3	7.8	6.8	7.2	6.1	6.6
Temp.(°C)	58	42	38	32	30	29	28
Co₃(mg/L)	0	0	0.18	0	0.56	0	1.28
HCO₃(mg/L)	2660	7.73	1650	51	2840	26	3640
COD(mg/L)	4610	1387	5210	248	4280	682	3840
BOD₅(mg/L)	900	140	1280	60	1200	10	680
DO(mg/L)	1	2	0.50	4	0.85	4	1.30
Mg(mg/L)	113.3	787	326	149	233	1080	246
SO₄(mg/L)	57	60	164	425	525	305	310
Ba(mg/L)	27	22	14	3	23	7	32
NO₃(mg/L)	4.3	0.5	6.40	0.20	0.56	6.30	460
NH₃(mg/L)	3	1.24	3.26	0.68	3.42	1.88	0.38
Salinity(Cl)mg/L	11516	7033	9506	7607	8508	6358	7610
TSS (mg/L)	63	250	23	182	14	230	08
TDS (mg/L)	17348	19633	14880	15322	16840	14232	13406
OIL AND GREASE (mg/L)	66	12	26.40	0	14.20	0	9.60
Ca (mg/L)	91	110	138	178	48	226	148
P (mg/L)	62	18	340	410	432	430	480
Cd (mg/L)	0.03	0.06	0.08	0.01	0.068	0.03	0.56
Cr (mg/L)	0.20	0.12	0	0	0.43	0.03	0
Cu (mg/L)	0.50	0	0.16	0.28	0	0	0.038
Pb (mg/L)	0.08	0.06	0.43	0.02	0.008	0.08	0
K (mg/L)	114	128	326	0	142	0	0.38
Zn (mg/L)	0.11	0.12	0.21	0	0.53	0	0.15

SW = Surface water, BS= Bottom sediment. TDS=Total dissolved solids, TSS= Total suspended solids. GPS BEARINGS: Discharge point: 04 22 12 E, 06 09 15 N., 500M UPSTREAM: 04 47 30 E, 06 23 00 N., 500M DOWNSTREAM: 04 39 30 E, 06 23 10 N.

TABLE 3: Relative Population Densities of Microorganisms found in Produce Water and the Receiving water during the late Dry Season sampling period.

	Total Heterotrophic Bacterial counts	Total Hydrocarbon Utilizing Bacterial counts	% Hydrocarbon Utilizing Bacteria	Total Heterotrophic Fungal and Yeast Counts	Hydrocarbon Utilizing Fungal and Yeast Counts	% Hydrocarbon Utilizing Fungi and Yeasts	SRB COUNTS
Treated Produced Water (cfu/mlx10 ⁵)	23	1.20	5.20	0.28	0.096	34.20	1.0
Receiving Water at discharge point (cfu/mlx10 ⁵) SW	30	5.60	18.60	0.52	0.015	2.88	1.20
Bottom sediment at discharge point(cfu/gx10 ⁵) BS	126	14	11.11	0.98	0.055	5.60	10
500m upstream from discharge point(cfu/mlx10 ⁵) SW	14	0.16	1.14	0.85	0.008	0.94	0
500m upstream from discharge point(cfu/gx10 ⁵) BS	48	1.38	2.87	1.46	0.032	2.19	1.0
500m downstream from discharge point(cfu/mlx10 ⁵) SW	13	0.024	0.18	0.65	0.001	0.15	0
500m downstream from discharge point(cfu/gx10 ⁵) BS	44	0.86	0.51	1.36	0.0012	0.088	0

SW = Surface water, BS= Bottom sediment. GPS BEARINGS: Discharge point: 04 22 12 E, 06 09 15 N., 500M UPSTREAM: 04 47 30 E, 06 23 00 N., 500M DOWNSTREAM: 04 39 30 E, 06 23 10 N

Table 4: Relative Population Densities of Microorganisms found in Produce Water and the Receiving water during the late Wet Season sampling period.

	Total Heterotrophic Bacterial counts	Total Hydrocarbon Utilizing Bacterial counts	% Hydrocarbon Utilizing Bacteria	Total Heterotrophic Fungal and Yeast Counts	Hydrocarbon Utilizing Fungal and Yeast Counts	% Hydrocarbon Utilizing Fungi and Yeasts	SRB COUNTS
Treated Produced Water (cfu/mlx10 ⁵)	28	1.10	3.92	0.12	0.0032	2.66	0.10
Receiving Water at discharge point (cfu/mlx10 ⁵) SW	96	3.20	3.33	1.48	0.068	4.59	0.20
Bottom sediment at discharge point(cfu/gx10 ⁵) BS	148	4.50	3.04	2.65	0.042	1.58	2.50
500m upstream from discharge point(cfu/mlx10 ⁵) SW	26	0.068	0.26	1.50	0.0012	0.08	0
500m upstream from discharge point(cfu/gx10 ⁵) BS	32	0.62	1.93	0.18	0.005	2.77	0.10
500m downstream from discharge point(cfu/mlx10 ⁵) SW	22	0.015	0.068	0.32	0.0011	0.61	0
500m downstream from discharge point(cfu/gx10 ⁵) BS	28	0.068	0.24	1.80	0.021	1.16	0

SW = Surface water, BS= Bottom sediment. GPS BEARINGS: Discharge point: 04 22 12 E, 06 09 15 N., 500M UPSTREAM: 04 47 30 E, 06 23 00 N., 500M DOWNSTREAM: 04 39 30 E, 06 23 10 N.

Table 5: Hydrocarbon Utilizing Microorganisms isolated from Produce water and the Receiving water during the two Seasonal periods under investigation.

	LATE DRY SEASON PERIOD		LATE WET SEASON PERIOD	
	BACTERIA	FUNGI/YEASTS	BACTERIA	FUNGI/YEASTS
1. Treated Produce Water	<i>Corynebacterium</i> sp. <i>Pseudomonas</i> sp. <i>Pseudomonas mallei</i>	<i>Aspergillus niger</i> <i>Penicillium crysogenum</i>	<i>Pseudomonas</i> sp., <i>Bacillus</i> sp., <i>Pseudomonas pseudomallei</i> , <i>Flavobacterium</i> sp.	<i>Aspergillus niger</i> ,
2. Receiving Water at the Discharge Point. SW	<i>Vibrio</i> sp., <i>Pseudomonas</i> sp., <i>Acinetobacter lwoffii</i> . <i>Alkaligenes</i> sp. <i>Pseudomonas mallei</i>	<i>Penicillium crysogenum</i> <i>Aspergillus niger</i> <i>Aspergillus tamarrii</i>	<i>Acinetobacter lwoffii</i> , <i>Pseudomonas</i> sp., <i>Enterobacter</i> sp., <i>Alkaligenes</i> sp., <i>Flavobacterium</i> sp.	<i>Aspergillus niger</i> <i>Aspergillus fumigatus</i> <i>Penicillium crysogenum</i>
3. Bottom Sediment at the Discharge point. BS	<i>Flavobacterium</i> sp. <i>Micrococcus</i> sp., <i>Alkaligenes</i> sp. <i>Vibrio</i> sp., <i>Bacillus</i> sp. <i>Corynebacterium</i> sp.	<i>Aspergillus flavus</i> <i>Aspergillus niger</i> <i>Rhodotorula</i> sp. <i>Candida</i> sp	<i>Alkaligenes</i> sp., <i>Bacillus</i> sp., <i>Corynebacterium</i> sp., <i>Pseudomonas</i> sp.	<i>Aspergillus niger</i> , <i>Candida</i> sp., <i>Penicillium</i> sp., <i>Rhizopus</i> sp.
4. 500m upstream from discharge point. SW	<i>Vibrio</i> sp., <i>Pseudomonas mallei</i> <i>Corynebacterium</i> sp., <i>Pseudomonas</i> sp.	<i>Aspergillus flavus</i> <i>Penicillium pinophylum</i>	<i>Micrococcus</i> sp., <i>Pseudomonas</i> sp., <i>Enterobacter</i> sp., <i>Corynebacterium</i> sp., <i>Achromobacter</i> sp., <i>Pseudomonas mallei</i> .	<i>Aspergillus flavus</i> , <i>Candida</i> sp., <i>Penicillium pinophylum</i>
5. 500m upstream from discharge point. BS	<i>Vibrio</i> sp., <i>Bacillus</i> sp., <i>Flavobacterium</i> sp.	<i>Rhizopus</i> sp. <i>Aspergillus niger</i> <i>Penicillium crusogenum</i>	<i>Corynebacterium</i> sp., <i>Vibrio</i> sp., <i>Bacillus</i> sp., <i>Micrococcus</i> sp	<i>Penicillium</i> sp., <i>Aspergillus niger</i> , <i>Aspergillus flavus</i>
6. 500m downstream from discharge point. SW	<i>Enterobacterium</i> sp., <i>Bacillus</i> sp.	<i>Aspergillus niger</i> <i>Penicillium</i> sp.	<i>Alkaligenes</i> sp., <i>Aeromonas</i> sp., <i>Pseudomonas mallei</i> , <i>Pseudomonas pseudomallei</i>	<i>Penicillium</i> sp., <i>Penicillium crysogenum</i> , <i>Aspergillus niger</i>
7. 500m downstream from discharge point. BS	<i>Vibrio</i> sp., <i>Alkaligenes</i> sp., <i>Micrococcus</i> sp.	<i>Penicillium pinophylum</i> , <i>Rhizopus</i> sp	<i>Pseudomonas</i> sp., <i>Flavobacterium</i> sp	<i>Aspergillus niger</i> , <i>Rhizopus</i> sp.

SW = Surface water, BS= Bottom sediment. GPS BEARINGS: Discharge point: 04 22 12 E, 06 09 15 N., 500M UPSTREAM: 04 47 30 E, 06 23 00 N., 500M DOWNSTREAM: 04 39 30 E, 06 23 10 N.

4.0 Discussion:

A wide variety of microbial species has been isolated from produced water and there is a strong indication that produced water harbour original and specific indigenous microorganisms (Maggot, 2005). Although population densities of microorganisms in produced water is usually not very high, total bacterial counts can reach up to 10^5 - 10^6 CfU/ml, these rather low population densities according to Maggot (2005), indicate that oil field waters constitute a nutrient limited environment. In the present study, Produce water

from Escravos tank farm have a bacterial counts of 23 - 28×10^5 CfU/ml and only about 3.92 -5.20 % have the capability to degrade petroleum hydrocarbons. The results of the physicochemical analysis showed that nutrients (N and P) in produced water are not really limiting. Head et al, 2003 have noted that Nitrogen is unlikely to be limiting in petroleum reservoirs and produce water because of abundant ammonium ions buffered by reservoir minerals which should be the ideal nitrogen source for insitu microbial activity. Okoro and Amund (2002) have also advanced that

produced water from Escravos tank farm is readily biodegradable and it contains sufficient nutrients and carbon sources that can support microbial growth and proliferation.

In the present study, the two microbial groups of particular interest are the hydrocarbon utilizing bacteria (HUB) and the sulphate reducing bacteria (SRB). A wide variety of hydrocarbon utilizing bacteria have been isolated from produced water from Escravos tank farm (Okoro and Amund, 2002, Okoro, 2008), Sulphate reducing bacteria have also been detected at considerable high levels in produced water (Okoro, 1999). The aim of the present study therefore is to identify possible impacts, these two groups of microorganisms are likely to cause in the receiving shallow and near shore marine environment where the dilution and mixing rates of the produced water constituents with the receiving marine environment is low.

The analytical data from the present study showed that produced water had considerable concentrations of hydrocarbon utilizing bacteria (HUB) during the two seasons under investigation ($1.10 - 1.20 \times 10^5$ CfU/ml) same is applicable to Sulphate reducing bacteria (SRB) ($0.10 - 1 \times 10^5$ CfU/ml). Bottom sediment section of produced water discharge point showed relatively high concentration of HUB ($4.50 - 14 \times 10^5$ CfU/g) and SRB ($2.50 - 10 \times 10^5$ CfU/g) during the two seasons under investigation. Samples taken up to a distance of 500m upstream which corresponded with the directional flow of the discharged produced water also showed relatively high concentrations of HUB and SRB counts. On the contrary, samples taken from opposite direction (500m downstream) showed very low concentrations of HUB and there was no indication of the presence of SRB in both sediment and water samples. This is a strong indication that Produced water is the source of the accumulated HUB and SRB in the bottom sediment and surface water samples of the discharge area. Birkeland (2005) have advanced that oil fields are the natural habitat of SRBs, the first indication of this was in 1926 when SRB was first detected in produced water samples from a number of oil fields in Illinois, USA by Bastin and associates. Since then, a great variety of SRBs have been isolated from oil fields around the world (Birkeland, 2005).

The environmental implications of produced water being discharged in a shallow near shore environment is focused on the fact that the level of mixing and dilution of produced water constituents with the receiving marine environment is likely to be low which may lead to the accumulation of most of the constituents in the sediment. The accumulation of hydrocarbon degrading microorganisms from produced water in the sediment is desirable and will lead to a positive impact because the accumulated hydrocarbon utilizing microorganisms will be responsible for the

degradation and detoxification of toxic organic compounds. On the contrary, the accumulation of sulphate reducing bacteria in the sediment will lead to a negative impact because of the following reasons. Sulphate reducing bacteria in the sediment reduces sulphate to sulphide while oxidizing degradable organic electron donors, the presence of sulphide in the environment poses some health and safety risks because of the toxicity, corrosive and souring of hydrogen sulphide generated (Hubert and Voordouw, 2007), except in some cases where the competition for available nutrients, carbon sources and organic electron donors have led to other microorganisms outcompeting SRBs and rendering them less potent as demonstrated by Hubert and Voordouw, (2007), the presence of SRB in any environment is not desirable.

5.0 Conclusion:

The present study have demonstrated that Produced water discharges in near shore shallow environment leads to the accumulation of the indigenous microbial flora of the produced water both in the surface water and the sediment at the discharge point up to a distance of 500m upstream along the directional flow of the produced water. Substantial concentrations of these microorganisms are being accumulated over a long period of time, while the HUBs are beneficial to the environment in terms of its hydrocarbon degradation potentials, the SRBs are detrimental because of the production of hydrogen sulphide which is toxic to humans and marine animals.

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CORRESPONDING AUTHOR:

Dr. Chuma C Okoro
 Department of Biological Sciences and Biotechnology
 Caleb University, Lagos Nigeria
 Tel: 08033072754, 01-7430285
 e-mail: chuma2k2001@yahoo.com
 P. O. BOX 146, UNIVERSITY OF LAGOS POST OFFICE, LAGOS, NIGERIA

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Dr. Chuma C Okoro is presently a senior lecturer at the Department of Biological Sciences and Biotechnology Caleb University, Lagos, Nigeria.

Traditional wireless Communication and its Model in South Asian Region

DharmaKeerthi Sri Ranjan, G.D.

Faculty of Mass Media, SriPalee Campus, University of Colombo, Sri Lanka.

Department of Sociology, Wuhan University, Wuhan, 430072 P.R. China.

Sri_2007@hotmail.com

Abstract: Traditional wireless Communication is encompassed by the new communication technologies and the heterogeneous vision of a culturally diverse society. This speedy diffusion of latest applications of the new media is exploited for the information and entertainments in the rural locales. As a consequence of this the traditional media net work is being affected at an alarming rate in the periphery. The folk cultural tradition has become to tune pop songs and pop songs associated cultural traditions. These associations mainly occur at the economically and socially marginalized people. These modern information identities, based on the science and technology, are experiencing the western cultural denominations. But the traditional wireless communicational patterns were interconnected collectively with the nature oriented human factors. The newly contextualized model (DSR Model*) on the traditional media based on the Ethnographic approach, discusses the traditional wireless communication system, established in the indigenous territory. [Journal of American Science 2010:6(3) 102-108]. (ISSN: 1545-1003).

Key Words: Traditional media, Traditional social context, New Model for the traditional media

01. Introduction:

Man has been lost his ideological freedom with starting of communication to a larger audience, his sensational and coherent social feelings were affected from the social boarder forces from the time of his conception. Signs and symbols were the preliminary communicational elements used from his primitive stage which led later for the cultural hegemonistic experience. When this cultural implication is unmasked it repressive dimensions of social living not previously distinguished is exposed. Mass communication is producing effects for individuals and persuades them into an overall program. Communication hegemonism fashions individuals with the cultural fabrication assessing either foreign or domestic. The hegemonism is characterized and processed as a product of the ideological content and economic milieu from which it immersed. The cultural components and ideological modes are multiplied by the media. From the primitive societies into the modern formations signs, symbols, gestures and other verbal and non-verbal communicational patterns were utilized to pass mind and mental sensations on to others, universally. He desired to control the mind of others over the communication, mainly based on the "human factors" (Cueller, 1995). This had been progressed as a visceral need of human beings and later of the culture. This key media perpetuates the status quo and contributed little to social change. The wireless traditional communication and its hegemonic perspective served

important heuristic purposes and supported to maintain the status quo in the society.

02. Traditional Media:

The folk media products credited as drama, dancing, music, paintings, religious, ethics, poetry and ballads, and man's other structural germane, uncovered in a broader context of conceptual reformulations into a limited social and geographical areas transmitting them over oral and visual traditions from history to present, probably controlling the prototypes of behavior and the minds of their fellow beings. These traditional boundaries were supremacy enough to uphold the ingredients within their systems due to the ineffectiveness of the traditional communication to penetrate other heterogeneous boundaries. The results of this social vacuum were the sui-generis and local version of hegemonic domain in the homogeneity. Accordingly, they maintained the authority in the ground of cultural diversity. The "authority" and the "diversity" sometimes obliged into a harmonious interactions and the other occasion created the violence confrontations showing their inherent human desires for the hegemonic rationales at the beginning to the present of his evolution.

This traditional media fabricated an enormous store of ethical behavior, ideas, values and norms etc, patronizing and strengthening the social integration, social power, sentimental bonds of each other and

interrelations among the social institutions in traditional societies. Village inhabitants were imbued with a moral conscience that determines by their diurnal actions. Mediators failed to assume sophisticated managerial approaches and had to abide into certain self – imposed local versions codes and components.

These traditional communicational blueprints and the media are still breathing extremely, dominant and treated significantly in their day to day life of the masses in South Asian countries. From the primordial instances, fire endowed diverse shades of cultural connotation.

The hundred of signifiers along with the traditional masses signified the thousands of senses in to their respective community. The drummer was the conventional mediator in the medieval epoch in the Sri Lankan social context, was manipulated by the sovereign to dispatch obligatory information to his lieges. The mediator was the important expedient of communication between folk and the monarch. Even in British colonial aeon in Sri Lanka, this ingredient of the tradition, was sheltered productively by the British governors in order to transmit obligatory messages to the lieges.

This element rendered his ministrations on the subsequent charges (Rathnapala, 1991).

1. To bring the monarchical proclamations to his lieges.
2. To bring the monarchical proclaim of emergence and summon the people to battle during the time of incursions and to herald the news of antagonists.
3. To bring the appraisals for the people who rendered the services to the monarch, religion and society and to summon them for fulfillment of their duties.
4. To profess the names of law-breakers and to bade the lieges in the name of the sovereign to apprehend them.
5. To bring out the news of the courts, politics, and economic affairs that the lieges should be acquainted.

The way side resting places where the masses relaxed on their ride were the influential hub to disseminate information, rumors and gossips which were rapidly gulped by them and multiplied out quickly to their areas.

The socio – cultural hubs in the rural locales were very influential in news dissemination. The centers can be categorized into two under subsequent captions (Rathnapala, 1991).

1. Stable hubs of news dissemination - folk assembled habitually.
2. Provisional hubs of news dissemination - festivals held at sacred shrines, festivals of matrimony, Coffee shops, The way side resting place, The house of village leader, and Bathing place (for women) etc.

It was natural for them to earn each other's company for a couple of hours at the sunset when the folk masses tired after callous running of the day. These places were rendering and influential role of disseminating information.

It was significant the character of village leader in disseminating news among the folk. The information generated towards from the outsidess was filtered through the community leaders before disseminating them in their regional areas. They would be able to mould the public estimation and the mass life in the village. They exercised the mightiness of the leader ship through filtering information consciously and unconsciously.

“Hoot” was one of the particular set of inter-personal channels in traditional communication system in the country expanse. It was conceptualized to dominate for many sentiments which can be depicted them as follows (Rathnapala, 1991).

1. To indicate one's direction to others.
2. To receive assistance when one's gone his way.
3. To gesture of goodwill.
4. To make signs of one's presence.
5. To frighten the wild animals.
6. To throw out one's annoyance and social remonstrations.
7. To reckon someone to one's place.

Shrill and fierce note of the hoot was symbolized as “hoot of the devil” which was considered as inauspicious and form of apathy. The “hoot of the jackals” is still deemed as an omen of the tragedy or adversity. But the urban populace considered the hoot as a sign of contempt or more precisely as a means of registering group disapproval.

Gossips, Rumors, storytelling and further forms of verbal communication co-operated in dominant

composition in disseminating information in rural areas. These forms have taken much rapidity of scattering from mouth to mouth and they often pass through outside the villages. These gossips might channel itself to a place, person, things or the events which disseminated habitually on the unwholesome, unpalatable plights of a persons or things.

As an expression of its own artistic-esthetic perceptions sign and symbols were dramatically structuralized into the multi dimensional routine of the village community. In the Sri Lankan social context the loin cloth, the winnowing fan and the mat had been encoded into the symbol of sexual intercourse. The mat that kept unrolled made consciousness for sexual intercourse. If it was made in front of the man by the woman, was conceptualized the craving for sexual behavior. Another symbolical expression of the mat in the uxorial residence was that a woman throws the mat away it symbolically means the readiness or eagerness to end the marriage soon.

The polyandry family was an accredited sexual union under a same shelter, marrying a wife with few brothers. It was a custom for the co-husband whose desires for copulation with the common wife was to hang the loin cloth on the door. This custom articulated that the particular husband was together with the wife. The co-husband did not agitate under any conditions as long as the loin cloth hangs there. Mostly the co-husband went out into the garden and worked, tolerating them for better surroundings.

Color also signified a variety of shades in the macro social structure of the folk. With respect to color white, let to experience the condolence, soreness, purity and simplicity and it also symbolized the good will peace and neutral in a micro complex manner.

The complexities of the traditional poetical forms are still awe-inspiring macro repository in the social base of the South Asia. Perspectives of the long history emphasizes that the style of the poet was based on the stresses of syllables and on the sentences. The panegyric songs explicated in a symbolic process the distinctive behaviors of the folk and the listeners gulped the news and extended back into their villages again.

It is not obscure that the "Ballad paper" enjoyed masses as a congenial essay from bottom to up in the social hierarchy. These structures of thoughts grounded as a production of meaning so as to make the incident appear natural and inevitable. When one or two individuals read it dramatically, others joined it with the chorus. It may be about robbery, rape case, arson, murder or sacrilege etc.

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This criticism did not come with an antagonistic mode of reasoning or destructing but it made the sense of presupposition. They characterized these features vividly and lively at the populace. Folk throng to listen the ballads and those who interested to repeat bought them at home. In vertical and horizontal structuring of rural space, the message was dispersed as most central metaphors in their catalogue.

Wild paper transmitted the message through a literary device and clustered of rhetorical figures as a communication system requiring decoding or interpretation in order to make ease the masses to understand. They wrote the news in verse or prose anonymously by hand and paste them on several places. The readers attempted to perceive a set of equivalents existing between the symbolic system and the referential system. These variations or equivalents of the structure constituted the textual materials to be decoded. These wild papers were compiled with a view of assassinating a character of an opponent. These "degree zero" styles, a neutral and colorless writings are very effective textual materials (Roland Barthes, 1976).

Another cultural expression was the folk tales which extremely admired element, implied dynamism on around the rural parishes. What was a unique traditional literary source, which encouraged the masses with sufficient information standing on the precedent immeasurable experience. The folk tales had been intended as the glorified great master whose capability would modify and building up the behavioral patterns and the personality of the people. This was necessarily an incomplete look at the sense of the problems, some possible solutions being revised and certainly a notion of a dynamism and synthesis of individual and collective experience, transmitted in artistic expression in general and literature. Sri Lanka, India, Nepal and Bhutan in South Asia are weighted in Hinduism, Buddhism and Taoism, etc. After the fountain of Buddhism into Sri Lanka in third century B.C., the disciples initialized to pursuit the folktales to demonstrate the religious schools.

The ancestors of the rural villages from the ancient times were the repository of the folklore. They (Speakers) transmitted their knowledge, beliefs, behavioral patterns and experience (Message) to their younger generation (Audience or receivers) over the folk media. The ancestors of the extended family pattern enchanted folklore for the younger generation every day meeting on a mat at the verandah at sunset in the evening. The grand persons particularly sat on the little high elevation and delivered folk tales and songs to those who were sitting on low positions. The children listened avidly to them. Habitually, the

bordering children gathered at the leader's house to listening to the folktales and songs in the evening. They eager and geared up to employ these experiences in their life itself and shared and repeated all them with their peer groups too. According to the socio-historical context its artistic values, norms, ideas enriched and transmitted history and traditions over its own aesthetic codes predicated on its social functionality. The folklore is an aesthetic worth psycho therapy served from pre-colonial times in the South Asia.

Folk media have been made use of family planning most in the African countries and the countries like Iran etc. For an example Iranian radio and Television (NIRT) instituted a center for the preservation of traditional music and the arts etc. In 1970s both the folk media and mass media utilized incorporate for the family planning programs to bring the idea much closer to practical implementations. In Sri Lanka context, for the religious and economic rationale, they made use of folk media to arouse the audience feelings and to orient the atmosphere for change the society.

Ethno linguistic groups were able to transcribe their oral poetry and narratives as a means of enriching their own lives. When they were employing or occupying of free times of the day, particularly eve of the day, invariably songs were sung. When the folk gather together in order to take part in a definite social action, involving physical labor, sung songs to eradicate their solitude. When one line recited by a leader, others of the group followed him to lighten the burden of manual labor in which they were involved. This rural leadership was ritually oriented and benign influence on his population.

The folk songs can be assorted for convenience, as follows.

- The songs associate the important occasions of the one's life. - Child birth, puberty, marriage and death (Door of passages).
- The songs about the popular customs and ceremonies.
- The love songs
- The dual songs
- The didactic songs
- The recreational songs
- The songs of magic and witchcraft
- The occupational songs
- The ritual songs

- The obscene songs
- The ballads or Narrative songs
- The riddle songs etc.

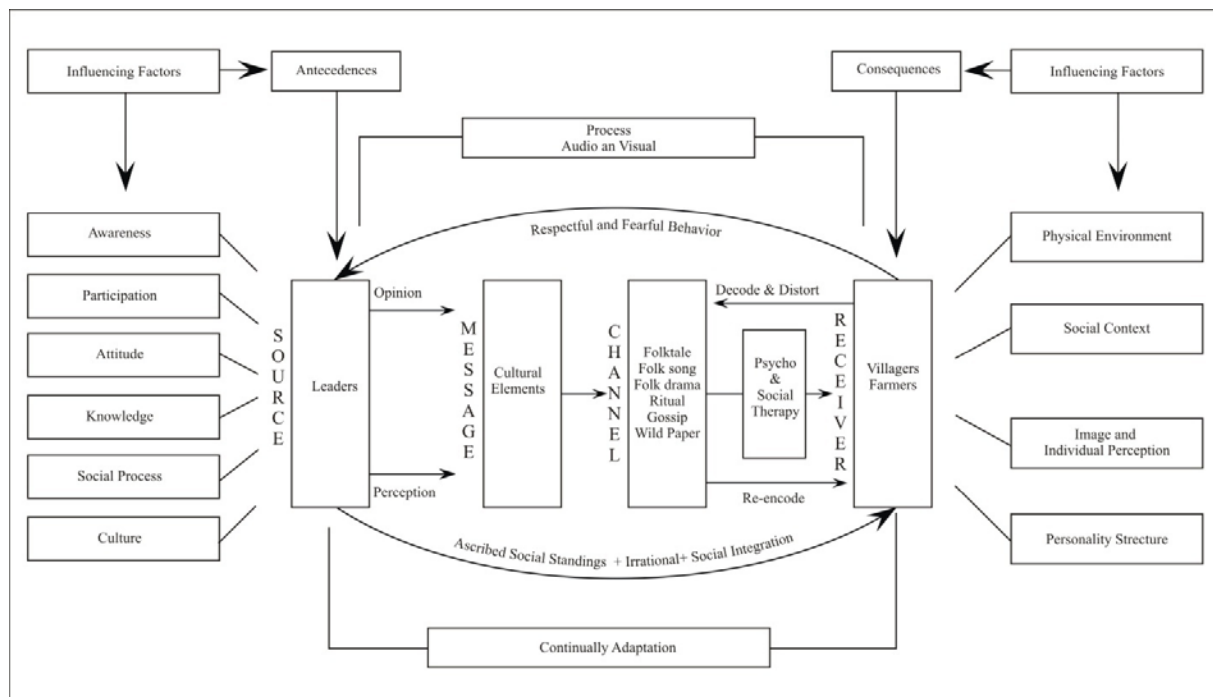
03. Traditional Media as a Model of Interpersonal Communication – DSR Model:-

The DSR model of interpersonal communication is based on sociology and anthropology. This stands on the assumption that one must need to develop critical general consciousness on the human behavior to analyze his communication patterns. The stage of this "message cycle" is based on intentional, as well as unintentional communication of the man and his relationship during the process of communication. This actual communication event recycled or updated by the tradition or by the ascribed social standings before the entire message is completed. No two way communication events are ever the same under this cultural authenticity.

Traditional media were not stand on electronic communication but pedestal on human communication which influenced his beneficiaries through close interaction persuaded by the belief, awareness, and participation. The media and the source which were invariably slanted into the socio-cultural roots, not based on the atomistic competition and profit coverage orientation. The traditional media accredited the audience to be linked closer to their groups by imparting common experience. The philosophy behind this was self-organization and self- mastering system (Dynamic and structure; Self-masterism). This system was composed of two layers; The "Physical Basis Being Field" and The "Social Basis Being Field". These macro- structural ontological substances were composite on three elements; mind, behavior and matter. Traditional media model maintain the transformation of similitude caliber of human social life uncovering the lively beauty of the physical environment, naturally and orderly in the kinesis of time and space leading towards the independence, co-ordination, absorption and stagnant.

The modes of this structural interpersonal communication model were integrated with the Source, Message, Channel, and Receiver (SMCR). Models of "cultural interactions" and "communication" were integrated into this systematic model of traditional communication.

Traditional Media as a Model of Interpersonal Communication - DSR Model



Traditional leaders and opinion leaders (Source) are powered by their social and physical elements of societies from the far ancient times. Independent factors, indicated in the above figure have been influencing for the source, message, channel and receivers (SMCR) constantly and they became dependent. Source is rich with awareness of their environment, persuasive ability, participation, knowledge, social practices and the cultural patterns which enlightened within their traditional circle. These dependent factors (SMCR) are well based on the social process, cultural matters and the physical environment. The source is not alienated and has emotional interpersonal relationships, probably be able to communicate well in traditional structure.

Ascribed social standings and irrational social circumstances are the driving force to manipulate and maintain the traditional societies. It is powered by caste hierarchy than the class classifications. The social and cultural elements influence and entwine with the message in this two way communication which streaming with two different forms from source to receiver and vice versa. DSR model suggests that the factors in the message (Cultural elements - values, norms, customs, awareness, expectations, knowledge, attitudes, emotions, feelings, experience, etc.) maintain the communication fidelity and vice versa knowledge, attitudes, emotions and feelings etc are structured as

subsystem respectively in the functional process. Ethics and values are effective in inter and intra operational system in the Information – Decision – Control Chain in the communication circle. The message has been structured in which something comes first, second, third and so on. The elements operate in the structure of the message which produces the effects on the receiver. The message which is contextualized and encoded with the cultural elements, over the source, including a group of codes, symbols, language styles, sounds, images, signs, and arrangements can be acceded as the climax situation of the arrangements. The message consists of opinion, perception and the ideological position of the source about and he decides how to encode the content with the intention of converting the audience.

The message delivers through much kind of channels such as folk tales, folk songs, rituals, drama, folk sports, gossips, wild papers etc. Whenever the source wants to communicate, his cultural patterns would influence him to select the channel. The channels have some kind of encoding and decoding devices. Sometimes one uses more than one channel to make the message more effective over the orally, auditory and visual.

This model emphasizes that the Source and the encoder are the separate parts of the one person, and the decoder and the encoder are the separate part at

the destination / receivers. Again this model finds that each person who engages in the process of communication is both an encoder and a decoder. Receivers deliver and stimulate decoding and distorting the information as a message into the selected channels again. The receivers cannot be abstained from the influencing factors come from consciously and unconsciously shaping and creating a disposition of the receiving message, constantly to the public sphere, according to the Physical environment and the social context of the receiver, the image or the individual perception of the receiver, personality structure of the receiver, and the audience he faced at the time of the message and the existing situation. The prestige and credibility of the medium are important elements to make an image of the receivers mind. It uses a familiar medium and local language to pass on the relevant messages, addresses, local issues, needs and problems, and uses more the local talents, artists and other available resources.

Message is frequently affected by the immediate social surroundings, the receiver's social context, the surrounding society where the receiver lives as well as the individual he interacts. Social context, image and perception, personality structure of the receiver, are the more influencing factors than the others to shape the message. For an example; religious, sensational or devout groups. This very situation of receiving may influence on the receiver's experience.

Most messages are referred as gossips, exaggerations, and abbreviations or completely incorrect. Channels re-encode these messages again into the receivers, maintaining the speed enough to spread throughout the village. The receivers as members of the public are experiencing the situation same as not in modern media. As a member of this homogeneous public, the individual does face any great insist on to respond or to act in a certain way due to the less anonymous face-to-face situation. These channels are informal and work vertically and horizontally. Communication travelling down through vertical channels may be delivered from face to face or written form. The receivers active in listening, understood, believed, accepted, and acted on the messages, if the level of trust is low. The villagers would tend to put more faith in word – of – mouth information. This model illustrates how interpersonal field of experience expresses into the interpersonal communication.

The traditional media forms and developed over the ages and ensure the emotional integrity of the region. This tradition can be ascertained as rigid media, semi rigid media and non rigid media which help to make an unrivaled social fabric of the community in the rural sphere.

Folk media is one of the most prominent information systems among the rural population and are powerful of establishing the social integration, protecting and dissemination of cultural values and satisfying the national and societal needs. Folk media are generally inexpensive, portable, easily accessible, locally oriented, flexible, subject to change and capable of incorporating new forms and ideas. They belong to the community and not to individuals or private, public industry or any other states. There is no competition and are not managed by any other commercial channels. The two way communication pattern and the message repetitionability of the folk media make the message stronger among the rural masses. Flexibility, credibility, cultural relevancy, entertainment value, acceptability are among the virtues of the folk media. It looks as a total welfare of the whole society in many sidedness of cultural, economic and social development for up lifting the quality of life of the rural masses.

Folk media intimate with the masses, rich in variety, relished by different age groups, and by both sexes, theme carries traditionally and having greater potential for persuasive communication, face to face communication and instant feedback (Ranganath, 1976). It exist joy and sorrow, triumph and defeat of the peasant people in the village. Traditional media is highly functional and inculcate socially accepted norms, values and performances in general socializing process (Dissanayake, 1977). For an instance, one of the folk dramas "*Sokary*" is preferred by Sri Lankan rural and urban audience brings the strong message into the mass consciousness as a great tradition. But its origin was in the consciousness of the rural masses as a little tradition.

Indigenous media, verbal, visual, and aural forms, used mostly as an entertainment media too. This dynamic media enable to motivate and instruct the audience to serve certain societal and cultural purposes by bringing people into community relations and aiding their socialization into approved form of behavior by the society. Thus media are singing the cultural praises of vital cultural themes and recounting of the groups ideals. With the repetition of the rituals and the rhythmic tangible form serve to reinforce and concretize cultural themes and belief into rural masses. Thus repeated pattern of rituals and dissemination of cultural information conserve the socio cultural resources. People may not "learn" so much from the media as they become accustomed to a standardized ritual (Berelson, 1949).

The folk media are obviously not only the mechanism of promoting social integration; one functional alternative is humor. Humor mostly based

on jokes about certain subjects, the glorification of the social traditions and the kinship patterns etc. In the area of religion jokes are permitted about certain themes, such as religious deities and the saints but no jokes are uncovered about core areas.

The traditional media in the South Asian countries are attempting to preserve the cultural identity of indigenous performing arts and bring a sense of functional relevancy to the countries. All India radio, in its rural broadcasting most probably use folk media in their daily programs narrated by conventional characters who convey the typical life and folklore of the rural areas (Ranganath, 1976).

The new technologies are employing new dimensions to disseminate information in greater efficiency and accuracy. The newest advance technologies do not benefit periphery because of lack of technology, scientific knowledge and the human resources.

According to the Lazarsfeld, development of communication technology, there was a great attention to its effects on the existing media (Lazarsfeld, 1940). Change is the characteristic of all cultures, but the rate and the direction of change is varying considerably. I propose that this media can carry the modern messages effectively at the mass consciousness in the periphery.

04. Conclusion:

Visceral need of human beings control the mind of others over the communication from his primitive stage to the satellite era. Tradition, modern and the new media are the three consecutive periods of its progress. But modern media is effective with the transitional phase of the communication which integrated the audience than ever in the past promoting the social de-integrational basis structural settings. Social cohesion and human factors basis traditional communication empowered the ascribed social standings and irrational basis of the traditional context. But sophisticated technological pedestal modern and new media continue to practice with increasing variations, rationales, respect less attention to the elements of the geographical borders, multi challenge to the national broadcasters, and organic solidarity prevailing over the doubtlessly associated cultural forms and past slow motion social context.

* **DSR** stands for **DharmaKeerthi Sri Ranjan**,
Lecturer,
SriPalee Campus
University of Colombo, Horana, Sri Lanka.

