VENTURING INTO RESEARCH AND INNOVATION

BOOK OF ABSTRACTS (M.Phil & Ph.D)

&

PROJECT REPORTS (2009-14)

Compiled & Published

By

Research, Innovation & Publication Cell, Shillong College

shillcollres14@gmail.com

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13. Assessing Microbiological Safety of Drinking water in Shillong, Meghalaya
    - Dr(Ms)I.Lyngdoh & Mrs M.Diengdoh,Deptt. of Microbiology
14. Diversity and Abundance of insects at Nongrim Hills, Shillong
    -Dr S.Khongwir & Holystar Horam, Department of Zoology
15. Principles of Soil Science *-Dr S.Khongwir- & Shanti Bikash Chakma Department of Zoology*
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The Research Cell for the Academic year 2009-12 comprises of the following :

CONVENER

Dr (Ms) R.Dkhar, Department of Education

JOINT CONVENER

Dr C.Masharing, Department of Chemistry

MEMBERS :-

Dr M.N.Bhattacharjee, Department of Chemistry
Dr (Ms) D.L.Buam, Department of Chemistry
Dr (Mrs) H.Diengdoh, Department of Education
Dr S.Khongwir, Department of Zoology
Shri S.Goswami, Department of Statistics
Mrs P.Kharkrang, Department of Microbiology
Mrs D.Lyngdoh, Department of Botany
Shri G.R.Rumnong, Department of English

The Research Cell for the Academic year 2013-15 comprises of the following :

CONVENER

Dr (Ms) D.L.Buam, Department of Chemistry

JOINT CONVENERS

Dr S.Khongwir , Department of Zoology
Dr(Ms) S.Khyriemujat, Department of Sociology

MEMBERS :

Dr M.N.Bhattacharjee, Department of Chemistry
Dr(Ms) R.Dkhar, Department of Education
Dr S.Sarma, Department of Commerce & Management
Dr(Ms) L.M.Jyrwa, Department of Zoology,
Dr C.Masharing, Department of Chemistry
Smt P.Kharkrang, Department of Microbiology
Dr (Ms) I.Lyngdoh, Department of Microbiology
Dr (Mrs) A.Lyngdoh, Department of Botany
Dr B.P.Tripathi, Department of Philosophy
Dr(Ms) M.B.Lynser, Department of Environment Science
Dr(Ms) B.M.Laloo, Department of Chemistry
Shri P.Pyrtuh, Department of Economics

Foreword

Research and innovation are very important in higher education.It is a necessity for enhancing the techniques and methods funding the philosophy of any research program. Hence Shillong College initiated steps to constitute the Research &Publication Cell on 3rd July 2009 with the suggestion of the Former Principal Dr (Mrs)M.P.R.Lyngdoh to the need of promoting research activity of students and teachers. The College authority had decided to provide financial assistance to carry out projects whereby teachers' projects were sanctioned for Rs 5000 and students' projects were sanctioned for Rs 3000/- for a duration of 6 months. Apart from College Minor Projects, some teachers were also involved in Minor Research Projects under UGC,NER. There were 4 UGC-Sponsored Minor Research projects in 2009-10 and 12 College Minor Projects of teachers and students. In 2014-15 there were 6 Teachers' projects and 5 Teachers-Students' Projects sponsored by the college that are ongoing and some are completed and there were 7 UGC-MRP proposals in 2014 out of which 5 were approved by the UGC for the duration 2014-15. In a recent meeting of the Fund Allocation Committee of the College, some changes in the funding of college projects were made whereby the Science,Technology & Environment Projects have been enhanced to Rs 20,000 for a duration of 2 years and Rs 12,000 for a duration of 1 year, for Arts,Humanities & Commerce Rs 15000 for a duration of 2 years and Rs 10,000 for a duration of 1 year

I am delighted to learn that the Research & Publication Cell in a committee had decided to compile all UGC-MRP and College Project reports as a volume to be published by the College, the work is in the process and some of the ongoing projects are yet to be published in the next volume. This publication will contribute as a documentary record and a treasure for the future researchers and young college students of the region. Appreciation and gratitude shown to all the members of the Cell and to those who are involved and aspiring for improvement of research and innovation in the college. I wish the very best to the Convener and members of the Cell.

Dr K.D.Ramsiej,
PRINCIPAL,
Shillong College

Preface

The Research Committee was formed in the year 2009. The Principal (former Principal) Dr. (Mrs.) M.P.R Lyngdoh together with the Vice Principal Dr. M. Dey recognized the need for improving the research proficiency of the teachers as well as the students and proposed to provide opportunities by allowing them to carry out research activities in the college. In order to pursue these objectives with the different departments of the college, the college authority felt the need to form a Research Committee. Thus the Research committee was constituted in 2009 and it has been renamed as "Research and Publication Committee" since 2012.

Since the beginning the Committee had proposed for the publication of the research papers in the form of a book/ journal when sufficient number of such papers is obtained. The Committee has also undertaken the task of compiling the M.Phil/Ph.D Abstracts of the teachers of the college.

With the formation of this Committee a total of 18 (eighteen) minor projects have been undertaken and submitted by the teachers and students of the different departments of the college.

This book is a collection of the abstracts of research papers which is the outcome of the studies conducted by the teachers at their M. Phil/ Ph.D level and also the research papers based on the minor research projects of the college.

The objective of this book is to bring out the research studies of our teachers and students and to keep the scholars, teachers and researchers informed about them. It is hoped that the readers will find this book interesting and useful.

Dr. (Ms.) Ruby Dkhar
(Former Convener)
Research & Publication Committee

THE FOLLOWING TEACHERS HAVE BEEN AWARDED THE PH.D/MPHIL DEGREE IN THE LAST FIVE YEARS FROM 2010-2015 :

1. Shri P.Shabong, Department of Khasi was awarded M.Phil Degree in 2010
2. Smt A.Mitri,Department of Computer Science was awarded M.Phil Degree in 2010
3. Dr M.Challam,Partimer Department of Zoology was awarded Ph.D Degree in 2011
4. Dr H.Diengdoh, Department of Education was awarded Ph.D Degree in 2011
5. Smt J. Rivulet Gidon, Department of Mathematics awarded M.Phil in 2011
6. Dr. S. Sarma, Department of Commerce was awarded Ph.DDegree in 2011
7. Dr I.Lyngdoh, Department of Microbiology was awarded Ph.DDegree in 2012
8. Dr Marvellous Lynser,Department of Environment was awarded the Ph.D Degree in 2013
9. Dr Donald B.Jyrwa, Part-timer,Department of Zoology was awarded Ph.D Degree in 2013
10. Dr S.Khyriemujat, Department of Sociology was awarded Ph.D Degree in 2013
11. Smt W.C.K.Sohliya,Department of Management was awarded M.Phil Degree in 2014
12. Shri P.Nongrum,Department of Khasi was awarded M.Phil Degree in 2014
13. Dr(Mrs)A.Lyngdoh,Department of Botany,Shillong College was awarded Ph.D Degree in 2014
14. Dr(Mrs)Barisha Wahlang, Part-timer,Department of Chemistry,was awarded Ph.D Degree in 2015
15. Dr(Ms)E.M.Pala,Department of Zoology was awarded Ph.D Degree in 2015
16. Dr(Ms)B.M.Laloo,Department of Chemistry was awarded Ph.D Degree in 2015

Introduction

"Some men look at things the way they are and ask why , I dream of things that are not and ask why not"
- Robert Kennedy

Research is an important component in education today, it motivates and forms the basis of thinking out of the box and so it is imperative that research plays a key role in education of the present era. Research can open doors to knowledge that empowers teachers and learners in all spheres of work, studies etc. Moreover it can open opportunities to collaborative exchange with institutions, organisations, corporates all over the country.

It is known that science is a study of facts based on experimental findings, and so scientific research implies that theoretical knowledge along with practice brings the purpose of education on a sound footing, so the research based education is linked with the future quality education in this new era of smart learning. In fact scientific research encourages analytical, practical and observation skills in the young minds. Today's education involves more than just classroom teaching and learning, it goes out the box. The situation in the present changing world necessitates transformation or redesigning of education system, not only by introducing innovations but developing learner-centric or student-centric approach in the entire education scenario so that learners are given opportunities to develop and know their skills more than just acquiring knowledge.

In the same way, social science research has come to occupy an increasingly important role in academic curricula. The basic purpose of social science research is to make sense of what goes around us in our society and in societies other than our own so that there is better understanding of each other within a society and across societies. Thus the objective of social of social scientist is, to understand and analyse the inter-relationship among the structures and processes of all aspects of the social world, including their enduring and changing dimensions. The students who hope, instead, to obtain an administrative position in government or business must also acquire some of this knowledge. As he moves upward through the various jobs, he will often be faced with the problem of evaluating reports. The market analyst, the public-opinion expert, the investigator of communication and propaganda- all are gathering facts for the government and business needs. Knowledge of social research is useful for interpreting and weighing reports.