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Lesser Chamber Effect inside Open Top Chambers Provides Near-Natural Microenvironment for CO₂ Enrichment Studies in an Alpine Region of India

Ashish Kumar Chaturvedi,* Pratti Prasad and Mohan Chandra Nautiyal

High Altitude Plant Physiology Research Centre

Post Box No. -14, H N B Garhwal University

Srinagar Garhwal – 246174,

Uttarakhand, India

*ashi_spc@rediffmail.com,

ashispc@gmail.com

Abstract: Open top chambers (OTCs) were designed and established for the first time in an Indian alpine territory for revealing the effects of realistic elevated carbon dioxide (CO₂) concentrations on growth forms of alpine region of India in natural conditions. Comparison of the microclimatic parameters which affect the growth and physiology of alpine plants was done in three conditions viz. open field, polyhouse and OTCs to trace out the chamber effect inside OTCs. Present communication reveals the efficiency of Open Top Chambers for climate simulation techniques in Indian alpine region. Simple designing and construction of open top chambers make them the most probable method to be used for long-term elevated CO₂ revelation of alpine ecosystems. The operation of the system was satisfactory during the first growing season and repeatability of the gas treatments can be regarded well in this low cost exposure system. [Journal of American Science 2010;6(3):109-117]. (ISSN: 1545-1003)

Keywords: Climate change; Open Top Chambers; CO₂ enrichment; Alpine region; Garhwal Himalaya

1. Introduction

The Himalaya represents the largest mountain chain covering approximately 8 million km² in surface area and occupying a length of approximately 3000 km. Owing to enormous size and elevation, the Himalaya represents a complete transaction from tropical to temperate conditions despite its location near the tropics. Out of 7000 endemic species of plants found in India, over 3000 grow in the Himalayan region (Chatterjee, 1980). Whereas alpine environment is exceptionally variable and as a result of decreasing atmospheric pressure, the partial pressures of O₂ and CO₂ in the atmosphere fall with altitude. For overcoming all these adverse climatic factors, the alpine plants adapt themselves morphologically as well as physiologically. The prediction of global climate change has extracted a wide multiplicity of research in the past 25 years. One of the aspects that have received liberal attention is prickly rise in the atmospheric CO₂ concentration and the effects thereof on plant growth and functioning (Ward and Strain, 1999; Körner, 2001; Bazzaz and Catovsky, 2002). Changes in ecosystem carbon and water balance have been predicted to result from increased temperature and from the direct effect of rising CO₂ on photosynthesis and evapotranspiration. But ecosystem retorted for elevated CO₂ cannot be forecasted without field experiments, because the interface of elevated CO₂ with other environmental factors particularly temperature, nutrient and water supply is complex chiefly in alpine region. Such field experiments will essentially be enduring and the

intrinsic inconsistency in native ecosystems experiments will require many replications. All experimental methods for exposing plants to altered atmospheric composition also alter the microenvironment which means that the need to understand the effect of the chamber microenvironment on the experimental results increases with the complexity of the questions concentrated on.

An immense work has already been done on the alpine communities of Garhwal (Semwal et al, 1981; Ram and Arya, 1991; Nautiyal et al, 1997) but to the best of our knowledge, research using climate simulation experiments in alpine region of India is still lacking. A simple hypothesis on climate change research needed in alpine region of India has been forecasted by some workers (Chaturvedi et al, 2007). Research investigations for climate change on plants have given three possible equipments, namely open-field CO₂ enrichment (FACE) systems (McLeod and Baker, 1988), fully-enclosed chambers (Lucas et al, 1987) and Open top chambers (Heagle et al, 1973). The three techniques, namely FACE, OTCs and fully-enclosed chambers, have different performance/cost benefits and cannot be compared directly. The research reported in this communication identifies the sensitivity of OTCs microclimate, capabilities and limitations of open top chambers for elevated CO₂ studies and to demonstrate the potential applications in context to alpine regions of India.

2. Materials and methods

2.1 Site description

The selected site for the establishment of Open top chambers is the alpine field station (Figure1) of High Altitude Plant Physiology Research Centre of H.N.B. Garhwal University, Srinagar, Garhwal, situated at Tungnath ($30^{\circ} 14'N$ Latitude and $79^{\circ} 13'E$ longitude at an altitude of 3600m above MSL). The heavy

snowfall, frost, high wind velocity, low oxygen and carbon dioxide concentration have a great impact on the habit of plant species including their growth forms, life form and life cycle pattern. The site is also famous as treasury of diverse alpine medicinal plants.

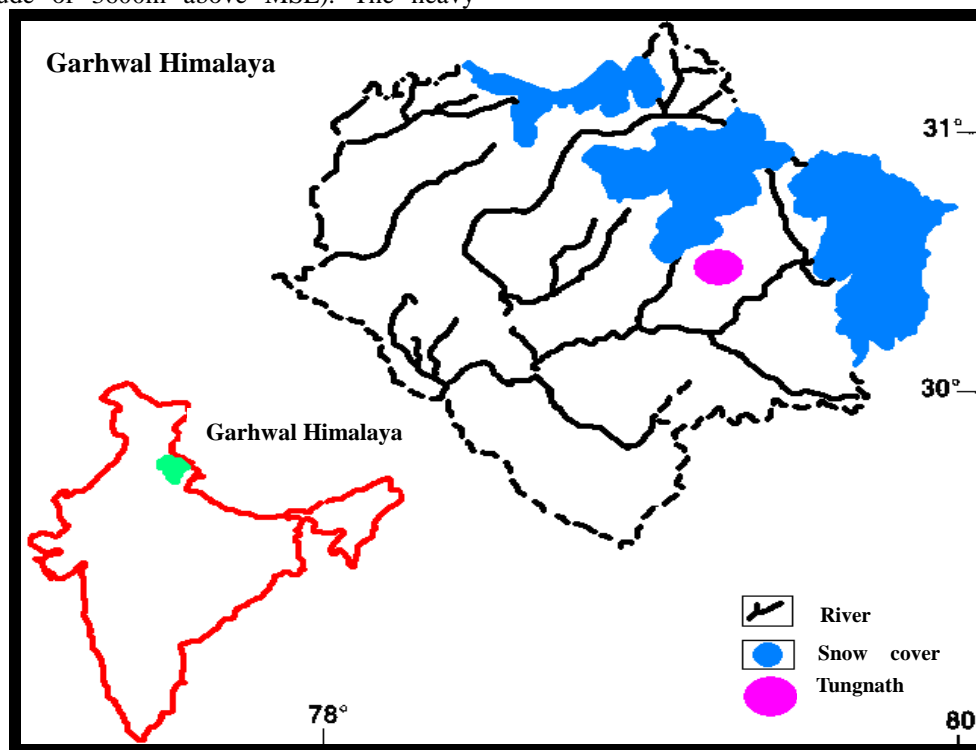


Figure1. Location map of the study site

2.2 Indian Scenario regarding CO₂ enrichment facilities

For studying the response of crop plants under elevated CO₂ conditions in India design (3 m diameter x 3 m height) used for OTCs was according to South Asian climatic conditions (Upreti, 1998). These Chambers with frustum are being used by South Asian CO₂ research network for multi country multidisciplinary CO₂ crop response studies.

Besides Open Top Chambers, a new advanced “Free Air CO₂ Enrichment Technique” also provides a technology for enriching larger areas of vegetation with CO₂ for extended areas of vegetation with CO₂ for extended period of time at lesser cost per unit area than any other known technique. FACE concept of producing CO₂ concentration gradient experiments are done with promising results (Upreti et al, 2007).

2.3 Alpine scenario for CO₂ enrichment facilities in India

An alpine region due to its harsher climate is much tougher region to conduct climate change experiments. Thorny transportation and hard conditions

throughout the season makes it difficult for designing the experiments soon.

Therefore, we have designed the Open Top Chambers that can survive in harsher conditions of alpine. We have modified the design for alpine region as the vertically 3 m high OTCs can't withstand the higher wind velocity of alpine. So, in this design the OTCs of 3 m diam. and 2.4 m in height are installed at the alpine region of Tungnath.

2.4 Specifications of OTCs used for CO₂ enrichment in alpine region of India

Structure of OTC having a size of 3m diameter x 2.4 m height. OTCs are made of square G.I. pipe 38mm x 38mm \pm 1 mm with aluminium strips, leak proof auto closing doors. Complete structure fixed at 2' below ground on a cement concrete platform up to 3' from earth surface. Covering of OTCs is UV stabilized transparent low density polythene film 200 GSM with special distribution system. In CO₂ supply control solenoid valve and pressure gauge with timer were fitted within the air blower (along with connecting duct covered with polythene sheet). Chambers are equipped

with a frustum at the top to deflect air and prevent dilution of the CO₂ concentration within the chamber. A cylindrical double walled plenum around the base for uniform CO₂ circulation. Inner side of the plenum was perforated with numerous gas outlets (Figure 2). Distribution of CO₂ was done using fan 12" blower. Blowers also helped in maintaining inside air

temperature closure to that of outside ambient atmosphere. Double stage double meter gas regulator of brass fitted with stainless steel diaphragm suitable for CO₂ supply was used. CO₂ gas was supplied through this whole system using CO₂ cylinders of 20 Kg gas capacities fitted in a row.

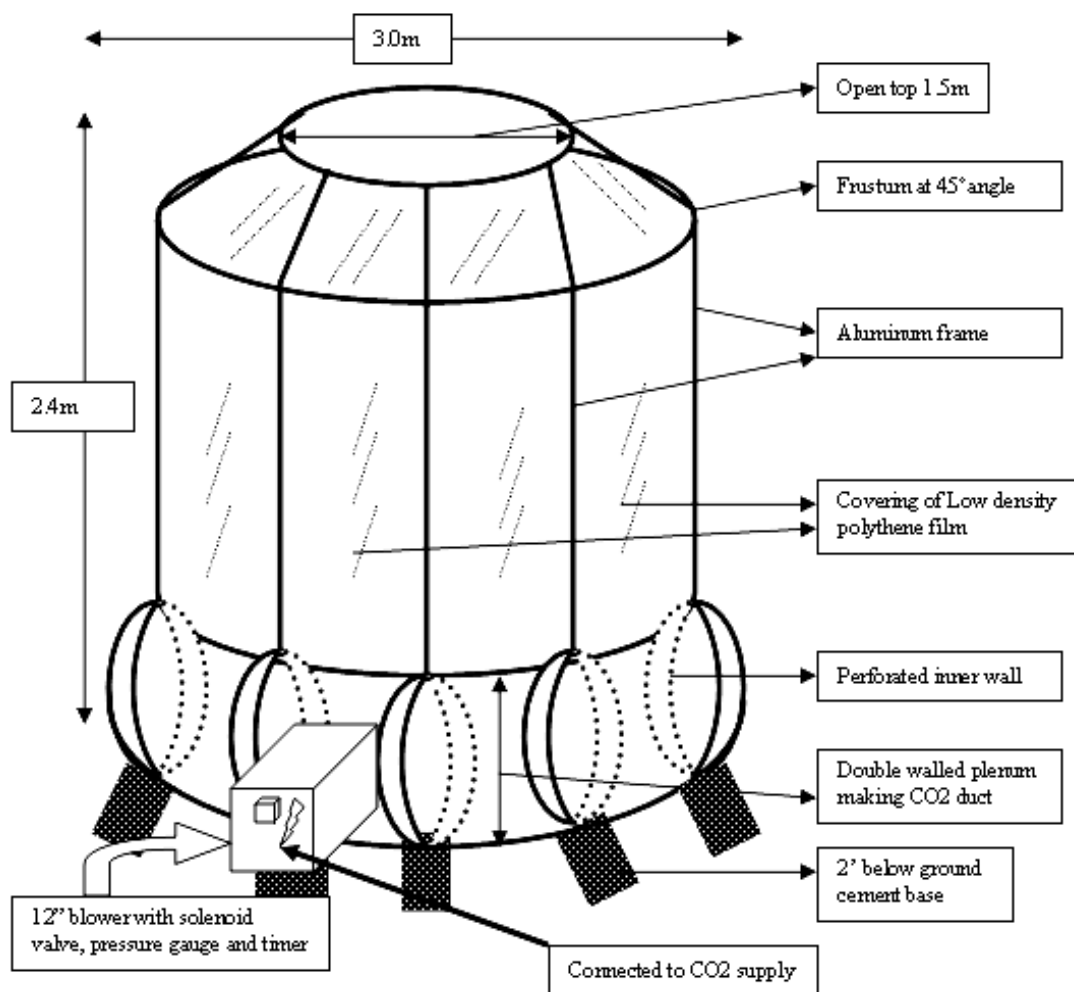


Figure2. Open top chamber design for alpine region of India



Open Top Chamber established at Tungnath (3600m above MSL), an alpine region of Garhwal Himalaya. (Photo credit: Ashish K.Chaturvedi)

2.5 CO₂ treatments and observations

In two installed Open Top Chambers (OTCs) one was treated as Control Open Top Chamber (COTC) in which ambient air was circulated and monitored whereas in other Open Top Chamber (EOTC) elevated CO₂ (600-700 μmolmol^{-1}) concentration was given. The pure carbon dioxide was supplied using 20 Kg gas capacity carbon dioxide cylinders. Air circulation was done to the chamber via air blowers located near the base of the chamber, and CO₂ was added to the incoming air maintaining a positive air pressure and flow within the chambers.

CO₂ and PAR (Photosynthetically active radiation) measurements were made by a portable Infra Red Gas Analyzer, IRGA (ADC, LCPro+ Hoddlesdon, UK). Daily meteorological observations for air temperature, Humidity % and Soil temperature (15 cm Depth) inside OTCs, Polyhouse and in open conditions were done to compare the microclimatological variations. Monthly variations in CO₂ Concentration inside OTCs, Polyhouse and open conditions were recorded throughout the season from May 2008 to September 2008. For studying the diurnal variations, measurements were performed for cloudless days in the last week of May 2008. Data collected every two hours from 8:00 to 18:00 solar time were analyzed statistically.

3. Results and discussion

3.1 Variation in CO₂ concentration

A representative time course of CO₂ concentration in open and polyhouse condition is shown in Figures 3 whereas Figure 4 depicted the diurnal variation in COTC (control OTC) having ambient CO₂ and in EOTC (elevated open top chambers) having

elevated CO₂. Results exemplify the natural diurnal variability of CO₂ concentrations inside polyhouse, open and in OTCs and the capability of the system to maintain separation between the ambient and elevated treatments. CO₂ concentrations vary at a single monitoring location and between monitoring locations within a chamber (Drake et al, 1989). But varying CO₂ concentration inside Open top chambers in comparison to polyhouse was attributed to the storming of air surrounding the chamber and was relative to outside wind speed. The enhancement in control achieved in the chamber with frustum confirms the importance of this design characteristic. Control of CO₂ concentration can be achieved without automated CO₂ delivery (Drake et al, 1989; Rogers et al, 1983). Little advantage in scheming spatial variations in CO₂ concentrations is probably to be achieved by automating CO₂ control because these variations are mainly determined by outside wind velocity and interior variations in turbulence. Figure 8 shows the monthly variation in CO₂ concentration in different conditions.

3.2 Temperature differences

Temperature plays an important role in morphophysiology of alpine plants. Keeping this fact in view this is very necessary to see how much variation in temperature occurs inside the OTCs. Air temperature within open top chambers used in studies of crop species are commonly reported to be less than 1°C greater than air temperatures outside the chambers, but in an extensive study of the environment in open top chambers, some workers (Weinstock et al, 1982) found temperature differences of up to 3.7°C. Monthly variation in min/max temperature and air temperatures of OTC, polyhouse and open conditions are shown in Table 1 and 2 respectively. Temperature difference in the OTCs was non significant in all months except in May where on average 2.0°C increase was observed in comparison to polyhouse where the increase in min as well as max temperature was significantly higher. Air temperature differences between Control OTCs (COTC) and elevated OTC (EOTC) were not much affected by CO₂ treatment (Figure 5). Temperature differences can be minimized by using a high aeration rate.

3.3 Humidity

Humidity % was slightly higher inside the open top chambers than in open condition but statistically non significant whereas in case of polyhouse a significant increase in humidity was observed throughout the season (Table 3).

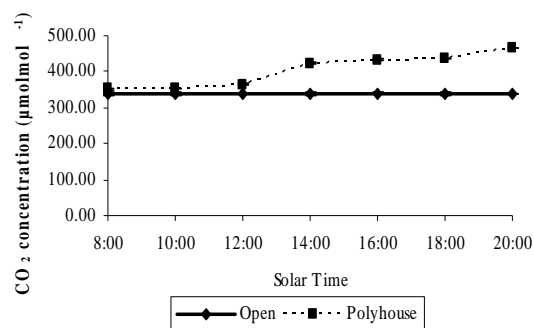


Figure 3. Diurnal Changes of CO₂ concentration in Open and polyhouse conditions

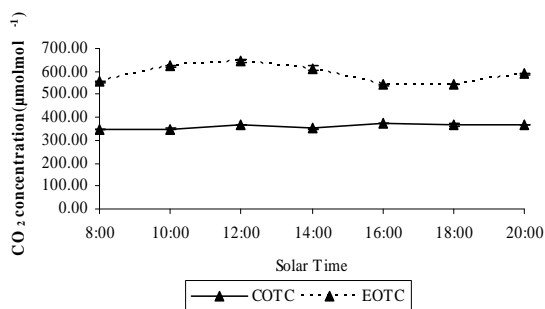


Figure 4. Diurnal Changes of CO₂ concentration inside Open Top Chambers

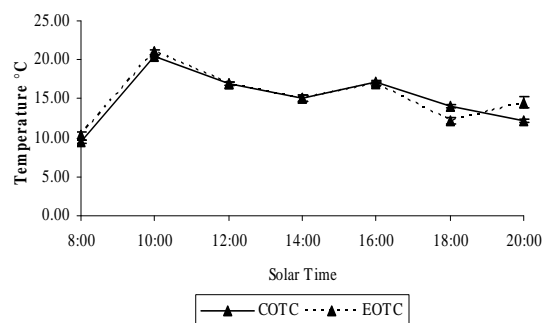


Figure 5. Diurnal changes of temperature inside Open Top Chambers

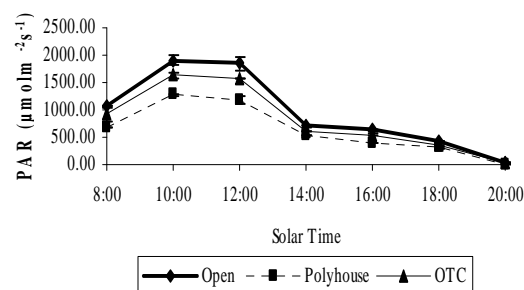


Figure 6. Diurnal variation of PAR in Open Top Chambers, Polyhouse and Open conditions

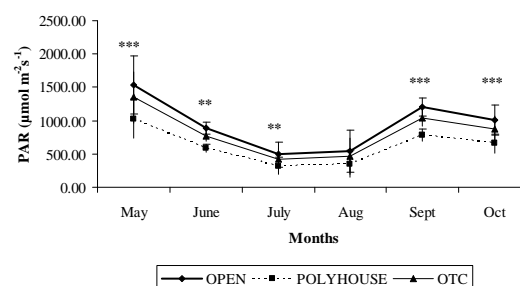


Figure 7. Monthly variation in Photosynthetically Active Radiation (PAR) in Open, Polyhouse and OTC

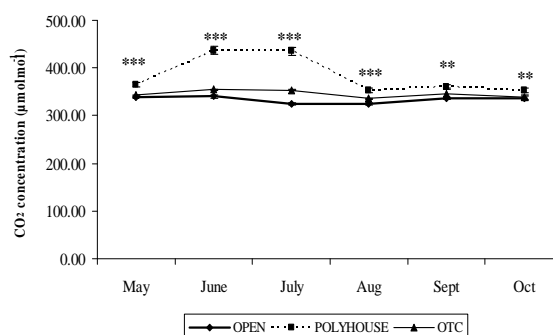


Figure 8. Monthly variation in CO₂ concentration in Open, Polyhouse and OTC

Table 1. Monthly variation in min/max temperature in different conditions

Minimum temperature ($^{\circ}\text{C}$)	Open	Polyhouse	OTC	P value (LSD)
May	6.27 \pm 1.70	11.60 \pm 2.46*	8.27 \pm 1.64*	<0.001(1.31)
June	8.23 \pm 1.68	12.73 \pm 3.18*	8.53 \pm 1.61	<0.001(1.51)
July	8.93 \pm 2.15	11.77 \pm 2.67*	9.13 \pm 2.40	<0.001(1.61)
August	9.90 \pm 1.09	15.87 \pm 1.59*	10.53 \pm 0.78	<0.001(0.80)
September	6.63 \pm 1.33	14.57 \pm 1.01*	6.90 \pm 1.18	<0.001(0.78)
October	4.23 \pm 1.45	9.60 \pm 4.86*	4.53 \pm 1.41	<0.001(2.02)
Months X Conditions	P<0.001			
Maximum temperature ($^{\circ}\text{C}$)	Open	Polyhouse	OTC	P value (LSD)
May	16.53 \pm 3.54	21.07 \pm 5.85*	18.70 \pm 3.03	<0.001(2.87)
June	20.70 \pm 4.68	30.60 \pm 5.47*	21.07 \pm 1.93	<0.001(2.86)
July	19.83 \pm 1.82	30.27 \pm 3.83*	20.03 \pm 2.41	<0.001(1.87)
August	20.47 \pm 1.41	32.80 \pm 1.99*	20.83 \pm 1.42	<0.001(1.08)
September	18.07 \pm 2.21	32.73 \pm 4.42*	18.53 \pm 2.05	<0.001(2.05)
October	12.67 \pm 4.88	26.10 \pm 6.08*	11.73 \pm 1.28	<0.001(3.03)
Months X Conditions	P<0.001			

*significant

Table 2. Monthly variations in air temperature in different conditions

Solar Time	Conditions	May	June	July	August	September	October	Months X Conditions
8.00	OPEN	11.83 \pm 3.13	13.33 \pm 2.55	13.43 \pm 2.46	12.60 \pm 1.92	10.83 \pm 2.44	6.70 \pm 2.04	<0.001
	POLYHOUSE	15.60 \pm 4.88*	21.07 \pm 5.84*	17.77 \pm 3.43*	21.33 \pm 3.77*	20.87 \pm 3.54*	11.13 \pm 1.53*	
	OTC	13.23 \pm 3.10	13.47 \pm 2.94	13.47 \pm 3.13	12.90 \pm 1.71	11.13 \pm 2.29	7.20 \pm 1.92	
	P Value (LSD)	<0.001(2.53)	<0.001(2.70)	<0.001(2.02)	<0.001(1.75)	<0.001(1.90)	<0.001(1.22)	
12.00	OPEN	17.00 \pm 3.63	18.47 \pm 6.27	16.53 \pm 2.96	14.50 \pm 1.53	13.40 \pm 2.03	11.87 \pm 1.81	<0.001
	POLYHOUSE	21.73 \pm 3.81*	22.47 \pm 3.76*	22.03 \pm 3.79*	25.87 \pm 4.22*	26.43 \pm 5.28*	18.60 \pm 2.01*	
	OTC	18.83 \pm 3.81	18.97 \pm 3.72	17.50 \pm 2.60	14.97 \pm 1.35	13.77 \pm 1.65	12.13 \pm 1.50	
	P Value (LSD)	<0.001(2.49)	<0.01(3.15)	<0.001(2.10)	<0.001(1.80)	<0.001(2.26)	<0.001(1.19)	
4.00	OPEN	15.33 \pm 3.27	17.60 \pm 7.67	13.20 \pm 2.89	14.00 \pm 1.86	13.27 \pm 3.59	10.73 \pm 1.87	<0.001
	POLYHOUSE	21.17 \pm 3.73*	22.43 \pm 3.43*	17.33 \pm 4.80*	22.43 \pm 3.38*	25.47 \pm 6.47*	17.13 \pm 1.93*	
	OTC	16.73 \pm 3.18	18.10 \pm 2.22	14.87 \pm 2.21	14.40 \pm 1.33	13.97 \pm 2.91	11.10 \pm 1.49	
	P Value (LSD)	<0.001(2.27)	<0.001(3.34)	<0.001(2.31)	<0.001(1.57)	<0.001(3.05)	<0.001(1.18)	

*significant

Table 3. Monthly variations in % Humidity in different conditions

Solar Time	Conditions	May	June	July	August	September	October	Months X Conditions
8:00	OPEN	50.20±13.39	70.23±12.09	63.83±13.94	66.33±14.97	65.33±17.65	47.20±11.46	<0.001
	POLYHOUSE	72.90±8.97*	78.50±7.20*	73.57±10.51*	70.90±11.46	74.37±6.14	72.43±3.52*	
	OTC	54.60±12.59	70.40±11.76	64.60±12.97	67.87±12.74	67.33±14.82	50.67±9.70	
	P Value (LSD)	<0.001(7.85)	<0.01(7.04)	<0.01(8.34)	>0.05(8.73)	<0.05(9.15)	<0.001(5.92)	
12:00	OPEN	41.00±12.95	62.73±10.79	56.57±12.51	58.00±12.65	55.20±11.33	44.53±9.12	>0.05
	POLYHOUSE	50.93±13.88*	71.03±7.11*	70.47±12.17*	64.90±13.98	64.90±13.98*	50.63±10.47*	
	OTC	45.97±12.73	63.07±10.08	57.03±11.84	59.20±10.93	56.53±10.29	46.53±7.76	
	P Value (LSD)	<0.05(8.77)	<0.01(6.29)	<0.001(8.09)	>0.05(8.36)	<0.01(7.96)	<0.05(6.10)	
4:00	OPEN	50.10±16.23	60.23±8.86	52.77±14.38	54.80±16.54	53.87±14.66	47.50±11.40	>0.05
	POLYHOUSE	60.63±16.77*	67.27±8.14*	68.80±11.66*	61.07±8.81	68.53±9.88*	53.87±14.66	
	OTC	51.13±10.60	60.63±7.99	53.90±13.62	57.50±12.84	55.50±12.21	48.57±10.15	
	P Value (LSD)	<0.05(9.84)	<0.01(5.54)	<0.001(8.82)	>0.05(8.72)	<0.001(8.25)	>0.05(8.12)	

*significant

Table 4. Monthly variations in soil temperature in different conditions

Solar Time	Conditions	May	June	July	August	September	October	Months X Conditions
8:00	OPEN	11.73±2.03	12.10±2.66	13.50±2.22	13.43±2.37	12.93±1.82	10.30±2.77	>0.05
	POLYHOUSE	15.83±2.59*	16.30±2.76*	18.17±2.17*	16.93±2.27*	16.57±1.52*	12.73±3.47*	
	OTC	11.87±2.16	12.23±2.31	13.73±2.02	13.83±2.13	13.00±1.74	10.67±2.56	
	P Value(LSD)	<0.001(1.51)	<0.001(1.72)	<0.001(1.42)	<0.001(1.50)	<0.001(1.13)	<0.01(1.96)	
12:00	OPEN	14.67±3.46	15.20±3.00	16.13±3.20	16.00±3.14	15.53±3.09	12.13±4.07	>0.05
	POLYHOUSE	17.97±2.77*	17.90±3.13*	20.37±3.15*	19.33±2.86*	19.30±1.90*	14.40±3.99	
	OTC	14.80±3.27	15.23±3.00	16.40±2.98	16.67±2.43	15.70±2.91	12.27±3.85	
	P Value (LSD)	<0.001(2.11)	<0.001(2.02)	<0.001(2.06)	<0.001(1.87)	<0.001(1.78)	>0.05(2.63)	
4:00	OPEN	13.50±3.29	13.30±3.75	11.90±3.10	12.90±1.97	12.60±1.65	11.50±2.83	<0.05
	POLYHOUSE	15.90±3.33*	16.50±3.28*	17.13±3.01*	16.27±2.35*	15.90±1.84*	13.13±3.48	
	OTC	13.60±3.12	13.33±3.72	12.07±2.95	13.37±1.30	12.87±1.41	11.77±2.39	
	P Value (LSD)	<0.01(2.15)	<0.001(2.38)	<0.001(2.00)	<0.001(1.27)	<0.001(1.09)	>0.05(1.95)	

*significant

Table 5. Comparison of diurnal reductions of photosynthetically-active radiation (PAR) through polyhouse and Open Top Chambers

Solar Time	(PAR) Open	(PAR) Polyhouse		(PAR) OTC	
	$\mu\text{molm}^{-2}\text{s}^{-1}$	$\mu\text{molm}^{-2}\text{s}^{-1}$	% reduction	$\mu\text{molm}^{-2}\text{s}^{-1}$	% reduction
8:00	1056.17±13.38	671.75±6.18	36.39	932.60±138.20	11.7
10:00	1908.00±74.26	1272.00±11.53	33.33	1631.75±48.04	14.51
12:00	1840.60±123.25	1172.56±75.06	36.26	1584.39±3.21	13.92
14:00	704.67±18.04	530.67±2.52	24.69	606.15±5.51	13.98
16:00	628.33±4.04	392.33±14.22	37.55	552.93±3.79	12
18:00	431.00±6.71	310.00±7.70	28.07	370.66±15.58	14
20:00	37.00±2.89	15.73±3.54	57.48	31.73±3.57	14.24

3.4 Soil temperature

Soil temperature inside the Open top chambers with little variations remains closer to the open ambient conditions in comparison to polyhouse where a significant increase in soil temperature throughout the season was recorded (Table 4).

3.5 Solar radiation dwindling

Intense solar radiation in alpine region makes the alpine vegetation to have special physioanatomical acclimation to high irradiance. Thus, necessity of less light attenuation inside open top chambers makes them easy to conduct the CO₂ enrichment studies in alpine region. Generally, solar radiation is attenuated 10-20% by open top chambers (Drake et al, 1989; Weinstock et al, 1982; Heagle et al, 1979; Sanders et al, 1991)

In this study, we have found about 12-14% decrease inside OTCs in comparison to polyhouse where the decrease was near about 33-35%. A diurnal course of incident PAR inside OTCs, polyhouses compared with open ambient condition is depicted in Figure 6. Table 5 shows comparison of diurnal % reduction of PAR in polyhouse and Open top chambers in relation to open condition. In case of monthly variation in incident PAR same pattern was observed. Figure 7 depicts that there was a significant variation in PAR in different conditions throughout the season.

4. Conclusion

In alpine environment, the dynamics and functionality are controlled by low-temperature conditions, are considered to be particularly sensitive to climate change and global warming (Körner, 1999, IPCC, 2001). Hence effect of elevated CO₂ will have unpredictable impact on the alpine plants of India. Therefore, forecasting of dynamism of morpho-physiological and biochemical response of alpine plants under elevated CO₂ can only be possible with a leak proof CO₂ enrichment facility. The system described for CO₂ exposure of alpine ecosystem is simple and many replications in a harsh natural ecosystem are possible. This makes it a cost-effective means of gathering the requirements for field research on the effect of CO₂ on alpine ecosystems. There are several research needs to improve the open top chamber as a field experimental tool in context to alpine region of India. The combined effect of increased atmospheric humidity and temperature with increased CO₂ on plant growth in the field is also desirable to be addressed. We do declare that building these systems is easy, only that these systems are intrinsically simpler than others, provided that the effects on microenvironment are not as much as inside polyhouse, Open top chambers are probably the only practical option at present for studies on effects of elevated atmospheric CO₂ on Alpine ecosystems of India. Thus establishment of Open Top Chambers in Alpine of Tungnath (at 3600m above MSL) in Garhwal Himalaya will certainly be fruitful in observing the

impact of increasing CO₂ concentration on alpine plants in context to global climate change and its response on alpine plants of India.

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Correspondence to:

Ashish Kumar Chaturvedi
High Altitude Plant Physiology Research Centre
Post Box No. -14, H N B Garhwal University
Srinagar Garhwal – 246174, Uttarakhand, India
Phone No. – 09411056641 (M), 01346252172 (O)
Fax No. – 01346252070
ashi_spc@rediffmail.com
ashispc@gmail.com

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Phyllosphere Fungi of *Alnus nepalensis*, *Castanopsis hystrix* and *Schima walichii* in a Subtropical Forest of North East India

A. Kayini and R.R. Pandey

Department of Life Sciences, Manipur University, Canchipur, Imphal – 795 003, India

kayinkrich@gmail.com; pandey.rr@rediffmail.com

Abstract: A total of 38 epiphytic and endophytic phyllosphere fungi were isolated from living leaves of *Alnus nepalensis*, *Castanopsis hystrix* and *Schima walichii* by using a combination of cultural methods i.e. dilution plating, washed disk and surface sterilization, respectively at bimonthly intervals during July, 2008 to May, 2009. *Alternaria alternata*, *Cladosporium cladosporioides*, *Fusarium oxysporum* and *Pestalotiopsis* sp. were the dominant colonizers of three forest tree leaves. The type of fungal species isolated from different test leaves were found to be influenced by the method of isolation. Some species could be recovered by a particular culture method while others were recovered by two or all three isolation methods. *Alternaria raphani*, *Epicoccum purpurascens* and *Gliocladium roseum* from *Alnus nepalensis* leaves and *Scopulariopsis* sp. and *Trichoderma harzianum* from *Castanopsis hystrix* were the species recovered specifically by washed disk method. Whereas, *Gliocladium fimbriatum* was isolated only from *Schima walichii* leaves as endophytic fungi. [Journal of American Science 2010;6(3):118-124]. (ISSN: 1545-1003).

Key words: Phyllosphere fungi, epiphytes, endophytes, *Alnus nepalensis*, *Castanopsis hystrix*, *Schima walichii*

1. Introduction

The phyllosphere is the living leaf as a whole and includes the surface (phylloplane) and internal tissues colonized by a variety of epiphytic and endophytic microorganisms respectively, thereby occupying two distinct habitats on the leaf (Andrews, 1996; Carroll *et al.*, 1977; Petrini, 1991). The interest shown in the last few years in the study of phyllosphere microbes is due principally to their interactions with plants, herbivores and pathogens on living leaves which may be involved in the plant immunity system, reabsorption of organic and mineral matters from leachates, redistribution of nutrients prior to leaf fall and participation in the primary degradation of plant tissues (Carroll *et al.*, 1977; Cabral, 1985; Lindow and Brandl, 2003; Osono, 2006). Another aspect of colonization ecology of phylloplane and/or phyllosphere fungi principally relates to the prevailing microenvironmental conditions on the leaf surfaces and their physical, chemical and phenological properties which affect the fungal establishment thereon (Pandey, 1990; Dix and Webster, 1995).

Studies on endophytic fungi in tree leaves have been carried out for several host species, when their significance as common symbionts and possible mutualists of plants were recognized (Carroll, 1995). Majority of such studies describing the diversity of phyllosphere fungi on different hosts and in various habitats have however, dealt with either annuals or perennials bearing short-lived deciduous leaves. Less is known about the long-lived leaves of evergreens (Mishra and Dickinson, 1981) though Ruinen (1961)

demonstrated that the persistent leaves of tropical plants supported complex and extensive microbial flora.

North eastern India forms an important portion of Indo-Burma biodiversity hot spots (Pawar *et al.*, 2007). The nature and abundance of epiphytic and endophytic leaf fungi have been studied mainly in cool and temperate forests, but their investigation in other regions of the world e.g. warm temperate to tropical or subtropical forests are less explored (Heredia, 1993; Hata *et al.*, 2002). Moreover a perusal of available literature reveals that no attention has been paid to the phyllosphere mycoflora of *Alnus nepalensis*, *Castanopsis hystrix* and *Schima walichii* in subtropical habitats of North eastern India.

Therefore, with this perspective it was thought desirable to undertake a preliminary study on the diversity of phyllosphere fungal community of three dominant tree species in a natural mixed subtropical forest of Manipur, North eastern region of India.

2. Material and Methods

2.1. Collection of samples

The studies were conducted in a natural mixed forest located in the Taphou Naga hill range (25° 15' N Latitude and 94° 15' E Longitude) at an altitude of 1200 m asl, which is about 2 km north-west of Senapati District headquarter and 65 km north of Imphal city, Manipur, India. The mean minimum and maximum temperature during the study period (July 2008 – May 2009) ranged between 13.9 °C to 25.1 °C in the months of

January 09 and July 08, respectively. The mean relative humidity varied from 56.9% to 84.6% whereas the total monthly rainfall ranged between 0 mm to 210.2 mm (Fig. 1). Healthy mature green leaves of *Alnus nepalensis*, *Castanopsis hystrix* and *Schima walichii* were collected from each of 5 trees randomly from the branches at 10 ft height in the canopies, separately. Leaves from 5 branches of

each tree species, representing both the margin and interior of the canopy were sampled at bimonthly intervals during July, September and November, 2008 and January, March and May, 2009, respectively. The leaves of each tree species were kept in separate polyethylene bags and brought to the laboratory for isolation of epiphytic and endophytic phyllosphere fungi.

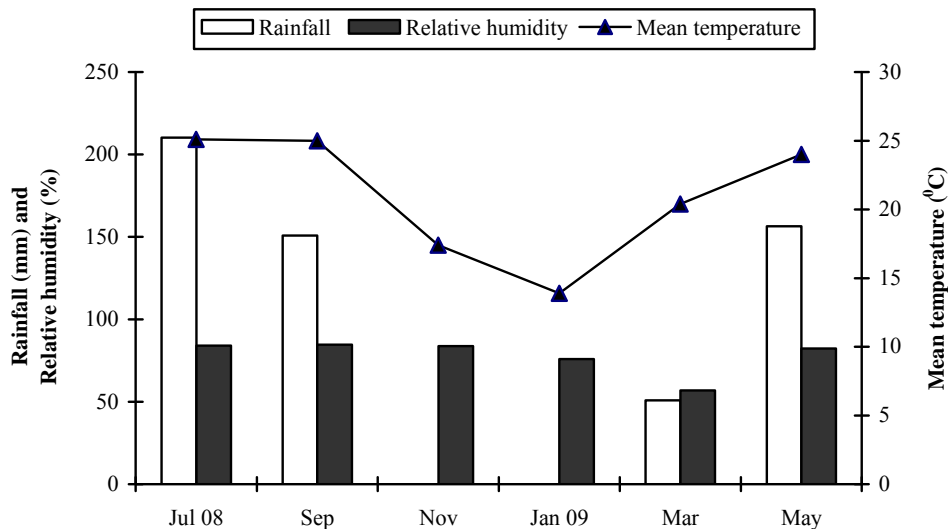


Figure 1. Monthly changes in climatic variables during the study period.

2.2. Isolation procedure

(a) Dilution plate method: One hundred leaf disks (5 mm diam.), two from each of fifty leaves of a tree species, were punched out with the flame sterilized cork borer and transferred separately, into 250 ml conical flasks containing 100 ml sterilized distilled water. The flasks were shaken for 20 min on a horizontal mechanical shaker to detach the fungal propagules present thereon. One ml aliquot of diluted suspension (10^{-3}) was pipetted out separately into each of 5 Petri dishes (9 cm diam) and 15 ml cooled (35 °C) and molten Czapek-Dox + 0.05% (w/v) Yeast extract agar medium supplemented with Streptomycin (100 mg/l). The plates were gently rotated clockwise and anticlockwise to ensure uniform distribution of homogenates and then incubated at 25 ± 1 °C under fluorescent light for 7 days. The fungal colonies appeared on the plates after incubation were identified. Isolates that remained sterile were recorded as sterile mycelia.

(b) Washed disk method: Twenty five disks (5 mm diam) of each leaf type were procured separately, and serially washed in 10 changes of sterile distilled water (1 min/washing). The disks were then dried in folds of sterile filter paper and five disks were inoculated at equal distance in each of 5 Petri plates containing 15 ml cooled Czapek-

Dox agar medium. The plates were incubated as above.

(c) Surface sterilization method: Twenty five (5 mm diam) leaf disks of each tree species were prepared as above and submerged in 70% ethanol for 1 min, then transferred into 15% H_2O_2 for 1 min and again kept into 70% ethanol for 1 min (Kinkel and Andrews, 1988). Thereafter, the disks were serially washed in 10 changes of sterile distilled water, then blotted dry, inoculated in each of 5 Petri dishes (5 disks/plate) containing Czapek-Dox agar medium and incubated as above.

2.3. Calculation

The relative abundance (%) of each fungal species isolated by dilution plating was calculated as: (Number of colonies of a fungal species/ Total number of fungal colonies) \times 100. Percent frequency of occurrence of each fungus recovered by washed disk and surface sterilization methods was calculated as: (Number of leaf disks on which a fungal species occurred/ Total number of leaf disks observed) \times 100.

3. Results and Discussion

A total of 24 and 38 endophytic and epiphytic fungal species, respectively were isolated

from phyllosphere of *Alnus nepalensis*, *Castanopsis hystrix* and *Schima walichii* living leaves by using different cultural methods. Out of which 22 species were common to the three leaf types recovered at least by two or all employed methods (Tables 1, 2 & 3). *Alternaria alternata*, *Cladosporium cladosporioides*, *Fusarium oxysporum* and *Pestalotiopsis* sp. were the dominant surface and interior colonizers of different tree species leaves. In general, these species were extensively reported as common primary saprobes and ubiquitous hyphomycetes

from attached leaf surfaces of wide variety of plants throughout the world (Breeze and Dix, 1981; Mishra and Dickinson, 1981; Pandey, 1990; Andrews, 1996; Osono, 2006) which can withstand on adverse conditions such as desiccation, UV radiation and microbial lysis by producing thick walled pigmented multicellular spores and microsclerotia (Hudson, 1968; Sadaka and Ponge, 2003). These fungi are normally encountered as epiphytes, but some can also occur as endophytes (Petrini, 1991).

Table 1. Epiphytic fungi of three forest tree leaves isolated by dilution plate method.

Fungal species	Forest trees species																	
	<i>Alnus nepalensis</i>						<i>Castanopsis hystrix</i>						<i>Schima walichii</i>					
	Sampling months																	
	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May
<i>Alternaria alternata</i>	16.7	15.2	-	-	-	20.0	19.4	-	-	-	-	15.4	27.3	-	-	-	-	-
<i>Aspergillus flavus</i>	23.5	-	-	-	-	-	-	16.7	-	-	-	-	-	-	-	-	-	-
<i>A. niger</i>	23.0	22.2	27.3	-	-	-	18.9	-	-	-	-	-	26.1	-	-	-	-	-
<i>Cladosporium</i> sp.	-	-	-	36.0	9.3	-	-	-	-	-	10.5	20.0	-	-	-	28.1	-	-
<i>C.cladosporioides</i>	-	37.5	17.9	-	51.1	25.0	-	-	-	25.4	26.0	36.0	-	-	-	-	11.4	33.3
<i>Curvularia lunata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.2	-
<i>Fusarium oxysporum</i>	-	18.5	33.3	14	-	-	-	-	-	-	-	31.8	-	-	39.3	-	14.3	-
<i>F. poae</i>	-	-	-	-	-	-	16.2	10.3	17.6	-	15.4	-	-	-	-	-	-	-
<i>Gliocladium penicillioides</i>	-	-	-	-	-	-	28.6	17.1	25.0	-	-	-	27.3	25.9	-	-	-	-
<i>Graphium penicillioides</i>	-	-	-	-	16.0	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mucor hiemalis</i>	-	-	-	18.5	-	-	-	-	-	-	-	-	-	-	28.7	-	8.0	-
<i>Paecilomyces varioti</i>	-	18.7	42.9	-	-	-	-	-	-	-	10.0	-	20.0	23.5	-	-	-	-
<i>Penicillium</i> sp.	-	-	-	-	-	-	28.6	23.4	23.5	12.7	-	-	-	-	-	-	-	-
<i>P. expansum</i>	-	-	-	-	40.0	28.5	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. diversum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.8	22.2	-
<i>P. glabrum</i>	-	-	-	-	-	-	36.4	-	-	-	-	-	-	-	-	-	-	-
<i>P. italicum</i>	-	-	-	16.7	-	28.5	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. javanicum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.3	26.3	22.9	81.8
<i>P. rubrum</i>	23.6	-	-	-	-	-	29.7	-	-	-	19.0	-	16.4	-	-	-	-	-
<i>Pestalotiopsis</i> sp.	-	30.5	38.2	-	11.1	25.0	-	-	36.0	15.9	17.0	-	-	40.9	30.4	-	-	-
<i>Trichoderma koningii</i>	26.0	-	-	-	-	-	31.3	20.6	-	-	-	-	-	-	16.7	-	-	-
<i>T. viride</i>	-	-	-	10.0	-	-	-	15.4	34.8	-	-	-	-	-	25.2	-	31.6	-
<i>Trichothecium roseum</i>	-	-	-	20.4	29.2	-	-	-	-	31.7	-	-	-	-	-	17.5	-	-
<i>Verticillium terrestre</i>	29.4	15.3	-	-	-	-	-	23.5	-	17.9	-	-	-	-	-	-	13.5	-
Dark sterile mycelia	-	-	-	-	13.3	50.0	-	-	-	17.6	20.0	16.6	-	-	-	25.0	30.0	-
White sterile mcelia	-	-	-	-	-	40.0	-	11.1	-	-	17.5	23.0	-	20.9	-	15.8	-	-

Table 2. Epiphytic fungi of living leaves of three different forest tree species isolated by washed disk method.

Fungal species	Forest trees species																	
	<i>Alnus nepalensis</i>						<i>Castanopsis hystrix</i>						<i>Schima walichii</i>					
	Sampling months																	
	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May
<i>Alternaria alternata</i>	26.6	-	-	-	12.0	26.0	-	26.6	-	-	-	-	20.0	-	-	-	-	-
<i>A. raphani</i>	-	-	-	-	4.0	24.0	-	-	-	-	-	-	-	-	-	-	-	-
<i>A. tenuissima</i>	-	-	-	-	-	-	-	-	-	-	-	8.0	-	-	-	-	4.0	36.0
<i>Aspergillus flavus</i>	-	-	-	-	-	-	-	-	4.0	16.0	8.0	-	-	-	-	-	-	-
<i>A. niger</i>	20.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Aureobasidium pullulans</i>	-	-	-	8.0	8.0	-	8.0	8.0	20.0	-	-	-	-	-	-	-	-	-
<i>Cladosporium cladosporioides</i>	-	-	-	16.0	16.0	24.0	-	-	-	-	-	-	-	-	33.3		8.0	20.0
<i>Epicoccum purpurascens</i>	-	-	-	-	4.0	8.0	-	-	-	-	-	-	-	-	-	-	-	-
<i>Fusarium equiseti</i>	-	-	-	-	-	4.0	-	-	-	-	-	-	-	-	-	-	-	-
<i>F. oxysporum</i>	13.0	-	33.3	12.0	12.0	-	-	6.6	6.6	-	-	20.0	40.0		6.6	12.0	4.0	-
<i>Gliocladium penicillioides</i>	-	20.0	-	-	-	-	6.6	-	-	-	-	-	-	6.6	-	-	-	-
<i>G. roseum</i>	-	-	-	-	4.0	8.0	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mucor hiemalis</i>	20.0	20.0	6.6	60.0	-	-	-	-	-	-	-	-	-	6.6	20.0	-	-	-
<i>Nigrospora sphaerica</i>	-	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paecilomyces varioti</i>	33.3	-	-	-	-	-	-	-	-	-	-	-	-	6.6	-	-	-	-
<i>Penicillium italicum</i>	-	-	-	4.0	-	-	-	-	-	4.0	12.0	10.0	-	8.0	-	-	-	-
<i>P. javanicum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.0	-	12.0	-
<i>P. rubrum</i>	-	-	-	-	-	-	-	-	-	-	-	-	20.0	-	-	-	-	-
<i>Pestalotiopsis</i> sp.	-	60.0	26.6	-	28.0	56.0	-	-	60.0	32.0	96.0	76.0	-	53.3	60.0	20.0	68.0	16.0
<i>Scopulariopsis</i> sp.	-	-	-	-	-	-	-	-	-	-	4.0	12.0	-	-	-	-	-	-
<i>Trichoderma harzianum</i>	-	-	-	-	-	-	-	-	-	-	8.0	4.0	-	-	-	-	-	-
<i>T. koningii</i>	20.0	-	33.3	-	-	-	20.0	33.3	-	-	-	-	-	-	-	-	-	-
<i>T. viride</i>	-	-	6.6	-	-	-	-	33.3	13.3	-	-	-	-	-	-	-	-	-
<i>Trichothecium roseum</i>	-	-	-	12.0	12.0	-	-	-	-	48.0	-	-	-	-	-	16.0	-	-
<i>Verticillium terrestre</i>	-	13.3	-	4.0	8.0	-	-	-	-	-	-	-	-	13.3	-	-	-	-
Dark sterile mycelia	20.0	20.0	-	4.0	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-
White sterile mycelia	-	-	6.6	8.0	4.0	-	6.6	-	-	-	12.0		-	6.6	-	-	4.0	-

Table 3. Endophytic phyllosphere fungi of different forest trees isolated by surface sterilization method.

Fungal species	Forest trees species																	
	<i>Alnus nepalensis</i>						<i>Castanopsis hystrix</i>						<i>Schima walichii</i>					
	Sampling months																	
	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May
<i>Alternaria alternata</i>	20.0	-	13.3	-	-	4.0	20.0	-	-	4.0	-	-	6.6	-	-	-	-	-
<i>Aspergillus flavus</i>	-	-	-	-	-	-	-	-	-	4.0	8.0	-	-	-	-	-	-	-
<i>A. niger</i>	-	46.0	-	-	-	-	20.0	-	-	-	-	-	26.6	-	-	-	-	-
<i>Aureobasidium pullulans</i>	-	-	-	12.0	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-
<i>Cladosporium cladosporioides</i>	-	-	33.3	20.0	4.0	-	-	-	6.6	-	-	8.0	-	6.6	26.6	16.0	-	16.0
<i>Curvularia pallescens</i>	13.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Fusarium oxysporum</i>	-	-	-	-	-	-	-	6.6	-	-	-	-	-	-	-	-	-	-
<i>Gliocladium fimbriatum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.3	16.0	16.0	-
<i>G.penicillioides</i>	-	-	-	-	-	-	20.0	13.3	-	-	-	-	6.6	13.3	-	-	-	-
<i>Graphium penicillioides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mucor hiemalis</i>	-	-	-	-	16.0	-	26.6	6.6	-	-	-	-	-	-	-	4.0	-	-
<i>Nigrospora sphaerica</i>	-	-	-	-	-	4.0	-	-	-	-	-	24.0	-	-	-	-	-	-
<i>Paecilomyces varioti</i>	13.3	6.6	-	12.0	4.0	-	-	26.6	-	-	4.0	-	46.6	26.6	-	-	-	-
<i>Penicillium expansum</i>	-	-	-	-	16.0	16.0	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. italicum</i>	-	-	-	28.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. rubrum</i>	26.6	-	-	-	-	-	6.6	-	-	-	-	-	53.3	-	-	-	-	40.0
<i>Pestalotiopsis</i> sp.	-	33.3	33.3	-	12.0	-		20.0	6.6	4.0	16.0	52.0	-	-	33.3	-	-	-
<i>Trichoderma koningii</i>	-	-	6.6	-	-	-	-	-	-	-	-	-	-	-	-	32.0	24.0	-
<i>T. viride</i>	-	33.3	6.6	24.0	-	-	-	-	6.6	-	-	-	-	26.6	-	-	4.0	-
<i>Trichothecium roseum</i>	-	-	-	-	-	-	-	-	8.0	36.0	-	-	-	-	-	-	-	-
<i>Verticillium terrestre</i>	6.6	-	-	-	-	-	-	-	-	-	-	-	-	33.3	-	-	8.0	-
Dark sterile mycelia	-	-	13.3	-	64.0	-	-	-	6.6	20.0	8.0	-	-	-	-	-	-	4.0
White sterile mycelia	-	-	-	24.0	4.0	24.0	-	-	13.3	48.0	72.0	60.0	-	-	-	40.0	20.0	-
Unidentified I	-	-	-	-	-	16.0	-	-	-	-	8.0	-	-	-	-	-	-	-

Other fungi like *Aspergillus niger*, *Mucor hiemalis*, *Paecilomyces varioti*, *Penicillium rubrum*, *Trichothecium roseum*, *Trichoderma koningii* and *T. viride* were also found common on phyllosphere of at least two or all three leaves with varying relative abundance and/or occurrences (Tables 1, 2 & 3). Some of these species are able to utilize cellulosic components and gallic acid (Kjøller and Struwe, 1987; Rai *et al.*, 1988) and also found to play important role in primary degradation of plant tissues. In the present study, specific phyllosphere fungi showed differential seasonal preferences on three tree leaf types during various isolation periods. For example, *Gliocladium penicillioides* and *P. varioti* were

recovered from *Schima walichii* leaves by dilution plating during rainy sampling months, whereas they were isolated during rainy and winter sampling periods from other test leaves. The variations observed in species richness and compositions of phyllosphere mycoflora on different leaf types during various sampling months can be assumed as the differences in competitive abilities, life cycle characteristics, potentialities to utilize residual organic chemical resources between the species present thereon (Osono, 2006). Besides these, prevailing environmental variables such as temperature, moisture and humidity during different sampling periods have also been reported

to affect the changes in population of specific phyllosphere fungi (Breeze and Dix, 1981).

The type of fungal species isolated from different test leaves were found to be influenced by the method of isolation. Some species could be recovered by a particular culture method while others were isolated by two or all three isolation methods. *Alternaria raphani*, *Epicoccum purpurascens* and *Gliocladium roseum* from *Alnus nepalensis* leaves and *Scopulariopsis* sp and *Trichoderma harzianum* from *Castanopsis hystrix* were the fungus occurred specifically by washed disk method whereas, *Gliocladium fimbriatum* was isolated only from *Schima walichii* leaves as endophytic fungi. *Fusarium equiseti* from *Alnus nepalensis*, *Penicillium glabrum* from *Castanopsis hystrix* and *Curvularia lunata* from *Schima walichii* were found only once during the sampling period which represent the specialization in a relatively narrow niche dimension by these fungi (Wildman and Parkinson, 1979). However, the possibility of a chance occurrence of certain fungal species on a particular leaf type cannot be overruled. Frequently recovered fungal species like *Aspergillus*, *Penicillium* and *Trichoderma* spp. from three plant leaf samples, grow quickly and produce large number of conidia which are easily dispersed and exhibit wide ecological spectrum (Christensen, 1981). The white and dark coloured sterile mycelia isolated from different leaf types (Tables 1, 2 & 3) must be representing those species which do not produce spores naturally or under cultural conditions including monokaryotic Basidiomycetes.

In conclusion, the present study revealed that despite the variation in physical, chemical and phenological properties in three leaf types, the fungal species isolated were more or less, similar and common to all except for some host and culture method-specific fungi. Further investigations on the dynamics of endophytic and epiphytic fungal species compositions associated with the same host leaves in other sites or during different seasons and increased sampling efforts could yield more fungal taxa and could further clarify the effect of host leaf on the fungal populations.

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Corresponding Author

Dr. R.R. Pandey
Department of Life Sciences
Manipur University
Canchipur, Imphal-795 003, India.
Tel.: +91 9436025986, Fax: +91 385 2435083

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LAND MANAGEMENT AND ITS PROBLEMS IN NOTSE, SMALL TOWN IN SOUTHERN TOGO

Komlan Dela Gake, Jianguo Chen

China University of Geosciences, 388 LuMo Road, Wuhan, Hubei 430074, China

glanok79@hotmail.com

ABSTRACT: Nowadays the analysis of any urban city uses modern techniques such as remote sensing and geographic information system. But in the cities of developing countries this is not often the case, due to lack of means and, on the other hand, lack of political will. The case of Notse, a small town in southern Togo is no exception. Therefore the analysis of the city in this paper will be based on the results of research carried out on the field. However the goal is to reach the constitution of databases that can be used as starting point for the use of the new technologies. Our investigation allowed us to update the problems undermining the development of the town, namely: the lack of reliable data on urban planning, the lack of services and basic facilities to name a few. Further on the assessment will allow us to draw the necessary conclusions and a useful approach to improve the development of the city with new technologies. Consequently, a spatial development plan is proposed to serve as a starting point to a more technological and professional approach of what a 21st century city planning should be. This plan is essentially based on the results of spatial and demographic data analysis. [Journal of American Science 2010;6(3):125-135]. (ISSN: 1545-1003).

Keywords: Field work, Geographic Information System, Database constitution, Spatial Development Plan.

1-INTRODUCTION

The development and planning of cities in West Africa's former colonies were thought as the western model; timidly taking into account the customs of the countries. Notse, a small town in southern Togo, did not escape this trend. But nearly half-century after independence, the outcome was not as well expected. With the advent of the decentralization, hope for local development was born. Unfortunately, this process was also a failure, because although the central government gave locals authorities decision-making power and almost total autonomy; it failed to support that action by not providing the technical tools that would allow these communities to manage and plan the development of their own cities. Among these tools, GIS (Geographic Information System) appears to be the most important and efficient. Consequently the question arises: *"Where does Notse stand in the application of this new planning tool?"*

Based on previous research, the answer is alarming as well; the city has none of the modern equipment and tools for planning its development. The city of Notse is the capital town of the Haho district; it is therefore a central point and by extension the nucleus of local and regional development. This has as immediate effect a relative density of the local population. As part of its history, the city gathers each year, in early September, the whole Ewe community in the sub-region and the

Diaspora within the framework of celebration of Agbogbozan.

These two factors have resulted in a rapid and unplanned development of the city; which resulted in an uncontrolled urbanization. The city is a sad display of the nonexistent organization and planning, noticeable to the spectator just by walking through it. This situation is even more evident if we take a look at the poor condition of the infrastructures (such as roads and some networks), and the presence of several empty plots. The few existing equipment are unevenly distributed.

Adding to this, the primary activity of the city, agriculture, destroyed the surrounding environment due to: (i) the intensification of agricultural practices, (ii) the cutting of trees for exportation as well as charcoal factories. These practices are depriving the city of its natural curtain of vegetation, which will lead to a long-term problem of erosion, and a consequent possible desertification.

Objective: The aim of this paper is to point out ways for the local sustainable development of the city by highlighting the negative effect of not using the GIS tool for managing and planning.

2-MATERIALS AND METHODS

Overview of the study area: With an area of approximately of 2,000 ha and estimated population of 32 950 people, Notse is a land lying in the

southern part Togo, between Lat: 6°55'56.37"N and 6°58'24.06"N / Long: 1° 9'2.40"E and 1°11'31.19"E. It is the main city in the prefecture of Haho. It is located 100km north of the city of Lome (capital town of Togo) on the 1st National Road. It occupies a position of city crossroads between the latter and the 5th National Road. (Refer to Map 01)

The city has four seasons including two wet and two dry: Long wet season: from half-march to half-july; Short wet season: from half-september to half-november; Long dry season: from half-november to half-march; Short dry season: from half-july to half-september. The average annual temperature is 27°C and the average annual rainfall is 1200mm.

Methodologies: The objective will be reached by means of integrating field surveys and geotechnologies such as GIS.

The basic data required for this study is the land cover map. A geographic base map can be generated by using the results of the field survey. Appropriate corrections are required to ensure geographical accuracy such as geo-referencing with satellite images as Google Earth images. Accuracy can be ensured depending on the resolution of the satellite images. Certainly the use of such maps is limited as compared to the ones based on topographical surveys. If possible topographical survey should be made to ensure considerable accuracy.

Information on past land uses when compared to the existing land cover is useful for detecting changes. The survey of the changing landscape would be carried with the help of the field.

Social and economic survey will render information about population, economic activities, equipment and living conditions.

3-UNDERSTANDING OF LOCAL LAND TENURE MANAGEMENT

The legislation in Notse as in the whole of Togo stipulates that the land belongs to local authorities. It actually means that the authorities are free to enforce status changes if it suits their interests. These authorities put on the market plots that come under the responsibility of the central government in what concerns project development. Generally, plots destined to construction projects or containing actual buildings generally follow a grid pattern of 20m x 30m (600m²) in most new blocks. Older parts of towns though present irregular frames with areas ranging from 200m² to over 600m².

Referring to year 2003 a 600m² plot in the city centre cost about one million (1,000,000) XOF; in the outskirts it cost about two hundred thousand

(200,000) XOF. This huge difference in price is mainly due to the location of plots. In fact the plots located in the old centre, naturally became the first blocks of the city centre. For this reason they benefit from more equipment, both infrastructures and superstructures.

This phenomenon has a negative side since is the ground for price speculation and translates into proliferation of interstitial spaces most often used as dump sites or, in a smaller scale, as areas of urban agriculture.

Due to the scarcity of plots in centre town a large proportion of the population prefer to live in the suburbs while hoping that services (basic amenities such as electricity and water) will be implemented in a short delay, hence causing the proliferation of interstitial spaces.

All these factors combined with the fact that land belongs to local authorities and not the state, help create and maintain the phenomenon of increasing urbanization, which is demonstrated by the disproportionate spatial expansion of the city, disrespecting areas and demographic needs.

Property acquisition methods: At Notse, documents related to real estate are scarce. Consequently statistical data is also scarce. Nevertheless there are three methods to own land: **(i)Donation:** which can be done within the donor's lineage or different lineage. In the second case, non-relatives are integrated into the clan exercising their right of usufruct for having explored a plot of land for a number of years. **(ii)Inheritance:** in this case land passes from father to son and is collectively owned by the descendants of the first landholder. In urban areas this practice often results in the splitting of the assets; several single owners are generated and almost always opt to build houses. **(iii)Sale:** three steps should be followed when land is acquired through purchase. *First*, plotted council estate is made available to prospective buyers (plotting of the land is not always strictly legal); *Second*, after selection of the buyer, a sales contract is produced involving the buyer, the surveyor, the head of the council selling the land, a traditional authority (county chief or district chief), *Third*, the surveyor is responsible (in a case of a regular plotting) to gather the necessary paperwork issued by the town hall in order to prepare the sales contract, the legal certificate and the title deed.

Role of local authorities in land management: Nowadays and in the absence of up-to-date planning documents and their enforcement, plots are clandestinely assigned by surveyors who do not necessarily obey administrative regulations. In 1989

the technical department of the Notse's city council made an inventory of all illegal plots and submitted it to the DGHU (National Agency for Habitat and Urbanism) for assessment and approval. At present, town authorities take steps to develop a master development plan and town planning scheme, which will forcibly regulate all construction plans.

Nevertheless the city hall has limited financial resources originating from fees charged for issuing cession documents. This fee corresponds to 5,000 XOF; also each surveyor pays a fee of 7,000 XOF. The goal is to charge sellers as well and 10% of the estate sale price as payment of the administrative certificate.

It should be stressed that in urban areas, land (obtained either by inheritance or sale) that is planned for housing projects is subject to a 50% repossession of the area by the state that can allocate a portion for infrastructures, another portion for superstructures or just file the land as administrative reservation. If needed, local authorities can allocate plots to carry out specific projects.

4-SPATIAL ORGANIZATION AND ITS EVOLUTION

Although commonly city boundaries are defined by decree, in the present case they have been agreed consensually between Haho's and Notse's authorities. The city area is roughly over 2000ha of which 60% correspond to the urban habitat and the remaining 40% to intra-urban agricultural areas. The whole of the area consists of 4 major areas broken down into 28 neighbourhoods. Population density among the neighbourhoods (as show in the Table 01 and Map 02) can vary from 2 people/ha in new areas, to 760 people/ha in old areas.

The spatial evolution of Notse can be summarized in three major steps: **Step 1: Before the independence of Togo**, Notse was a group of scattered villages. Today they constitute the original core, including the following districts: ADIM, DAKPODJI, AGBALADOME, TAKO 1, TCOUMIKPOTA, KRATCHI, WOBEDOME, EKLI, HOUTO, HOUNSA, KPOTA, and TOGBEGNIGBA. All these districts are contained by the Wall of Agokoli. **Step 2: Between 1970 and 1990**, this period corresponds to the widening of the original core through creation of illegal plots. As a result the districts of TEGBE, TEGBE ZONGO, TEGBE LOM-NAVA, ALINO, NAOLO and SOEKPE were born. **Step 3: 1990 until today**, the last expansion dating from the early '90s reflect the influence of the newly launched technical department

of Notse's city hall. As a result land fragmentation had rules to be followed and along with it a proper road network. New neighbourhoods were created: AGBOGBOGODO, AHADJOPEME, BLAKPA-PANI, AKPOVOU, FIAGBEDOU, TAKO 2, and TEGBE-ANAGOKONDJI.

In general terms, the spatial evolution of Notse follows two main axes: the 1st National Road and also the Kpalimé-Tohoun road. The eastern and southern boundaries roughly match the old Wall of Agbogbo. The choice of these two axes is explained by their quality as service roads (mainly the 1st National Road, an important commercial route that enjoys amenities such as electricity and water).

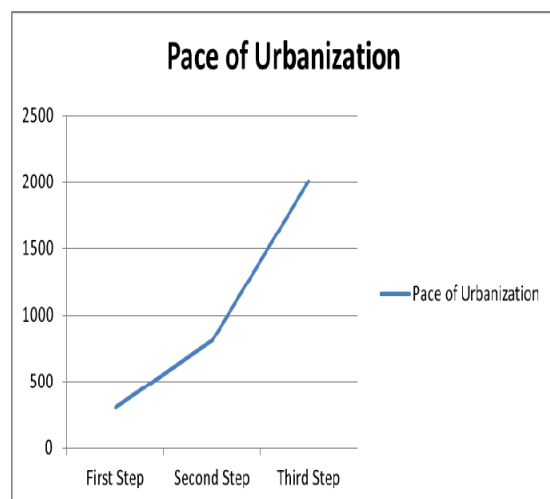
As show in Table 02 and Graphic 01, the urban area went from 306.74 ha in its first stage to 809.40 ha in the second stage and to 2010.05 ha in the third stage. The evolution rates are respectively 37.89% and 40.26%. The increase of the urban area to 809.40 ha corresponds to the post-independence period; this period is known for its important demographic growth as a result of the economic and health policies adopted by the government. The second increase of the urban area was also followed by a population growth. In this case migrants in search of land for agriculture and jobs (possibly at the SOTOCO plant). Also the strong spatial growth of the town was due to increasing assignment of unauthorized plots in the town's outskirts expanding its boundaries although with low population density. The increasing construction rate is not always in tune with a harmonious development of the city once are not in synchrony with services and basic infrastructure causing sanitary, social and ecological problems.

Table 02: Evolution of Urbanization

N°	Steps	Urban area in ha	Rate in %
1	Before the independence	306,74	37,89 40,26
2	From 1970 to 1990	809,40	
3	From 1990 until today	2010,05	

Soucre: ourselves

Graph 01: Pace of urbanisation



5-DEMOGRAPHIC DATA

At this point in time there are no updated data concerning the population of Notse. In fact the last census dates from 1981. Available data derive from the censuses of 1959, 1970 and 1981. Moreover there are estimates provided by the local authorities based on the census referred above and the census conducted by the General Bureau of Statistics in January 1997.

The census of 1959, 1970 and 1981 indicate respectively a population of 3 800, 7 605 and 8 916 inhabitants hence a corresponding growth rate of 6.5% and 1.5%.

In 1991, the evaluation of Yves MARGUERAT proposes a figure of 10,000 inhabitants and a growth rate of 1.2%.

In 1997, the count of the General Bureau of Statistics unveils a population of 27 000 inhabitants and a growth rate of 18%.

In 2003, the population was estimated at 30 000 inhabitants and a growth rate of 1.77%.

From 1959 to 2003 the population of Notse grew from 3 800 to 30 000 inhabitants, a ratio of about 8. This development had two distinct growth rates between 1970 and 1981 and between 1991 and 1997. The first one is due to the demographic and health policies adopted by the Togolese authorities following the independence of the country. The second one is due to the proliferation of administration units followed by the creation of new jobs especially in the tertiary sector. Furthermore it is the result of natural growth as well as the contribution of immigrants to work in cotton fields. Between both ends of the time frame the population

grew at an average rate of 4.8%. The latter is within the growth rates of urban centres (4% to 5.3%) as advanced by the Journal of Urban Sectors in Togo of February 1998.

Having in mind the last rate and based on the population of 2003, the 2005's population estimate is 32 950 inhabitants by using the geometric growth formula: $Pop_{2005} = Pop_{2003} (1+t)^x$

Where:

Pop_{2005} represents the population of 2005

Pop_{2003} the population of 2003

t represents the average annual absolute change

x represents the number of years between the two times

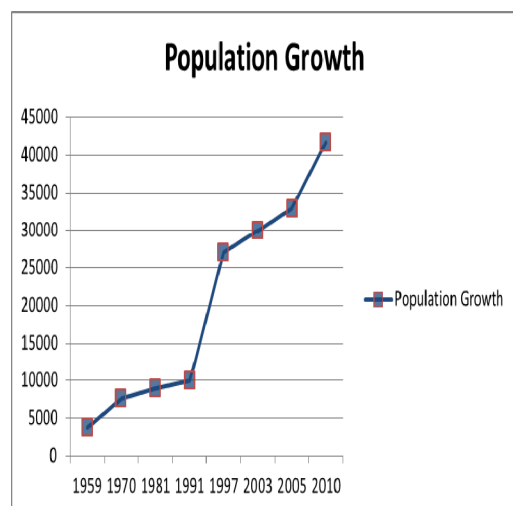
Table 03: Estimated population

Year	Population	Growth Rate
1959	3 800	6,50%
1970	7 605	
1981	8 916	1,50%
1991	10 000	1,20%
1997	27 000	18,00%
2003	30 000	1,77%
2005	32 950	4,80%

Source: General Bureau of Statistics

By using the same formula and the average annual absolute change of 4,8%, the population of 2010 should be 41 653 inhabitants.

Graph 02: Population growth



6-ENVIRONMENTAL PROBLEMS

Environmental problems related to excess farming:

The surrounding areas of Notse show noticeable signs of flora degradation. This degradation, apparent to the naked eye, is due to: firstly, intensive cotton cultivation and secondly, specific human practices such as: an uncontrolled logging of trees for coal and/or heating and an excess of bushfires in drought periods. Eventually, these practices will lead to:

- the destruction of the physical environment changing the nature of the soil and sediments, the microclimate, and soil erosion;
- the disappearance of some animal species;
- the disappearance of some plant species;
- a change in the ecosystem.

Environmental problems related to lifestyle:

Although the neighbourhood committee made efforts regarding garbage collection, it is highly regrettable that much remains to be done in the management of domestic waste. A quick stroll around Notse spotlights the disruption in garbage collection and processing. Noticeable details are: the presence of many wild dump sites; the absence of intermediate garbage collectors; and the pollution caused by filth accumulation around the built area.

Notse's pluvial water collectors system is highly insufficient in face of present needs and there is no drainage system covering domestic waste water. The few roadside gutters in place are used to dump solid waste, causing their obstruction. Very few concessions have adequate toilet facilities, the majority of the population use surrounding nature

contributing to spread various epidemic diseases. Also, due to the lack of a sewage system, more than 80% of the waste generated end up in the surrounding nature. The lack of sanitary equipment and ductwork lead to severe hygiene problems.

7-BALANCE - DIAGNOSTIC

The analysis of Notse unveils the constraints that undermine the town's development but also the trumps.

7.1- THE CONSTRAINTS

Physical and natural environment: Notse's topography is loosely similar to a basin, forming a large number of flood areas mainly during the rainy season. The weak drainage associated with the slight slopes of the terrain creates spots of water retention.

These two factors combined promote the proliferation of pathogens and act as a source of diseases. Also, the rocky structure of the soil prevents easy access to groundwater.

Urban sanitation and environment: The problem of unhealthy urban conditions in Notse has various causes:

- The lack of a proper garbage collection system generating the proliferation of wild dump sites in interstitial spaces, which are often sources of infectious diseases.
- This phenomenon is exacerbated by the lack of adequate rain and waste water drainage systems; the only rain water sewage system in place is used as a dump site and where silt accumulates.

The intensification of farming (especially cotton cultivation) and logging for charcoal around Notse deprives the city of its natural vegetation protection and has an effect on its microclimate.

The land: Most regrettably Notse lacks urban planning documents. The town has to deal with anarchic production practices and space occupancy. The situation is even more serious since many surveyors involved in urban development have insufficient qualifications translating into lack of proper technical knowledge vital for a sound exercise of their functions. The single fact of allocating flood land for building purposes, exposing the population to floods is living proof of that.

Also, administrative reserves that are kept inactive for a number of years end up being fragmented into lots and sold to privates to build houses.

Finally, litigation regarding land becoming more and more frequent is the face of the lack of regulation of land ownership (land title) and land management schemes.

Urbanized areas: The organization of the built area of Notse is in total decrepitude, particularly houses in the old town nuclei. This part of town has an irregular layout and winding, tortuous pathways. This fact does not facilitate service implementation in the area. Construction is rather anarchic. Due to the lack of control from the town hall, inhabitants build according to their means and don't comply with the legislation ruling land. The proof is the existence of many interstitial spaces, mainly in new neighbourhoods. Indeed, in more recent areas one can see an effort has been made regarding plots layout although it is a more social than administrative effort. Since people look for inexpensive plots they are forced to move away from centre town and carry out their own house plans without knowledge or approval of the authorities.

Infrastructure equipment: Apart from the 1st National Road (often source of noise due to its intense traffic), all other roads are not paved explaining their poor conditions. The increasing traffic along the 1st National Road, besides the noise pollution it causes, will ultimately lead to its degradation unless appropriate measures are taken.

The existing open gutters are used as garbage dumps especially around the central market. The streams that cross town are not subject to proper unblocking. These channels are chosen to dump garbage and an ideal site of proliferation of wild vegetation. This does not facilitate irrigation, causes floods in the rain season, promote stagnation areas that are sources of parasites and breeding grounds for larvae and insects.

Public lighting is not provided, the connection to the electricity, water and telephone networks are feebly provided.

7.2- THE ASSETS

Notse's population presently is closed to 40 000 inhabitants. The high rate of young population is a reserve and guarantee of the continuity and development of the city and its surrounding areas, if suitable structures are made available to the population in what concerns education, training and health. The melting pot of such heterogynous population is a rich and dynamic development factor.

Notse is the capital of the prefecture of Haho. This status grants the right to have decentralized state services, perform prefectural services and other institutions that could foster investment. The city is a traffic and commerce crossroad linking several directions – inland, Lome and Togo's neighbouring countries (Benin, Burkina-Faso and Ghana). This strategic location is of major importance in what concerns commercial and economic activities. Its market and inherent different fluxes justify its prefectural and regional stature. Such traffic flows may constitute a factor for business development.

The available fertile land suitable for agriculture (both for food and industrial processing), strong pillar of the local economy is decisive for its development. Also the presence of three streams and an artificial lake is a support for fishing activities and a source of irrigation and water supply. The soil is rich in clay adequate to make pottery, second flagship of the town.

8-CONCLUSION AND PROPOSITIONS

The analysis of the studied elements will result in a diagnostic assessment which sums up the assets and constraints to development. This helps establish actions for a sustainable development which we can summarize as follows: (i) Strengthening of management and planning capacity of the town, (ii) Creation and strengthening of infrastructure facilities. To do this, the municipality must adopt new space management tools to set up a database. This database will integrate addressing operations and be updated regularly through: studies using the satellite data, the use of remote sensing technology for a clearer and more precise idea of the town evolution in real time, the processing of digital data by GIS software for a better approach and data analysis.

And to timidly start the constitution of digital data, we propose the establishment of a scheme of spatial planning based on data collected in situ (Map 04). Far from being complete it could serve as a basis for the establishment of a real planning plan. This scheme has the advantage of identifying the non-constructible areas from the constructible ones, areas to restructure, areas of expansion, the commercial pole and other.

Areas to restructure: The original site of the city including the old town area is to restructure because of their irregular pattern which makes neither traffic nor access to it easier.

Area to densify: These areas are fields of agriculture which contain a few isolated buildings. This densification should take into account the areas of urban agriculture.

Areas to regulate: This concerns essentially the new neighborhoods where housing estates are being made so far underground.

Easement areas: Especially the parts along the rivers.

Farming areas: These are spaces that can be used to crop agriculture such as cotton.

Commercial pole: It covers the market and its surrounding area. This area is the busiest of the city, and on medium and long term, we expect increased business with the construction of shops and stores.

ACKNOWLEDGMENTS: By far claiming an exhaustive study, we expect with this paper to contribute to the awakening of a collective consciousness in the town of Notse, with the intention of uniting the intervening forces for a better and integrated development. We also wish to sincerely thank the local population for its warm welcome, the City Council and the Prefecture for their help and finally a special thank you to the chief surveyor of the town of Notse.