The Research and Publication Cell, Shillong College has been constituted on 3rd July 2009 by the former Principal Dr (Mrs)M.P.R.Lyngdoh in response to the suggestion given by the NAAC peer team which visited the College to promote research activity and so the aim is to acquaint the students and the teachers with the modes of thought and use of techniques and to enrich their analytical capabilities. The students will not only develop their skills and talents but will enhance their general awareness and become useful members of the society. The Research Cell,Shillong College sends project proposals of the teachers / students to the Principal for approval by the UGC or by the College through the Fund Allocation Committee, the details of the College Minor projects are available in the college website shillongcollege.ac.in

This compilation comprises of abstracts of Thesis of Teachers with PhD degree and abstracts of Dissertation of Teachers with MPhil degree and also the minor research projects of teachers and students as well funded by the college and also some by the UGC,NER. There were 4 teachers' projects in 2009-10, 3 projects in 2010-11, and 3 Teachers-Students Projects in 2009-10, then 1 Teacher's project in 2010-11 and 1 Teachers' Project in 2012-13. Apart from College Minor Projects, some teachers were also involved in UGC-Minor Research Projects NER.There were 4 UGC-Sponsored Minor Research projects in 2009-10, in 2014-15 there were 6 Teachers' projects and 5 Teachers-Students' Projects sponsored by the College that are ongoing and some are completed and there were 7 UGC-MRP proposals in 2014 out of which 5 were approved by the UGC for the duration 2014-16.

We hope that the book will encourage teachers and students to carry out research activities in their respective fields of interest, and that it will be a useful source of information to all the readers as well. The Committee is thankful to all teachers and students for the contribution and cooperation.

D.L.Buam
Convener

S.Khyriemujat
Joint Convener

S.Khongwir
Joint Convener

RESEARCH & PUBLICATION CELL

STUDIES ON CERTAIN ASPECTS OF BIOCHEMICAL GENETICS IN SELECTED SPECIES OF FROGS FROM NORTH-EASTERN REGION OF INDIA

Dr M.Dey,
Department of Zoology& Vice Principal

Abstract

The transition from water to land is a very remarkable step in the phylogenetic history of vertebrates. This conquest of land was initiated by the primitive amphibians in the Devonean period. In the course of their evolutionary history amphibians have become extraordinarily modified to lead a dual life. Their life cycle involves a drastic metamorphosis. They are cold blooded and so hibernate during winter months.

They are world wide in distribution and as many as 2600 species of anurans, the largest group of amphibians have been reported. In India anurans are represented by about 165 species of frogs and toads belonging to 6 families. Out of the 55 species of anurans reported from North-eastern region of India 40 belongs the hills of Meghalaya. In spite of this richness genetic studies on these species are very limited. The present investigation is thus carried out to evaluate the expression selected genes on the basis of electrophoretic pattern of multi locus isozyme systems. Seven species of frogs belonging to three families were analysed from different populations to study the isozyme pattern. The results are recorded in chapter one. In chapter two the developmental genetic aspects of the isozymes during tadpole growth and metamorphosis has been studied for commonly available species.

In each of these chapters We have included the pattern of gene expression of four dehydrogenases (viz. Lactate dehydrogenase, Malate dehydrogenase, Alcohol dehydrogenase and Glucose-6-phosphate dehydrogenase). Seven tissues of adult frogs were analysed to study the electrophoretic pattern of the isozymes. Tadpole tail muscle, head region and liver tissues were used for similar study at different stages of development.

Expression of these genes were interpreted with reference to the available literature. Significant variations with respect to tissue specificity and species specific expression obtained in our studies were correlated with local ecological conditions as well as with physiological states of the frogs. The differential pattern of isozymes observed during the growth and mertamorphosis of tadpoles implied accurately programmed activation/repression phenomenon of structural genes at specific developmental stages. However, the molecular genetic mechanism of events and our presumption of various correlates with the observed gene expression remain inconclusive and need further research to draw a final conclusion.

SYNTHESIS AND STRUCTURAL ASSESSMENT OF FLUORO, MIXED-FLUORO AND ACETYLACETONATO COMPOUNDS OF MANGANESE +(III) AND +(II) AND STUDIES OF REACTIVITY OF A NEW CHROMIUM(VI) REAGENT – PYRIDINIUM FLUOROCHROMATE (PFC)

Dr M.N.Bhattacharjee
Department of Chemistry

Abstract

The thesis comprises of two parts and has altogether ten Chapters. While Chapters 1 to 8, based on the studies of synthesis and structural assessment of compounds of manganese +(III) and manganese +(II), constitute Part I of the thesis, Part II, consisting of two Chapters (chapters 9 and 10), contains the results of studies of reactivity of a new reagent 'Pyridinium Flurochromate(VI) (PFC)'.

In *Chapter I*, three new and general methods have been described for the synthesis of alkali-metal and ammonium pentafluoromanganates(III), A_2MnF_5 (A = Na, K, Cs or NH_4). The first method is based on the direct electron-

transfer reaction between potassium, $KMnO_4$, acetylacetone (Hacac) in the presence of alkali-metal or ammonium bifluoride, AHF_2, (A = Na, K, Cs or NH_4), leading to the synthesis of A_2MnF_5 compounds. This method does not require anhydrous or aqueous HF. The basis of the second method is the reaction among MnO(OH), 40% HF and AHF_2 (A = Na, K, Cs or NH_4) giving A_2MnF_5 compounds. The third method involves the reaction of potassium permanganate, $KMnO_4$, with alkali-metal or ammonium biflouride, AHF_2 (A = Na, K or NH_4), and 40% HF at *ca* 100 °C giving crystalline A_2MnF_5 compounds. This method does not require any extra reducing agent. The compounds have been characterised on the basis of the results of chemical analyses, chemical determination of the oxidation state of manganese, magnetic susceptibility measurements, infrared and electronic spectroscopic studies. The lower magnetic moments of A_2MnF_5compounds (*ca* 3.2 BM) have been ascribed to antiferromagnetic exchange interaction between the contiguous manganese(III) through a –Mn-F-Mn- chain. The complex ion $[MnF_5]^{2-}$ has been shown, from i.r. and electronic spectral studies, to have a tetragonally elongated octahedral structure with a D_{4h} symmetry.

Chapter 2 describes the synthesis and structural assessment of $AMnF_4.H_2O$ compounds. Deep-brown crystalline compounds, alkali-metal tetrafluromanganate(III) monohydrates, $AMnF_4.H_2O$ (A = Rb or Cs), have been synthesized directly from reactions of $KMnO_4$ with AHF_2 (A = Rb or Cs) and 40% HF at *ca.* 100 °c without making use of any reducing agent. Similar compounds were also obtained by the reaction of MnO(OH) with AHF_2 and 40% hydrofluoric acid at 100 °C. Characterisation and assessment of molecular structure of the compounds were made from the results of elemental analyses, chemical determination of the oxidation state of manganese, magnetic susceptibility measurements, infrared and electronic spectroscopic studies. The i.r. and electronic spectra suggest a tetragonally elongated octahedral structure of the complex ion in the solid state, with D_{4h} symmetry as a consequence of the Jahn-Teller effect on manganese(III). The complex ion, $[MnF4]^-$, very likely, has a polymeric structure through trans-linked –F-Mn-F- chains.

Chapter 3 of the thesis presents the synthesis and assessment of structure of alkali-metal and ammonium trifluromonosulphatomanganates(III), $A_2[MnF_3(SO_4)]$ (A = Li, Na, K or NH_4). Pink-brown crystalline alkali-metal and ammonium trifluoromonosulphatomanganates(III), $A_2[MnF_3(SO_4)]$, have been synthesised in very high yields from the reaction of $KMnO_4$ (in the presence of formaldehyde solution) or MnO(OH) with 40% hydrofluoric acid and A_2SO_4 (A = Li, Na, K or NH_4). Also the reaction of MnO(OH) with 40% HF and $A_2S_2O_8$ (A = K or NH4) affords $A_2[MnF_3(SO_4)]$. Persulphate, $S_2O_8^{2-}$, cannot oxidize Mn^{3+} under the present experimental conditions. While the chemically estimated oxidation states of manganese occur between 2.9 and 3.1, the room temperature magnetic moments lie in the range 4.0-4.2 BM. The observed magnetic moments suggest a lowering in the degree of anti-ferromagnetic exchange interaction in going from $[MnF_5]^{2-}$ to $[MnF_3(SO_4)]^{2-}$. The i.r. and electronic spectroscopic studies have been made. The i.r. spectra of the compounds suggest the lowering of symmetry of the SO_4^{2-} group from T_d to C_{2v} as a result of its coordination. It is not certain whether the SO_4^{2-} group is bonded in chelated or a bridging bidentate manner. The complex ion $[MnF_3(SO_4)]^{2-}$, may have a polymeric structure through a SO_4^{2-} bridging. However, the chances of fluoride bridging cannot be totally ruled out. $(NH_4)_2[MnF_3(SO_4)]$ on being pyrolysed at 340 °C yields $MnSO_4$.