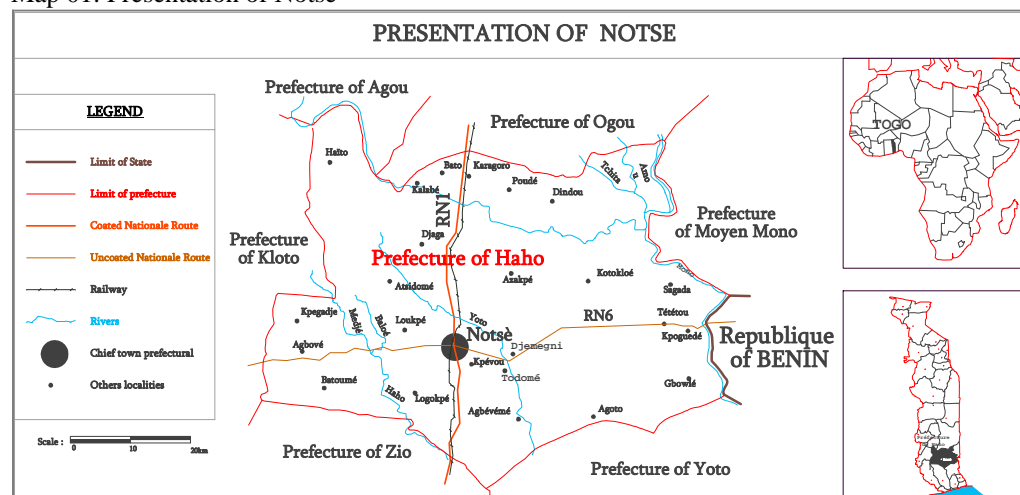
CORRESPONDING AUTHOR:

Komlan Dela Gake
Master Student in Applied Geographic Information System
China University of Geosciences, 388 LuMo road,
Wuhan, China. Zip code 430074.
Email: glanok79@hotmail.com

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Map Section

Map 01: Presentation of Notse

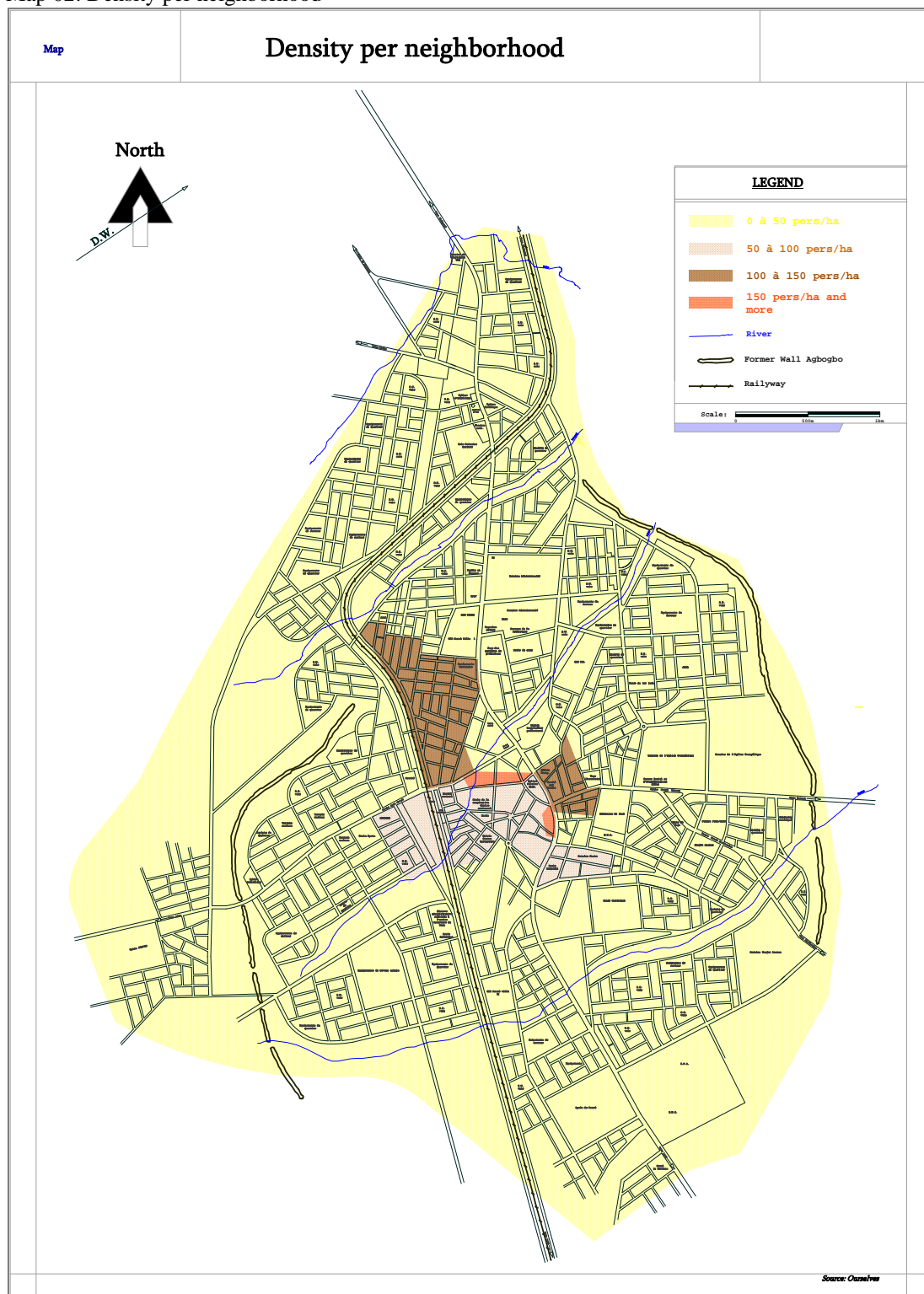


Source: Ourselves

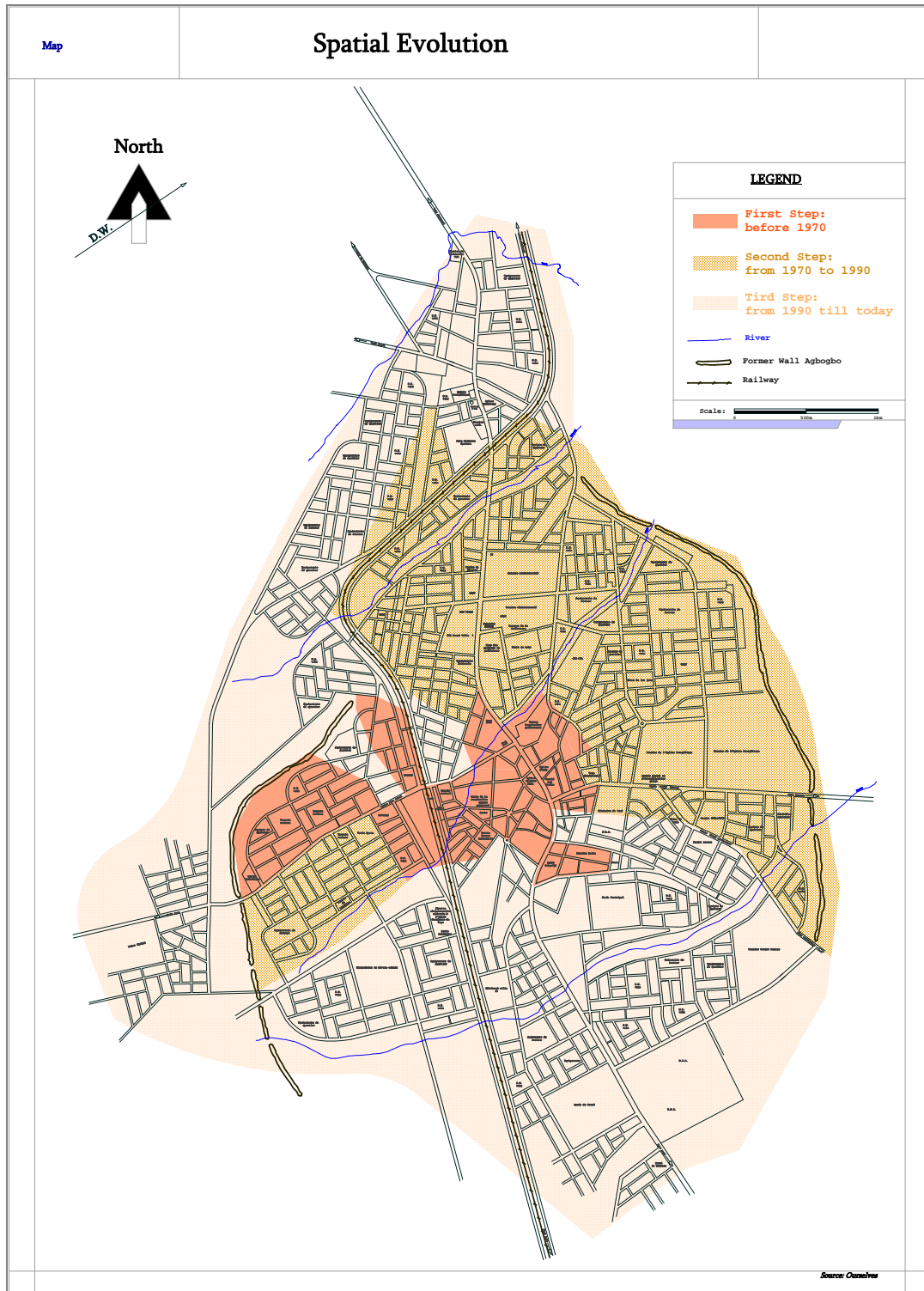
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Map 02: Density per neighborhood



Map 03: Spatial evolution



Map 04: Zoning Plan

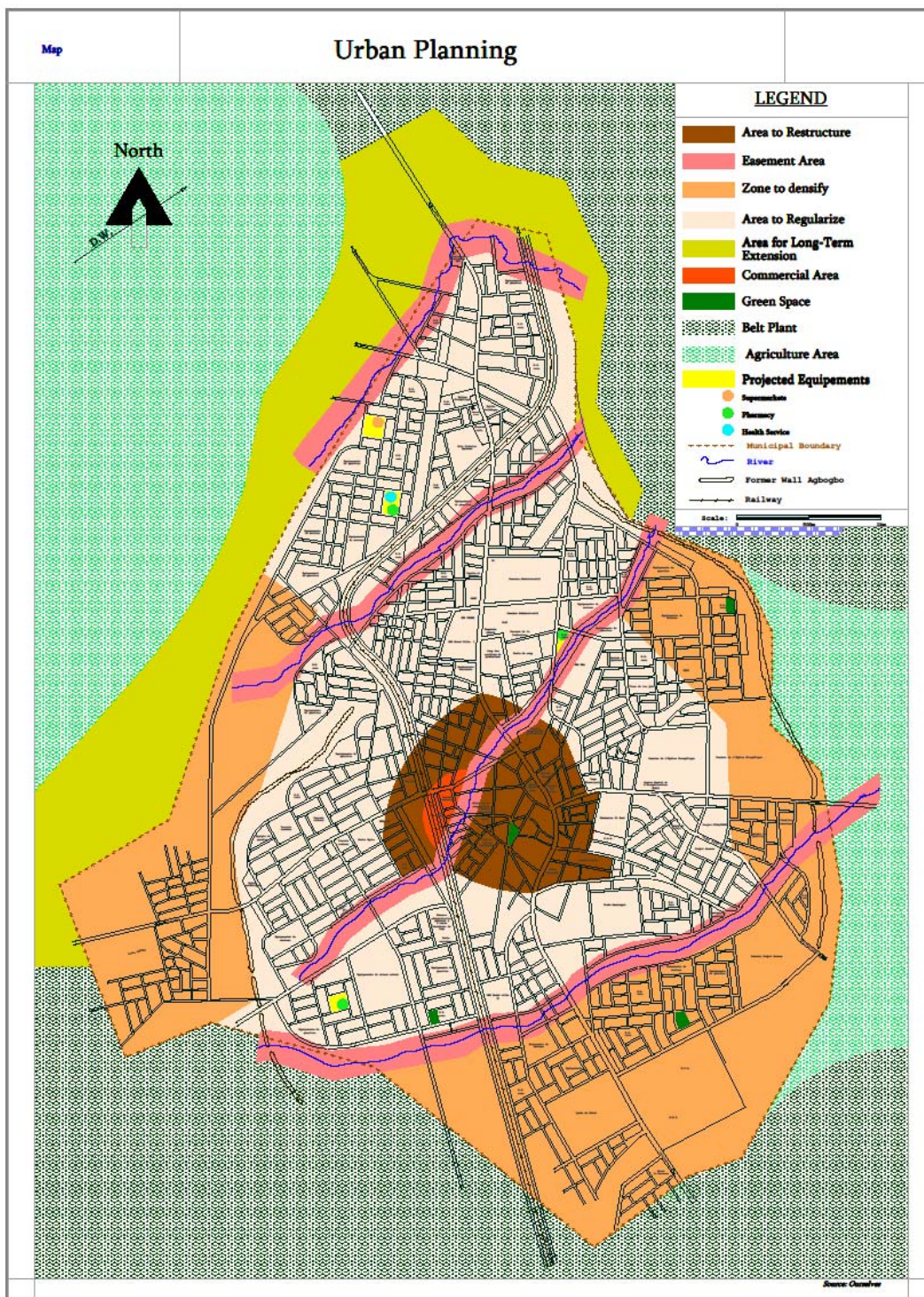


Table section

Table 01: Estimated Population in 2005 per neighborhood

Major Area	Neighbourhoods	Population Size	Areas in hectares	Density in people/ha
1	Akpovou	627	29,47	21,27
	Blakpa-Pani	627	30,48	20,57
	Dzogbé	405	40,45	10,01
	Fiagbédou	101	54,95	1,84
2	Tégbé	2430	155,21	15,65
	Tégbé-Zongo	3634	31,50	115,36
	Tégbé Lom –Nava	2615	187,88	13,92
	Tégbé Anagokondji	1822	16,68	109,23
3	Tako 1	1240	1,63	760,74
	Tako 2	1453	142,36	10,20
	Naolo	1755	148,65	11,80
	Ekli	1698	12,94	131,22
	Adimé	338	47,61	7,10
	Tchoumi Kpota	864	136,66	6,32
	Dakpodji	542	10,58	51,23
4	Wobédomé	739	3,91	189,00
	Kratchi	853	17,97	47,47
	Ahadjopémé	447	92,70	4,82
	Agbogbogodo	175	193,50	0,95
	Soékpé	895	72,25	12,39
	Alinou	3672	359,93	10,20
	Houto	588	7,93	74,15
	Kpota	1561	19,47	80,17
	Agbaladomé	1472	29,48	49,93
	Honsa	159	2,38	66,80
	Yénou	525	15,95	32,91
	Laklékpé	587	94,92	6,18
	Tokpégnigba	465	52,61	8,84
Total		32289	2010,05	

Source: General Bureau of Statistics

Using Topsis Method with Goal Programming for Best selection of Strategic Plans in BSC Model

Javad Dodangeh¹, Rosnah Bt Mohd Yusuff¹, Javad Jassbi²

¹. Department of Mechanical and Manufacturing Engineering, University Putra Malaysia, Malaysia

². Department of Industrial Management, Islamic Azad University, Science & Research Branch, Tehran, Iran
jdodangeh@yahoo.com

Abstract: Strategic planning is expressly significant for organization's success and competitive advantage making in an increasingly competitive business environment. Implementation of applicable strategies plays an important role for organizations' success. Balanced scorecard is a suitable tool for designing operative strategies. However, one of the balanced scorecard difficulties is the selection in strategic plans' performance. In this issue paper, was demonstrated a model for selection and ranking of strategic plans in Balanced Scorecard using Topsis method and Goal Programming model. So first using the view and consensus of organization's managers and experts' opinions, measures of four perspectives and objectives are settled in BSC. And then using experts' opinions and taking the relative importance of decision makers' opinions into consideration, by using Goal Programming model and Topsis method, the implementations of strategic plans are selected in BSC model. The results are revealed that the introduced methods are more reliable and acceptable and the experts were verified the model for selecting of strategic plans in BSC in operation. The initiated methods were used in a study and derived results from it were analyzed from various points of view. In this article Initiative is called strategic plans. [Journal of American Science 2010;6(3):136-142]. (ISSN: 1545-1003).

Keywords: Balanced scorecard model, MADM, MODM, Goal Programming, Topsis

1. Introduction

Organizations have always found it difficult to balance pressing operational concerns with long-term strategic priorities. The tension is crucial: World-class processes won't prompt to success without the right strategic direction, and the best strategy in the world will get nowhere without strong operations to execute it [1]. Considering the importance of strategic planning in organizations and producing the competitive advantage in them and actually, now a day the organization is moving in a competitive, and complex environment and there is a transaction among them. The senior managers and all those looking for comprehensive picture of present situation of the company and a clear understanding of present situation of the company and a clear understanding of its future image needs some information more than just Standards in financial operation to assess the strategic operation and long-term view of the company and also to achieve operational strategies.

Miscellaneous types of tools are offered for this process, Balanced Scorecard is a proper tool for evaluating and designing of operational strategies. This tool was introduced by Kaplan and Norton in 1992, for the first time [2-6]. BSC is a conceptual frame work and its function is to translate strategic objectives of a company into a set of operational attributes. These indices are usually selected from four financial, customer, internal processes and

learning and development perspectives [3, 7]. Many attributes were used for the advancement of the company in the direction of its perspective. Some other attributes are used for evaluation of company development in accessing to long-term objectives. Furthermore, BSC helps the managers to identify the lagging and leading attributes in their company. The framework of balances evaluation model is shown in the figure 1[3].

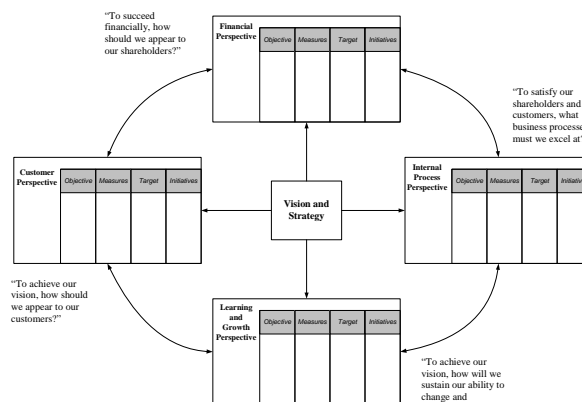


Figure1. Balanced Scorecard Model (Source: Kaplan & Norton 1992)

People mostly use one of two following methods for making decision:

Trial & Error method

Modeling method

In the trial & error method decision maker face the reality, so he/she selects one of the alternatives and witness the results. If decision errors are great and cause some problems, he/she changes the decision and selects other alternatives. In modeling method, decision maker models the real problem and specifies elements and their effect on each other and gets through model analysis and prediction of a real problem[8].

Multi-criteria decision making (MCDM) addresses to making decision in the aspect of multiple and conflicting criteria. In fact, there are two types of criteria: objectives and attributes. Accordingly, the MCDM problems can be broadly aligned into two categories:

- Multi-objective decision making (MODM)

- Multi-attribute decision making (MADM)

The main difference between MODM and MADM is that the former concentrates on continuous decision spaces, primarily on mathematical programming with several objective functions, the latter focuses on problems with discrete decision spaces.

2. Material and Methods

Multiple attribute decision making

Hwang & Yoon describe multiple decisions making as follows: multiple decision making is applied to preferable decisions (such as assessment, making priority and choice) between available classified alternatives by multiple attribute (and usually opposite)[9].

Deciding group face the common factors especially in MADM:

- 1- Alternatives
- 2- Multiple attributes
- 3- Dimensionless units
- 4- Attributes weight
- 5- Attributes quality
- 6- Relative importance of decision makers' opinions.

MADM methods are classified as to following groups:

- 1) *Compensatory methods*: If a production has high expenditure but good quality, in this case high expenditure is compensated by high quality [9]. These models are: ELECTRE, MDS, MRS, TOPSIS, SAW, LINEAR ASSIGNMENT and etc.
- 2) *Non compensatory methods*: When the attributes are separated e.g. for taking driving license tree non compensative important factors are brought up. These are: normal eye test, driving rule test and

practical driving examination, which one's strength in one of the tests doesn't compensate the others. These models are: DOMINANCE, LEXICOGRAPH, ELIMINATION, PERMUTATION and etc[10].

Multi-Objective Decision Making

Multi-objective decision making is recognized as the continuous kind of the MCDM. The main features of MODM problems are that decision makers need to obtain multiple objectives while these multiple objectives are non-commensurable and conflict with each other.

An MODM model considers a vector of decision variables, objective functions, and constraints. Decision makers attempt to maximize (or minimize) the objective functions. Since this problem has rarely a unique solution, decision makers are expected to choose a solution from among the set of efficient solutions (as alternatives), which will be explained later on in this section. Generally, the MODM problem can be formulated as follows:

$$\begin{aligned} \text{Max : } & f(x) \\ \text{s.t : } & x \in X = [x \in R^n | g(x) \leq b, x \geq 0] \end{aligned}$$

Where $f(x)$ represents n conflicting with objective functions, $g(x) \leq b$ represents is an n -vector of decision variables, $x \in R^n$.

Goal Programming

Goal programming was initially nominated by Charnes and Cooper (1961) and has been further advanced by Lee (1972), Ignizio (1976 and 1983), and Charnes and Cooper (1977). The method requests' decision makers to determine goals for each objective that they want to achieve. A preferred solution is then defined as the one that minimizes the deviations from the goals[11].

Experts Group and Strategic Plans Weights

Every MODM and MADM problem has some objective and attributes that should be recognized in problem by a decision maker in due courses. All MCDM methods need information that should be acquired based on relative importance of the objective. Objective weights can be assigned to objective directly by decision maker group or by scientific methods. These weights specify relative importance of every objective and attribute.

Usually groups are grouped based on their different levels in social status, knowledge and work experience. So every factor in special subject that cause increase or decrease of idea weight should be considered. In this regard assigning different weight

to person's opinions regarding to their knowledge and experience in relation with that subject seems necessary. We use hierarchical objectives for determination of strategic plans weights that you can see in the figure below [12].

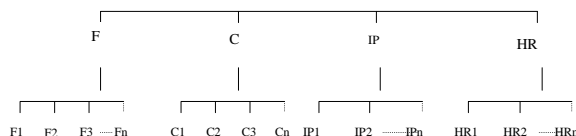


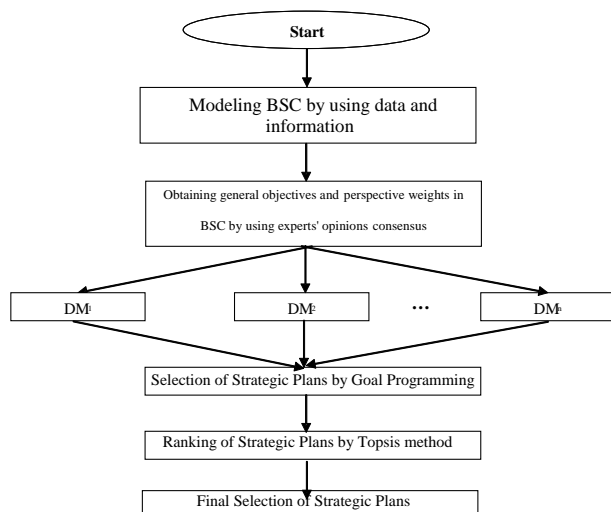
Figure4.1- set of hierarchical objectives

For this process, we have to determine the weights of perspectives and sub perspectives using of expert opinions. The final weights of sub perspectives (Financial, Customer, Internal Processes and Learning & Growth) were determined by using the geometric average method. The method for calculation is shown in below.

$$TW_{Cij} = \sqrt{W_{Ci} \cdot W_{Cij}} \quad (1)$$

TW_{Cij} : Final weights of objective
 W_{Ci} : Weights of perspective
 W_{Cij} : Weights of objective
 TW_{Cij} : Final weights of objective are equal the strategic plan weights [12].

Best Selection Algorithm of Strategic Plans in Bsc
 The algorithm is shown in following figure.



In this method, decision makers (DM) set goals for each objective that they wish to gain. And they determine the constraints for model. Zero-one Goal programming to choose strategic plans is established. And then by using Topsis method strategic plans are ranked.

Step 1: first we collect data and information containing general objectives, measures, quantitative targets and strategic plans in four perspectives and form the framework of BSC model.

Step 2: calculating the measures of aspect and general objectives is BSC using group decision making.

First, we choose the members of the decision making group (the experts) who has been significant in formation about the strategic problems and Initiatives. And then we calculate the measure of the experts' viewpoint about the four perspectives of BSC. After that we calculate the measures of perspectives from the experts view point. In the some way, we can calculate the measure of the general objectives in four perspectives of BSC.

Step 3: we should calculate the final measure of the general objective using the geometrical average.

Step 4: strategic plans are selected by MODM models (Goal programming).

In this article, we are used the zero-one Goal programming to selection of strategic plans. The model of zero-one Goal programming is like the formula below.

$$\begin{aligned}
 &\text{Max } G_1 : W_1 I_1 + W^2 I^2 + \dots W_n I_n \\
 &\text{Min } G_2 : C_1 I_1 + C^2 I^2 + \dots C_n I_n \\
 &\text{S. t: } g_i(x) \begin{cases} \leq \\ \geq \\ = \end{cases} ; I = 1, 2, \dots, m \quad (2)
 \end{aligned}$$

$$x_i \in \{0,1\}, J = 1, \dots, n$$

First objective (G1): the first objective (G1) is to maximize the importance of the strategic plan. Here, W is the measure or the importance of the strategic plan. The importance of the strategic plan was obtained using consensus of experts by group decision making.

The second objective (G2): Minimize the cost of strategic plan implementation.

The limitations: There are cost and logical limitations.

"W" is the sign for the importance of the strategic plan.

"I" is the sign for the strategic plan.

"C" is the sign for cost of strategic plan implementation.

Step 5: strategic plans are ranked by MADM models (Topsis).

This method was demonstrated in 1981 by Hwang and Yoon. In this method m alternative is computed by n attribute, and we can consider every problem as a geometrical system consisting of m point in n dimensional space.

This technique is founded based on the concept that selected alternative should have the least distance with a positive idea solution (the best possible state) and the most distance with a negative idea solution (the worst possible state)[9].

5.1. Transform decision matrix into the dimensionless matrix with using of relation:

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_{j=1}^m a_{ij}^2}} \quad (3)$$

5.2. Construct the Weighted Normalized Decision Matrix:

$$V = N_D \cdot W_{n \times n} = \begin{vmatrix} V_{11}, \dots & V_{1j}, \dots & V_{1n} \\ \vdots & \vdots & \vdots \\ V_{m1}, \dots & V_{mj}, \dots & V_{mn} \end{vmatrix} \quad (4)$$

5.3. Determine the Ideal and Negative-Ideal solutions:

$$A^+ = \left\{ \max_i v_{ij} \mid j \in j_1, \left(\min_i v_{ij} \mid j \in j_2 \right) \mid i = 1, 2, \dots, n \right. \\ \left. A^- = \left\{ \min_i v_{ij} \mid j \in j_1, \left(\max_i v_{ij} \mid j \in j_2 \right) \mid i = 1, 2, \dots, m \right. \right. \quad (5)$$

5.4. Calculate the Separation Measure:

$$d_{i^+} = \left\{ \sum_{j=1}^n (v_{ij} - v_j^+)^2 \right\}^{1/2}, \quad i = 1, 2, \dots, m \quad (6) \\ d_{i^-} = \left\{ \sum_{j=1}^n (v_{ij} - v_j^-)^2 \right\}^{1/2}, \quad i = 1, 2, \dots, m$$

5.5. Calculate the Relative Closeness for the Ideal Solution:

$$cl_{i^+} = \frac{d_{i^-}}{(d_{i^+} + d_{i^-})}, \quad 0 \leq cl_{i^+} \leq 1, \quad i = 1, 2, \dots, m \quad (7)$$

3.6. Rank the Preference Order:

The best (optimal) alternative can be decided according to the preference rank order of cl_{i^+} [12].

3. Results

A case study was conducted in electronic and computer research center of the university which is active in the field of producing industrial high capacity monitoring systems. Four experts consist of director manager, commercial manager, financial manager and production manager were selected and their opinions of four BSC's perspectives and four strategic objectives were taken for each perspective and the result were as follows:

Table1. Balance Scorecard model for electronic and computer research center of the university

Financial			
Objectives	Measures	Target	Initiatives
Income increasing	0.797	0.817	I1-Marketing Research
Profit increasing	0.133	0.153	I2- Marketing
Maximize of Investment Utilization	0.004	0.004	I3- Inventory Control
Cost decreasing	0.066	0.026	I4- ABC
Customer			
Increasing of customer satisfaction	0.27	0.236	I5-After sales Services
Increasing of Market share	0.027	0.024	I6- Marketing Research
Customer Supporting	0.541	0.505	I7-CRM
Increasing of added value for customers	0.162	0.236	I8-Value Engineering
Internal Processes			
Objectives	Measures	Target	Initiatives
On time delivery	0.07	0.06	I9- Time & Motion Study
Product development	0.873	0.886	I10- QFD
Products Quality	0.004	0.001	I11- ISO 9000
Continues improvement	0.052	0.054	I12- TQM
Learning & Growth			
Increasing of employees satisfaction	0.209	0.244	I13- increasing of personnel's' salary
Increasing of employees productivity	0.049	0.031	I14- personnel's' evaluation system
Personnel's Motivation	0.697	0.698	I15- Reward System
Increasing of informational skills	0.045	0.028	I16- MIS

Step 1: by using expert's opinion the framework from BSC model is formed to liken table 1.

Step 2: by using the consensus of expert's opinion, obtain the importance of BSC's perspectives and objectives, which are related to each perspective. Then by using the following geometrical average of the final weight, calculate (financial, customer, internal process and human resources) perspectives:

Table2. Final weight of objectives

Final weight of financial perspective objectives		Final weight of customer perspective objectives		Final weight of internal processes perspective objectives		Final weight of human resources perspective objectives	
O1	0.262750209	O4	0.26553440	O7	0.25466189	O10	0.242216096
O2	0.265570823	O5	0.264367619	O8	0.24651501	O11	0.241994263
O3	0.247798418	O6	0.260530249	O9	0.244923131	O12	0.23384371

Finally, we solve the problem through using the model of zero-one goal programming. The model of Goal programming (The form of problem) is as follows:

Max G1: 0.262750209 I1 +0.265570823 I2+0.256572961 I3+0.247798418 I4+0.26553440 I5+0.264367619 I6+0.258108369 I7+0.260530249 I8+0.254661897 I9+0.24651501 I10+0.24772033 I11+0.244923131 I12+0.242216096 I13+0.241994263 I14+0.237078527 I15+0.23384371 I16

Min G2: 5 I1+7 I2+3 I3+2 I4+4 I5+5 I6+2 I7+3 I8+4 I9+3 I10+3 I11+10 I12+20 I13+4 I14+3 I15+6 I16

S.T:

5 I1+7 I2+3 I3+2 I4+4 I5+5 I6+2 I7+3 I8+4 I9+3 I10+3 I11+10 I12+20 I13+4 I14+3 I15+6 I16<=50
I1+I6=1

$x_i \in \{0,1\}$, $J = 1, \dots, n$

Final weight of four attributes (1- importance, 2- Gap, 3- cost, 4- time) was calculated for priority of strategic plans performance.

1- Importance attribute: importance attribute is the degree of the weight or importance which each strategic plan has for the organization and this importance (weight) are defined by experts' and managers' opinions.

2- Gap attribute: the conception of the gap is in this manner that whatever the gap of the present situation be more than the desirable situation in the organization, its importance is more for the organization, and you should perform that strategic plan as soon as possible; in fact, gap is the distance between measure and target in BSC model.

3- Cost attribute: each organization has some budgetary limits and financial sources, so performance cost of each strategic plan should be defined.

4- Time attribute: performance time of each strategic plan is different from the others and shortness of strategic plan performance time causes the organization to obtain its target faster and vice versa [12].

Regarding to Topsis method and by using of experts opinion, the decision matrix is constructed:

Table3. Decision matrix based on Topsis method

	<i>Importance</i>	<i>Gap</i>	<i>Cost</i>	<i>Time</i>
I1	0.262750209	40	-5	-24
I2	0.265570823	10	-7	-14
I3	0.256572961	15	-3	-12
I4	0.247798418	5	-2	-16
I5	0.265534401	2	-4	-12
I6	0.264367619	20	-5	-24
I7	0.258108369	5	-2	-10
I8	0.260530249	4	-3	-14
I9	0.254661897	15	-4	-18
I10	0.24651501	4	-3	-10
I11	0.24772033	4	-3	-12
I12	0.244923131	25	-10	-24
I13	0.242216096	4	-20	-12
I14	0.241994263	20	-4	-16
I15	0.237078527	10	-3	-10
I16	0.23384371	15	-6	-24

And then the decision matrix regarding to the relation (2) is normalized.

Table4. Normalized decision matrix

	<i>Importance</i>	<i>Gap</i>	<i>Cost</i>	<i>Time</i>
I1	0.065396216	0.202020202	0.05952381	0.095238095
I2	0.065895426	0.050505051	0.083333333	0.055555556
I3	0.063662809	0.075757576	0.03571429	0.047619048
I4	0.061485603	0.025252525	0.02380952	0.063492063
I5	0.065886388	0.01010101	0.04761905	0.047619048
I6	0.065396216	0.101010101	0.05952381	0.095238095
I7	0.064043786	0.025252525	0.02380952	0.03968254
I8	0.064644721	0.02020202	0.03571429	0.055555556
I9	0.063188621	0.075757576	0.04761905	0.071428571
I10	0.061167154	0.02020202	0.03571429	0.03968254
I11	0.061466227	0.02020202	0.03571429	0.047619048
I12	0.060772165	0.126262626	0.11904762	0.095238095
I13	0.060100476	0.02020202	0.23809524	0.047619048
I14	0.060045433	0.101010101	0.04761905	0.063492063
I15	0.058825703	0.050505051	0.03571429	0.03968254
I16	0.058023056	0.075757576	0.07142857	0.095238095

Therefore, the attributes weights regarding to Entropy method is determined:

Table5. Attributes weights

	<u>Importance</u>	<u>Gap</u>	<u>Cost</u>	<u>Time</u>
wj	0.001389561	0.497898424	0.40950427	0.091207742

And afterwards the Relative Closeness for the Ideal Solution is calculated:

Table6. Relative Closeness for the Ideal Solution

c1	c2	c3	c4	c5	c6	c7	c8
0.883923	0.654922	0.584136	0.498085	0.446556	0.618544	0.498614	0.476164
c9	c10	c11	c12	c13	c14	c15	c16
0.568673	0.476552	0.476356	0.58096	0.054881	0.636157	0.528703	0.532151

Finally the performance of strategic plans by the Goal programming model is selected and with using Topsis method is ranked. The results are shown as follows:

Table7. Final ranks & selection of strategic plans

	Strategic plans	Selection	Ranking
I1	Marketing researches	Reject (0)	1
I2	Marketing	Accept(1)	2
I3	Inventory Management	Accept(1)	5
I4	ABC	Accept(1)	11
I5	After sales Services	Accept(1)	15
I6	Marketing researches	Reject (0)	4
I7	CRM	Accept(1)	10
I8	Value engineering	Accept(1)	14
I9	Time & Motion Study	Accept(1)	7
I10	QFD	Accept(1)	12
I11	ISO 9000	Accept(1)	13
I12	TQM	Reject (0)	6
I13	Increasing of personnel's salary	Reject (0)	16
I14	Personnel's evaluation system	Accept(1)	3
I15	Reward System	Accept(1)	9
I16	MIS	Accept(1)	8

4. Discussions

In view of the above remarks, Balanced Scorecard is a most important tool for evaluating and designing of operational strategies. One of the BSC problems in performance to choose the strategic plans (Initiatives) by considering the limitations of budget and time to achieve the Strategic objectives. Since there is no proper method of selecting the strategic plan in the performance of BSC, the model presented solves this problem by using zero-one goal programming and TOPSIS method. Whereas BSC is a conceptual model, using mathematical models and multi-criteria decision making models (MCDM) can present better results for selecting strategic plans. As the relative importance of decision maker's opinions (people who evaluate) is not considered, the presented model solves this problem by considering the relative importance of decision maker's opinions. Indeed the experts were ranked and selected strategic plans performance after comparison of the goal programming and TOPSIS method result. The produced result is more reliable and accepted. (Tables and calculations have been presented in detail in [12].

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Corresponding Author:

Department of Mechanical and Manufacturing Engineering
University Putra Malaysia
Serdang, Selangor D.E.
Malaysia
E-mail: jdodangeh@yahoo.com

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Biodegradation of Produced Water Hydrocarbons by *Aspergillus fumigatus*

Chuma C. Okoro¹, Olukayode O Amund²

¹ Department of Biological Sciences and Biotechnology, Caleb University, Lagos

² Department of Botany and Microbiology, University of Lagos, Nigeria

Tel: 08033072754, 01-7430285

e-mail: chuma2k2001@yahoo.com

P. O. Box 146, University of Lagos Post Office, Lagos, Nigeria

Abstract: Biodegradation studies of hydrocarbons in untreated produce water from an oil production facility in Nigeria were undertaken over a period of time using pure cultures of *Aspergillus fumigatus* isolated from the zone of produce water discharge into the receiving sea water. The rate of reduction in some petroleum hydrocarbon fractions such as n-Alkanes, Aromatics, Nitrogen Sulfur and Oxygen (NSO) containing compounds and Polycyclic aromatic hydrocarbons (PAHs) were monitored by means of Gas chromatography and Mass spectrometry using mechanically treated produced water as a reference. Gas chromatographic analysis showed that untreated produced water used in the study had an oil and grease content of 1407mg/l, this includes n-alkanes(608mg/l), Aromatics (13.88mg/l), NSO compounds (12.68mg/l) PAHs(0.833mg/l) and some unidentified greasy components. Upon mechanical treatment, the oil and grease component of produced water was reduced to 44mg/l comprising of n-alkanes (38.40mg/l), Aromatics (2.65mg/l), NSO compounds(1.78mg/l), PAHs (0.0655mg/l) and some unidentified greasy component. A pure culture of *Aspergillus fumigatus* after 120 days of exposure to untreated produce water was able to reduce the hydrocarbons to the following components. n-Alkanes (78.5mg/l), Aromatics(1.58mg/l), NSO compounds (1.22mg/l) and PAHs (0.0168 mg/l). This result indicate that produce water from Chevron's Escravos tank farm is readily biodegradable and the *Aspergillus fumigatus* culture used in the study was very effective in degrading the PAHs and NSO components of the hydrocarbon when compared with the conventional mechanical treatment process even though the biodegradation process was very slow. [Journal of American Science 2010;6(3):143-149]. (ISSN: 1545-1003).

Keywords: Pure culture, Produce water, Biodegradation, Oil and Grease.

1. Introduction:

Produced water is defined as the water (brine) brought up from the hydrocarbon bearing strata during the extraction of oil and or gas, this includes formation water, injection water, small volumes of condensed water and trace elements of treatment chemicals (Ayers and Parker,2003). Produced water is the highest volume waste generated in association with oil and gas production operations and is therefore one of the single greatest environmental impediment to natural gas and oil exploration.

Measurable impacts of produced water discharges have been observed in shallow and confined waters where the discharge plume contacts the sea floor, impacts that have been identified include elevated concentrations of petroleum hydrocarbons in the sediment and a possible decrease in diversity of benthic fauna near the discharge point (Ayers and Parker, 2003) but these impacts are rarely observed in open ocean environments where in most cases, the plume either does not contact the seafloor or is well diluted by the time it does.

Marine organisms are capable of bio-accumulating petroleum hydrocarbons, metals and radio nuclides in produce water (Ayers and Parker,

2003). Produced water is also known to be toxic to fishes and other marine animals (Middledich, 1984). A major cause for concern in recent times has been the presence of polycyclic aromatic hydrocarbons (PAHs), such as anthracene, phenanthrene, benzo(a) pyrene and benzo(a)anthracene, in produce water. Some of these compounds are recalcitrant and potential carcinogens, and they have the capability to bioaccumulate in food chains since they are not easily biodegradable (Neff,1985). This is a problem, because the produce water treatment systems currently in use by most oil production companies is primarily designed to remove particulate or dissolved oil and therefore has little effect on the concentrations of dissolved petroleum hydrocarbons and other organics in produce water (Lysyj, 1982).

Produced water is usually treated mechanically to remove as much as possible the oil present but the conventional mechanical treatment process have been unable to remove significantly the aromatic components of the hydrocarbon because they are partially soluble in water. This development has led to the search for an alternative biological treatment process that can complement the conventional mechanical treatment process.

Fungal cultures have been known to be very effective in the degradation of aromatic hydrocarbons. Andrea et al (2001) have successfully used mixed fungal cultures to degrade various fractions of PAHs and over 65% degradation rate was achieved with Phenanthrene and Naphtnalene. The degradation of hydrocarbons by yeasts and filamentous fungi has been investigated previously and it was concluded that most fungal species are excellent hydrocarbon degraders (Sutherland, 2004; Gadd, 2001). However, these studies did not investigate the degradation of produce water hydrocarbons by fungal isolates.

An investigation carried out on the biodegradation of produce water hydrocarbons by Okoro and Amund (2002) showed that produce water hydrocarbons are readily biodegradable by the indigenous microbial flora. Since fungal species form part of the produce water microflora, an attempt was made by Okoro (2008) to establish the role of individual fungal isolates in the degradation of produced water hydrocarbons.

Pure cultures of *Aspergillus niger* and *Penicillium* specie isolated from produce water showed extensive degradation of PAHs in produce water (Okoro, 2008). *Aspergillus fumigatus*, one of the commonest and the most abundant fungal specie found in Escravos river where produced water is continuously been discharged (Okoro, 1999), was used to degrade petroleum hydrocarbons in produce water in the present study. An attempt was also made in this study to use this ubiquitous fungal specie to degrade various fractions of petroleum hydrocarbons especially the recalcitrant PAHs in produce water. It is expected that a significant degradation of PAH in produce water by the indigenous fungal species will help to reduce the problem of bioaccumulation of these organic compounds in the marine animals, and also the resultant risks of potential health hazards associated with the consumption of the contaminated sea foods.

2. Materials and Methods

Sample Collection

Untreated produce water samples were collected with sterile 1000 L Wheaton glass bottles at a point before the final process stream of the Wemco treatment plant at Chevron's Escravos tank farm while the treated produce water samples were collected at a point after the final process stream where it is being discharged to the receiving water.

Enumeration of hydrocarbon utilizing Fungi

Hydrocarbon utilizing fungi in produce water were obtained by plating out at low dilutions 10^{-1} – 10^{-2} of samples on mineral salt medium of Mills *et al*

(1978). The composition of the medium is as follows in (g/L): NaCl (10), $MgSO_4 \cdot 7H_2O$ (0.42), KCl (0.29), KH_2PO_4 (0.83), Na_2HPO_4 (1.25), $NaNO_3$ (0.42), Agar bacteriological (15), distilled water (1000mls), and pH (7.2). The medium was autoclaved at 1.1 kg/cm^2 for 15 mins. The inoculated mineral agar plates were then inverted over sterile membrane filters moistened with crude oil (Escravos light) and held in the lid of the petridishes. The dishes were wrapped round with a masking tape so as to increase the vapour pressure within the petridishes while the plates were incubated at 29°C for 7 days. After incubation period, the fungal cultures were stained with methylene blue and observed under a high power resolution microscope ($\times 40$). The fungal culture was identified based on its morphological characteristics.

Analytical methods:

Separation of Aliphatic and Aromatic components of hydrocarbons in produced water using High Performance Liquid Chromatography (HPLC).

A measured quantity of the oil sample (10ml) was introduced into the bond elute filter to separate the hydrocarbons from the Nitrogen, Sulfur and Oxygen (NSO) containing components of the petroleum mixture. The filtrate (2 ml) containing both the aliphatic and the aromatic components of the petroleum mixture was injected into the HPLC (WATERS 486). The aliphatic component eluted after 18mins while the aromatic component after 45mins. Each fraction (0.2 μL) was subsequently analyzed by means of Gas chromatography attached to a mass selective detector.

Analysis of Total hydrocarbons, n-Alkanes and Polyaromatic hydrocarbons.

The method used in the analysis was described by Neff *et al*, (1989). The hydrocarbon extract was concentrated in a Kuderna-Danish flask on a 70°C water bath to approximately 1.0 ml. The concentrated extract was transferred to a 1-dram vial with a disposable pipette and the flask rinsed twice with 1 ml methylene chloride. The rinses were added to the vial and the volume of the extract was reduced to about 1ml with a gentle stream of purified nitrogen gas.

Total n-alkanes and aromatic concentrations were determined by GC-MS analysis of the F1 and F2 fractions respectively. Both resolved and unresolved hydrocarbons were quantified. The resolved concentrations were determined by summing the total resolved area with valley integration and then using an average n-alkane or PAH response factors to calculate an amount relative to the internal standard. The unresolved

concentrations were calculated by integrating the total area of the chromatogram (both resolved and unresolved complex mixture (ucm area), subtracting the resolved area and determining the amount relative to the internal standard.

Gas Chromatography of Oils

Fresh and degraded oil were analyzed by Gas chromatography using Hewlett Packard 5890 series 11 Gas chromatograph equipped with single flame ionization detector (FID) fitted with Perkin Elmer Nelson analog digital converter (900 series) and a Compaq deskpro computer. A J and W scientific DB-1 capillary column of 15 m length and an internal diameter of 0.32 mm wide bore of 1micron film thickness was used. A temperature program of 50-305°C increasing at 3.5°C per minute for 27.15min was employed. Hydrogen with a flow rate of 2ml per min was used as a carrier gas while the flow rate of air was 400ml per min. The detector temperature was 325°C while the injection port temperature was 305°C. The oil extracts of culture supernatants were dissolved in methylene chloride while a sample volume of 0.2µl was injected. The nC17/Pristane and nC18/Phytane ratios were subsequently calculated from the height of various chromatograms.

Biodegradation and Growth studies

Growth and degradation studies over a time course were carried out using untreated produce water from Escravos tank farm as the sole carbon and energy source. The untreated produce water used for the study had an initial oil and grease content of 1407 mg/l. Starter cultures were originally prepared using the minimal salts formulations of Mills *et al*, 1988 and the produce water as the sole carbon and energy source. 10 ml each of the pure fungal culture (*Aspergillus fumigatus*) was introduced into 500mL of produce water in a 1000 mL capacity wheaton glass bottle. The bottle was covered with a non-absorbent cotton wool and placed in a slanted position to allow air passage through the pores of the cotton wool. The bottles were shaken manually at regular intervals to

allow adequate mixing and homogeneity of the contents. The experimental setup was monitored for a period of 120 days and at a 30 day interval, cultural samples were collected and analysed for microbial load while the residual hydrocarbon was extracted with methylene chloride and analysed by Gas chromatography.

3. Results

The Untreated and Mechanically Treated Produce Water

The untreated produce water used for the experiment had an oil and grease content of 1407mg/l comprising of n-Alkanes (608 mg/l), aromatics (13.88mg/l), NSO compounds (12.68 mg/l) and PAHs (0.833mg/l) and an initial nC17/Pristane and nC18/Phytane ratios of 1.41 and 2.93 respectively while the mechanically treated produced water used as a reference had an initial oil and grease content of 44mg/l comprising of n-alkanes (38.4), aromatics (2.65), NSO compounds (1.78) and PAHs (0.0655) and an initial nC17/Pristane and nC18/Phytane ratios of 1.24 and 3.0 respectively. The GC chromatograms of both the untreated and the mechanically treated produced water are shown in Figs. 1 and 2 respectively.

Biodegradation of Produce water hydrocarbon with *Aspergillus fumigatus*

GC chromatogram of untreated produce water after a 120 day treatment with *Aspergillus fumigatus* is shown in Fig. 3, the corresponding nC17/Pristane and nC18/Phytane ratios are shown in Fig. 4. On the degradation of individual petroleum hydrocarbon components, it was observed that significant concentrations of aromatic components of the petroleum hydrocarbons were removed by the fungal cultures after 120 days of exposure. The residual concentrations of the hydrocarbon fractions are stated as follows; n-Alkanes (78.50mg/l), Total aromatics (1.58mg/l), NSO compounds (1.22mg/l) and PAH(0.0168mg/l).

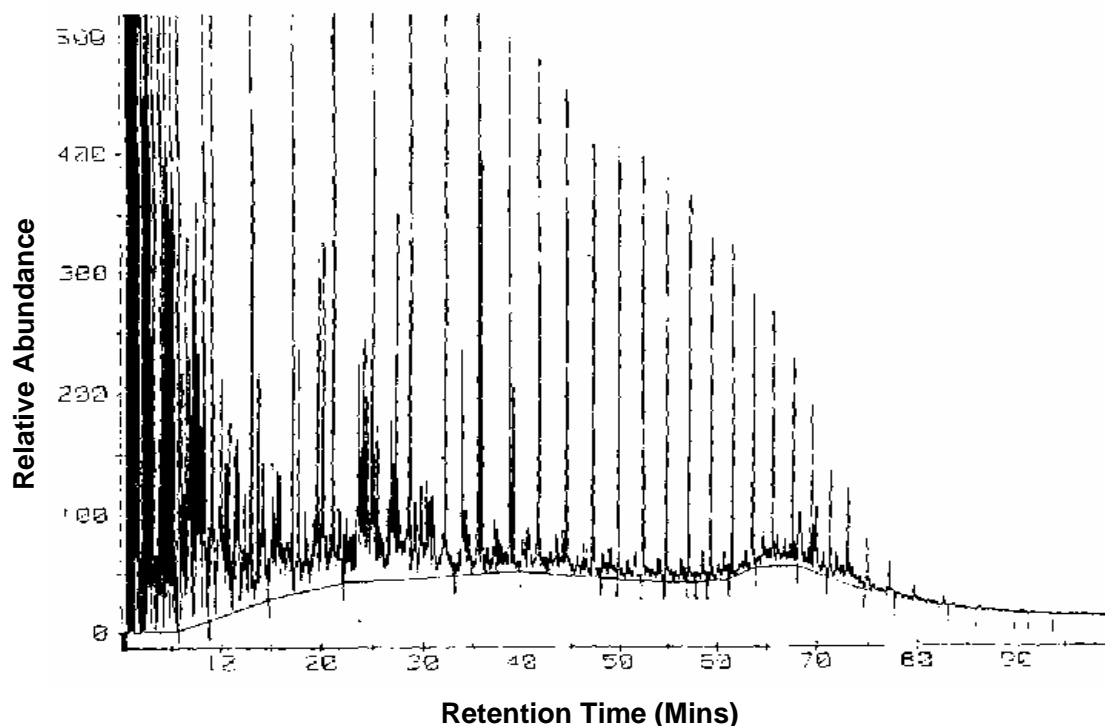


Figure 1: GC Chromatogram of untreated produced water from Escravos tank farm (nC17/pr. Ratio = 1.41, nC18/ph. Ratio = 2.93)

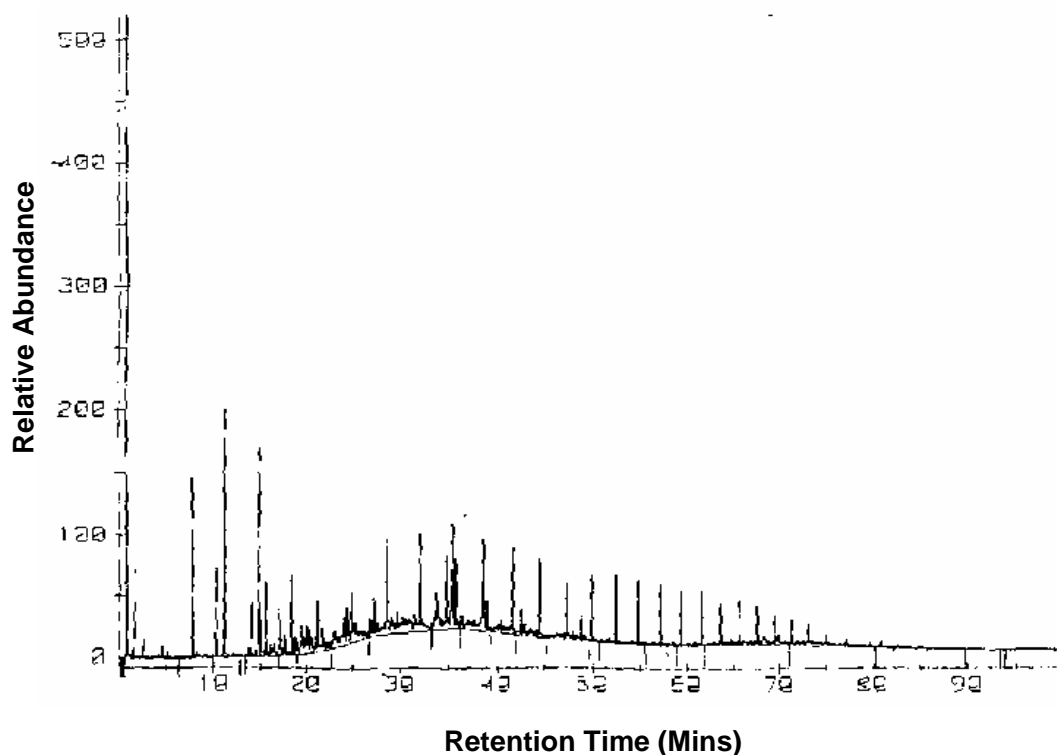


Figure 2: GC Chromatogram of mechanically treated produced water from Escravos tank farm (nC17/pr. Ratio = 1.24, nC18/ph. Ratio = 3.00)

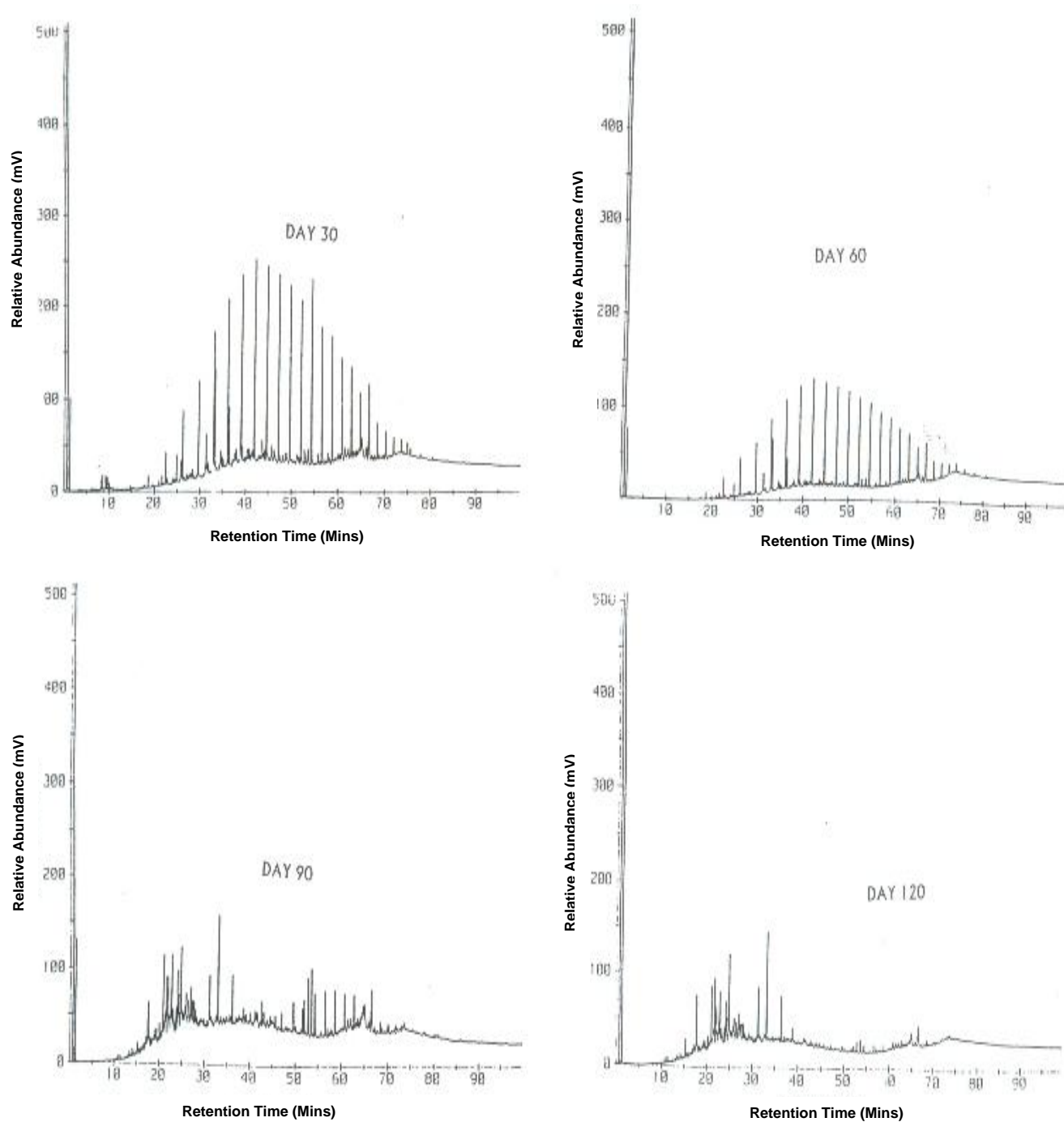


Figure 3. GC Chromatograms of untreated produce water after a 120 day exposure to an *Aspergillus fumigatus* culture

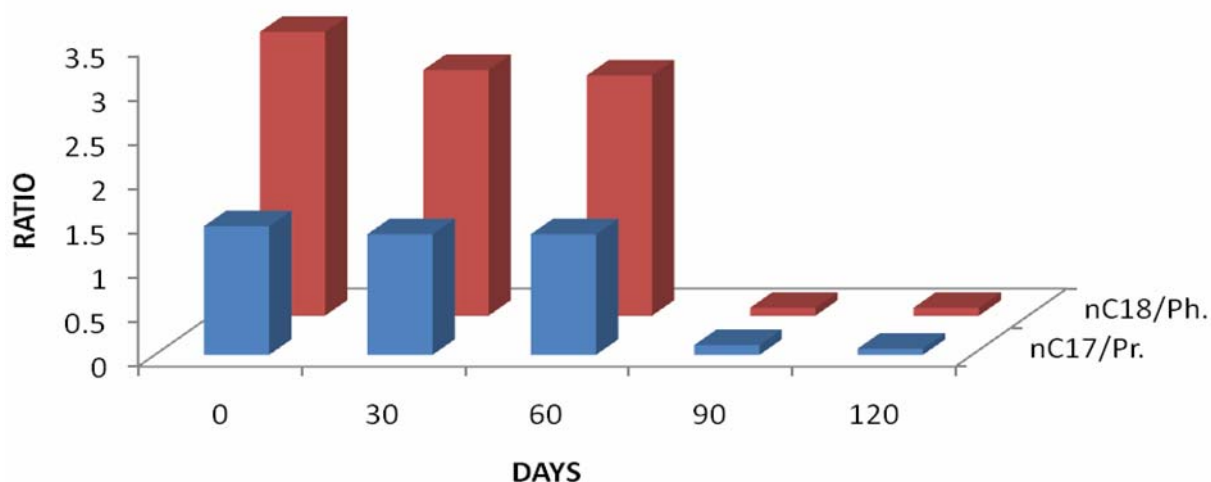


Figure 4. Biodegradation of Untreated produce water with *Aspergillus fumigatus* culture. The result is evaluated as decrease in nC17/Pristane and nC18/Phytane ratios

4. Discussion:

It has been reported in literature that a significant number of soil Fungi utilise petroleum hydrocarbons very efficiently though slowly (Canniglia et al,1980). Some researchers like Cerninglia (1992), Gadd(2001), Andrea et al, (2001), Sutherland (2004) and Okoro (2008) have also demonstrated that Fungi cultures are very efficient in the degradation of highly recalcitrant Polycyclic Aromatic Hydrocarbons (PAHs).

The predominance of *Aspergillus fumigatus* species within the discharge zone of produce water effluents (Okoro, 1999) led to the interest in the evaluation of its biodegradation potential especially as it relates to the degradation of highly recalcitrant PAHs in produce water.

The index used to monitor the progress of biodegradation is the rate of decrease in the ratios of nC17/Pristane and nC18/Phytane. Pritchard and Coaster (1991) used the same index to monitor the progress of biodegradation during the EPA Alaska oil spill biodegradation project. The application of this concept is based on the principle that during biodegradation, decreases of total oil residues could occur because of other non biological processes, thus changes in hydrocarbon composition that are indicative of biodegradation must be measured accurately. This is done historically by examining the weight ratios between hydrocarbons known to be readily biodegradable such as the C17 and C18 alkanes and those that biodegrade slowly such as the branched alkanes (Pristane and Phytane) but with very close chromatographic behaviour. A weight ratio less than 1 signifies considerable biodegradation Pritchard and Coaster (1991).

Both the treated and untreated produced water had weight ratios of nC17/Pristane and nC18/Phytane higher than 1, an indication that the hydrocarbon present was not biodegraded.

Relying on the nC17/Pristane and nC18/Phytane ratio index, *Aspergillus fumigatus* achieved considerable biodegradation after 90 days of exposure when the ratios dropped to 0.11 and 0.09 respectively. When compared with *Aspergillus niger* and *Penicillium* sp. used by Okoro (2008), the degradation pattern was almost similar except that *Aspergillus niger* and *Penicillium* sp. achieved considerable biodegradation after 60 days of exposure, this faster degradation rate is expected because the two fungal isolates used were originally isolated from produce water as opposed to *Asp. Fumigatus* that was isolated from Sea water.

On the degradation of PAHs, over 80% of residual PAHs were removed by *Aspergillus fumigatus* cultures after 120 days of exposure, a similar trend was observed with the other two fungal species used by Okoro (2008).

The present study have demonstrated that *Aspergillus fumigatus* is very efficient in the degradation of aromatics including the very recalcitrant PAHs in produce water and since the organism is predominant within the zone of discharge of produce water effluents, it can be very useful in the degradation of accumulated hydrocarbons in the bottom sediment of the discharge zone. This can happen naturally over a long period of time.

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Corresponding Author:

Dr. Chuma C. Okoro
Department of Biological Sciences and
Biotechnology, Caleb University, Lagos
Tel: 08033072754, 01-7430285
E-mail: chuma2k2001@yahoo.com
P. O. Box 146, University of Lagos Post Office,
Lagos, Nigeria

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Dr. Chuma C. Okoro
Dept. Of Biological Sciences and Biotechnology
Caleb University, Lagos

Comparison of the Type of the Web Base Advertising on E-Commerce Improvement

Maryam Mazandarani,
m93.maryam@yahoo.com

Abstract: There are several investigation that have been shown increase the Ecommerce improvements by web base advertising. Recently and specifically after developing on the personal, news, e-shops and web2 websites have been increase interesting to do E-commerce and improve it by the web based advertising. This investigation have been focused on comparison of the two type of the web base advertise on the visitors direction to the targets websites. Result of this investigation have been shown that the picture banner base advertise inside the news content is more effective to direction of the visitors to the targets website. Researcher in this research has been suggested to make the text base advertising in side the content to improve the E-commerce. [Journal of American Science 2010;6(3):150-156]. (ISSN: 1545-1003).

Keywords: Bossiness, E-commerce, Website, Web2, PHP Programming

Introduction

Recently have been shown increase to people interesting to E-commerce according to the web base works. Web base commerce or at the other hand electronic commerce has been known as new sort of the business by the some company and personal works (Gefen 2000). There are several investigation regard to improve the e-commerce website in some aspect as well as the security, server power and also web applications (Elnikety, Nahum et al. 2004) but there are a few researches regard to design plane and type of the advertise to make more visitor inside these type of the websites.

Recommender systems are being used by an ever-increasing number of E-commerce sites to help consumers find products to purchase. In this article they presented an explanation of how recommender systems are related to some traditional database analysis techniques.

The model predicts online buying by linking the purchase decision to what visitors do and to what they are exposed to while at the site. (Sismeiro and Bucklin 2004)

The failure of many B2C companies has triggered widespread concern about the future prospects of such firms (Saeed, Hwang et al. 2002). Surviving and newly formed companies are reevaluating their strategies and struggling to build a sustainable business model. The results demonstrate that advertising spending alone has only a negligible impact on firm performance. A more appropriate profit-enhancing strategy for B2C companies is to complement advertising spending with a superior shopping experience that augments the value customers gain from the purchase experience.

This paper presents an application of the analytic hierarchy process (AHP) used to select the best web site for online advertising (Ngai 2003). This method adopts a multi-criteria approach that can be used for analysis and comparison of web sites for online advertising. The method is based on pairwise comparison between several factors that affect the selection of the best web site

Electronic Commerce is the paperless exchange of business information using Electronic Data Interchange and related technologies. If you are familiar with Electronic Mail, computer bulletin boards, facsimile machines, Electronic Funds Transfer You can very well understand what is E-commerce. These are all forms of EC. All EC systems replace all or key parts of paper-based work flow with faster, cheaper, more efficient, and more reliable communications between machines. In today's Defense Department procurement arena, however the most important EC technology to know about is Electronic Data Interchange, or ED

An e-Commerce site is a content managed website application which allows members of the public to purchase specific products via transactions secured on the vendor's website. Typically this would involve an administration system which allows the client to manage their inventory, view orders and review transactions within the website database. Orders are typically processed via secure online Payment Service Providers such as World Pay, Pay Pal and Secure Trading or integrated service providers such as Streamline or Realex. Occasionally clients may have in-house card swiping facilities and orders can be relayed directly to their systems.

In conventional commerce, customer groups with similar interests can be observed. Similarly, customers in E-commerce naturally form groups (Wang, Makaroff et al. 2004). That's groups allow the organization to provide quality of service and perform capacity planning. From a system point of view, overall server performance can be improved and resources managed considering customer session behavior. Last studies have grouped customers using clustering technique. Other data metrics have been selected as criteria for grouping, in order to analyze different problems. The limitation for these approaches is that problem is analyzed separate. In solicitation to manage an E-commerce server well, they must analyze many dependent problems Comprehensive rather than separate. For Parable, they would like to know what's the impact on resource usage when optimizing revenue. So, they must understand the diversities and similarities between session groups chosen by different metrics. In that's paper characterizes customer groups for an E-rental business and compares customer groups created according to different criteria including services appealed, navigation pattern and resource usage. A significant finding of that's study shows that using each of the three criteria in relative yields roughly similar results, since customers looking for similar services tend to have similar navigation pattern similar server resource usage. So, it is proper to group customers in only one of these ways. Grouping customers by services solicited is suggested since this method transfers dependent better results and is simple to implement.

The faster mutation of interactive Internet services has led to both a permanent very number of modern web sites and to an increase in their functionality, which in turn makes them more complicated to them (Abbattista, Degemmis et al. 2002). The COGITO project aims at improve innovative software components allowing e-commerce compares to effectively set up and maintain web sites which address customers in personalized and proactive ways.

Inspects the applicability of determinants identified in a physical services environment to assess the services reporting to e-commerce (Cox and Dale 2001). That is argued the lack of human interaction during the Web

site experience means that determinants such as competence, courtesy, and friendliness, helpfulness, commitment, flexibility are not specific relevant in e-commerce. On the other hand, determinants such as accessibility, communication, credibility, understanding, appearance, and availability are equally applicable to e-commerce as they are in physical services. That's paper argues the needed for further researched to identify suitable determinants for the e-commerce operating environment.

Actually E-commerce is thinking an excellent alternative for companies to aim new customers (Albuquerque and Belchior 2002). Sometimes, many E-commerce Web sites have a short time. The prosperity of these virtual stores pertains on many issues, especially their quality; it is such a complex solution. This paper specifies a relevant set of E-commerce Web site quality attributes based on the literature. Research was undertaken to validate and establish the relative importance of these attributes. The results were obtained from a software quality evaluation model.

Typical web analytic packages provide basic key performance indicators and standard reports to help assess traffic patterns on the website (Kohavi and Parekh 2003), evaluate site performance and identify potential problems such as bad links resulting in page not found errors.

Based on they experience in mining data for multiple retail E-commerce sites, they offer several recommendations for supplementary analyses that they have found to be very useful in practice.

that's include analysis from errors, micro-conversions, real estate usage, search, product affinities and based on the construction of a customer signature, which in turn benefits from additional overlays, such as third-party demographic attributes. They describe the construction of such a signature and challenges faced by businesses attempting to construct it.

This research is going to examine effect of difference type of the advertise on the e-commerce improvements and increase the visitors. Have been applied two type of the advertise according to the text and picture banner base publishing to improve the e-commerce in this study. The model of this investigation has been shown at the figure 1.

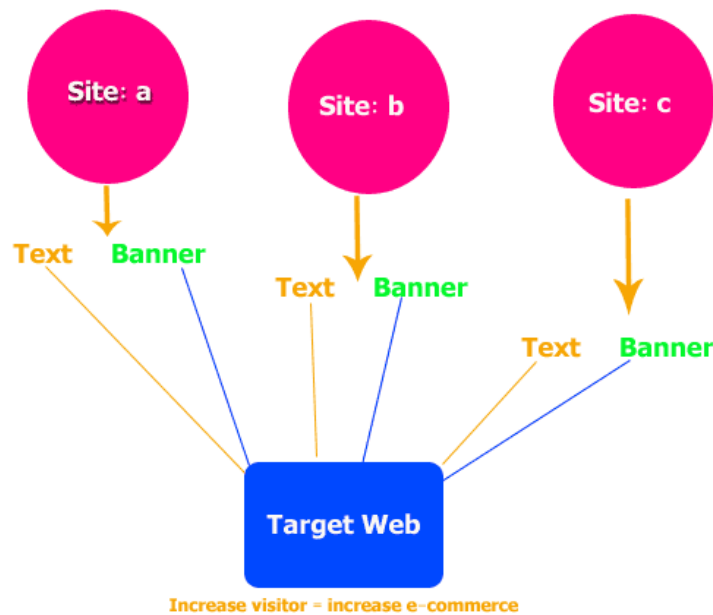


Figure 1: Moder of the target and publisher websites in this research

Methodology

This research is a web base survey. Researcher to make this research has been used one target website and three advertise publisher websites. The entire website in this survey was in Persian language. And all the website was rtl CSS. Alexa ranks (Zeng and Parmanto 2003) in all these website was less than 1000,000 at ranking. The target website domain name in this survey was www.womanday.ir. The advertise website in this research was as the following:

- www.iranianmalezi.com (Site: a)
- www.fitness2100.com (Site: b)
- www.aryamehan.com (Site: c)

Have been made tow type of the advertise in tree publisher website. The Text inside the content and banner (200 x 200 px) at right column of all WebPages was applied in three

websites. Click target according to the banner script component have been shown number of the clicks on the text advertise. This survey was continued for 1 month (September 2009). The target website was designed by open source script content management system (Joomla 1.5.1.4) . all the publisher website was updated by the news content daily (3 news daily). Banner design and text content as well as the color, size and location of the module was at the same conditions. The uptime of the websites was at 99.99 percent in month and linux dedicated server has been used to run all these websites. Php script banner component have been used for banner advertising and website analytics component was used for determination of the refer type and domain referral.

Alexa Rank during this research in all these website are the figure no: 1, 2, 3

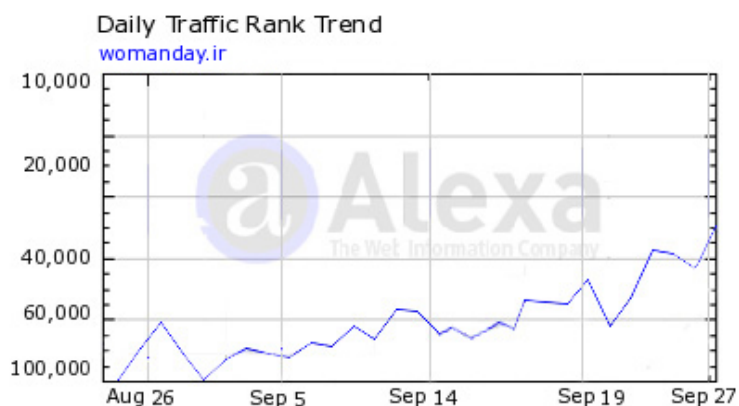


Figure 2: alexa rank for www.womanday.ir

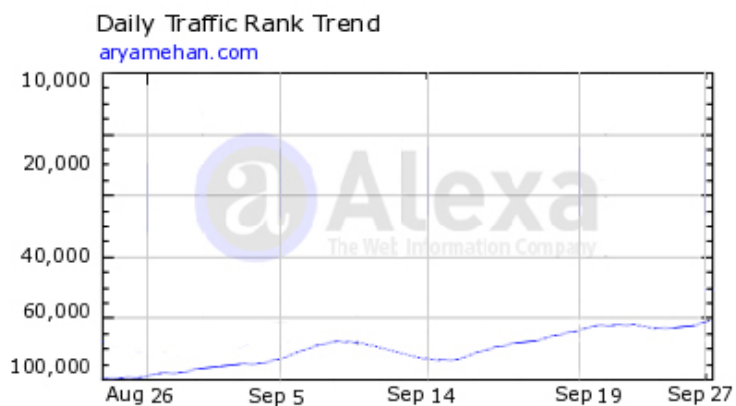


Figure 3: alexa rank for www.aryamehan.com



Figure 4; alexa rank for www.iranianmalezi.com

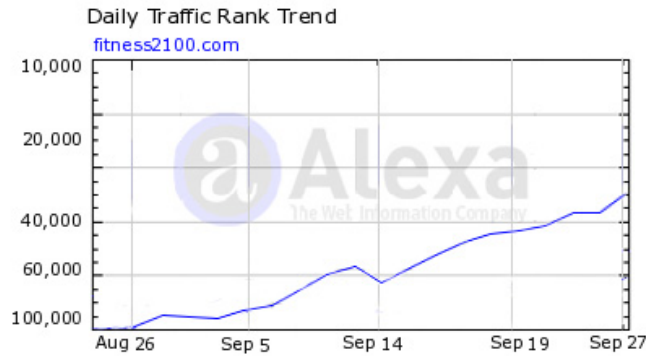


Figure 5: alexa rank for www.fitness2100.com

Statistical Methods:

To compare of the result in tow type of the advertising effect have been used descriptive data and also t-independent test. SPSS version 17 and Excel (OS Windows XP, Office 2003) software was used to analysis of data.

Result

The analysis of data in this investigation has been applied by SPSS software and T-independent test for compare of the mean. P

value was applied at .05. have been shown that there are significant difference between the mean and standard error between the text and banner advertise. All the site was used for 30 days and have been shown mean of the visitor by banner type was 53.23, 58.23 and 68.86 respectively in three website. Also mean of the visitor for per day in three website according to text banner was 21.83, 26.83 and 24.36 respectively. Have been shown significant difference between banner and text advertise in all three websites.

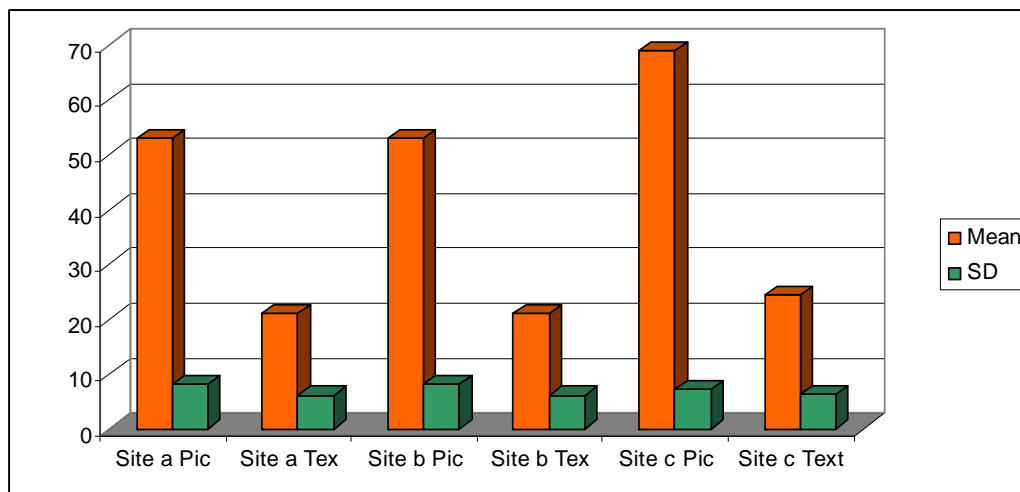


Figure 6: Compare the mean and standard deviation at three publisher website

Table 1: Descriptive Data in three publisher website

Banner Type	N	Mean	Std. Deviation	Std. Error Mean
Site: a Picture	30	53.23	8.140	1.486
Text	30	21.83	6.232	1.138
Site: b Picture	30	58.2333	8.13966	1.48609
Text	30	26.8333	6.23164	1.13774
Site: c Picture	30	68.8667	72.46056	13.22943
Text	30	24.3667	6.38686	1.16608

Table 2: T-Independent Test

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Site: a	Equal variances assumed	16.777	58	.000	31.400	1.872
	Equal variances not assumed	16.777	54.303	.000	31.400	1.872
Site: b	Equal variances assumed	16.777	58	.000	31.40000	1.87161
	Equal variances not assumed	16.777	54.303	.000	31.40000	1.87161
Site: c	Equal variances assumed	3.351	58	.001	44.50000	13.28072
	Equal variances not assumed	3.351	29.451	.002	44.50000	13.28072

Discussion

Have been shown the increase the site visitors with the banner base advertise in this investigation. However this research can not be extended in any type of the websites as well as the search engine or forums. This investigation was according to the Persian

language and news website and need to more research at the other languages websites. However researcher according to this research have been suggested to the publisher and advertise owner to use the banner base advertise to increase their visitor and e-commerce.

Corresponding Author:

Maryam Mazandarani
Kuala Lumpur, Malaysia
E-mail: m93.maryam@yahoo.com

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6 December 2009

Review article:

Contribution of Rice Husk Ash to the Properties of Mortar and Concrete: A Review

Alireza Naji Givi ¹, Suraya Abdul Rashid ², Farah Nora A. Aziz ³, Mohamad Amran Mohd Salleh ²

¹. Institute of Advanced Technology, Universiti Putra Malaysia, Malaysia

². Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia

³. Department of Civil Engineering, Faculty of Engineering, Universiti Putra Malaysia, Malaysia

². Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia
najigivi@yahoo.com

Abstract: In the last decade, the use of supplementary cementing materials has become an integral part of high strength and high performance concrete mix design. These can be natural materials, by-products or industrial wastes, or the ones requiring less energy and time to produce. Some of the commonly used supplementary cementing materials are fly ash, Silica Fume (SF), Ground Granulated Blast Furnace Slag (GGBFS) and Rice Husk Ash (RHA) etc. RHA is a by-product material obtained from the combustion of rice husk which consists of non-crystalline silicon dioxide with high specific surface area and high pozzolanic reactivity. It is used as pozzolanic material in mortar and concrete, and has demonstrated significant influence in improving the mechanical and durability properties of mortar and concrete. This paper presents an overview of the work carried out on the use of RHA as partial replacement of cement in mortar and concrete. Reported properties in this study are the mechanical, durability and fresh properties of mortar/concrete. [Journal of American Science 2010;6(3):157-165]. (ISSN: 1545-1003).