Synthesis and structural assessment of alkali-metal and ammonium triflouromonooxalatomanganates(III), $A_2[MnF_3(C_2O_4)]$ (A = Na. K or NH_4) have been reported in *Chapter 4*. The $A_2[MnF_3(C_2O_4)]$ compounds have been synthesized from the reaction of MnO(OH), 40% HF and alkali-metal or ammonium oxalate, $A_2C_2O_4$ (A = Na. K or NH_4) at the molar ratio MnO(OH):HF:$A_2C_2O_4$ at 1:4-5:1. Characterisation and assessment of molecular structure of the compounds were made from the results of elemental analyses, chemical determination of the oxidation states of manganese, magnetic susceptibility measurements, infrared and electronic spectroscopic studies. The mixed-fluorooxalato-manganates(III) are deep pink in colour and are comparatively more stable than the corresponding trisoxalatomanganate(III) complex $K_3[Mn(C_2O_4)_3].3H_2O$. While the chemically estimated oxidation state of manganese was found to be +3, the room temperature magnetic moments were found to lie between 4.2 and 4.3 BM. The relative lower magnetic moment values owe their origin to a weak anti-ferromagnetic exchange interaction. Infrared spectra of the $A_2[MnF_3(C_2O_4)]$ compounds suggest the presence of bridging oxalate ($C_2O_4^{2-}$) group. The complex ion $A_2[MnF_3(C_2O_4)]^{2-}$ may have a polymeric structure through a –Mn-C-C-Mn- chain and a weak –Mn-F-Mn- interaction.

The direct synthesis and electron-impact induced mass spectrometric studies of tris(acetylacetonato)manganese(III) constitute the basis of *Chapter 5*. It has shown that a concentrated solution of $KMnO_4$ undergoes a ready electron-

transfer reaction with acetylacetone (Hacac), in the absence of any buffer, giving a very high yield of tris(acetylacetonato)manganese(III), $Mn(C_5H_7O_2)_3$. The pH of the solution, recorded immediately after the formation of crystalline $Mn(acac)_3$ was found to be *ca* 5. Several advantages of the novel synthesis were discussed. The direct insertion technique has been found to be suitable for the mass spectrometric studies of $Mn(acac)_3$ compound. Electron-impact induced mass spectrometry showed the compound to be monomeric.

Chapter 6 of the thesis presents the synthesis of alkali-metal and ammonium trifluroaquomanganates(II), $A[MnF_3(H_2O)]$ (A = Na, K, Rb, Cs or NH_4). The electron-transfer reaction between hydrazine hydrate and $KMnO_4$ in the presence of alkali-metal or ammonium bifluorides, AHF_2 (A = Na, K or NH_4), readily gives light pinkish-white $A[MnF_3(H_2O)]$, in very high yields. The corresponding Rb^+ and Cs^+ salts have been obtained from the reaction of 20% hydrofluoric acid solution of $NH_4[MnF_3(H_2O)]$ with Rb_2CO_3 and Cs_2CO_3 respectively. The compounds have been characterised by elemental analyses, chemical determination of oxidation states of manganese in the compounds, room temperature magnetic susceptibility measurements, pyrolysis and infrared spectral studies. The i.r. spectra of the compounds showed the ί(Mn-F) to appear at *ca* 410 cm-1. The results of i.r. spectral and pyrolysis studies suggest the presence of coordinated water. The room temperature magnetic moments of the alkali-metal or ammonium trifluoroaquomanganates(II), $A[MnF_3(H_2O)]$, lie between 5.2 and 5.3 BM, well below the expected value for high–spin d^5-system. Considerably lower moments presumably owe their origin to anti-ferromagnetic exchange interaction between contiguous Mn^{2+} ions through –Mn-F-Mn- chain in the solid state. The complex species $[MnF_3(H_2O)]^-$ may have a polymeric structure through a weak –Mn-F-Mn- interaction.

In *Chapter 7*, the synthesis and assessment of structure of alkali-metal and ammonium fluoromonnooxalatomanganates(II), $A[MnF(C_2O_4)]$ (A = Na, K, or NH_4), have been described. The $A[MnF(C_2O_4)]$ compounds have been synthesized by the reactions of $KMnO_4$ or MnO(OH) with 40% hydrofluoric acid and alkali-metal or ammonium oxalate, $A_2C_2O_4$, at ca 100 °C. The compounds are white and stable for prolonged periods. $A[MnF(C_2O_4)]$ compounds have been characterised from the results of elemental analyses, magnetic susceptibility measurements, and infrared spectroscopic studies. The i.r. spectral studies of the compounds show that, unlike the trifluoromonooxalatomanganate(III) complexes described in Chapter 5, the fluoromonooxalatomanganates(II) complexes contain chelated oxalate groups. The room temperature magnetic moments of alkali-metal and ammonium fluoromonooxalatomanganates(II), $A[MnF(C_2O_4)]$, have been found to be remarkably low. The values lie between 3.8 and 3.9 BM, showing that a strong anti-ferromagnetic exchange interaction is operative in the complexes. The complex species, very likely, has a polymeric structure through a strong –Mn-F-Mn- interaction.

Chapter 8 describes a new synthesis and spectrometric studies of bis(acetylacetonato)manganese(II) dehydrate, $Mn(C_5H_7O_2)_2.2H_2O$. The synthesis is based on the reaction of $Mn(OH)_2$ with acetylacetone (Hacac) in presence of a very small amount of formaldehyde. The method is direct and simple and does not require any buffer, unlike the method recommended in the literature for the synthesis of $Mn(C_5H_7O_2)_2.2H_2O$. The role of formaldehyde is to protect bis(acetylacetonato)manganese(II) from being oxidized. The method is rapid and gives the product in a very high yield. Electron-impact induced mass spectrum of the compound, recorded using the direct insertion technique, and shows the compound to be monomeric in the vapour state. The spectrum also provides evidence for rearrangement to give Mn-CH_3 species.

The results of oxidation of organic substrates with a new and efficient oxidant pyridinium fluorochromate(VI), $C_5H_5NHCrO_3F$ (PFC), have been described in *Chapter 9*. The synthetic potential of pyridinium fluorochromate(VI) reagent has been investigated, and it has been found that the new reagent (PFC) has certain advantages over similar oxidizing agents in terms of amounts of oxidant and solvent required, short reaction times, and high yields. Pyridinium flurorochromate(VI) in dichloromethane oxidizes primary and secondary alcohols to aldehydes to ketones in very high yields; the reagent has been successfully applied to the oxidation of benzoin to benzyl, a tricyclic allylic alcohol, 4-oxotricyclo[5.2.1.$0^{2,6}$]-deca-3,8-diene, to the corresponding tricyclic enone respectively. PFC in dichloromethane also oxidizes anthracene and phenanthrene to anthraquinone and phenanthrene-9,10-quinone 68% and 52% yields respectively. The yields may be raised to 98% and 72% by using acetic acid as the reaction medium. PFC does not react with acetonitrile which is a suitable medium for studying oxidation kinetic and mechanism. The results hitherto obtained with pyridinium fluorochromate(V) (PFC) are very satisfactory and suggest the new reagent as a valuable addition to the existing oxidizing agents.

Chapter 10, indeed the last Chapter of the thesis, reports the kinetics and mechanism of the oxidation of alcohols by the new chromium(VI) reagent, pyridinium fluorochromate (PFC). Pyridinium Fluorochromate(VI), $C_5H_5NHCrO_3F$, has been shown to oxidize benzyl alcohol, ethanol and cyclohexanol to benzaldehyde, acetaldehyde and cyclohexanone respectively. While each of the oxidations, studied in acetonitrile-nitrobenzene (1:1, v/v) medium, has been found to be first order with respect to the oxidant, the rate is almost independent of the substrate concentration. The oxidation reactions are highly catalysed by acid. The acid-catalysed reactions being very fast, precluded determination of their order in acid media. The effects of temperature and solvent compositions were studied and activation parameters evaluated. The free energies of activation of the three reactions were found to lie between 91.82 and 92.65 kJ mol^{-1}. The near constancy of the $\Delta F^{\#}$ values suggests that a similar mechanism is operative in each of the three oxidations. From the results of these studies it appears that a hydride transfer mechanism is involved in the rate determining step of the PFC oxidations. Probable mechanisms have been discussed.

QUANTUM CHEMICAL STUDIES ON THE SALIENT ASPECTS OF HYDROGEN BONDING AMONG AROMATIC HETEROCYCLIC BASES

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Abstract

The chief objective of the work presented in the thesis lies in designing base-pairs between nitrogenous aromatic heterocycles with a view to eventually concewiving artificial information-bearing macromolecules and new functional structures which may take their cue from deoxyribonucleic acid as the prime information-bearing macromolecule in nature.The work has been divided into five Chapters :

Chapter I gives the introduction to different aspects of hydrogen bonding.The hydrogen bond in the world of life plays a key role in maintaining structure and specificity of biological systems like DNA and various proteins, and protein-nucleic acid conglomerates.For DNA, the genetic information is stored in the sequence of bases of the nucleic acid and this information is translated during protein synthesis into the amino acid sequence of the protein synthesized.

Chapter II deals with the theoretical aspects of hydrogen bonding which include use of the semiempirical and the ab initio quantum mechanical methods.Here the basic assumption is that all processes and phenomena have a well-defined molecular basis.In recent years there has been much progress toward the development of satisfactory semiempirical molecular orbital methods.Two-electron theory has been developed by Pople and his group which included CNDO/2 and MNDO.More recent developments along this line of semiempirical methodologies are represented by the MNDO,the AM1 and the PM3 SCF Molecular Orbital methods.Eventually the semiempirical PM3 SCF-Mo method was developed within MOPAC programme and successfully used to determine the interaction energies of nucleic acid base-pairs. The success of this method and its parametrisation scheme in dealing with hydrogen bonding has led to its adoption for the entire set of calculations embodied in the thesis.