Key words: Rice husk ash; concrete; mechanical properties of concrete; durability of concrete

1. Introduction

Rice plant is one of the plants that absorbs silica from the soil and assimilates it into its structure during the growth (Smith et al., 1986). Rice husk is the outer covering of the grain of rice plant with a high concentration of silica, generally more than 80-85% (Siddique 2008). It is responsible for approximately 30% of the gross weight of a rice kernel and normally contains 80% of organic and 20% of inorganic substances. Rice husk is produced in millions of tons per year as a waste material in agricultural and industrial processes. It can contribute about 20% of its weight to Rice Husk Ash (RHA) after incineration (Anwar et al., 2001). RHA is a highly pozzolanic material (Tashima et al., 2004). The non-crystalline silica and high specific surface area of the RHA are responsible for its high pozzolanic reactivity. RHA has been used in lime-pozzolana mixes and could be a suitable partly replacement for Portland cement (Smith et al., 1986; Zhang et al., 1996; Nicole et al., 2000; Sakr 2006; Sata et al., 2007; etc).

RHA concrete is like fly ash/slag concrete with regard to its strength development but with a higher pozzolanic activity it helps the pozzolanic reactions occur at early ages rather than later as is the case with other replacement cementing materials (Molhotra, 1993).

1.1. Properties of rice husk ash

The typical chemical composition and physical properties of RHA are given in Table 1 (Mehta 1992; Bui et al., 2005; Zhang et al., 1996).

1.2. Advantages of using rice husk ash in concrete

The use of RHA in concrete has been associated with the following essential assets:

- Increased compressive and flexural strengths (Zhang et al., 1996; Ismaila 1996; Rodriguez 2005)
- Reduced permeability (Zhang et al., 1996; Ganesan et al., 2007)
- Increased resistance to chemical attack (Chindaprasirt et al., 2007)
- Increased durability (Coutinho 2002)
- Reduced effects of alkali-silica reactivity (ASR) (Nicole et al., 2000)
- Reduced shrinkage due to particle packing, making concrete denser (Habeeb et al., 2009)
- Enhanced workability of concrete (Coutinho 2002; Habeeb et al., 2009; Mahmud et al., 2004)
- Reduced heat gain through the walls of buildings (Lertsatitthanakorn et al., 2009)
- Reduced amount of super plasticizer (Sata et al., 2007)
- Reduced potential for efflorescence due to reduced calcium hydracids (Chindaprasirt et al., 2007)

Table 1: Chemical and physical properties of RHA^a (Wt. %)

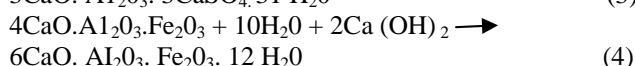
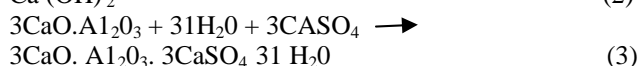
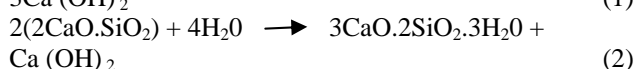
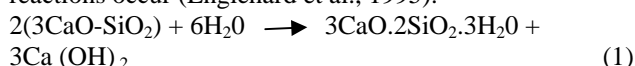
Chemical properties									
Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	Na ₂ O	K ₂ O	Loss on ignition
Mehta (1992)	87.2	0.15	0.16	0.55	0.35	0.24	1.12	3.68	8.55
Zhang et al. (1996)	87.3	0.15	0.16	0.55	0.35	0.24	1.12	3.68	8.55
Bui et al. (2005)	86.98	0.84	0.73	1.40	0.57	0.11	2.46	-----	5.14
Physical properties									
	Specific gravity (g/cm ³)			Mean particle size (μm)			Fineness: passing 45μm (%)		
Mehta (1992)	2.06			-----			99		
Zhang et al. (1996)	2.06			-----			99		
Bui et al. (2005)	2.10			7.4			---		

^aRice husk ash

2. Reaction mechanism

2.1. Pozzolanic reaction

A pozzolanic reaction occurs when a siliceous or aluminous material get in touch with calcium hydroxide in the presence of humidity to form compounds exhibiting cementitious properties (Papadakis et al., 2002). In the cement hydration development, the calcium silicate hydrate (C-S-H) and calcium hydroxide (Ca (OH)₂, or CH) are released within the hydration of two main components of cement namely tricalcium silicate (C3S) and dicalcium silicate (C2S) where C, S represent CaO and SiO₂ (Omotoso et al., 1995). Hydration of C3S, C2S also C3A and C4AF (A and F symbolize Al₂O₃ and Fe₂O₃) respectively, is important. Upon wetting, the following reactions occur (Englehard et al., 1995):



The C-S-H gel generated by the hydration of C3S and C2S in equations (1) and (2) is the main strengthening constituent. Calcium hydroxide and Ettringite (3CaO.3CaSO₄.31H₂O, equation 3) that are crystalline hydration products are randomly distributed and form the frame of the gel-like products. Hydration of C4AF (equation 4), consumes calcium hydroxide and generates gel-like products. Excess calcium hydroxide can be detrimental to concrete strength, due to tending the crystalline growth in one direction.

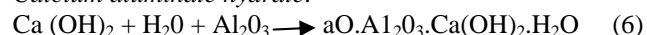
It is known that by adding pozzolanic material to mortar or concrete mix, the pozzolanic reaction will only start when CH is released and pozzolan/CH interaction exist (Villar Cocina et al., 2003). In the pozzolan-lime reaction, OH⁻ and Ca²⁺ react with the SiO₂ or Al₂O₃-SiO₂ framework to form calcium silicate hydrate (C-S-H),

calcium aluminate hydrate (C-A-H), and calcium aluminate ferrite hydrate:

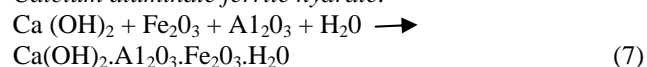
Tobermorite gel:



Calcium aluminate hydrate:



Calcium aluminate ferrite hydrate:



The crystallized compound of C-S-H and C-A-H, which are called cement gel, hardened with age to form a continuous binding matrix with a large surface area and are components responsible for the development of strength in the cement paste (Kassim et al., 2004). Pozzolan-lime reactions are slow, generally starting after one or more weeks (Englehard et al., 1995). The behavior of the delay in pozzolanic reaction will result in more permeable concrete at early ages and gradually becomes denser than plain concrete with time. This behavior is due to two reasons: Firstly, pozzolan particles become the precipitation sites for the early hydration C-S-H and CH that hinders pozzolanic reaction. Secondly, the strong dependency of the breaking down of glass phase on the alkalinity of the pore water which could only attain the high pH after some days of hydration. Pozzolan can partially replace cement in mortar or concrete mix without affecting strength development. The effect of the pozzolanic reaction produces more cement gel (i.e. C-S-H and C-A-H) reducing the pore size, blocks the capillary and produces denser concrete thus making it stronger and more durable.

2.2. Pozzolanic reaction of RHA

Data from reaction results between RHA and CH indicates that the amount of CH by 30% RHA in cement paste begins to decrease after 3 days, and by 91 days it reaches nearly zero, while in the control paste, it is considerably enlarged with hydration time (Yu et al., 1999). The addition of pozzolan decreases the formed CH by the pozzolanic reaction to produce more C-S-H gel that can improve the strength and durability of concrete (Aziz

et al., 2004). Amorphous silica that is found in some pozzolanic materials (Habeeb et al., 2009) reacts with lime more eagerly than those of crystalline form (Lin et al., 2003).

The most essential asset of RHA that identifies pozzolanic activity is the amorphous phase substance. The production of rice husk ash can lead to the formation of approximately 85% to 95% by weight of amorphous silica (Della et al., 2002). As a consequence of this characteristic, RHA is an extremely reactive pozzolanic substance appropriate for use in lime-pozzolan mixes and for Portland cement substitution. The reactivity of RHA associated to lime depends on a combination of two factors: namely the non-crystalline silica content and its specific surface (Dakrouy et al., 2008). Cement replacement by rice husk ash accelerates the early hydration of C3S. The increase in the early hydration rate of C3S is attributed to the high specific surface area of the rice husk ash (Feng et al., 2004). This phenomenon specially takes place with fine particles of RHA. Although the small particles of pozzolans are less reactive than Portland cements (Mehta et al., 1990), they produce a large number of nucleation sites for the precipitation of the hydration products by dispersing in cement pastes. Consequently, this mechanism creates the more homogenous and denser paste as for the distribution of the finer pores due to the pozzolanic reactions among the amorphous silica of the mineral addition and the CH (Isaia et al., 2003). Mehta (1987) reported that the finer particles of RHA speed up the reactions and form smaller CH crystals. Berry et al. (1994) revealed that high volume of not completely reacted pozzolanic particles in the cement paste may fill up the voids and enhance density of the paste. Cabrera et al. (2001) have exposed that pozzolanic reaction can be characterized by the Jander diffusion equation based on Fick's parabolic law of diffusion assuming the interface is a contracting sphere. The Jander equation for three dimensional diffusion in a sphere is $(1 - (1 - x)^{1/3})^2 = (D/r^2)kt$ where x is the fraction of the sphere that has reacted, r is initial radius of the starting sphere, and k is the diffusion constant.

2.3. Temperature effect

Exothermal reactions occur during the cement hydration. Hydration heat is an essential aspect that influences the setting and characteristic behavior of Portland cements. This temperature variation, from the initial moment of setting until the hardening of the cement, may cause shrinkage which results in the cracks formation that can be seen in some constructions (Rojas et al., 1993). Cement blended with pozzolanic materials usually has decreased heat of hydration compared to pure cement during the period of C3S hydration (Mostafa et al., 2005). The rate of hydration heat of the cement added with pozzolanic material mainly depends on three factors, C3S hydration, aluminate hydration and pozzolanic reaction (Hewlett, 1998). Likewise, RHA demonstrate increase of

hydration heat behavior (positive values) during the first 12 h. The increase in the hydration heat of cement blended with rice husk ash is due to (1) the acceleration of the early hydration of C3S ascribed to the high specific surface area of the rice husk ash (Feng et al., 2004) and (2) pozzolanic reaction. The comparison between the hydration heats of control sample (plain cement) with samples by partial pozzolanic materials replacement of cement is shown in Figure 1. Figure 1 demonstrates the cement added with RHA has larger enthalpy compared to the base cement (within 36 h). These effects can be summarized as the pozzolanic activity and the dilution effect. The pozzolanic effect is expected to increase the heat output due to the reaction of pozzolans with calcium hydroxide. The dilution effect is expected to decrease the heat output due to the dilution in the main cement compounds (C3S) (Mostafa et al., 2005).

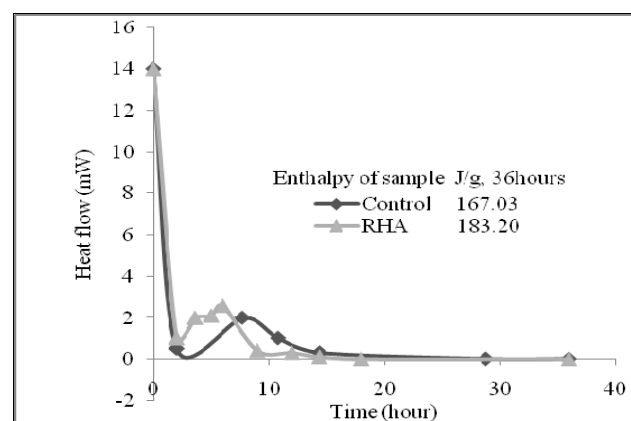


Figure 1. Calorimetric curves from the hydration of cement with 30% by weight of additive (Feng et al., 2004)

3. Fresh properties of mortar/concrete

3.1. Workability

Usually typical concrete mixtures contain too much mixing water because of two reasons: Firstly, the water demand and workability are significantly influenced by particle size distribution, particle packing effect, and voids present in the solid system. Typical concrete mixtures do not have an optimum particle size distribution, and this accounts for the undesirably high water requirement to achieve certain workability. Secondly, to plasticize a cement paste for achieving an acceptable consistency, much larger amounts of water than necessary for the hydration of cement have to be used because Portland cement particles, due to the presence of electric charge on the surface, tend to form flocs that trap volumes of the mixing water (Mehta 1997, 1999).

Studies by Owen (1979) and Jiang et al. (2000) have indicated that with high volume fly ash concrete mixtures, up to 20% reduction in water requirements can be achieved. However, there is the possibility of water reduction higher than 20% in the presence of RHA. This is because fine particles of rice husk ash get absorbed on the oppositely charged surfaces of cement particles and

prevent them from flocculation. The cement particles are thus effectively dispersed and will trap large amounts of water meaning that the system will have a reduced water requirement to achieve a given consistency. The particle packing effect is also responsible for the reduced water demand in plasticizing the system (Mehta 2004). Laskar et al. (2007) examined the effects of RHA on the rheological behavior of high performance concrete. In their study RHA was used to replace cement on mass basis at rates of 5%, 10%, 15% and 20%. Based on their test results, plastic viscosity increases tremendously with the increase in replacement level of RHA. RHA particles have the highest surface area and fineness and lower reaction ability than cement (Shetty 2004). RHA particles fill into the spaces made by larger cement particle, decrease frictional forces of RHA-ordinary Portland cement (OPC) system and improve packing ability thereby reducing yield stress. The steep increase in plastic viscosity with the replacement levels suggests that fineness and shape of RHA play critical role. The more the fineness the more is the number of contacts among the particles and hence the more is the resistance to flow. In addition, any deviation from a spherical shape implies an increase in plastic viscosity for the same phase volume (Nedhi et al., 1998).

3.2. Setting time

Initial and final setting time tests were shown to yield different results on plain cement paste and pastes having rice husk ash (Dakroury et al., 2008). The studies by Ganesan et al. (2008), Cook (1986), and Bhanumathidas et al. (2004) showed that RHA increases the setting time of pastes. Just like other hydraulic cement, the reactivity of rice husk ash cement depends very much upon the specific surface area or particle size. The rice husk ash cement with finer particles exhibits superior setting time behavior. Research has shown the increase in the initial setting time by raising the RHA level in the cement mixture over those of plain cement paste. Dakroury et al. (2008) contended that this may be due to the slower pace of heat induced evaporation of water from the cement-RHA (Figure 2).

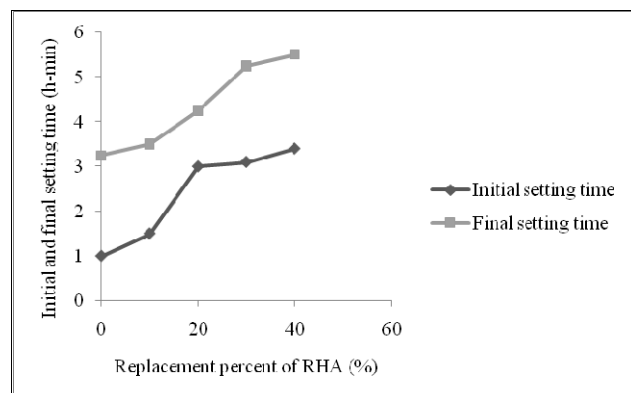


Figure 2. Initial and final setting times of RHA with different replacement percentages (Dakroury et al., 2008)

4. Properties of hardened mortar/concrete

4.1. Pore size distribution

There is a consensus among several researchers that with partial replacement of cement by pozzolans, porosity decreases in concrete. Blended (or pozzolanic) cements are being used worldwide to produce more homogenous hydration products by filling and segmentation of the capillary voids and produce ultimately more denser and impermeable concrete (Guneyisi et al., 2006). Figure 3 shows the effect of RHA content on the total porosity of RHA-hardened cement paste. When the percent of the RHA is increased, the total porosity is decreased.

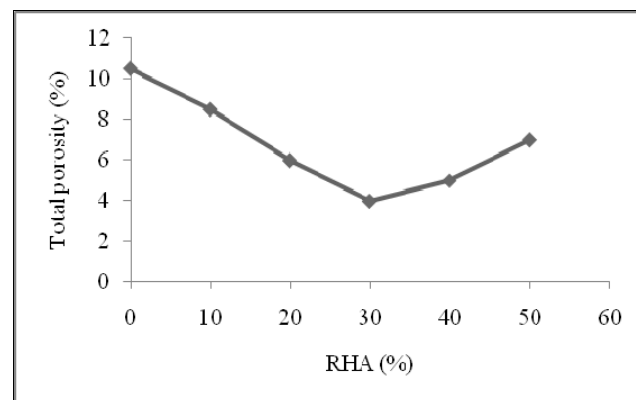


Figure 3. Total porosity of RHA hardened cement paste (Dakroury et al., 2008)

This decrease in the total porosity is attributed to the change occurring in the pore size distribution as a result of using RHA which could react with the calcium hydroxide to form C-S-H gel (Dakroury et al., 2008). Results due to the intensification mechanism of RHA blended concrete confirmed that the average pore size of concrete incorporating RHA is decreased compared to that of control concrete (Sugita et al., 1997).

4.2. Water absorption and sorptivity

One of the main sources of contamination of concrete in structures is water absorption which influences durability of the concrete and also has the risk of alkali aggregate reactions (Ithuralde 1992). The more impermeable the concrete, the greater will be its resistance to deterioration. The incorporation of pozzolan such as fly ash reduces the average pore size and results in a less permeable paste (Poon et al., 1997; Chindaprasirt et al., 2005). Literature studies have identified that commonly permeability of blended cement concrete is less than plain cement paste. It was observed that the incorporation of RHA in the composites could cause an extensive pore refinement in the matrix and in the interface layer, thereby decreasing water permeability (Rodrigues et al., 2006). The radial expansion of Portland cement hydration products in pozzolanic particles would have a pore modification effect therefore reduces the

interconnectedness among pores (Cook et al., 1987). This occurrence can be coupled with perfection on the interfacial transition zones among the cement matrix and aggregate (Toutanji et al., 2004). The permeability will decrease rapidly with the progress of the hydration. The presence of pozzolan leads to greater precipitation of cement gel products (Feng et al., 2004) than occurs in Portland cement alone, which more effectively block the pores helping to reduce permeability. Sarawathy et al. (2007) studied the effect of partial replacement of cement with RHA at different replacement levels on the porosity and water absorption of concrete and reported that the coefficient of water absorption for rice husk ash replaced concrete at all levels was less than control concrete.

4.3. Compressive strength

Inclusion of RHA as partial replacement of cement enhances the compressive strength of concrete, but the optimum replacement level of OPC by RHA to give maximum long term strength enhancement has been reported between 10% up to 30%. All these replacement levels of RHA are in percentage by weight of the total binder material. Mahmud et al. (1996) reported 15% cement replacement by RHA as an optimal level for achieving maximum strength. Zhang et al. (1996) suggested 10% RHA replacement exhibited upper strength than control OPC at all ages. Ganesan et al. (2007) concluded that concrete containing 15% of RHA showed an utmost compressive strength and loss at elevated content more than 15%. Dakrouy et al. (2008) reported that using 30% RHA as a replacement of part of cement could be considered optimum for all content of W/C ratios in investigated mortars because of its high value of compressive strength. Zhang et al. (1996) reported that achieving higher compressive strength and decrease of permeability in RHA blended concrete is perhaps caused by the reduced porosity, reduced calcium hydroxide content and reduced width of the interfacial zone between the paste and the aggregate. The development of more C-S-H gel in concrete with RHA may progress the concrete properties due to the reaction among RHA and calcium hydroxide in hydrating cement (Yu et al., 1999). It is apparent from the literature that generally RHA blended cement compared to OPC cement exhibited higher compressive strength than OPC. According to Rodriguez (2006) the RHA concrete had higher compressive strength at 91 days in comparison to that of the concrete without RHA. The increase in compressive strength of concretes with residual RHA may also be justified by the filler (physical) effect. It is concluded that RHA can provide a positive effect on the compressive strength of concrete at early ages. Besides, in the long term, the compressive strength of RHA blended concrete produced by controlled incineration shows better performance.

4.4. Tensile and Flexural Strength

Habeeb et al. (2009) investigated the effects of concrete incorporating 20% RHA as partial replacement of cement at three different particle sizes. In their study the tensile strength of concrete increased systematically with increasing RHA replacement. The results of tensile and flexural strength are shown in Table 2.

Table 2. Mechanical properties of concrete (Habeeb et al., 2009)

	Flexural Strength (MPa)			Tensile Splitting (MPa)		
	Age (days)			Age (days)		
Mix	28	90	180	28	90	180
CM ^a	4.5	4.9	5.1	2.6	2.8	2.9
20F1 ^b	4.9	5.4	5.5	2.9	3.0	3.2
20F2 ^c	5.0	5.4	5.7	3.2	3.3	3.5
20F3 ^d	5.2	5.7	6.1	3.2	3.5	3.9

^a Control mix

^b RHA with average particle size of 31.3

^c RHA with average particle size of 18.3

^d RHA with average particle size of 11.5

The use of RHA also resulted in significant improvement in flexural strength (De Sensale 2006, Sakr 2006). Habeeb et al. (2009) reported that the coarser RHA particle mixture showed the least improvement in tensile and flexural strength. Zhang et al. (1996) concluded that the addition of RHA to concrete exhibited an increase in the flexural strength and the higher strength was for the finer RHA mixture due to the increased pozzolanic reaction and the packing ability of the RHA fine particles.

5. Durability properties of concrete containing RHA

5.1. Alkali-silica reaction

Pozzolanic materials are used to prevent or minimize cracking in concrete due to the expansive gel formed by the alkali-silica reaction. Silica fume and RHA have been classified as highly active pozzolans. Hasparyk et al. (2000) studied the expansion of mortar bars made with different levels of cement replacement with rice husk ash (RHA). They reported that incorporation of high reactivity RHA as a partial cement replacement between 12% and 15% may be sufficient to control deleterious expansion due to alkali-silica reaction in concrete, depending on the nature of the aggregate. The mechanism by which RHA may suppress expansion due to alkali-silica reaction appeared to be entrapment of alkalis by the supplementary hydrates and a consequent decrease in the pH of pore solutions because the expansion of the mortar bar is sensitive to the pH level of the solution (Cao et al., 1997).

5.2. Chloride-ion diffusion

It is approved that the long term deterioration of concrete and corrosion of reinforcing steel commonly occurs by entrancing the chloride ions into body of concrete structures. It is also well known that the rate of chloride ion diffusion into concrete is related to the permeability and pore size distribution. Concretes made with blended cements generally have lower permeability and more discontinuous pore structure than plain Portland cement concrete. Therefore, the diffusivity of chloride ions in blended cement concretes tends to be lower (Cook 1989). The ability of RHA mixtures to reduce the potential detrimental effects of chloride intrusion into concrete was reported by Anwar et al. (2001). They demonstrated that RHA outperform the specimen containing OPC alone and the levels of total and soluble chloride ions had large reductions as the depth of concrete zones surveyed increased. They also determined that for concretes studied, the first 10 mm of concrete cover provides little barrier to chloride ion penetration and underscores the importance of concrete cover to the reinforcement. On the other hand, all the results of zone 20-30 mm show lower values of total chloride ions content than the limits of reinforcement corrosion threshold. Therefore it can be concluded that there are significant reductions in chloride ions permeability due to replacing the OPC with RHA. As the replacement level of the RHA increases from 10% to 20% by weight the results are affected and low chloride ions contents are obtained. Consequently, they concluded that concrete containing RHA may require less depth of cover to protect the reinforcing steel than those concretes using OPC alone. Moreover, Anwar et al. (2001) contended that the soluble chloride ions contents of zone (20, 30 mm) for RHA concretes are smaller than the limits of threshold for corrosion of steel.

Gaynor (1987) reported that one half or three fourths of penetrated chlorides ions in hardened concrete are soluble in water and free to contribute to corrosion, but some studies demonstrated that the RHA concrete mixes show lower percent than the one reported by Gaynor. For instance, Anwar et al. (2001) have reported that the presence of RHA in concrete shows lower ratio of soluble/total chloride ions content than those of OPC concretes. It is shown that proportions of no ground RHA did not significantly change rapid chloride penetrability classification of concrete. However, using finely ground RHA reduced the rapid chloride penetrability of concrete from a moderate rating to low or very low ratings depending on the type and addition level of RHA (Nehdi et al., 2003). Salas et al. (2009) reported that the reduction in the average pore diameter of cement paste caused by the incorporation of rice husk ash in the mix will effectively reduce the pore sizes, permeability, and diffusivity of chloride ions in concrete.

5.3. Sulfate resistance

The role of RHA on the sulfate resistance of heavyweight concrete has been investigated by some researchers. Sakr (2006) immersed the 100mm cubes in a 5% MgSO_4 solution at specific times (1, 3, and 6 months) and found out that the failure occurs in compressive strength of concrete cubes as a result of sulfate attack. The results of this study revealed that concrete mixed with RHA had good resistance to sulfate attack. He concluded that reductions in compressive strength of concrete incorporating 15% of RHA when immersed in a sulfate solution for 28 days was much lower than concrete without RHA and compressive strength was generally increased as the immersion time in the sulfate solution increased. From his reported results it can be concluded that the incorporation of fly ash and ground rice husk ash with Portland cement resulted in a significant improvement in the resistance to attack by 5% sodium sulfate solution. Similar results have been reported by Chindaprasirt et al. (2007). They reported that better dimension stability is obtained with blended cements containing fly ash and RHA. From literature study it can be concluded that despite having higher water demand characteristics, RHA at a dosage of up to 40% cement replacement is very effective in providing sulfate resistance. Also Chindaprasirt et al. (2007) found that fly ash and rice husk ash mortar are of lower pH levels and thus less susceptible to sulfate attack and up to 40% of Portland cement could be replaced with fly ash and RHA to make blended cement mortar with reasonable strength development and good sulfate resistance.

5.4. Corrosion resistance and drying shrinkage

Saraswathy et al. (2007) investigated the corrosion performance of concrete made with 0, 5, 10, 15, 20, 25, and 30% RHA as partial replacement of cement. They have monitored the open circuit potential measurements with reference to saturated calomel electrode (SCE) periodically with time as per ASTM C876. From their study it can be observed that the time of cracking were 42, 72, and 74 hours for concretes made with 0, 5, and 10% RHA. However, no cracking was observed for concretes with 15, 20, 25, and 30% RHA ever after 144 hours of exposure. These findings indicate that there was no crack in concretes made with 15, 20, 25 and 30% rice husk even after 144 h of exposure. In contrast, ordinary Portland cement concrete, the specimen was cracked after only 42 h of exposure in 5% NaCl solution. Saraswathy et al.'s (2007) study indicated that the concrete specimens containing 5 and 10% rice husk ash also failed within 72 and 74 hours of exposure. It can be concluded from their study that the replacement of rice husk ash refined the pores and thereby reducing the permeability. Moreover, the study by Saraswathy and her colleagues (2007) suggests that the incorporation of RHA up to 30% replacement level reduces the chloride penetration, decreases permeability, and improves strength and

corrosion resistance properties. Finally, they have recommended the replacement level of up to 25%. In the same vein, Chindapasirt et al. (2008) studied the effect of RHA and fly ash on corrosion resistance of Portland cement concrete and concluded that both fly ash and RHA are very effective in improving the corrosion resistance of mortars indicating better contribution of RHA to corrosion resistance in comparison to that of fly ash.

Similarly, Habeeb et al. (2009) studied the effect of RHA on shrinkage of concrete mixtures containing 20% of RHA at three different average particle sizes. They concluded that the drying shrinkage was significantly affected by RHA fineness. The addition of micro fine particles of RHA to concrete would increase the drying shrinkage. While coarser particles of RHA exhibited lower values than the plain cement based concrete. These contributions can be justified by the pozzolanic and the filler effects.

Conclusions

The employment of RHA in cement and concrete has gained considerable importance because of the requirements of environmental safety and more durable construction in the future. The use of RHA as partial replacement of cement in mortar and concrete has been extensively investigated in recent years. This literature review clearly demonstrates that RHA is an effective pozzolan which can contribute to mechanical properties of concrete.

RHA blended concrete can decrease the temperature effect that occurs during the cement hydration. RHA blended concrete can improve the workability of concrete compared to OPC. It can also increase the initial and also final setting time of cement pastes. Additionally, RHA blended concrete can decrease the total porosity of concrete and modifies the pore structure of the cement, mortar, and concrete, and significantly reduce the permeability which allows the influence of harmful ions leading to the deterioration of the concrete matrix. RHA blended concrete can improve the compressive strength as well as the tensile and flexural strength of concrete. RHA helps in enhancing the early age mechanical properties as well as long-term strength properties of cement concrete. Partial replacement of cement with RHA reduces the water penetration into concrete by capillary action. RHA replacement of cement is effective for improving the resistance of concrete to sulfate attack. The sulfate resistance of RHA concrete increases with increasing the RHA replacement level up to 40%. Substitution of RHA has shown to increase the chemical resistance of such mortars over those made with plain Portland cement. Incorporation of RHA as a partial cement replacement between 12% and 15% may be sufficient to control deleterious expansion due to alkali-silica reaction in concrete, depending on the nature of the aggregate. It can be concluded that the use of rice husk ash leads to enhanced resistance to segregation of fresh concrete

compared to a control mixture with Portland cement alone. Also RHA can significantly reduce the mortar-bar expansion. Finally, this literature search showed that the mechanical properties of concrete are enhanced when the substitution of Portland cement was done by RHA.

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Corresponding Author:

Alireza Naji Givi
Institute of Advanced Technology
Universiti Putra Malaysia, Malaysia
E-mail: najigivi@yahoo.com

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Quality Models in Software Engineering Literature: An Analytical and Comparative Study

Rafa E. Al-Qutaish, PhD

Al Ain University of Science and Technology – Abu Dhabi Campus, PO Box: 112612, Abu Dhabi, UAE.

rafa@ieee.org

Abstract: The quality of the software is critical and essential in different types of organizations. In some types of software, poor quality of the software product in sensitive systems (such as: real-time systems, control systems, etc.) may lead to loss of human life, permanent injury, mission failure, or financial loss. In software engineering literature, there are a number of quality models in which they contain a number of quality characteristics (or factors, as called in some models). These quality characteristics could be used to reflect the quality of the software product from the view of that characteristic. Selecting which one of the quality models to use is a real challenge. In this paper, we will discuss the contents of the following quality models: McCall's quality model, Boehm's quality model, Dromey's quality model, FURPS quality model and ISO 9126 quality model. In addition, we will focus on a comparison between these quality models, and find the key differences between them. [Journal of American Science 2010; 6(3):166-175]. (ISSN: 1545-1003).

Keywords: Software Quality; Quality Models; Quality Engineering; ISO 9126; McCall's Quality Model; Boehm's Quality Model; Dromey's Quality Model; FURPS Quality Model

1. Introduction

Software is critical in providing a competitive edge to many organizations, and is progressively becoming a key component of business systems, products and services. The quality of software products is now considered to be an essential element in business success [Veenendaal and McMullan, 1997]. Furthermore, the quality of software product is very important and essential since for example in some sensitive systems – such as, real-time systems, control systems, etc. – the poor quality may lead to financial loss, mission failure, permanent injury or even loss of human life.

There are several definitions for “software Quality” term, for examples, it is defined by the IEEE [1990] as the degree to which a system, component or process meets specified requirements and customer (user) needs (expectations). Pressman [2004] defines it as “conformance to explicitly stated functional and performance requirements, explicitly documented development standards, and implicit characteristics that are expected of all professionally developed software.” The ISO, by contrast, defines “quality” in ISO 14598-1 [ISO, 1999] as “the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs,” and Petrasch [1999] defines it as “the existence of characteristics of a product which can be assigned to requirements.”

There are a number of quality models in software engineering literature, each one of these quality models consists of a number of quality characteristics (or factors, as called in some models). These quality characteristics could be used to reflect

the quality of the software product from the view of that characteristic. Selecting which one of the quality models to use is a real challenge. In this paper, we will discuss the contents of the following quality models:

1. McCall's Quality Model.
2. Boehm's Quality Model.
3. Dromey's Quality Model.
4. FURPS Quality Model.
5. ISO 9126 Quality Model.

In addition, we will focus on a comparison between these quality models, and find the key differences between them.

The rest of this paper is structured as follows: Section 2 presents an overview of the five common quality models used in software engineering. Section 3 contains a detailed analysis and comparison between the five quality models. Finally, Section 4 concludes the paper with some comments.

2. An Overview of the Software Quality Models

2.1 McCall's Quality Model

McCall's Quality Model (also known as the General Electrics Model of 1977) is one of the most known quality models in the software engineering literature. It has been presented by Jim McCall et al. [1977]. This model originates from the US military and is primarily aimed towards the system developers and the system development

process [McCall et al, 1977]. Using this model, McCall attempts to bridge the gap between users and developers by focusing on a number of software quality factors that reflect both the users' views and the developers' priorities [McCall et al, 1977].

The structure of the McCall's quality model consists of three major perspectives (types of quality

characteristics) for defining and identifying the quality of a software product, and each of these major perspectives consists of a number of quality factors. Each of these quality factors has a set of quality criteria, and each quality criteria could be reflected by one or more metrics, see Figure 1 for the details of the McCall's quality model structure. The contents of the three major perspectives are the following:

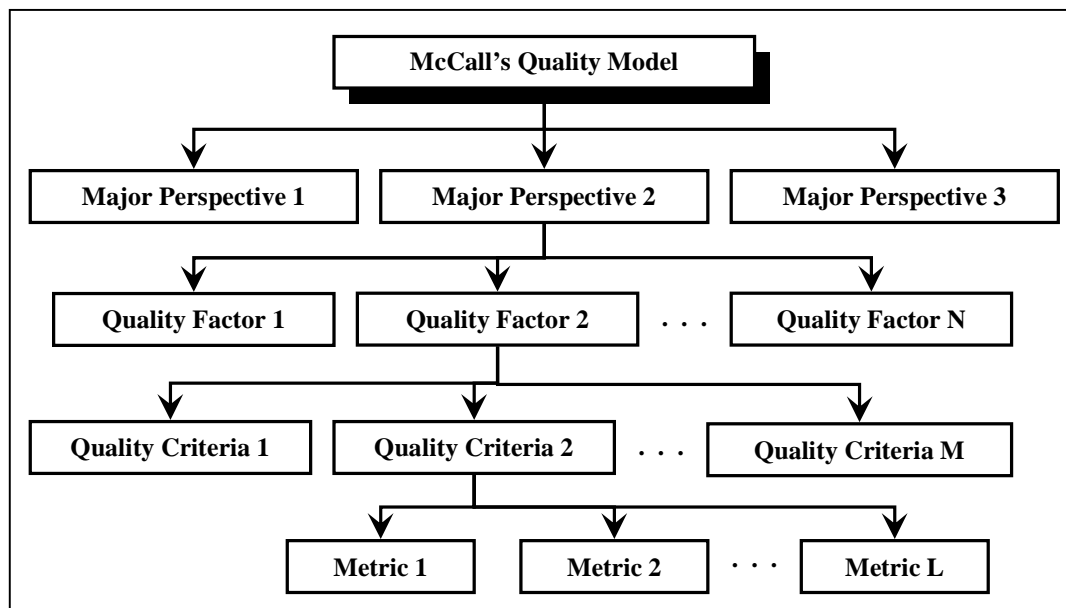


Figure 1. The structure of McCall's quality model

1. Product Revision: it is about the ability of the product to undergo changes, and it includes:
 - a. Maintainability: the effort required to locate and fix a fault in the program within its operating environment.
 - b. Flexibility: the ease of making changes required by changes in the operating environment.
 - c. Testability: the ease of testing the program, to ensure that it is error-free and meets its specification.
2. Product Operations: it is about the characteristics of the product operation. The quality of the product operations depends on:
 - a. Correctness: the extent to which a program fulfils its specification.
 - b. Reliability: the system ability not to fail.
 - c. Efficiency: it further categorized into execution efficiency and storage efficiency and generally meaning the use of resources, e.g. processor time, storage.
 - d. Integrity: the protection of the program from unauthorized access.
 - e. Usability: the ease of the use of the software.

3. Product Transition: it is about the adaptability of the product to new environments. It is all about:
 - a. Portability: the effort required to transfer a program from one environment to another.
 - b. Reusability: the ease of reusing software in a different context.
 - c. Interoperability: the effort required to couple the system to another system.

In more details, McCall's Quality Model consists of 11 quality factors to describe the external view of the software (from the users' view), 23 quality criteria to describe the internal view of the software (from the developer's view) and a set of Metrics which are defined and used to provide a scale and method for measurement. Table 1 presents two of the three major perspectives and their corresponding quality factors and quality criteria.

The main objective of the McCall's Quality Model is that the quality factors structure should provide a complete software quality picture [Kitchenham, 1996]. The actual quality metric is computed by answering "yes" and "no" questions. However, if answering equally amount of "yes" and

“no” on the questions measuring a quality criteria, then you will achieve 50% on that quality criteria.

Table 1. The contents of McCall’s quality model - product revision and product operations

Major Perspectives	Quality Factors	Quality Criteria
Product revision	Maintainability	Simplicity
		Conciseness
		Self-descriptiveness
		Modularity
	Flexibility	Self-descriptiveness
		Expandability
		Generality
	Testability	Simplicity
		Instrumentation
		Self-descriptiveness
		Modularity
Product operations	Correctness	Traceability
		Completeness
		Consistency
	Efficiency	Execution efficiency
		Storage efficiency
	Reliability	Consistency
		Accuracy
		Error tolerance
	Integrity	Access control
		Access audit
	Usability	Operability
		Training
		Communicativeness

2.2 Boehm’s Quality Model

Boehm [1976, 1978] introduced his quality model to automatically and quantitatively evaluate the quality of software. This model attempts to qualitatively define the quality of software by a predefined set of attributes and metrics. It consists of high-level characteristics, intermediate-level characteristics and lowest-level (primitive)

characteristics which contribute to the overall quality level (see Figure 2).

In this model, the high-level characteristics represent basic high-level requirements of actual use to which evaluation of software quality could be put. In its high-level, there are three characteristics, that is [Boehm et al, 1976, Boehm et al, 1978]:

1. As-is utility: to address how well, easily, reliably and efficiently can I use the software product as-is?
2. Maintainability: to address how easy is it to understand, modify and retest the software product?
3. Portability: to address if can I still use the software product when the environment has been changed?

Table 2 shows the contents of the Boehm’s quality model in the three levels, high-level, intermediate-level and lowest-level characteristics. In addition, it is noted that there is a number of the lowest-level characteristics which can be related to more than one intermediate-level characteristics, for example, the ‘Self Contentedness’ primitive characteristic could be related to the ‘reliability’ and ‘portability’ primitive characteristics.

In the intermediate level characteristic, there are seven quality characteristics that together represent the qualities expected from a software system [Boehm et al, 1976, Boehm et al, 1978]:

1. Portability: the software can be operated easily and well on computer configurations other than its current one.
2. Reliability: the software can be expected to perform its intended functions satisfactorily.
3. Efficiency: the software fulfills its purpose without waste of resources.
4. Usability: the software is reliable, efficient and human-engineered.
5. Testability: the software facilitates the establishment of verification criteria and supports evaluation of its performance.
6. Understandability: the software purpose is clear to the inspector.
7. Flexibility: the software facilitates the incorporation of changes, once the nature of the desired change has been determined.

The primitive characteristics can be used to provide the foundation for defining quality metrics, this use is one of the most important goals established by Boehm when he constructed his quality model. One or more metrics are supposed to measure a given primitive characteristic. Boehm [1978] defined the ‘metric’ as “a measure of extent or degree to which a product possesses and exhibits a certain (quality) characteristic.”

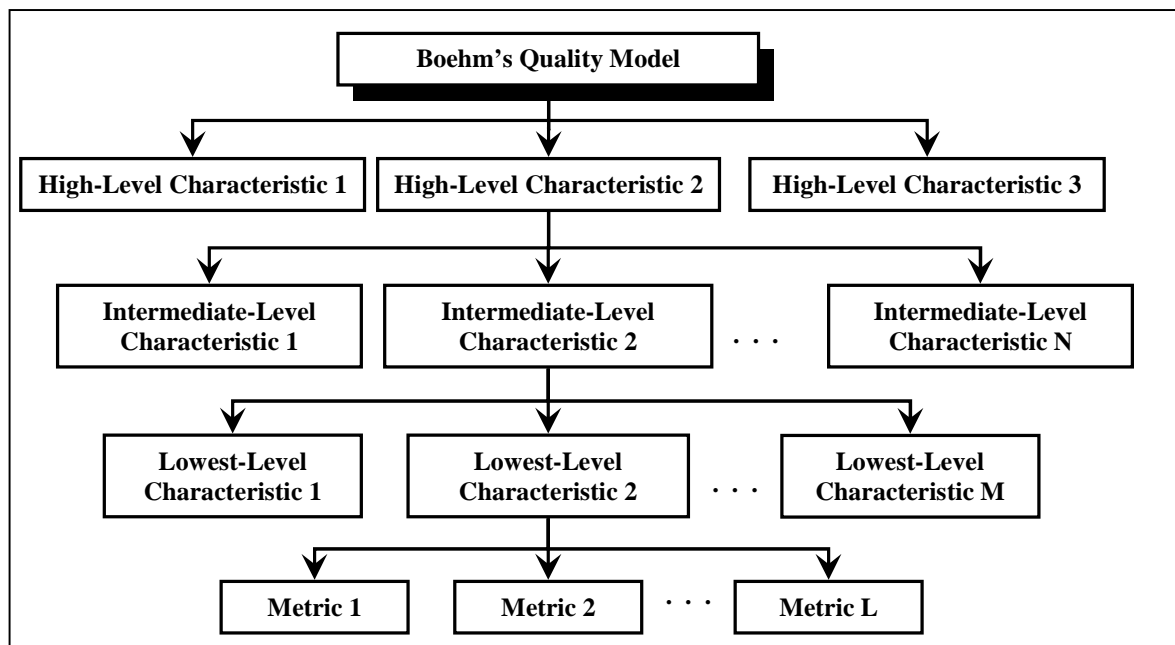


Figure 2. The structure of Boehm's quality model

Table 2. The contents of Boehm's quality model

High-Level Characteristics	Intermediate-Level Characteristics	Primitive Characteristics
As-is Utility	Reliability	Self Containedness Accuracy Completeness Robustness/Integrity Consistency
	Efficiency	Accountability Device Efficiency Accessibility
	Human Engineering	Robustness/Integrity Accessibility Communicativeness
Portability		Device Independence Self Containedness
Maintainability	Testability	Accountability Communicativeness Self Descriptiveness Structuredness
	Understandability	Consistency Structuredness Conciseness Legibility
	Modifiability	Structuredness Augmentability
3 High-Level Characteristics	7 Intermediate-Level Characteristics	15 Distinct Primitive Characteristics

2.3 Dromey's Quality Model

This quality model has been presented by Dromey [1995, 1996]. It is a product based quality model that recognizes that quality evaluation differs for each product and that a more dynamic idea for modeling the process is needed to be wide enough to

apply for different systems [Dromey, 1995]. Furthermore, Figure 3 shows that it consists of four software product properties and for each property there is a number of quality attributes. In addition, figure 4 shows the contents of the Dromey's quality model.

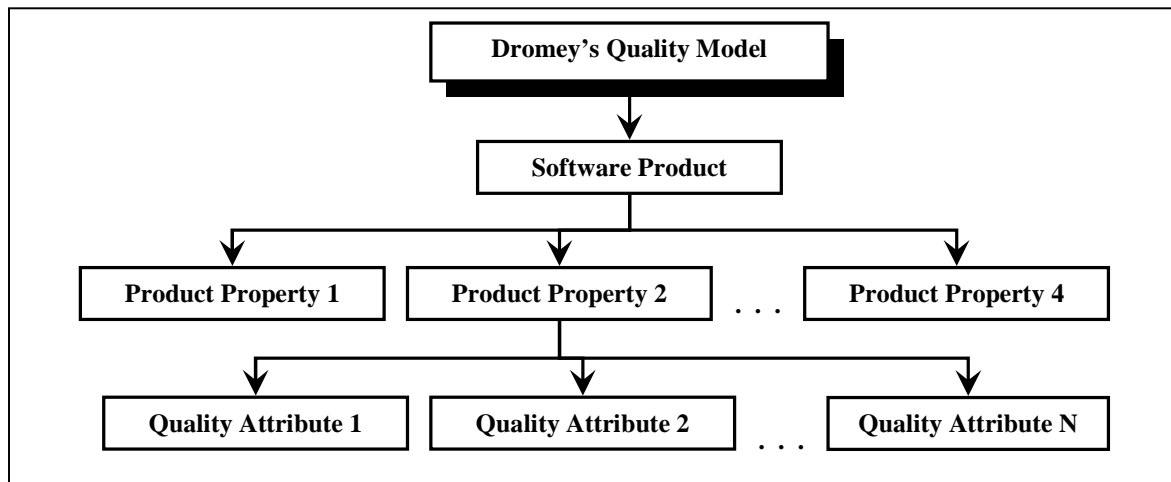


Figure 3. The structure of Dromey's quality model

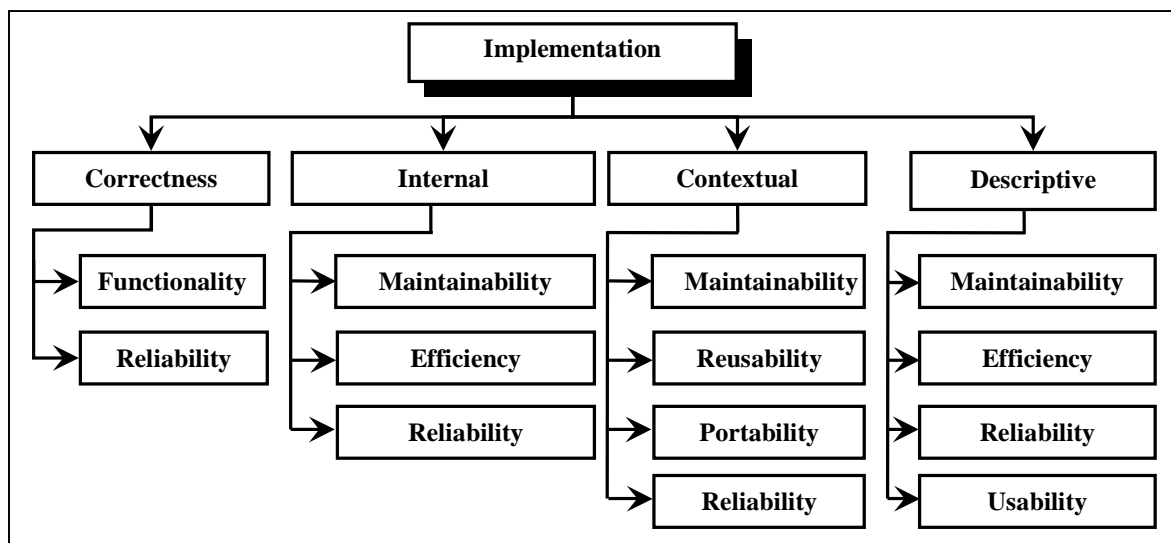


Figure 4. The contents of Dromey's quality model

2.4 FURPS Quality Model

The FURPS model originally presented by Robert Grady[1992], then it has been extended by IBM Rational Software [Jacobson et al, 1999, Kruchten, 2000] into FURPS+, where the '+' indicates such requirements as design constraints, implementation requirements, interface requirements and physical requirements [Jacobson et al, 1999].

In this quality model, the FURPS stands for [Grady, 1992] - as in Figure 5 - the following five characteristics:

1. Functionality: it may include feature sets, capabilities, and security.
2. Usability: it may include human factors, aesthetics, consistency in the user interface, online and context sensitive help, wizards and

- agents, user documentation, and training materials.
3. Reliability: it may include frequency and severity of failure, recoverability, predictability, accuracy, and mean time between failures (MTBF).
 4. Performance: it imposes conditions on functional requirements such as speed, efficiency, availability, accuracy, throughput, response time, recovery time, and resource usage.
 5. Supportability: it may include testability, extensibility, adaptability, maintainability, compatibility, configurability, serviceability, installability, and localizability.

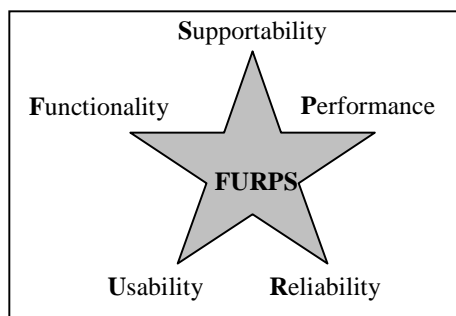


Figure 5. The contents of FURPS quality model

2.5 ISO 9126 Quality Model

In 1991, the ISO published its first international consensus on the terminology for the

quality characteristics for software product evaluation; this standard was called as Software Product Evaluation - Quality Characteristics and Guidelines for Their Use (ISO 9126) [ISO, 1991]. From 2001 to 2004, the ISO published an expanded version, containing both the ISO quality models and inventories of proposed measures for these models. The current version of the ISO 9126 series now consists of one International Standard (IS) and three Technical Reports (TRs):

1. ISO IS 9126-1: Quality Model [ISO, 2001].
2. ISO TR 9126-2: External Metrics [ISO, 2003].
3. ISO TR 9126-3: Internal Metrics [ISO, 2003].
4. ISO TR 9126-4: Quality in Use Metrics [ISO, 2004].

The first document of the ISO 9126 series – Quality Model – contains two-parts quality model for software product quality [ISO, 2001]:

1. Internal and external quality model.
2. Quality in use model.

The first part of the two-parts quality model determines six characteristics in which they are subdivided into twenty-seven sub-characteristics for internal and external quality, as in Figure 6 [ISO, 2001]. These sub-characteristics are a result of internal software attributes and are noticeable externally when the software is used as a part of a computer system. The second part of the two-part model indicates four quality in use characteristics, as in Figure 7 [ISO, 2001].

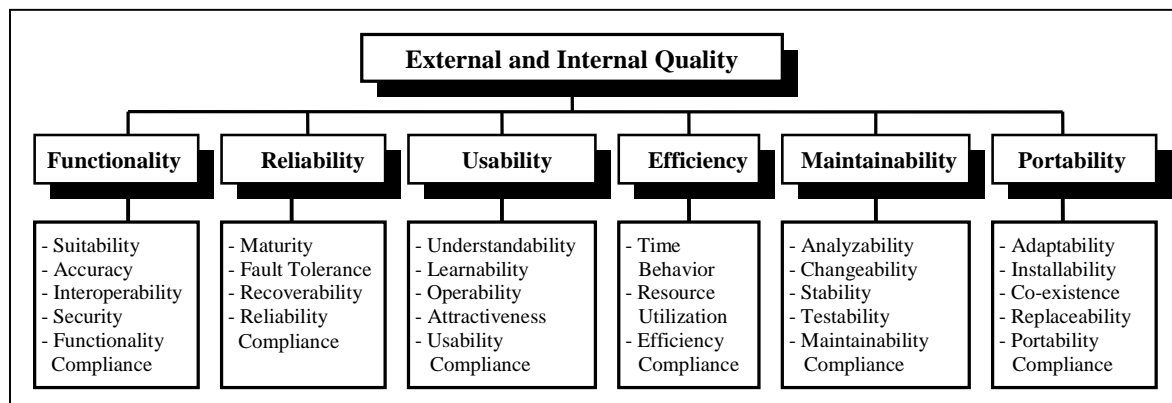


Figure 6. ISO 9126 quality model for external and internal quality (characteristics/sub-characteristics) [ISO, 2001]

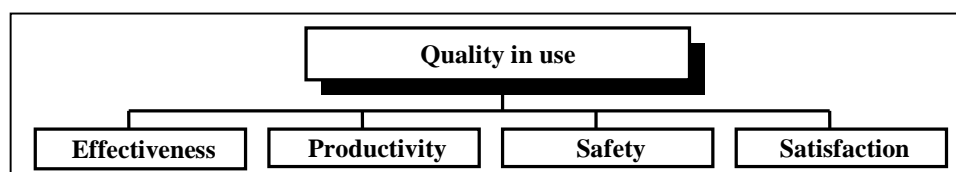


Figure 7. ISO 9126 quality model for quality in use (characteristics) [ISO, 2001]

Figure 8 shows the ISO view of the expected relationships between internal, external, and quality in use attributes. The internal quality attributes influence on the external quality attributes while the external attributes influences on the quality in use attributes. Furthermore, the quality in use depends on

the external quality while the external quality depends on the internal quality [ISO, 2001].

For the internal and external software products, each quality characteristics and its corresponding sub-characteristics are defined in ISO 9126-1 [ISO, 2001] as follows:

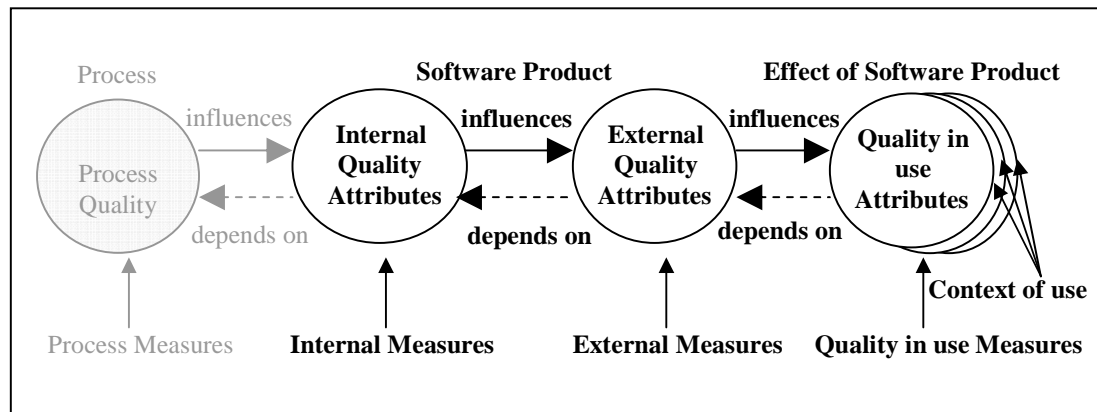


Figure 8. Quality in the lifecycle [ISO, 2001]

1. **Functionality**: “the capability of the software product to provide functions which meet stated and implied needs when the software is used under specified conditions”. It contains the following sub-characteristics:
 - a. **Suitability**: “the capability of the software product to provide an appropriate set of functions for specified tasks and user objectives”.
 - b. **Accuracy**: “the capability of the software product to provide the right or agreed results or effects with the needed degree of precision”.
 - c. **Security**: “the capability of the software product to protect information and data so that unauthorised persons or systems cannot read or modify them and authorised persons or systems are not denied access to them”.
 - d. **Interoperability**: “the capability of the software product to interact with one or more specified systems”.
 - e. **Functionality Compliance**: “the capability of the software product to adhere to standards, conventions or regulations in laws and similar prescriptions relating to functionality”.
2. **Reliability**: “The capability of the software product to maintain a specified level of performance when used under specified conditions”. It includes the following sub-characteristics:
 - a. **Maturity**: “the capability of the software product to avoid failure as a result of faults in the software”.
 - b. **Fault tolerance**: “the capability of the software product to maintain a specified level of performance in cases of software faults or of infringement of its specified interface”.
 - c. **Recoverability**: “the capability of the software product to re-establish a specified level of performance and recover the data directly affected in the case of a failure”.
 - d. **Reliability Compliance**: “the capability of the software product to adhere to standards, conventions or regulations relating to reliability”.
3. **Usability**: “the capability of the software product to be understood, learned, used, and attractive to the user, when used under specified conditions”. It contains the following sub-characteristics:
 - a. **Understandability**: “the capability of the software product to enable the user to understand whether the software is suitable, and how it can be used for particular tasks and conditions of use”.
 - b. **Learnability**: “the capability of the software product to enable the user to learn its application”.
 - c. **Operability**: “the capability of the software product to enable the user to operate and control it”.
 - d. **Attractiveness**: “the capability of the software product to be attractive to the user”.
 - e. **Usability Compliance**: “the capability of the software product to adhere to standards,

- conventions, style guides or regulations relating to usability”.
4. Efficiency: “the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions”. It includes the following sub-characteristics:
 - a. Time behaviour: “the capability of the software product to provide appropriate response and processing times and throughput rates when performing its function, under stated conditions”.
 - b. Resource behaviour: “the capability of the software product to use appropriate amounts and types of resources when the software performs its function under stated conditions”.
 - c. Efficiency Compliance: “the capability of the software product to adhere to standards or conventions relating to efficiency”.
 5. Maintainability: “the capability of the software product to be modified. Modifications may include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications”. It contains the following sub-characteristics:
 - a. Analyzability: “the capability of the software product to be diagnosed for deficiencies or causes of failures in the software, or for the parts to be modified to be identified”.
 - b. Changeability: “the capability of the software product to enable a specified modification to be implemented”.
 - c. Stability: “the capability of the software product to avoid unexpected effects from modifications of the software”.
 - d. Testability: “the capability of the software product to enable modified software to be validated”.
 - e. Maintainability Compliance: “the capability of the software product to adhere to standards or conventions relating to maintainability”.
 6. Portability: “the capability of the software product to be transferred from one environment to another”. It includes the following sub-characteristics:
 - a. Adaptability: “the capability of the software product to be adapted for different specified environments without applying actions or means other than those provided for this purpose for the software considered”.
 - b. Installability: “the capability of the software product to be installed in a specified

environment”.

- c. Co-existence: “the capability of the software product to co-exist with other independent software in a common environment sharing common resources”.
- d. Replaceability: “the capability of the software product to be used in place of another specified software product for the same purpose in the same environment”.
- e. Portability Compliance: “the capability of the software product to adhere to standards or conventions relating to portability”.

3. Analysis of the Quality Models

In this section, a comparison between the availability of the characteristics (called factors or attributes in some quality models) within the five quality models will be presented. Table 3 presents this comparison, at the end this table you will find the number of the corresponding characteristics for each quality model.

From the 17 characteristics, only one characteristic is common to all quality models, that is, the ‘reliability’. Also, there are only three characteristics (i.e. ‘efficiency’, ‘usability’ and ‘portability’) which are belonging to four quality models. Two characteristic is common only to three quality models, that is, the ‘functionality’ and ‘maintainability’ characteristics. Two characteristic belong to two quality models, that is, the ‘testability’ and ‘reusability’ characteristics. And, nine characteristics (i.e. ‘flexibility’, ‘correctness’, ‘integrity’ and ‘interoperability’ in McCall’s quality model; ‘human engineering’, ‘understandability’ and ‘modifiability’ in Boehm’s quality model; ‘performance’ and ‘supportability’ in FURPS quality model) are defined in only one quality model.

Furthermore, it can be noted that the ‘testability’, ‘interoperability’ and ‘understandability’ are used as factors/attributes/characteristics in some quality models. However, in ISO 9126-1, these factors/attributes/characteristics are defined as sub-characteristics. More specifically, the ‘testability’ is belonging to the ‘maintainability’ characteristic, the ‘understandability’ is belonging to the ‘usability’ characteristic, and the ‘interoperability’ is belonging to the ‘functionality’ characteristic.

From our point of view, the ISO 9126-1 quality model is the most useful one since it has been built based on an international consensus and agreement from all the country members of the ISO organization.

Table 3. A comparison between the five quality models

Factors/Attributes/Characteristics	McCall	Boehm	Dromey	FURPS	ISO 9126
Maintainability	✓		✓		✓
Flexibility	✓				
Testability	✓	✓			
Correctness	✓				
Efficiency	✓	✓	✓		✓
Reliability	✓	✓	✓	✓	✓
Integrity	✓				
Usability	✓		✓	✓	✓
Portability	✓	✓	✓		✓
Reusability	✓		✓		
Interoperability	✓				
Human Engineering		✓			
Understandability		✓			
Modifiability		✓			
Functionality			✓	✓	✓
Performance				✓	
Supportability				✓	
17	11	7	7	5	6

4. Discussion

There are a number of quality models in software engineering literature, each one of these quality models consists of a number of quality characteristics (or factors, as called in some models). These quality characteristics could be used to reflect the quality of the software product from the view of that characteristic. Selecting which one of the quality models to use is a real challenge. In this paper, we have discussed and compared the following quality models:

1. McCall's Quality Model.
2. Boehm's Quality Model.
3. Dromey's Quality Model.
4. FURPS Quality Model.
5. ISO 9126 Quality Model.

Based on the discussion of the five quality models and on the comparison between them, the following comments could be written:

1. In McCall's quality model, the quality is subjectively measured based on the judgment on the person(s) answering the questions ('yes' or

'no' questions).

2. Three of the characteristics are used in the ISO 9126-1 quality model as sub-characteristics from other characteristics.
3. The FURPS quality model is built and extended to be used in the IBM Rational Software Company. Therefore, it is a special-purpose quality model, that is, for the benefits of that company.
4. The metrics in the lower level of the McCall's, Boehm's, Dromey's and FURPS quality models are neither clearly nor completely defined and connected to the upper level of the quality models. For example, in McCall's quality model, the metrics should be clearly and completely defined and connected to the corresponding quality criteria, see Figure 1.

The ISO 9126-1 quality model is the most useful one since it has been built based on an international consensus and agreement from all the country members of the ISO organization.

Corresponding Author:

Dr. Rafa E. Al-Qutaish

Al Ain University of Science and Technology – Abu Dhabi Campus, P.O. Box: 112612, Abu Dhabi, UAE.

E-mail: rafa@ieee.org

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The Cost of Climate Change in Tanzania: Impacts and Adaptations

Ceven Shemsanga¹ Anne Nyatichi Omambia¹, Yansheng Gu¹

¹ School of Environmental Studies, China University of Geosciences, Wuhan
388 Lumo Road, Wuhan, 430074, Hubei Province, P.R. China. 7ceven@gmail.com

Abstract: In recent years, Tanzania has witnessed a number of climate related disasters namely, flooding, droughts, widespread crop failures, livestock deaths and intensification of climate sensitive diseases among others. Regular climate discussions in the country have often underestimate crucial problems related to climate change like chronic energy crisis and influx of people to urban areas arguably because of failing agriculture in farming areas. This paper has highlighted the fact that the poor, usually with limited resources and who contribute the least to the causes of climate change are the most affected in many ways. In addition, it gives a detailed account of the issues of climate change in Tanzania and explains the effects of climate variability using examples. The effects of climate change in the country are widespread and significantly interfere with agriculture, while at the same time, reducing the ability of the society to deliver services. Indigenous knowledge such as survival skills and coping mechanisms adopted by different societies in Tanzania, have been discussed in the paper. Such coping mechanisms however are overwhelmed by the impacts of climate change on the people. Different institutions including the government have taken some positive steps towards combating climate change; however the efforts done so far are insufficient. In addition, addressing climate change in Tanzania is hindered with inadequate resources, corruption and poor coordination and implementation of combating measures. Generally current climate variability in the nation is an issue of concern for all future plans and must be addressed. [Journal of American Science 2010; 6(3):182-196]. (ISSN: 1545-1003).

Keywords: Climate change, Tanzania, Adaptations, Responses.

1.0. Introduction

Human development, especially industrialization has led to an increase in greenhouse gases (GHGs) into the atmosphere that has resulted to weather changes (IPCC, 2007). Arguably, two major problems facing the world today are global climate change and population growth, the link between the two being food quality and quantity. Unfortunately climate change has badly affected food availability and many people find it hard to meet their basic needs (IPCC, 2001, Mwandosya, et al., 1998).

Until recently, many people had considered climate change impacts to be only potential effects and/or of a few isolated cases (places and individuals). However, it is increasingly clear that climate change is happening now, and widespread to the extent that humanity is not prepared for and must act. Today, few individuals deny the facts and impacts of climate change to humanity compared to a few decades ago (IPCC, 2001, 2007). As a result, scientists, economists and politicians across the world are trying to agree on the best way forward in dealing with climate variability. Climate change impacts have direct consequences on the economy, ecosystems, water resources, weather events, health issues, desertification, sea level rise (IPCC, 2001) and even on political and social stability like displacement of people and conflicts (Christian Aid, 2006). The impacts of climate variability in

developing countries are numerous; for example, the recent drought in Kenya has resulted into unprecedented water shortages and triggered inter-communal conflicts and misunderstandings with neighboring Uganda (Ibid). The unrest are not limited to Kenya and Uganda, they are increasingly widespread in many places like Somalia, Ethiopia (Ibid), Tanzania (URT, 2007) among others. Climate change is already projected to result into 50 million environmental refugees as early as 2010 (Myers, 1993). Consequently, countries that had historically found it difficult to compromise economic development for climate change have joined into the international efforts to combat the variability. Traditionally, developing countries, including the emerging economies like India, China and Brazil have argued that they contributed less to the climate change causes and are still poor to be held responsible in combating measures, which often include some economic sacrifices (IPCC, 2007). While such arguments are true, they are not helpful as almost everywhere today the effects of climate change are increasing. Studies have shown that climate change will cause more casualties in developing countries than developed countries on account that those countries tend to have fewer resources to cope with the effects and generally live in vulnerable locations (IPCC, 2001, 2007). African countries are especially vulnerable to the effects of climate change because of the over-

dependence of rain-fed agriculture, recurrent droughts, inadequate land distribution and policies, and widespread poverty (Ibid). Poor people are particularly vulnerable because poverty is associated with high reliance on natural resources which are already impacted by climate change and in turn it constrains community's adaptive options. In developing countries like Tanzania, major pressing issues like food security, poverty, and water availability are all interconnected with climate change.

However, climate change effects impact different groups of the societies differently. In Tanzania, consequences of climate change have even taken a gender dimension in which women are seen to be more vulnerable on account of deep-rooted socio-economical and historical barriers (Lambrou and Piana, 2005). Climate change in Tanzania is also linked to increasing problem of plant toxicity to livestock and potentially to man. In the recent past, significant losses of livestock during drought episodes were linked to plant toxicity (Ngomuo, et al., 2001). Studies in other parts of the world also indicate that the problem of plant poisoning is worsened and/or triggered by climate change, specifically drought (Thurrow and Taylor, 1999).

Probably, the worst impact of climate variability in Tanzania is its interference with food security (URT, 2003). Today climate change plays a diminishing role in nearly all value chains in Tanzania including to more than 90 % of the population dependent on agriculture or agricultural related activities. Agriculture in the country largely depends on rainfall which is increasingly becoming unpredictable and unreliable with worsening climate change impacts. In addition, some societies in Tanzania namely, Masaai, Barabaig and Nyaturu have their livelihood largely dependent on livestock husbandry (URT, 2003, 2007). Livestock sector in the country is among the worst hit by the climate variability via repeated droughts. Food insecurity most times renders working populations weak and unable to work in the fields for the next harvests hence any food shortage outbreak could have long term effects. Malnutrition from food shortage, which is already seen as a direct consequence of climate change in the country, decreases immunity and expose the affected to opportunistic diseases that would otherwise be resisted. Reliable water availability, whether in the form of rain or water sources is also linked to human health and generally economic stability of families. Shortage of water for agriculture and domestic use is often followed by sky-rocketing food price and outbreak of disease like malaria,

Cholera, diarrhea, typhoid, all of which are climate sensitive (Yanda, 2005).

Climate change in Tanzania will have many more negative impacts to the population. Increased CO₂ concentration in vegetation will decrease protein content with consequences to both livestock and human health; in addition it will cause a decline in environmental services like water and biodiversity. High sea temperatures will disrupt marine ecosystems and increased evapo-transpiration rate whilst heat stress to plants will reduce crop yields. On the other hand, salt water incursion and sea level rise will disrupt water supplies, further damage ecosystems, accelerate loss of land and undermine agriculture among others (Mwandosya, et al., 1998). Worth noting, these effects are already being felt in many places in the country.

1.1 Country background information

1.1.1 Location

Tanzania is the largest country in East Africa, covering an area of 945,200 km², 60,000 of which is inland water. Tanzania lies close to the equator in the East Coast of Africa between parallel 1°S and 12°S and meridians 30°E and 40°E (Fig. 1). By being close to the equator, the climate variations in temperature are not very extreme. Tanzania's area includes island areas of Pemba, Zanzibar, Mafia and a narrow coastal line strip. Apart from a small belt along the coast of about 800km² which is less than 200m a.s.l., the rest of the country is well above 1000m a.s.l. Tanzania extends from Lake Tanganyika in the West to the Indian Ocean in the East. Lake Nyasa and River Ruvuma are in the South whilst Lake Victoria is found in the North. It borders Uganda (North), Rwanda and Burundi (North-West), Malawi and Zambia (South-West), Mozambique (South), Kenya (North-East) and Indian Ocean (East) (URT, 2007).

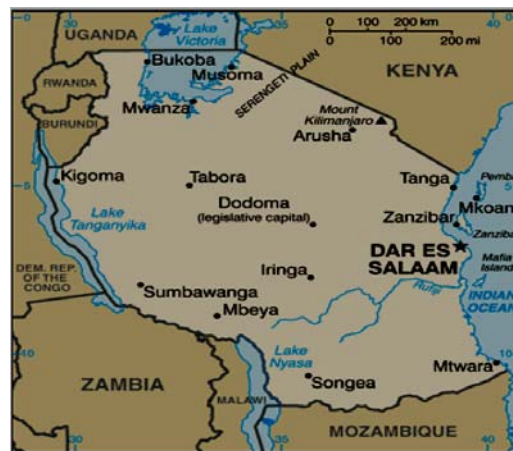


Figure 1: The map of Tanzania showing location and neighbors
Tanzania is among top African countries in terms of biodiversity of both flora and fauna

1.1.2 Biodiversity and natural resources

species in its terrestrial and marine ecosystems. It has numerous vegetation cover distributed along the diverse landscapes. Its characteristic geographic location, i.e. located close to the equator and elevation ranging from sea level to Africa's highest point (5985m a.s.l), makes Tanzania home to a number of endemic plants and animal species most of which are of world importance. It has very rare ecosystems in several of its natural forests namely East and West Usambara, Kilimanjaro National Park and spectacular wildlife ecosystems in the Serengeti, Ngorongoro, Mikumi, Manyara, Tarangire, Selous nature reserves to mention just a few. Tanzania is home to more than a third of total plants species in Africa (UNEP, 1998). In all, it has more than 12,700 plants species unevenly distributed across the country. In summary, the biodiversity and the degree of endemism of animal species are made up of primates (20 species, 4 of which are endemic), antelopes (34 species and 2 endemic) fish (with many endemic in Lake Victoria, Tanganyika and Nyasa and other small lakes and rivers), reptiles (290 species, 75 of which are endemic), amphibians (40 endemic), invertebrates and plants around 11,000 species including many endemic (URT, 2007). The great Mount Kilimanjaro with its glaciated peak is iconic and a major socio-economic asset for Tanzania. Tanzania is also among the richest countries in terms of geological deposits of useful minerals such as gold, diamond and tanzanite, the latter only found in Tanzania (Mwandosya, et al, 1998).

1.1.4 Land use and climate

Proportionally, Tanzania has larger protected land areas (29% of the total land size) than most of African countries. The protected areas comprises of important ecosystems including 12 national parks, 28 game reserves, the Ngorongoro conservation area, and 38 game-controlled areas, the total of which is 240,000 km². Moreover, it has 540 forest reserves covering an area 132,000 km² (15% of the total wood land of Tanzania). About 42% of the land is under some form of cultivation whilst 26% of the land is infected by tsetse flies thus rendered unusable for livestock and agricultural activities (UNEP, 1998).

As a result of its geographic position and geological features again, Tanzania has interesting climate patterns. It has a mixture of climatic conditions from tropical (coastal areas) to temperate and alpine deserts (on slopes of Mount Kilimanjaro). The north-east monsoon wind blows from December to March bringing the hot weather, whilst the southeast monsoon winds blow from March to September bringing intermittent rains. Across the country, temperature and precipitation vary between (20°C to 32°C) and 600mm to

1800mm) respectively. The mean duration of the dry season is between 5 to 6 months.

In Tanzania altitude is an important factor in rainfall patterns; higher elevations usually receive more precipitation than lower ones. Tanzania has both bimodal and unimodal rainfall patterns. The former, consisting of long rains (locally referred to as *Masika*) come between March to May and short rains, (*Vuli*), between October to December. According to Mwandosya, et al., 1998, however, the total amount of rainfall is not so much. Only about half of the country receives more than 762 mm of rainfall annually. Variations in rainfall in the country are strongly related to the sea surface temperature variations (SST) in the Indian and the Atlantic Oceans which may sometimes alter standard oscillation outcomes (Paavola, 2003). Moreover, the climate of Tanzania is also greatly influenced by El Niño and La Nina both of which have serious climatic problems. In Tanzania, the first and second years of El Nino brings less and more than usual amount of rainfall. Like in the rest of Africa, La Nina reduces rainfall in the first year and increases it in the second year. This alteration results into flooding and drought, the commonest climatic hazards in the country (Ibid).

2.0. Overview of climate change in Tanzania

The wider global climate change trends are greatly reflected in Tanzania's climate. Because of her geographical location and the topographical characteristics, the country offers the best opportunity to study and further understand global climate trends. Recent researches have suggested that, alongside other East African countries, climate change has badly affected the country. Deteriorating water quality and quantity, loss of biodiversity and declining agricultural productivity due to climate change, are no longer potential threats but rather threats that have already struck and caused Tanzanians repeated misery (Yanda, 2005).

Studies show that in Tanzania mean annual temperatures and average daily temperatures will rise by between 2 to 4°C by 2075 as a direct consequence of climate change (URT, 2003). Putting Tanzania into a wider African context however, it is projected to warm up less than many countries notably north-western and southern Africa (URT, 2007). Interestingly, the interior parts of the country are projected to face higher temperature increases than coastal areas whilst cold and dry seasons will warm more than warm and wet seasons (Mwandosya, et al., 1998).

Apart from temperature data, change in rainfall patterns is likely to be more torturous and with immediate severe effects. In Tanzania, rainfall models indicate that rainfall will become less predictable and their intensity more volatile (IPCC,

2001). Tanzania expects to have a decrease in rainfall by between 0 to 20% in the inner parts of the land. Northeast, southeast and the Lake Victoria basin however, expects to have a total increase in rainfall by between 20 to 50% (Mwandosya, et al., 1998, Hulme, et al., 2001). Such major changes in rainfall patterns will inevitably have severe consequences to the society, some of which (repeated droughts and floods) are already happening (Ibid).

Recent studies on climate change in Tanzania show that there will be an increase in extreme weather events (URT, 2003). The extreme weather events in Tanzania are associated with flooding, droughts, cyclones, tropical storms all of which are projected to be more intense, frequent and unpredictable (Ibid). The vulnerability of the country to extreme weather events can specifically be looked at in terms of the recurring drought conditions and the recent El Niño seasons of 1992-1993 and 1997-1998. In terms of impacts to the society, the named El Niño episodes were very significant because they were accompanied with heavy socio-economic losses. The episodes resulted into nationwide power blackout and rationing, food shortages and sky rocketing prices, massive losses of livestock and agricultural crops (Paavola, 2003). Consequently, the government had to introduce emergency food aids to many parts of the country during which families walked for up to 50kms to receive their handouts. Most importantly, the El Niño resulted into widespread of diseases namely malaria, diarrhea and cholera which added economic hardships to the government and families. Moreover, there were widespread infrastructural, human settlements, livelihood and other property damages all of which overwhelmed the country and its people (URT, 2003).

Regardless of her low level of development, Tanzania has its contribution to global warming. The major ways by which Tanzania contributes to climate change include deforestation, large animal herds with accompanied overgrazing, mining activities, air pollution especially from industries, and vehicles, land use changes, and waste management especially poor solid waste collection and disposal mechanisms. Generally however, Tanzania's contribution to causes of climate change is generally very low compared to other countries. In terms of contribution by sector, land use change in the country contributes more to the problems than fossil fuel emission primarily because of its low level of development. Thus, efforts to combat climate variability in the country will have to focus more on land use change sector (UNEP, 1999). On the other side, Tanzania contributes significantly in carbon sinking/sequestration via its massive ocean environment, wetlands, forests and land.

To best explain the cost of climate change impacts and adaptations in Tanzania, it is best to look at it in the following contexts.

2.1. Health sector

It is already known that climate variability plays a central role in the geographical distribution and reproduction of vectors responsible for a number of diseases in Tanzania (URT, 2007). According to Lindsay and Martens, (1998) distribution of vector borne diseases in humans is limited by too cold temperatures, thus the increasing global warming pauses an eminent risk to human life via infectious diseases epidemics, and other health risks like heat stress to bio-forms. For example, the climate sensitive diseases, such as cholera, malaria, rift valley fever (Paavola, 2003) and meningitis were all eminent during the El Niño season of 1992-1993. Yet warmer climate will increase water born diseases like schistosomiasis and trypanosomiasis, whilst elevated frequency of flooding and drought would increase water borne diseases like typhoid and cholera (Paavola, 2003, URT, 2007). Although climate change has resulted to many health complications in Tanzania (URT, 2003, 2007), two major diseases namely malaria and cholera (which affects many people and have wider socio-economic implications to Tanzania) have been discussed in this paper.

2.1.1. Malaria

Inter-governmental Panel on Climate Change (IPCC, 2001) conclusion show that more than 90% of global mortality due to malaria occurs in Africa i.e. up to 1 million deaths annually. Malaria is the number one killer of children, pregnant women and the elderly on the continent (IPCC, 2007). It is also the leading cause of infant mortality (20%) and constitutes 10% of the continent's overall disease burden (Ibid).