Chapter III deals with the study of self-association among various nitrogen heterocycles.Self-association and uniqueness of self-recognition lead eventually to duplex structures in which both the strands are identical, so that replication would result in a strand copy identical to the original template strand,unlike DNA which consists of complementary strands.The search for a set of self-associative base-pairs mimicking the characteristics and functionality of DNA bases led to the identification of three substituted imidazole base pairs as possible candidates.

Chapter IV deals with the possibilities of hetero-associative hydrogen-bonded base-pairing between various nitrogenous bases with a view to mimic the complementary base-pairing of natural DNA.Various sets of bases were considered to study pairing between substituted pyridines, pyrimidines and pyrazines using the PM3 SCF-MO methodology.The intermolecular configurations are studied in the context of a search for sets of four or more different bases forming two or more base pairs which reproduce the essential features of the DNA Watson- Crick base-pairs with regard to basic structure and function.

Chapter V covers some further aspects of hydrogen bonding among aromatic heterocyclic bases.

ORGANOTIN (IV) COMPLEXES OF SCHIFF BASE LIGANDS DERIVED FROM AMINOACETIC ACID AND AMINOBENZOIC ACID SYSTEMS: SYNTHESIS, STRUCTURE AND BIOLOGICAL PROPERTIES

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Abstract

The thesis is divided into seven chapters. The salient features are described below:

A brief review on the chemistry and structural possibilities of transition metal followed by organotin(IV) complexes of schiff base derived from amino acetic acids are presented in Chapter 1.

The sodium or potassium salt of the ligands (L^1HNa & $L^{1\text{-}11}HK$) and ($L^{12\text{-}13}HH'$ & $L^{12}HNa$) used for synthesizing various organotin(IV) compounds are described in Chapter 2 and 6 respectively. The ligands ($L^{1\text{-}11}HK$), was prepared by condensing potassium glycinate, *â*-alaninate and *l*-phenylalaninate with acetylacetone, salicyladehyde, 2-hydroxyacetophenone and 2-hydroxy-3-methylacetophenone in either methanol or ethanol under cold conditions (15-20 °C). On the other hand, the formation of sodium salt (L^1HNa) was effected by the reaction of sodium glycinate with acetylacetone in aqueous-methanol solution. The Na/K salts of the ligands were characterized by elemental analysis and IR spectroscopy. Where as ligands ($L^{12\text{-}13}HH'$) was prepared by condensing *p*-aminobenzoic with acetylacetone or salicyladehyde in ethanol under reflux condition. The sodium salt ($L^{12}HNa$) was prepared by dissolving $L^{12}HH'$ with $NaHCO_3$ in water and have been characterized by IR spectroscopy along with the elemental analysis. The ^1H- and ^{13}C- NMR signals were recorded only for ($L^{12\text{-}13}HH'$) and were assigned by the use of correlated spectroscopy (COSY), heteronuclear single-quantum correlation (HMQC) and heteronuclear multiple-bond connectivities (HMBC) experiments using gradient coherence selection and also by examining the spin-spin splitting pattern of the signals.

The organotin(IV) complexes derived from 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate (L^1H) and, 2-{[(*E*)-1-(2-hydroxyaryl)alkylidene]amino}acetate ($L^{2\text{-}4}H$) are described in Chapter 3. In this chapter, the synthesis of the organotin(IV) complexes is again divided into three main sub-section i.e., (i) synthesis of diorganotin(IV complexes from 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate (L^1H) and, 2-{[(*E*)-1-(2-hydroxyaryl)alkylidene]amino}acetate ($L^{2\text{-}4}H$) (ii) synthesis of triorganotin(IV complexes from 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate (L^1H) and, (iii) the formation of mixed ligand diorganotin(IV) and the mixed di- and tri-organotin(IV) complexes.

Reactions of sodium or potassium 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate and 2-{[(*E*)-1-(2-hydroxyaryl)alkylidene]amino}acetate with the R_2SnCl_2 (R = Me, ^{n}Bu, Ph and Bz) in equimolar ratio in methanol or methanol benzene mixture resulted in the smooth formation of the diorganotin(IV) complexes **1-8**. These complexes were isolated as $[R_2SnL^1]$ (R = Me, Ph and Bz) **1-3**, $[^nBu_2SnL]_3.S$ (L = L^2 or L^4 ; S = 0.5 C_3H_6O or 0.5C_6H_6) **4** and **7**, and $[R_2SnL^3(OH_2)]_2$ (R = Me and ^{n}Bu] **5-6** and $[Ph_2SnL^4]_n.0.5C_6H_6$ **8**, after suitable work-up and recrystallization. In a similar way, the reactions of sodium or potassium 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate with R_3SnCl (R = Me, ^{n}Bu, Ph and Bz) in methanol or chloroform yielded triorganotin(IV) complexes of compositions R_3SnL^1H **9-11** and $[R_3SnL^1H]_2$ **12**.

Finally, the ability of diphenyltin(IV) complexes e.g., $[Ph_2SnL^3]$ to undergo additional coordination was studied by treating it with one equivalent of 1,10-phenanthroline, which yielded the adduct $[Ph_2SnL^3.Phen]$ **13** in moderate yield. On the other hand, the mixed di- and tri-organotin(IV) complexes of composition $Ph_2SnL.Ph_3SnCl$ **14-15** were obtained by the reactions of Ph_2SnL (L = L^1 or L^4) with Ph_3SnCl in benzene. The summary of synthetic methodologies is depicted in Scheme 3.1 while the synthetic details and characterization data are presented in section 3.5.

The diorganotin(IV) complexes of compositions $[R_2SnL^1]$ (R = Me, Ph and Bz) **1-3**, $[^nBu_2SnL]_3.S$ (L = L^2 or L^4 ; S = 0.5 C_3H_6O or 0.5C_6H_6) **4** and **7**, $[R_2SnL^3(OH_2)]_2$ (R = Me and ^{n}Bu] **5-6** and $[Ph_2SnL^4]_n.0.5C_6H_6$ **8** have been characterized by ^1H, ^{13}C, ^{119}Sn NMR and ^{119}Sn Mössbauer spectroscopic techniques, where possible. Unsolvated form of complex **8** and two others, **5** and **6**, were reported previously by Basu Baul et al. and their structures were predicted

on the basis of IR, NMR (^{1}H, ^{13}C, ^{119}Sn) and, ^{119}Sn Mössbauer spectroscopy for **5** and **6**. The complexes **5** and **6** have been re-investigated in the present work in order to have more precise information on their structures, e.g. X-ray structures. Further, the diorganotin(IV) complexes **4-8** provided X-ray quality crystals and hence their final structures in solid state were predicted by X-ray crystallography. The solid state ^{117}Sn CP MAS NMR data (where measurements are possible) were also obtained for these complexes and the data were correlated with the crystallographic results while the cleavage of the most labile bond in each molecule has been studied using ESI mass spectroscopy.

The crystal structures of diorganotin(IV) complexes, $[Me_2SnL^3.OH_2]_2$ (**5**), $[^nBuSnL^3.OH_2]_2$ (**6**), $[^nBu_2SnL^2]_3.0.5C_3H_6O$ (**4**), $[^nBu_2SnL^4]_3.0.5C_6H_6$ (**7**) and $[Ph_2SnL^4]_n.0.5C_6H_6$ (**8**) (L = carboxylic acid residue, i.e., 2-{[(*E*)-1-(2-oxyaryl)alkylidine]amino}acetate, were determined. The crystal structure of **5** is composed of centrosymmetric dimmers of the basic $Me_2SnL^3.OH_2$ moiety, where the two Sn-centres are linked by two asymmetric Sn-O···Sn bridges involving the carboxylic acid O atom of the ligand and a long Sn···O distance of 3.174 (2) ú. The dimmers are further linked into columns by hydrogen bonds. The coordination geometry about the Sn atoms is a distorted pentagonal bipyramid with the two methyl groups in the axial positions. The crystal structure of complex **6** exhibits the same dimeric $[R_2SnL.OH_2]_2$ structural motif and Sn atom coordination geometry as complex **5**. The same Sn atom coordination geometry is observed in complex **4**, which is a cyclic trinuclear $[^nBu_2SnL^2]_3$ complex. Each Sn atom is coordinated by the phenoxide O atom, one carboxylate O atom and the imino N atom from one ligand and both the *exo*- and *endo*-carboxylate O atoms (mean Sn-O(exo): 2.35 ú; Sn-O(*endo*): 2.96 ú) from an adjacent ligand to form the equatorial plane, while the two butyl groups occupy axial positions. Complex **7** was found to crystallize in two polymorphic forms. The Sn-complex in both forms has a trinuclear $[^nBu_2SnL^4]_3$ structural motif similar to that found in **4**. In complex **8**, distorted trigonal bipyramidal Ph_2SnL^4 units are linked into polymeric cis-breidged chains by a weak Sn···O interaction 3.49(2) ú involving the *exocyclic* O atom of the tridentate ligand of a neighbouring Sn-complex unit. This interaction completes a highly distorted octahedron about the Sn atom, where the weakly coordinated *exocyclic* O atom and one phenyl group are *trans* to one another.

The triorganotin(IV) complexes R_3SnL^1H (R = Me, ^{n}Bu, Ph) **9-11** and $[Bz_3SnL^1H]_2$ **12** were characterized by IR, NMR (^{1}H, ^{13}C, ^{119}Sn) and ^{119}Sn Mössbauer spectroscopy. A full characterization of the structure of one of the complex **12** was accomplished by single crystal X-ray crystallography. Complex **12** exists as centrosymmetric dimers in which two ligand molecules bridge the two tin centres. Each of the tin atoms in the dimeric unit is five-coordinate with an approximately trigonal bipyramidal configuration. The three benzyl groups take up the equatorial positions while the axial positions are occupied by a carboxylate oxygen from one ligand molecule O(2), and the alkoxy oxygen, O(1), of the second ligand molecule. The two O-Sn-O axes in each dimer are approximately parallel to each other. The carboxylate groups are monodentate. Each of the two ligands coordinates in the form of a zwitterion, where the alkoxy proton has migrated to the imine nitrogen, but is still hydrogen-bonded to the alkoxy oxygen.The mixed ligand diphenyltin(IV) complex $[Ph_2SnL^3.Phen]$ **13** and, mixed di- and tri-organotin(IV) complexes of composition $Ph_2SnL.Ph_3SnCl$ (L = L^1 and L^4) **14-15** were characterized by IR, NMR (^{1}H, ^{13}C, ^{119}Sn) and single crystal X-ray crystallography while ^{119}Sn Mössbauer spectroscopy have been used only for **14** and ESI mass spectrometry for **13**. The structure of $[Ph_2SnL^4.Ph_3SnCl]$ (**15**) is virtually isomorphous with that of the $[Ph_2SnL^1.Ph_3SnCl]$ (**14**) and both are dinuclear tin complex. The only differences are the ligands, i.e., 2-{[(2*Z*)-3-hydroxy-1-methyl-2-butenylidene]amino}acetate (in **14**) and 2-{[(*E*)-1-(3-methyl-2-hydroxyphenyl)-methylidene]amino}acetate (in **15**) which are bridging two trigonal bipyramidal tin centers. In all other respects, the structures of both the complexes are same and have similar coordination geometry at each tin atom. The following specific details are given for the structure of **15**, but the comments apply equally well to the complex **14** and it is apparent that changing carboxylate ligands has an insignificant influence on the overall structure of the molecule and the coordination geometry of the Sn-atoms. In **15**, atom Sn1 has a distorted trigonal bipyramidal coordination geometry, with atoms O(1) and O(3) occupying axial positions and the O(1)-Sn-O(3) angle distorted from linearity by 19.13 (13)°. The C(10)-Sn(1)-C(11) angle is also about 14° wider than in an ideal trigonal bipyramid. Atom Sn1 lies 0.027(1) Å out of the trigonal plane formed by atoms N(1), C(10) and C(11) in the direction of atom O(3). The geometry about atom Sn(2) is also distorted trigonal bipyramidal, with atoms C(1) and O(2) defining the axial positions, but the O(1)-Sn-O(3) angle is distorted from linearity by only 3.76 (9)°. Atom Sn(2) lies 0.224(1) Å out of the trigonal plane formed by atoms C(24), C(30) and C(36) in the direction of the Cl atom. The O(2)-Sn bond is about 0.24 Å longer than the O(1)-Sn(1) bond and the carboxylate C-O distances are inversely related. The carboxy-

late C-O bonds are not completely delocalized, with the C(1)-O(2) bond having much more double-bond character than the C(1)-O(1) bond. Details analyses of structure are presented in this chapter.

The Chem draw structures of organotin(IV) complexes which are characterized by single crystal X-ray crystallography, e.g., $[^nBu_2SnL^2]_3.0.5C_3H_6O$ (**4**), $[Me_2SnL^3(OH)_2]_2$ (**5**), $[^nBu_2SnL^3(OH)_2]_2$ (**6**), $[^nBu_2SnL^4]_3.0.5C_6H_6$ (**7**), $[Ph_2SnL^4]_n.0.5C_6H_6$ (**8**), $[Bz_3SnL^1H]_2$(**12**), $[Ph_2SnL^3.Phen]$ (**13**), $[Ph_2SnL^1.Ph_3SnCl]$ (**14**) and $[Ph_2SnL^4.Ph_3SnCl]$ (**15**), are summarized hereunder.

A STUDY OF SEMINORMALIZATION OF RINGS AND NORMALIZATION OF MODULES

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Abstract

In this dissertation we study about seminormality of a ring which is an important tool in the study of normalization of modules. The case of semi-normality in graded rings has been dealt with separately in chapter two. Here we give a brief description of the main results of each chapter of this dissertation. Chapter 0 is introductory in nature. It consists of basic de_nitions and results on integrally closed rings, normal rings, valuation rings and their properties, invertible modules, invertible fractional ideals, Picards group of a commutative ring, etc.

The _rst chapter is devoted to the survey of the work done by Brewer, McCrimmon, Costa, Rush, Swan and Traverso on Seminormal rings. Some of the main results in this chapter are:

Theorem *1.1.28.* Let R be a subring of the ring S. If R is n-root closed in S, then R[X] is n-root closed in S[X]. Theorem 1.1.31. Suppose that R is a reduced ring whose total quotient

ring Q(R) is an absolutely at ring. (In particular, R could be any integral domain or a reduced Noetherian ring). Then

(1) Let n > 1 be a positive integer. If R is n- root closed, then so is R[X]. 1

(2) If R is root- closed, so is R[X].

(3) If R is (2,3)- closed, so is R[X].

(4) If R is F- closed, so is R[X].

Theorem *1.2.6.* Let R be a ring and B an overring of R which is integral over R. The following properties of R are equivalent.

(1) R is seminormal in B.

(2) If y 2 B and yn 2 R for all large n, then y 2 R.

(3) If y 2 B and ym; yn 2 R for relatively prime integers m; n _ 1, then

y 2 R.

(4) R is an intersection of rings +

PR obtained from B by glueing over prime

ideals P of R.

Corollary 1.2.7. Let A _ B _ C, C integral over A. If A is seminormal in B and B is seminormal in C, then A is seminormal in C.

Theorem 1.2.10. +

BR is the largest subring R0 of B such that:

(1) 8P 2 Spec(R), there is exactly one P0 2 Spec(R0) lying over P.

(2) the canonical homomorphism k(P) ÀÛÜ! k(P0) is an isomorphism.

Corollary 1.2.11. (1) If A _ C _ B and A is seminormal in B, then A is seminormal in C. (2) If A _ B , A _ C _ + BA, then C has the following

2

properties:

(i) 8P 2 Spec(A), there is exactly one Q 2 Spec(C) lying over P.

(ii) The canonical homomorphism

AP

PAP

ÀÛÜ!

CQ

QCQ

is an isomorphism.

Proposition 1.2.14 If A _ B _ C then A _ C is subintegral if and only if A _ B and B _ C are.

Corollory 1.2.16. +

BA is the smallest ring containing A which is semi-normal in B.

Proposition 1.2.18. The formation of +

BA commutes with localization

with respect to multiplicative subsets S of A.

Proposition 1.3.4. If A _ B is seminormal and S is a multiplicative closed subset of A, then AS _ BS is seminormal. Also A _ B is seminormal if and only if AM _ BM is seminormal for all maximal ideals of A.

Corollary 1.3.8 Let R _ B with B seminormal. Then R is seminormal if and only if R is seminormal in B.

Proposition 1.3.9. Let R be a reduced commutative ring. Then R is seminormal if and only if R is seminormal in T(R).

Proposition 1.3.14. R is seminormal if and only if

R = fx 2 T(R) : x

1 2 RP + J(T(R)P) for every P 2 Spec(R)g.

The second chapter includes few preliminary results on graded rings followed by a study of the work done by J.V.Leahy and M.A. Vitulli on semi-

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normal graded rings. Some of the interesting results in this chapter are given below:

Proposition 2.1.7. Let R _ S be an integral extension of graded rings. Then R is seminormal in S if and only if R contains each homogeneous element s of S such that s2; s3 2 R.

Corollary 2.1.8. Let R be a reduced graded ring with a _nite number of minimal primes. Then the seminormalization +R of R is a graded ring and contains R as a graded subring.

In chapter three, we discuss how normalization of ideals and modules can be extended from ideas of normalization in rings. Here we see that valuations determine the integral closures of ideals. Some of the results in this chapter are stated as follows:

Proposition 3.1.9. Let I be an ideal in R and r 2 R. Then r is integral over I if and only if there exists a _nitely generated R- module M such that rM _ IM and such that whenever aM = 0 for some a 2 R, then ar 2

p

0.

Further, if I is _nitely generated and contains a non- zero-divisor, r is integral over I if and only if there exists a _nitely generated faithful R-module M such that

IM = (I + (r))M.