Malaria is the most important public health concern in Tanzania, especially so in children under five years of age and among pregnant women (four times more likely to suffer from malaria than the average population). Tanzania squarely lies in the malaria zone (MOH, 1997) and thus very vulnerable to the disease. The disease accounts for 16.7% of all reported deaths and is one of the leading causes of morbidity, ranging from 24.4% in Rukwa region to 48.9% in Dar es Salaam (URT, 2003, 2007). Likewise, it is a leading cause of morbidity in both outpatient attendance and inpatient admissions, responsible for up to 40% of overall outpatient attendances (MOH, 1997).

Malaria is a tropical disease caused by four different species of *Plasmodium species*. The commonest and most dangerous species of the plasmodium in Tanzania being *Plasmodium falciparum* (MOH, 1997). The latter is known to

cause cerebral malaria. The parasites are transmitted from one person to another via female anopheles mosquitoes. Transmission depends upon the number of times the infected mosquito bites and duration of the mosquito lifespan which is largely a function of climatic conditions. Survival of adult *anopheles* is usually influenced by variables like temperature, humidity and rainfall (Craig, et al., 2004). Rainfall and drought influence breeding habitats for Anopheles. The former forms new stagnant water pools whilst the latter results into reduction in water volume of water bodies, e.g. streams, rivers and lakes to form many pools of stagnant water which in turn favours mosquito multiplication. Maximum larval development of anopheles mosquitoes occurs at 28°C whilst an adult anopheles develops best at around 32°C. Thus, temperature plays an important role in aquatic development stage of anopheles mosquitoes. In recent years in Tanzania more cases of malaria have been reported due to continuing warming up across the country including in highland areas (URT, 2007).

In places where anopheles mosquitoes cannot survive there is no transmission of malaria. Statistics show that in East African highlands, there had not been a recorded malaria epidemic between 1960s to early 1980s. However over the last two decades, there have been widespread cases of recorded malaria in the areas. Malaria cases have slowly been moving upwards from the traditional low-lands. Generally, the warming up in Tanzania has resulted into otherwise non-natural ranges for anopheles mosquitoes increasingly becoming favorable for their survival (Matola, et al., 1987; Fowler, et al., 1993). Cases of malaria are increasingly becoming common in mountainous areas e.g. Lushoto (Tanga region), Njombe (Iringa region) and Kilimanjaro region where a few years ago it was not a problem (WHO 1998, URT, 2007, Lindsay and Martens, 1998, URT, 2003, URT, 2007). Yanda, (2005) reports that malaria cases are creeping from the traditional low-land to highlands. According to Yanda, (2005) for example climate, land use changes and increasing human population have a close relationship with increasing malaria and diarrhea diseases outbreak in the Lake Victoria region.

In recent years however, apart from climate change, malaria problem has also been complicated by the growing parasite resistance to first line anti-malarial drugs and mosquito resistance to insecticides. Moreover, the widespread outbreaks of the diseases have also been linked to the El Niño phenomenon with increase in both rainfall and temperature (Lindblade, et al., 1999). According to IPCC, 2001, El Niño results into strangely elevated precipitation in certain parts of equatorial East Africa and can result in resurgence in malaria

cases. Other studies have given similar results that unusual rainfall patterns and elevated maximum temperatures have a close relationship with malaria outbreaks (Craig, et al., 2004).

Economically, malaria is one of the biggest burdens in Tanzania and generally Africa. According to W.H.O, 2002, malaria claims more than US\$ 12 billion every year of the African GDP. If climate change is to continue unchecked, it is likely that more people in uninfected regions in Tanzania would suffer financial burdens from the disease and require government attention. In Tanzania malaria continues to pose challenges on the community, the effects varying from school absenteeism to low productivity at workplaces. Agricultural productivity and outputs from other economic sectors are thus directly affected by malaria (URT, 2007, MOH, 1997).

2.1.2. Cholera

In Tanzania, cholera outbreak was for the first time reported in 1936 (Yanda, 2005). Cholera outbreaks are usually associated with wet seasons; therefore any increase in the amount of rainfall would add to cases of cholera. The current climate change has positively played in favour of both spread and intensity of cholera in Tanzania. The recent spread and outbreak are concomitant with the climate prediction in the country. As already earlier, rainfall is projected to increase in North East, South East, Lake Victoria basin and coastal areas (Mwandosya, et al., 1998, Hulme, et al., 2001). It is in the named region where most cholera outbreaks have been reported in the recent years. Furthermore, coastal residents are increasingly getting cholera outbreaks from extreme weather events of the recent developments (IPCC, 2001). In Tanzania, cholera has serious economic implications including cost of treating the sick, controlling the outbreak and reduced labor. Specifically, cholera outbreaks are economically detrimental since its control often involves closing of some businesses like food centers, adding the costs of water treatments and disinfections, all of which requires economic sacrifices (URT, 2003).

2.2. Agriculture, livestock and food security

In Tanzania climate change poses its worst impact through interference with food security to the growing population. According to the government, 19% of the populations live below the food poverty line whilst 36% of the population lives below the wider poverty line (URT, 2005). Agriculture is an important sector in Tanzania; it is named the backbone of the country on account of its contribution to the GDP and employment opportunities it offers. Agriculture typically contributes around 25.8% of GDP and comprises up to 40% of export earnings (URT, 2007);

accordingly, the sector continues to drive economic growth. For example in 1992, it contributed 42.9 % of the GDP (URT, 2001), more recently however, its contribution to the GDP has been severely reduced among other reasons due to climate-related agriculture failures. Because the agricultural system is largely-rain fed which is increasingly becoming unpredictable and unreliable with the continuing effects of climate change, the largest employer of the population is kept in jeopardy (Paavola, 2003, URT, 2003). Worth noting, about 80% of poor Tanzanians live in rural areas where agriculture accounts for more than 75% of rural household incomes. In addition, agricultural holdings are typically dominated by small scale, subsistence farmers cultivating plots ranging from 0.9 to 3 ha (URT, 2007). Furthermore, agricultural system in the country is almost entirely targeted at food production.

The impacts of climate variability on agriculture sector in Tanzania include shifting in agro-ecological zones, prolonged dry episodes, unpredictability in rainfall, uncertainty in cropping patterns, increased weed competition with crops for (moisture, nutrients and light) and ecological changes for pests and diseases (Paavola, 2003, URT, 2007). Shortening and/or change of the growing season, a trend that has already been observed in Tanzania is seen as a direct consequence of the warming up and changes in rainfall (Ibid). According to Funk, et al., 2005, in Tanzania and East Africa at large, there has been a decrease in long-cycle crops and rainfall between March and May from 1996 to 2003. Even more worrisome, climate variability will require plants to adapt to the new situation, which keeps on changing (Paavola, 2003). Moreover, there is enough scientific evidence pertaining to pests, diseases and weeds intensifying with warming up of the environment (Ibid).

The recent droughts and associated crop failures have led to severe hunger to many places in Tanzania that forced the government to organize food aid to the people. For example in Dodoma region there had been an 80% decrease in harvests as a direct result of poor or late arrival of rainfall. In 2005, the *Vuli*, short rains were very poor in many regions including areas where the rains are usually plenty, like Kilimanjaro region. The shortage of the mentioned rains again triggered food aids to the starving people especially in coastal and north-east regions (URT, 2007). Moreover, in 2003 FAO described Tanzania as having a very high level of undernourishment, with 43% of the population being under nourished directly because of drought related food shortages (FAO, 2003a). In 1992 for instance the average food supply in kcal/person/day was 2080, whereas by 2001 it had fallen to 1770. Similarly, in

percentage terms, the undernourished comprised 35% of the population in 1992 and 43% in 2001. The effects of the climate variability have contributed to shortage of food and increase in the rate of malnutrition to children in the country (URT, 2007, MOH, 1997). Studies already show dim figures for the continuing failure in agricultural productivity in Tanzania. Being a staple food for most Tanzanians, maize that is widely grown in Tanzania is projected to be affected the most by recent climate variability. Mwandosya, et al., 1998 had projected that if the greenhouse gas CO₂, will double and average temperature increase by between 2°C to 4°C, then maize harvest will decrease by up to 33%. The situation will even be bad in some place (Dodoma and Tabora) where up to 80% of this important source of carbohydrate will be lost (Paavola, 2003). Statistics show that maize is not the only crop that will be affected in the nation, according to URT, (2007), cotton yields could as well decrease by between 10%-20% with major economical implications.

The alternative to effects of drought in Tanzania's agriculture would be to strengthen irrigation projects; however irrigation in the country is also suffering from poor water supply. Water for irrigation is becoming very unreliable and thus places where their major economic activities depend on irrigated agriculture will have severe economic hardships on account of the continuing climate variability (URT, 2003).

Even worse, in places where climate change is said to increase rainfall and thus flooding like coastal regions further effects on agriculture are eminent. Flooding are associated with nutrients leaching, water logging and sweeping away of crops and the top fertile soils. These effects have already been reported in many places in the those regions (URT, 2003, 2007). In addition, infrastructures like roads are also swept away by floods which complicates the transportation of agricultural produce and farm inputs to market places and farming areas respectively, hence poverty intensification.

2.2.1. Livestock

With the current climate variability, livestock productivity, survival and distribution will be affected through reduced quantity and quality of range-land and prevalence of vector-borne livestock diseases (IPCC, 2001, URT, 2003). Deaths of large numbers of livestock due to lack of water and pasture has been of repeated occurrence in Tanzania in recent years hence threatening livelihood of pastoralists in the country. Some hopes however exist as a number of pastoralist societies have started to learn alternative livelihood support activities. Such adaptations however are only useful for short-term and non-severe effects of

climate change. In addition, distribution of tsetse flies could shift into North East Tanzania and thus reduce land for human settlements, grazing ranges and other developments (IPCC, 2001). Sadly, the latter location has many pastoralist communities in the country (URT, 2007). Other effects on livestock include reduced productivity (draught power, milk and meat) as increased carbon dioxide reduces protein available from vegetation and eruption of new pests and diseases for example ticks, snails and other pests. Studies show that milk and meat production will be reduced following the stress on the grazing lands (URT, 2003, 2007, IPCC, 2001). Worth noting, the number of livestock already overwhelms the carrying capacity of many grazing grounds in central and north-west Tanzania where droughts are common. As a result, pastoralists are forced to relocate to places where pasture and water are available (Shayo, 2006, URT, 2007). However, the tendency has already caused conflicts between different pastoralist societies on one hand and farmers and pastoralists on the other. Moreover there are reported conflicts between livestock and wildlife (Ibid).

2.3. Fisheries, coastal and water resources

2.3.1. Fresh water resources

Studies have indicated that Tanzania water resources will have non-uniform impacts as a result of climate change. Among the impacts Tanzania is likely to face include, water logging, water pollution, increasing river flow in some basins, drying up of some water bodies, intrusion of sea water into fresh water bodies including groundwater e.t.c (URT, 2007). In the recent past, 2/3 of rivers in Tanzania have had reduced water volume as a result of decreased rainfall (Orindi and Murray, 2005). However, while Pangani and Ruvu rivers are projected to have a decrease in water flow, Rufiji, will have a slight increase (Mwandosya, et al, 1998). At the national level nevertheless water flow is projected to become more seasonal and scarce. Other studies have shown dim predictions that by 2025 the availability of fresh water in Tanzania will be reduced to half the rates of 1990 (Sharma, et al., 1996). The projection is that water flow change will be between 5 to 10% in all basins in Tanzania (Mwandosya, et al., 1998). To be more specific, Ruvu basin is projected to have up to 10% decline in its runoff (URT, 2003). The basin is very important to Tanzania as it supplies water to the huge population of Dar es Salaam. Sadly, the trend above has been widely observed in many other places in Tanzania. Most small rivers and springs have either disappeared or become seasonal as a result there has been a steady encroachment into wetlands and water bodies in the country (URT, 2007).

Changes in water flow in these basins have already caused some socio-economic and ecological impacts in Tanzania. They include decreased HEP generation, decreased biodiversity, lowered agricultural productivity (e.g. irrigation projects), domestic water shortage etc. All these add hardships to already struggling communities (Orinda and Murray, 2005). Lake Victoria has already been impacted by climate change and its water level is likely to be variable in the future (Mwandosya, et al, 1998, Yanda, 2005). The Pangani basin, which is economically and ecologically important to Tanzania, is under threat from losing most of its resources partly because of the melting of the Kilimanjaro glaciers which feed it (Thompson, et al., 2002). Currently, rationing of both water and electricity is of repeated occurrence in many places across the country. Further deterioration in water availability will have major effects in Tanzania where already some communities (25% of the population) are walking an average of over 30 minutes looking for water (URT, 2003).

Hemp, (2005) has given a closer look at the overall effects of climate change in water supply as directly related to reduced precipitation and humidity. According to Hemp, (2005) there has been an increase in the intensity and frequency of wild fire on the forests on Mount Kilimanjaro partly because of dry conditions there hence affecting the hydrological balance. The forest of Kilimanjaro contributes up to 500 m³ of water to the Pangani basin by collecting rain and fog at higher altitudes of the Mountain. Even more worrying, the effects of climate change are not limited to Mount Kilimanjaro alone, a more or less similar trend is observed in other highland forests and mountains in Tanzania (URT, 2003, 2007). Moreover, the warming up and changes in rainfall patterns may potentially affect groundwater recharge with considerable hydrological implications in the country (Paavola, 2003). That will have catastrophic impacts as some drought-prone areas in Tanzania like the capital-Dodoma, entirely depends of the groundwater system (Paavola, 2003). Historically, water resources have been a source of tension between nations for many years (Christian Aid, 2006). Arguably, as a sign of worsening situation, there have in recent years been tensions on water resources within the national borders (Paavola, 2003).

2.3.2. Coastal resources

Following the continuing melting of the polar ice caps, expansion of the surface sea water molecules due to increasing temperature and hence the projections by the IPCC of 8-96cm rise of the sea by 2100, Tanzania is among the likely countries to suffer significant impacts in her coastal regions

and ecosystems. Tanzania enjoys an 800km² long coastal line that varies in width from about 20km to 70 km. Major cities of national and international importance like Zanzibar, Bagamoyo and Pangani lie in the coast (Mwaipopo, 2001). Tanzania's coast has many important resources that support a large population; these include the Rufiji delta, mangrove forests and swamps, tidal marshes, sand and mudflats among others. Unlike inner parts of the country, the coastal areas are projected to be less affected by droughts. Unfortunately, the coastal areas are geared to experience increased mean rainfall and cyclical variation, which could aggravate both frequency and severity of flooding (Paavola, 2003, Mwandosya, et al., 1998). The projected sea level rise in the nation will have major impacts namely land losses of between 247-494 km² (based on sea-level rise of 0.5 and 1m respectively), coastal erosion, saline intrusion in fresh water bodies (e.g. the Rufiji delta), extreme weather events, inundation of low-lying coastal areas and small islands, coral bleaching, damage to coastal structures and properties, loss of coastal and marine habitats and ecosystems e.g. mangroves and fishes (URT, 2007). Maziwe Island in Pangani district is already submerged as a direct result of climate change. With about 16% of the population found within the 800km² coast-line, the projected sea level rise will have detrimental consequences to the coastal communities including on the ecosystems they directly depend on. The government of Tanzania is aware of the eminent danger to the coastal line and has estimated the damages of sea level rise in Dar es Salaam alone to be between 48-82 million USD for a 0.5 to 1m sea level rise respectively. Other coastal areas under the same threat include coast Region, Mtwara and Lindi (URT, 2003). Important economic activities to the local communities in the areas like salt making, tourism and fishing are very likely to further be impacted if climate change continues (Mwandosya, et al., 1998, Paavola, 2y003).

2.3.3. Fisheries

Warm temperatures are usually associated with faster depletion of oxygen supply in water thus affect fisheries (Fick, et al., 2005). According to Roessig, et al., (2004), warm temperatures have been noticed to have depressing impacts on fisheries of the whole of East African region in both fresh water and sea water. Fishing employs many people and offers an important source of food in Tanzania. Any major imbalances in the sector will have major detrimental effects to both food security and economic opportunities (Mwandosya, et al., 1998, Paavola, 2003).

2.4 Energy issues and climate change

Tanzania's energy balance is dominated by biomass (90%), mostly fuel-wood, charcoal and plant residues. Commercial energy sources like petroleum and electricity accounts for only 8% and 1% respectively (UNEP, 1999); the former is mainly from hydropower (Mwandosya, et al., 1998). Coal and natural gas accounts for less than 1% of the energy balance in Tanzania. Thus, much of the demand for fuel wood is met from forests. However, wood is becoming increasingly scarce because drought and desertification all of which collapse the energy pyramid in the country. Some studies have shown that charcoal and fuel-wood usage in Tanzania is estimated at 32m³ million tons per annum which has contributed to deforestation (UNEP, 1999). Traditionally, women and children are responsible for fuel-wood gathering in Tanzania. As wood becomes rare in neighborhoods, they travel long distances to collect firewood where they risk harassment and many school hours for the children lost.

Effects of climate change in energy sector in Tanzania can be discussed from diverse angles namely availability, production or distribution of energy. The recent climate variability has posed significant challenges in major sources of energy in the country, namely biomass and hydropower power (URT, 2007). The effects in energy, industry and transport in Tanzania can be looked at either drying up of water bodies which produce electricity, destruction of infrastructure (roads, railways, gas pipelines and electric poles) to transport and distribute energy or ecological imbalances, deforestation and desertification and thus reduction of wood energy.

Since electricity generation in Tanzania largely depends on hydropower, changes in water flow have affected the capacity of Tanzania to supply power to its fast growing population. Low water levels in electricity generating dams in recent years have forced them to be temporarily shut down thus affecting the main source of electricity in the country (URT, 2007, Paavola, 2003, Mwandosya, et al., 1998). For example, the hydro-electric power crisis of 2006/2007 which was accompanied by power blackouts and rationing in the nation (URT, 2007) was directly a consequence of drought related climate change. Currently, Tanzania is having major power shortage and again there is a nationwide rationing. The recent energy crisis due to drought (hence impacts on HEP generation) in Tanzania has been very serious to the extent that it resulted into resignation of the former prime minister. The former prime minister and two of his cabinet ministers resigned after an emergency electric generation scandal. The scandal was related to abuse of power in contracting a fake American company called Richmond to produce

emergence electricity using generators (Transparency International, 2009).

2.5 Forestry, grasslands, wildlife

Tanzania is among the leading nations in terms of the forested land in Africa, the forests land makes 338,000 km² which is an equivalent of 44% of the total land area (UNEP, 1998). These forests offer basic household needs like fuel wood (firewood and charcoal), vegetables, medicines, honey, etc, hence very important. Up to 50% needs of some families in Tanzania directly depend on forests resources (Paavola, 2003). In addition, the majority of endangered species and precious biodiversity in Tanzania directly depend on these forest ecosystems (World Bank, 2002).

Although Tanzania is among the richest countries in terms of biodiversity (UNEP, 1998, URT, 2007), her forests are under major continuing danger of deforestation from both anthropogenic activities and climate change. In 2002, it was estimated that deforestation rate in the country was about 91,276 hectares per year. Among the main anthropogenic activities responsible for deforestation include overgrazing, high demands for wood energy, wildfires, and over-exploitation of wood resources for commercial purposes and clearing for agriculture and settlement. The named activities have been contributing a significant amount of CO₂ in the atmosphere while increasingly reducing carbon sinks (URT, 2007).

Like in many other countries in Africa, the biodiversity of Tanzania is expected to change as different species try to adjust and cope with the impacts of climate change (Lovett, et al, 2005). Much more, climate change may trigger loss of some species; displacement and forced migration of ecosystems and potentially adjust seasons and migratory roots of birds and animals. Yet entire genetic structures, as affected by changes in breeding rates, could be altered (Rubenstein, 1992). According to URT, (2007), changes in forest types, species composition and distribution will have major ecological implications in the country. Already some displacements and changes in species composition are witnessed in Mount Kilimanjaro (Hemp, 2005) and East Usambara Mountains (Shemsanga, 2003). Because of the climate variability, the bulky of forests in Tanzania are set to be shifted to drier ecosystems (URT, 2003). Due to increased ambient temperatures and decreasing precipitation, many important forests are likely to be substituted by grasslands and woodlands. Moreover, climate change has direct effects on the species invasiveness. It is already known that invasive species tends to adapt better to changing climate (Malcolm, 2002). In some places in the nation, important forest reserves like the East Usambara forest reserve are already struggling with

a number of invasive species like *Lantana camara* and *Maesopsis eminii* (Shemsanga, 2003). Moreover, there could be elevated conflicts between man and wildlife for resources (URT, 2003, URT, 2007). Climate variability is increasing occurrence and severity of wild fires (Hemp, 2005) that in turn is affecting the distribution of species, changes in land-cover, reducing the forests size and subsequently drying up of streams and rivers (Paavola, 2003). In addition, because 90% of Tanzania's energy use is based on biomass, mainly fuel-wood and charcoal any major shifts in availability of wood energy would disturb a huge numbers of people both in rural and urban areas. Worth mentioning, in Tanzania cooking energy directly touches on the crucial issue of nutrition value of food (Paavola, 2003). The effects of climate change under this category are especially worrisome because it is through this sector the country gains its foreign currency via tourism and forest products thus there is an eminent danger of decrease in employment and foreign exchange (URT, 2007).

2.6 Retreating glaciers on Mount Kilimanjaro

Mount Kilimanjaro is the highest mountain in Africa that stands 5,895m tall. The volcanic mountain is located on Kenya-Tanzania border (3°04'S, 37°21'E). Apart from offering an excellent site to study climate change (Thompson, et al., 2002), the mountain is also a biodiversity hot-spot with up to 3000 plant species. As a result, the mountain has been sustaining large populations of local inhabitants in addition to being a source of water for an even larger population downstream.

Arguably, Mount Kilimanjaro offers the best opportunity to study climate change in Tanzania. Although the retreat of glaciers of Mount Kilimanjaro has been recorded since 1850, the current recession is possible the fastest and most alarming (Mwaipopo, 2001). The early retreat of glaciers on the Kilimanjaro was due to natural climatic shifts whilst the warming up of the Earth after the industrial era has led to current faster recession of the glaciers. There is no argument today regarding the retreat of Kilimanjaro glacier; the glaciers have been retreating in unprecedented scale in the recent years directly because of climate change (Hemp, 2005, Thompson, et al., 2002). The retreat of the glaciers is probably the most iconic indication of climate change impacts in Tanzania (Ibid). The most recent available data shows that the glaciers were about 4.2km² in 1976 (Hastenrath and Greischar, 1997). In 2000, the remaining glaciers were only 2.6km² (Thompson, et al., 2002). It is projected that there will be no glaciers on the mountain by the year 2020 (Ibid). The melting of glacier is supported by modern climatic data recorded on the Mountain. There has been a

decline of about 177mils (11%) of rainfall since 1935 on the Mountain. On the other hand, temperature has been observed to increase on the mountain at different periods. Based on measurement records on the mountain, temperature increased drastically over the period of 25 years from 1976 and that the daily annual temperature average increase at a rate of 0.275°C per year (Altmann, et al., 2002). Tanzania Meteorological Agency gives more shocking statistics; it estimates that about 80% of the snow at Mt. Kilimanjaro has already disappeared leading to reduced water flow to millions of people downstream (URT, 2007).

Concomitant with the retreat the glaciers, there has been an increase in wildfire on the Mountain due to climate change and other human factors (Hemp, 2005). The consequences of melting glaciers on the mountain have important socio-economic implications to Tanzania. Retreat and potential disappearance of the glaciers accompanied with forest fires have put the lives of over a million people on the Mountain slopes at

jeopardy of water stress and will have other hydrological imbalance in the region. The glaciers are approximated to contribute 1 million m^3 of water supply in the Pangani basin. The water of the Mountain which proceeds as Pangani River has important socio-economic use including at *Nyumba ya Mungu* hydropower dam, irrigation and domestic use by millions of Tanzanian downstream (URT, 2003).

The evidence of climate change in the Kilimanjaro is enormous. There are already changes in migration behaviours and population dynamics of animals on the mountain (Mwaipopo, 2001). The retreat of the glaciers and other ecosystem changes on the mountain are likely to significantly interfere with tourism industry in the country. Noteworthy, Kilimanjaro National Park stands to be the major attraction for both tourists and researchers in Tanzania. Apart from tourism offering foreign currency to the government, it offers significant employment to many Tanzanians (URT, 2007).

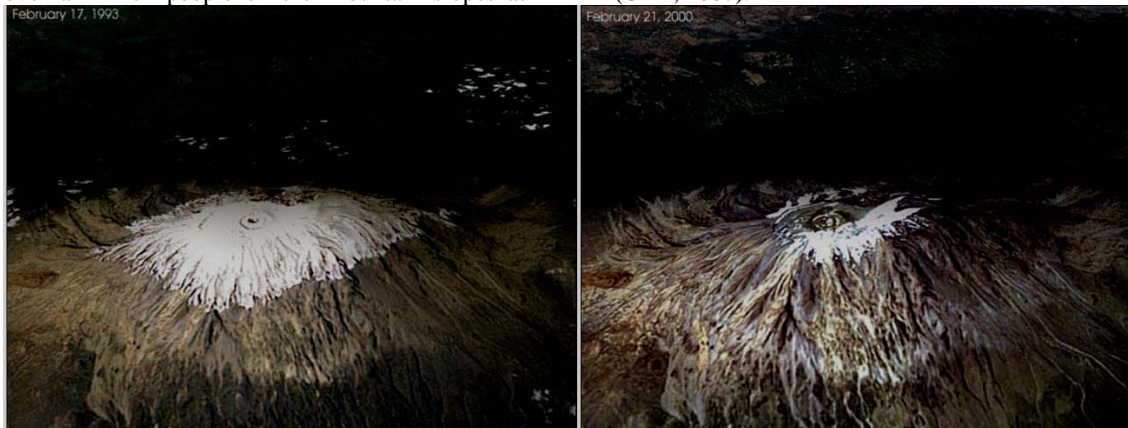


Figure 2: Showing loss of ice cap on Mt. Kilimanjaro between 1993 and 2000 (Source: URT, 2007)

3.0. An overview of response and adaptation measures to climate change in Tanzania

Addressing climate change is one thing Tanzania must do. Any successful breakthrough in poverty alleviation in the country will have to include climate change mitigations by the government and its institutions, private sector and the general community at various levels. Generally, climate change adaptation measures in Tanzania will be different from society to society owing to its geographical, sociological and economical characteristics. Some studies have shown that some societies in Tanzania are already coping with the effects of climate change (Shayo, 2006, Ponte, 1998). However, such adaptation mechanisms are hampered by the severity and the speed of climate change effects, widespread corruption and resource constraints. In this paper, adaptation measures in the country will be addressed separately for local people and the government and its institutions.

3.1. Local level: Indigenous initiatives to living with climate change vulnerability

As the effects of climate change in Tanzania continue to impoverish the population, became more severe and of repeated nature, different societies developed/relied on diverse local strategies to cope with the challenge. Worth noting, most local people find it hard to cope with climate change using modern technologies like high input agriculture and biotechnology and have relied on their indigenous skills. However, most of these local coping strategies could only be applicable in a short term and/or less severe impacts. The strategies are likely to leave populations vulnerable to both climate change and the associated poverty in the longer term (Orindi and Murray, 2005). The various coping strategies by different societies in the country are collectively discussed hereunder.

As a direct outcome of climate change, local people in some parts of Tanzania have adopted to other activities apart from their traditional livelihood, agriculture. In places where climate change has resulted into repeated agricultural failures, it is now common to find members of typical farming villages doing extra farm activities to maximize survival. Such activities may include, charcoal burning, brick making, fishing, casual laboring depending on the geographical locations and seasons (Shayo, 2006). Climate change has also forced people to move from their villages to urban areas for paid employment. For example, it is common to find young people mostly after primary education moving to big cities to look for jobs. Sadly, employment opportunities are limited and some end up being jobless and even harassed.

In addition both farmers and pastoralists have adapted to some local ways of predicting short to long term climatic changes such as drought. Once the drought is locally predicted, pastoralist would distribute livestock and/or shifting herd to safer places to reduce risk. Northern societies namely Barabaig and Masaai have particularly been involved in transhumance. For example, Morogoro region has observed huge influx of pastoralists with large herd of livestock (Paavola, 2003).

In addition, when drought is likely, pastoralists in drought-prone areas have adapted to reserve pasture for weak stocks such as sick, young, and lactating animals. Such a method would enable them to survive during the drought season and reduce deaths of weak individuals (Shayo, 2006). Moreover, the repeated occurrence of climate disasters has forced some pastoralist societies in Tanzania to reduce the numbers of their herd as a coping mechanism. Interestingly, some pastoralist societies have even strategized into paid employments in cities and cultivation of food crops (Ibid).

Farmers on the other hand, would grow traditionally drought-resistant crops such as sorghum, cassava and millet rather than maize (which has been failing many farmers) when drought is anticipated (Ibid). In addition, intercropping with the aim of maximizing harvest is becoming common. According to Shayo, (2006), it is common to find more than five different crops being grown in a piece of land in the common drought-prone areas. Yet some farmers would open up of larger pieces of land for agricultural activities and applying more agricultural inputs in attempting to have better harvest. Places where irrigated agriculture is possible people have been trying to water their crops in the absence of rainfall. Apart from that, some farmers have also changed planting seasons as affected by potential drought occurrence (Orinda and Murray, 2005).

Interestingly also, some local people have developed their own skills related to disease control to crops, animals and even stored of grains. According to (Shayo, 2006), some societies use their local skills to control livestock diseases as an adaptive strategy to counter the effect climate change. Grains are preserved using traditional skills rather than the conventional methods in the country. It is common to find local people storing their grains especially seeds above kitchen so that the smoke will help to preserve the grains against seed pests. Some skills also exist in terms of animal disease control (Ibid).

Furthermore, as climate change continues to increase scarcity of wood near neighborhoods, some societies have turned into growing their own trees for fuel wood consumption instead of relying on the scarce and unreliable supply from the surrounding areas. Regions where tree planting is becoming common include Tanga, Kilimanjaro and Morogoro among others. Usually fast growing trees such as *Gravellia robusta* and *Eucalyptus spp* are popular. Regrettably, the latter species is known for its own environmental problems (FAO, 1998). In addition, rainfall is scarce and many trees grow with difficult and take longer to grow. Yet many people are adapting to the use of fuel saving stoves which generally, are affordable, easy to make and use less fuel wood.

3.2. National level: The government and institutions

Tanzania government has done a lot to address the crucial issue of climate change and wider environmental issues in the country. In the international arena for example, Tanzania is also a signatory to and has acceded to a number of international and regional environmental treaties (NEMC, 1994, URT, 2007). Efforts to effectively achieve ends have however been hit by corruption, inadequate skills, low technology and generally low ability of the government to implement strategies to combat environmental challenges. Exceptionally, corruption remains to be such a deadlock in many socio-economic issues in Tanzania.

3.2.1 Policy issues on climate change in Tanzania

It is difficult to address policy issues pertaining to climate change without looking at the wider environmental challenges. Addressing climate change likewise requires more than local efforts as it recognizes no national boundaries (IPPC, 2001). When the effects of climate change and general environmental degradation became more severe and revealing, and with the widespread concession that poverty alleviation strategies would not be successful without integrations of

sustainable environmental management, the government of Tanzania took decisive steps towards a comprehensive environmental policy in 1994. Several interconnected issues had forced the government to take such steps. These included, the vulnerability of some local environments and especially loss of wildlife habitats and biodiversity, deterioration of marine and freshwater ecosystems, widespread deforestation, land degradation, soil erosion and inadequate land and water management at various levels, pollution, high population growth, persistent poverty to the population and climate change. Thus a National Environmental Action Plan was formulated in 1994 (URT, 1994). This plan later laid the foundation for National Environmental Action Policy, (URT, 1997b, UNEP, 1998) and thus clear acknowledgement between poverty, human health and environmental degradation was indicated and accounted for.

The government of Tanzania has realized that dealing with climate change requires local, regional and international efforts as both the causes and effects of climate change recognize no

geographical boundaries. Tanzania has taken some steps in addressing the issue of climate change in its widest sense. It ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996. Generally, notable progress has been made to address climate variability in Tanzania. Consequently, DANIDA recently gave funds to Tanzania to develop methodology and capacity building in GHG mitigation assessment. However, Tanzania still faces difficulty in coping with climate change due to many factors including rapid growing populations, urbanization, and inability of the government to deliver services to its citizens. Since major contributions to emissions to GHG in Tanzania is through land use change and forests related sources, any mitigation of climate change including carbon sequestration should target forests and land use sector (UNEP, 1999). Regrettably, forest management and other natural management in Tanzania are faced with corruption and incompetence (Jansen, 2009).

3.2.2. Government's efforts on adaptation strategies to climate change vulnerability

Dealing with the issue of climate change in Tanzania requires a wide range of measures. The country has done its part in setting standard measures and responses to the impacts of climate

variability. Apart from policy issues discussed above, the government's adaptation measures to vulnerability in the main areas under climate change considerations in this paper are summarized in table (1) below.

Table 1: Government's strategies to climate change vulnerability (URT, 2007, NEMC, 1994, 2002, Mwandosya, et al., 1998)

Agriculture and livestock sector	Forests, grassland and wildlife	Water resource	Coastal resources	Energy sector	Health sector
Investment in research and development on drought and diseases tolerant seed varieties	Establishment of collaborative forest management in various districts	Integrated water resource Management	Establishment of numerous marine and coastal environment management programmes and projects in the country	Improvement and intensification of clean thermal power generation projects	Establishment of the integrated diseases surveillance response system to prevent, mitigate and respond to epidemics in the country by the Ministry of Health
Strengthening of agriculture extension services to farmers and livestock keepers	Ensure ecosystem stability through conservation of forest biodiversity, water catchment and soil fertility e.g., Eastern Arc Conservation Project	New water infrastructure development e.g. new dam sites, reservoir construction	The National integrated coastal environment management strategy	Protection of hydropower water catchments	Presence of emergency plan response unit, which coordinates and manages all health related hazards, including epidemics, accidents, drought and flood
Facilitation of small scale irrigation schemes	The ongoing national-wide tree planting campaign	Conjunctive water use and Inter-basin transfers	Mangrove management programme	Increasing availability of biomass resources	Strengthening the use of traditional/alternative medicines nation wide
Diversification of agriculture, involving growing different	Enforcement of	Protection of water catchments,		Improvement of biomass to	Establishment of the Traditional Medicines

crops on different land units	participatory forest management programmes throughout the country	groundwater and diversification the use of ground water in drought prone areas like the capital Dodoma		energy conversion efficiency	Research Unit at Muhimbili Medical Research Institute to run parallel with conventional medicine
Water harvesting from rainfall to be used during water scarcity		Rainwater Harvesting and water conservation		Improvement in end-use energy efficiency Programmes	Increasing the number of rural health centers and personnel

4.0. Conclusion

Climate change is already affecting Tanzania both economically and socially. There has been a vivid underestimation of impacts of climate change in the country. This study concludes that rural dwellers in Tanzania are more vulnerable to the effects of climate change than urban dwellers partly because of their limited resources, poor exposure to various technologies and their overdependence on natural resources which are threatened by climate change. In addition, because of Tanzania's overdependence on biomass and hydropower for energy needs, she is faced with an energy crisis unless the declining wood availability stops and/or alternative forms of energy are made available and affordable.

Survival skills and local responses to the effects of climate variability have done little to help the poor in the country, should the impacts continue and/or become severe, they are unlikely to be useful. Local strategies, like seed preservation however, can be incorporated into national strategies to combating climate change impacts.

The government and other institutions in the country have taken some measures to address challenges of climate change. Among the positive things done includes creation of relatively sound policies and operationalizing of several institutions dealing with climate change and environmental management. However the efforts done are not enough and most institutions dealing with climate change are ill equipped to address the complex issue of climate change in the country. More can still be done to include participatory approaches in a wider perspective in the nation regarding the issue of environmental management.

5.0. Recommendations: the way forward

Different adaptations and strategies are hereunder proposed as possible responses to climate change impacts in Tanzania. Coal, is among the leading cause of GHG in the world (IPCC, 2007). It has increasingly been used in many developing and developed countries and blamed for immediate deterioration of the air quality and for the global warming (IPCC, 2001,

2007). Unfortunately, Tanzania government has recently started to use coal to generate electricity and plans to expand its application even further. As an alternative to capitalization on coal, Tanzania is rich in natural gas which is seen as a reliable and relatively clean source of energy.

Although hydropower generation is seriously being hit by climate change, efforts can still be made to strengthen its potentials by improving the existing hydropower centers and building reservoirs to reserve rain water when available and thus be used during droughts. The good side of climate change in Tanzania is that there are some basins when climate change is actually predicted to increase rainfall/river runoff. Efforts can be concentrated to those areas and improve efficiency of other dams so as to have better energy security. The government should try to limit the importation of used vehicles which are often unwanted in their former countries. Other recommendations on dealing with climate causes and impacts of climate variability in Tanzania are stipulated hereunder.

- Reduce the number of livestock by keeping a few productive numbers, and enhance intensive agro-pastoral activities such as zero grazing where possible.
- Continued efforts in afforestation and ecosystem restoration across the country and control of forest fires. Farm afforestation will reduce pressure on natural forests for wood.
- Implementation and improving counter-measures against devastating events on livelihoods e.g. early warning systems to and relocation to vulnerable areas/people.
- Introduction of crop species resistant to environmental stresses like drought, pests and diseases to reduce crop failures.
- Promotion of non-agricultural income generating activities to vulnerable areas so as to reduce pressure on natural resources.
- Cross-sectoral coordination for improved livelihood of the people by harmonising all policy issues. There should be one environmental law that addresses all issues concerning the environment rather than having diverse pieces of legislations under different

authorities which often times contradict with each other. Enhancement in participatory policy in all aspects of the society e.g. resources management and utilization.

- Good governance and accountability with renewed fight against corruption of all forms.
- Restoration of mangroves and construction of ocean currents protection walls.
- Energy diversification in both rural and urban areas so as to reduce pressure on biomass. Dissemination and expansion of the cheap and readily available technology like fuel wood serving stoves and continued investment in alternative forms of energy like wind and solar.
- Implementation of the rapid bus transit project in big cities to minimize congestion and subsequent air pollution from vehicles.

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Correspondence to:

Ceven Shemsanga,
C/O Kassim Ramadhani
Department of Physical Sciences,
Faculty of Science,
Sokoine University of Agriculture,
P. O. Box. 3038, Morogoro, Tanzania

China University of Geosciences (Wuhan),
C/O International Cooperation Office,
388 Lumo Lu, Wuhan, 430074, Hubei, P.R.CHINA
Tel: +255654491877; Email: 7ceven@gmail.com

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