Proposition 3.2.3. Let R be an integral domain with _eld of fractions K. Let I be an ideal in R and let V be a valuation ring between R and K. Then

4

IV = IV = IV

Proposition 3.2.4. Let R be a ring, not necessarily Noetherian, and I be an ideal in R. Then

I =

\

V 2S

IV \ R,

where V varies over all valuation domains of the _eld of fractions K of R that contains R.

In the last section we discussed a special case where the ring R is an integral domain and obtained the following result.

Proposition 3.4.3. Let R be a Noetherian domain. When N = R, the above de_nition is equivalent to the usual de_nition of integrality over R. That is, _ 2 K is integral over R if and only if _ 2 K is integral over R regarded as an R- module.

EFFECTS OF OSMOTIC,HYPER-AMMONIA AND DESICCATION STESSES ON GLUCONEOGENISIS IN THE AIR-BREATHING CATFISH, CLARIASBATRACHUS-

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Abstract

Objectives:

1. To study the effects of osmotic, hyper-ammonia and desiccation stresses on gluconeogenesis in the air-breathing catfish, *Clarias batrachus.*

Plan Of Work:

1. *C. batrachus* was exposed to hypertonic exposure (150 mM NaCl) for 7 and 14 days and the following parameters were studied:

- Changes in the activity of three key gluconeogenic enzymes namely, phosphoenolpyruvate carboxykinase (PEPCK), fructose 1, 6,-biphosphatase (FBPase) and glucose-6-phosphatase (G6Pase) in different tissues such as liver, kidney, brain and muscle.
- Rates of gluconeogenic fluxes from different gluconeogenic substrates by the perfused liver of treated fish.
- Changes in the levels of glucose in different tissues such as liver, kidney, muscle, brain and plasma.
- Changes in the concentrations of PEPCK and G6Pase enzyme proteins and that of Hsp70 by Western blot analysis.
- Changes in the relative expression of PEPCK mRNA by real time qPCR technique.

2. *C. batrachus* was exposed to high environmental environmental ammonia (25 mM NH_4Cl) for 7 and 14 days, and the parameters mentioned in No. 1 were studied.
3. *C. batrachus* was kept inside the mud peat for one month mimicking their normal habitat in summer and all the parameters mentioned in No. 1 were studied.

Major Observation:

In the first experiment, fishes were exposed to hypertonic environment (150 mM NaCl solution) for 7 and 14 days. A steady state efflux of glucose was generated due to gluconeogenesis from the perfused liver of control fish while infusing with different gluconeogenic substrates such as lactate, pyruvate and glutamate, which increased significantly in fishes following *in situ* exposure to hypertonic saline environment. There was a maximum increase of gluconeogenic flux with lactate as a substrate, indicating the predominance of an active Cori cycle in the walking catfish. The glucose concentration also increased significantly in all the tissues including the plasma within 7 days of hypertonic exposure, followed by further increase after 14 days. Among the tissues, the concentration of glucose was highest in liver followed by kidney, muscle and brain, both after 7 and 14 days of exposure. In plasma, glucose increased by 51% after 7 days, followed by a further increase (97%) after 14 days of exposure. It was further observed that this increase in glucose concentration was further accompanied by increased activities of different gluconeogenic enzymes namely PEPCK, FBPase and G6Pase, not only in liver and kidney but also in other tissues like brain and muscle except for G6Pase, the activity of which could not be detected in brain and muscle of both control and treated fish. Liver had the highest PEPCK activity, which was followed by kidney, brain, and muscle, after 7 days of exposure, followed by further increase after 14 days of exposure. The specific activity of PEPCK increased in a similar pattern like that of tissue activity with a maximum increase in liver, followed by kidney, brain and muscle, following 7 days of hypertonic exposure. However, after 14 days of hypertonic exposure, the specific activity was maximum in liver, followed by brain, kidney and muscle.

The FBPase activity was widely distributed in different tissues of *C. batrachus* with a maximal increase of activity recorded in liver, followed by kidney, brain and muscle following 7 and 14 days of exposure to hypertonic environment. The specific activity increased maximally in liver, followed by kidney, muscle and brain following 7 days of hypertonic exposure. The similar pattern of increase in different tissues was observed after 14 days of exposure.

The tissue activity of G6Pase in *C. batrachus* was maximal in liver, which increased after 7 days and with no further increase after 14 days of exposure. Similarly in kidney, the tissue activity increased after 7 days of exposure, with no further increase after 14 days of exposure. Similar pattern of increase was observed in the specific activity of G6Pase with maximal activity in liver, followed by kidney after 7 days with no further changes of activity after 14 days of exposure.

As evidenced from western blot analyses, there was an increase in the abundance of PEPCK and G6Pase enzymes protein concentrations. In case of PEPCK, the enzyme protein concentration elevated maximally by 2.5 and 1.95 fold in liver and brain, respectively, after 14 days, and by 2.05 and 1.9 fold in kidney and muscle, respectively, after 7 days of exposure. In case of G6Pase, the enzyme protein concentration elevated maximally by 2.75 and 2.45 fold, respectively, in liver and kidney after 7 days of exposure.

Further, analysis on relative expression of mRNA for PEPCK, the key regulatory gluconeogenic enzyme, by real time qPCR analysis shows that the PEPCK mRNA level was significantly elevated both in liver and kidney tissues by 2.45 and 2.18 fold after 7 days, which was further elevated to 3.6 and 3.8 fold, respectively, in these two tissues after 14 days of exposure to environmental hypertonicity compared to control fish, thus clearly indicating regulation at transcriptional level.

There was also an upregulation of Hsp70 expression, the major molecular chaperone, in different tissues of walking catfish as evidenced by an increase in the protein concentration following hypertonic exposure. In liver, the Hsp70 concentration increased maximally by 2.91 fold after 14 days of exposure, whereas in kidney, muscle and brain, the Hsp70 elevated maximally by 2.9, 2.15 fold and 1.55 fold, respectively, after 7 days of exposure.

In another experiment, fishes were exposed to high environmental ammonia (25 mM NH_4Cl solution) for 14 days. The rate of gluconeogenic fluxes in presence of three potential substrates such as lactate, pyruvate and glutamate from the perfused liver of *C. batrachus* shows significant increase following exposure to 7 and 14 days of high environmental ammonia. Further, it has been observed that the rate of gluconeogenesis increased maximally with glutamate as a gluconeogenic substrate, followed by lactate and pyruvate, indicating that the presence of an amino acid gluconeogenesis as well lactate gluconeogenesis through the Cori cycle. The glucose concentration also increased significantly in all the tissues except in muscle where glucose did not even increase after 14 days of exposure. However, in plasma, glucose increased within 7 days of exposure to high environmental ammonia, followed by further increase after 14 days of exposure. This increase was further accompanied by the increase of activities of three different gluconeogenic enzymes such as PEPCK, FBPase and G6Pase in liver, kidney, brain and muscle. The PEPCK was observed to increase maximally in kidney, followed by liver, muscle and brain both after 7 and 14 days of exposure to high environmental ammonia. The specific activity was also seen to increase maximally in kidney, followed by muscle, liver and brain following 7 days of exposure to high environmental ammonia.

Similarly, for FBPase and G6Pase, the activities were seen to be maximum in kidney followed by liver and other tissues. For FBPase, the specific activity increased maximally in kidney, followed by liver, muscle and brain following 7 days of exposure to high environmental ammonia. After 14 days of exposure, the maximum increase of specific activity was again recorded in kidney, followed by brain, liver and muscle. For G6Pase, the specific activity maximally increased in kidney, followed by liver, after 7 days of exposure to high environmental ammonia, with no further increase of activity after 14 days of exposure. Further, there was an increase in the abundance of PEPCK and G6Pase enzyme protein concentrations as evidenced from the western blot analyses. In case of PEPCK, the enzyme protein concentration elevated maximally by 1.75 fold and 1.68 fold in liver and brain, respectively, after 14 days, and by 1.60 fold in kidney, after 7 days and by 1.9 fold in muscle after 14 days of exposure. For G6Pase, the enzyme protein concentration elevated maximally by 1.65 and 1.59 fold, respectively, in liver and kidney after 14 days of exposure. The PEPCK mRNA level was also significantly elevated both in liver and kidney tissues by 2.13 and 2.25 fold, respectively, after 7 days, which was further elevated by 2.71 and 3.18 fold, respectively, after 14 days of exposure to high environmental ammonia, indicating a regulation at the transcriptional level.

An upregulation of Hsp70 expression, the major molecular chaperone, was also observed during exposure to 25 mM NH_4Cl, in different tissues of the walking catfish, possibly to defend against the hyper-ammonia-mediated stressors. The Hsp70 concentration increased maximally by 2.42, 2.29 and 2.11 after 14 days of exposure respectively, in liver, muscle and kidney, whereas in brain, the maximum increase of 1.82 was observed after 7 days of exposure.

In another experiment, *C. batrachus* was kept inside the mud peat for one month mimicking their natural habitat in summer. The objective of this experiment was to elucidate the possible role of gluconeogenic pathway as an energy source adopted by the walking catfish to defend against various environmental stresses such as ammonia toxicity, hypoxia, osmolarity etc., during exposure to mud peat (semi-dry conditions), which they face in their natural habitat in certain seasons of the year. Upregulation of gluconeogenesis on exposure to semi-dry conditions for a month is evidenced by the fact that there was an increase in the gluconeogenic fluxes by the perfused liver with three different substrates like lactate, pyruvate and glutamate compared to the control fish. The glucose concentration also increased significantly in all tissues including the plasma following exposure to mud peat for one month. Further, there was an increase in the activities of different gluconeogenic enzymes, in different tissues with liver and kidney being the major sites, during exposure to semi-dry conditions for a month. The tissue activity of PEPCK increased significantly in all the tissues following exposure to mud peat for one month. The tissue activity of PEPCK increased maximally in liver, followed by kidney, brain, and muscle. However, the specific activity of PEPCK, increased maximally in liver, followed by muscle, brain and kidney. The tissue activity of FBPase activity increased maximally in kidney, followed by brain, liver and muscle after one month of exposure to mud peat. The pattern of changes of specific activity of FBPase following exposure to mud peat was similar to that of tissue activity in different tissues. In case of G6Pase, both tissue activity and specific activity increased maximally in kidney, followed by liver. As evidenced by western blot analyses, the increase of PEPCK and G6Pase activities in different tissues of walking catfish was accompanied by significant elevation in the levels of both the enzyme protein concentrations. In case of PEPCK, the enzyme protein concentration elevated maximally by 2.5 fold in liver, followed by brain (1.5 fold), kidney (1.42) and muscle (1.24 fold). In case of G6Pase, the enzyme protein concentration elevated maximally by 1.87 and 1.5 fold, in kidney and liver, respectively. Analysis on relative expression of mRNA for PEPCK by real time qPCR technique indicated that the mRNA level was significantly elevated both in liver and kidney tissues by 3.5 and 2.8 fold, respectively, following exposure to mud peat for one month.

Exposure to mud peat for one month also upregulated the Hsp70 expression in different tissues of walking catfish. In liver, it increased maximally by 2.5 fold, followed by kidney (1.96 fold), muscle (1.81 fold) and brain (1.6 fold).

Conclusion:

The Present Study Provided evidences that environmental hypertonicity leads to induction of gluconeogenesis as there was a significant increase of gluconeogenic fluxes from the perfused liver of the walking catfish with a maximum increase with lactate as a substrate during 7 and 14 days of exposure to hypertonicity, indicating the predominance of lactate gluconeogenesis through the Cori cycle, as well as amino acid gluconeogenesis which were accompanied by favorable changes of activities of different gluconeogenic enzymes namely, PEPCK, FBPase and G6Pase both in liver and kidney, the two potential gluconeogenic organs in this fish. The activity of PEPCK and FBPase were also found to be significantly elevated in other tissues like brain and muscle of walking catfish following hypertonic exposure, which was accompanied by the increase in abundance of PEPCK enzyme protein concentrations in all the four tissues and G6Pase in liver and kidney. The activity of G6Pase could not be detected in brain and muscle of both control and treated fish. There was also a significant increase of PEPCK mRNA level in liver and kidney of treated fish compared to control. Therefore, the upregulation of PEPCK and G6Pase genes probably takes place at a transcriptional level leading to an increase in the activity of key gluconeogenic enzymes following *in situ* exposure to hypertonic environment, and this could be as a result of decreasing of water content or cell volume in the different tissues of this catfish. Thus, these biochemical adaptational strategies, possibly as a consequence of changes of hydration status/cell volume of different cell types during environmental hypertonicity, would assist in maintaining glucose homeostasis and proper energy supply mainly to support metabolic demands for ion transport and other altered metabolic processes.

Exposure to high environmental ammonia would also demand higher energy requirement to handle the problem of ammonia toxicity. As expected, the gluconeogenic activity was stimulated under hyper-ammonia stress caused by exposing the fish in high environmental ammonia. There was significant increase of gluconeogenic fluxes from the

perfused liver of the walking catfish with a maximum increase with glutamate and lactate as substrates during 7 and 14 days of exposure to 25 mM NH_4Cl, indicating the predominance of amino acid gluconeogenesis as well as lactate gluconeogenesis through the Cori cycle. The glucose concentration also increased significantly in all the tissues including the plasma during exposure to high environmental ammonia, which was accompanied with overall elevation of activities of PEPCK, FBPase and G6Pase enzymes in different tissues. The increase was further accompanied by the increase in abundance of PEPCK and G6Pase enzyme protein concentrations in both liver and kidney. Thus, the induction of PEPCK and G6Pase activities could be suggested as a result of transcriptional regulation of PEPCK and G6Pase genes under high environmental ammonia. The present findings gave a possible indication that glucose metabolism plays an important role in walking catfish for proper energy supply atleast under such environmental conditions, as suggested for various group of fishes, and interestingly gluconeogenesis appears to be the major source of glucose production in this carnivorous fish. High synthesis and more accumulation of different non-essential FAAs in different tissues of walking catfish by stimulating various amino acid metabolism-related enzymes have been reported during exposure to high environmental ammonia. Thus, it appears that amino acid gluconeogenesis in this carnivorous fish is quite predominant with the possibility of further stimulation of gluconeogenic activity under hyper-ammonia stress as observed in the present study. Exposure to high environmental ammonia also leads to an increase in the level of cortisol in walking catfish as reported earlier and cortisol treatment was reported to increase amino acid gluconeogenesis in some other fishes. Thus, increasing the level of cortisol in high environmental ammonia could be one of the reasons of stimulation of gluconeogenesis in this fish as one of the adaptational strategies to tackle the problem of hyper-ammonia stress. This probably helps in proper energy supply and also for glucose homeostasis in this fish during environmental insults.

The present study further indicated that the gluconeogenesis is also upregulated in the walking catfish while living inside the mud peat for one month as evidenced by the fact that there was an increase in the gluconeogenic fluxes by the perfused liver with three different substrates like lactate, pyruvate and glutamate compared to control fish. Further, there was increase of activity of all the three key gluconeogenic enzymes such as PEPCK, FBPase and G6Pase in different tissues of walking catfish while living inside the mud peat. The increase of PEPCK and G6Pase activities was also accompanied by more abundance of these enzymes protein concentrations and significant increase of PEPCK mRNA concentration in liver and kidney of walking during exposure to mud peat. PEPCK, which catalyses a regulatory step in gluconeogenesis, is suggested to be regulated at the level of transcriptional initiation as shown in some reports. There could be two possibilities of stimulation of gluconeogenesis in walking catfish during their stay inside the mud peat under semi-dry conditions especially in summer when they face acute shortage of water in their natural habitats. One possibility could be high accumulation of endogenously built ammonia due to difficulty of excretion of ammonia, which results in more synthesis of non-essential amino acids, and hence stimulation of amino acid gluconeogenesis under hyper-ammonia stress. Another possibility could be due to hypoxic stress, which they may face in semi-dry environment of mud peat leading to an induction of certain genes involved in gluconeogenesis. Further, there may be dehydration stress to this fish while living inside the mud peat under semi-dry condition, which may result to changes of hydration status of different cells as observed during hypertonicity, thereby leading to a stimulation of gluconeogenesis in this fish under desiccation stress. In conclusion, desiccation stress, that results while living inside the mud peat under semi-dry conditions, results in stimulation of gluconeogenesis mainly by inducing the activities of key gluconeogenic enzymes probably at the transcriptional level. It helps in better adaptation of this fish to defend against various dehydration-induced stressors and for proper energy supply along with the glucose homeostasis.

Further, there are evidences from the present study that the levels of Hsp70, a major molecular chaperone, are increased during different environmental constraints such hypertonicity, hyper-ammonia and desiccation stresses. This probably occurs to defend against various cellular damages caused by various environmental stressors, which may lead to mis-folding, unfolding and denaturation of certain proteins.

Thus, in conclusion, gluconeogenesis appears to play a vital role in this air-breathing walking catfish for maintaining the glucose homeostasis and also for high glucose production mostly from dietary proteins and amino acids as may be required for proper energy supply mainly to support high metabolic demands for ion transport and other metabolic activities during cell volume changes under osmotic, hyper-ammonia and desiccation stresses.

FOREST PRODUCTS OF RAID SAW SYMPER, MEGHALAYA AND THEIR CONTRIBUTION TO THE LIVELIHOOD OF THE PEOPLE

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Abstract

Forest products have played a key role in the sustenance of human civilization since time immemorial. They constitute a critical component of food and livelihood security; in that they act as safety nets in times of hardship and provide a source of income to cash-poor households. The term 'Forest Product' encompasses all biological materials derived from the forest ecosystem for human use. Broadly they can be categorized as timber and non timber forest products (NTFPs). Timber include industrial round wood and derived sawn wood, wood chips, wood-based panels and pulp, while non-timber forest products include all plants and plant materials used for food, fuel, fodder, medicine, storage and wrapping materials, raw material for handicrafts, biochemicals, as well as animals such as birds, reptiles and fishes, for food and feather other than timber. Millions of people throughout the world harvest forest products both for subsistence and commercial use. The significance of forest products to livelihoods can be measured by the diversity of NTFPs used by a household. The quantity of forest products harvested by households varies across all forest types, income and caste, across seasons and geographical location. Estimating values of forests and deriving the contribution of forest products to household income help towards understanding the role of forests in rural livelihood. Further, understanding the resource-use patterns of traditional communities living in and around forest and using forests resources in various ways provides a basis for seeking the participation of such communities in forest conservation.

The north-eastern part of India and particularly Meghalaya is known for its rich forest cover and high poverty incidence. These forests support rich diversity of timber as well as NTFPs which are an integral part of the traditional life style of the people in the region. Studies on diversity and utilization of the forest products, particularly those focusing on contribution of forest products to households' livelihood are scarce in this part of the world. The available studies mainly focus on commercial NTFPs extracted from managed forests, agro-forests and plantations. The wild and subsistence forest products collected from natural forests of the region have not received due attention of researchers.

The present study is aimed to find out the importance of forest products in the livelihood of forest dependent communities by investigating the forest vegetation structure and examining the pattern of utilization of this natural resource by the rural people. It attempts to analyze the species diversity and community structure of traditionally managed forests along disturbance and management gradient with a larger goal of understanding the linkages between community composition and forest product availability and extraction. The research also aims to inventorise and document the variety and utilization of forest products collected by the people and study the knowledge associated with product's use. It also estimates the contribution made by forest products towards rural livelihood and to find out as to which section of the society are more likely to benefit from the resource. Further, it aims to determine the household's socio-economic characteristics that influence dependency of rural people on income from forest products and examines the role of forest products in reducing income inequality amongst rural households.

The research was carried out in Raid Saw Symper in the East Khasi Hill district of Meghalaya. The area is situated on the uplands. The soil condition is harsh and the place receives torrential rain for most part of the year. The agricultural activity is therefore limited resulting in high dependency of people on forests. More than fifty percent of the land in the area is under forest cover. All the forests belong to the people and are subjected to different traditional management practices. The East Khasi Hill district where Raid Saw Symper is located has experienced a sharp decline (750 sq km) in forest cover between 2001 and 2011 (FSI, 2001-2011). There is also high incidence of poverty in the study area.

To understand the status and type of forests, and variety of forest products available for use by the people of Raid Saw Symper, the floristic composition and phytosociology of five traditionally managed forests of the area were studied using quadrat method. All important parameters relating to plant community structure were worked out using standard procedures. These five forests *viz.*, (i) *Law Kyntang* (LKY) or Sacred grove (ii) *Law Adong* (LAD) or Village restricted forest (iii) *Law Raid* (LRA) or Group of village forest (iv) *Law Khurit* (LKH) or Private forest and (v) *Law Kur* (LKU) or Clan forest are located within the same physiographic zone and more or less at same altitudinal

range (1480-1740 masl). They are subjected to different types of management systems, permitting certain human activities to take place thus causing varying levels of disturbances. Intensity of disturbances increases from LKY<LAD<LRA<LKH<LKU. A total number of 217 species belonging to 156 genera and 82 families were recorded from the five forests in the study area, out of which 24 species belonged to endemic and 13 species to rare category. Considering the human pressure in some of the studied forests and the harsh climatic condition (e.g., extreme rainfall) prevailing in the area, the forest of the area can be considered quite rich in species diversity and endemic species. Species composition and community structure in the five traditionally managed forests of the study area varied with the type of activities permitted and level of disturbances. Less disturbed forests *viz.*, LKY and LAD have higher species richness and diversity than disturbed forests (LRA, LKH and LKU). The overall species richness index was highest for LAD forest and least for LKH forest. Species richness, density and basal cover for trees were low in forests open for extraction of timber, firewood and shifting cultivation whereas, for undergrowth *viz.*, shrubs and herbs, it was higher in disturbed forests. Species richness index for trees was highest in LKY, for shrubs in LRA, for climber & liana species was high in LAD and for herbs in LKU forest. In almost all the forests, majority of the species were found to occur in Raunkier's frequency class A, showing that the forests are highly heterogeneous and patchy in terms of species distribution. Further, it was found that most species exhibit clump or contagious distribution in all forests. Four distinct layers *viz.*, canopy layer (>15 m height), sub-canopy (8 to 15 m), under canopy (<8m) and ground vegetation (upto 2m height) which included shrubs and herbs could be recognized in all the five forests, though in some forests canopy layer was more sparse than the others. In LKY, LAD and LRA tree species share almost equal IVI, while in LKH and LKU, the tree layer was found to be dominated mainly by *Pinus kesiya,* a secondary successional species. It was often observed that there was a significant change in species composition when management system involved change in landuse as seen in the case of LKH and LKU. Highest similarity of tree and shrub species was found between LKY and LAD forests, whereas, for climber & liana and herb species it was highest between LAD and LRA forests which may be attributed to the similar management regime. Shannon species diversity index for trees, shrubs, climbers & lianas was higher for protected and less disturbed forests, maximum in LAD, while for herbs it was maximum in LKU, the highly disturbed forest. Simpson dominance index for tree and climber & liana species was maximum in LKY, for shrubs in LKU and for herbs in LKH. Pielou evenness index for all life forms was maximum in LRA, except for herb species which was highest in LKY. In all the five forests, tree density and species richness consistently decreased with increase in girth size resulting in a reverse J-shaped curve signifying the preponderance of young individuals, a characteristic feature of regenerating forest. The percentage of early successional tree species increases with increasing level of disturbance.

The diversity and utilization of forest products by the local people in Raid Saw Symper was studied by employing various participatory research techniques such as Participatory Rural Appraisal and informal Key Informant Survey. Identification and evaluation of plant and animal species collected by the people was done using standard publications. People of Saw Symper possess a vast knowledge on utilization of floral and faunal forest products. A total of 347 forest products were used by the people, out of which 13 were timber products and the rest 334 were non timber forest products. The study elucidates the importance of NTFPs over timber products in the area. Timber from the community forests is mainly harvested for subsistence use, whereas from private forests small scale trade of timber was recorded. *Pinus kesiya* and *Schima wallichii* are the two tree species preferred as commercial timber. It was also found that higher number of floral (195) than faunal (139) NTFPs were utilized by the people of the Saw Symper. The 195 floral NTFPs utilized by people emanated from 158 plant species out of which 29 have multiple uses while the rest 129 have single use. Trees are the dominant life form that is used by the people, followed by shrubs, herbs and climbers. A variety of mushroom and bamboo species are also used by the people of the area. Majority of the plant species collected by the people are used as food (39%), followed by medicine (21%) and fuelwood (17%). While other studies reported leaves as most commonly harvested plant part, in the present study it was found that fruits were the most common plant parts harvested by the people. Availability of NTFPs was higher during the rainy-summer months than during the dry-winter season. Collection time for fruits and leafy vegetables is mainly during the wet months (April to November) because of their availability and low volume, while firewood and poles for construction are mainly collected during the dry season (November to March) as it is more convenient for transportation. Majority (79%) of the floral NTFPs harvested by people are meant for subsistence use. Sustainability of forest product harvesting depends very much on the plant part which is harvested. Studies found that harvesting of fruits and seeds have less impact on the species at individual and population level, provided correct harvesting method is employed and other parts of the tree are not damaged during harvesting. In the present study, harvesting of forest products can be said to be sustainable as the plant parts with

highest utilization are fruits, leaves, seeds and flowers, followed by stems and barks and to a small extent whole plant, roots and rhizome. Out of 217 plants encountered in the phytosociological survey, one hundred and twenty species are not utilized by people, whereas, people have knowledge on the uses of an additional 32 species which were not encountered during phytosociological study. Further, it was found that availability of number of non-timber useful plant species was highest in LRA forest and least in LKH forest. LKY forest is also rich in non timber useful plant species, however, since extraction in this forest is restricted therefore, it is not of much use to the people. Faunal forest products are also collected by the people of the area, though not as popular as floral forest products. A total of 139 faunal forest products obtained from 137 animal species are utilized by people of Saw Symper. Majority (92%) of these are hunted/collected for food and very few for medicinal purposes (3%). The largest percentage (54%) is represented by the bird category, followed by mammals (23%), pisces (13%), insects (7%), amphibians (1%) and crustaceans (1%).

Contribution of forest product income to rural livelihood was worked out based on the total household income. Data were collected from 120 households (>10% of total households of the study area) located in 4 villages. Firstly, net income from different sources available in the area was calculated to derive the percentage contribution of forest product to the total household income. Cost of own labour was not taken into account while calculating net income. Secondly, the study investigated the relevance of forest product income to households of different income groups. Thirdly, it examined the key socioeconomic characteristics that determine a household dependency on forests in the area and the role of forest products in reducing income inequality among the households. The study revealed a high dependence of people of Saw Symper on forest products as all the surveyed households were engaged in the collection of some sort of forest products for subsistence use. Five important sources of income were identified in the area *viz.*, income from forest products, agriculture, livestock, daily wage and salaried jobs & businesses. On an average forest products contributed nearly 14 % of the total household income. Income from floral forest products was found to be higher than from faunal forest products. Firewood emerged as the most important forest products for the households of Saw Symper. The economic importance of forest products differs between households in different income groups. The households belonging to High Income Group (HIG) extract more forest products in quantitative terms and have significantly higher cash returns than poorer ones. But the households belonging to Low Income Group (LIG) are relatively more dependent on forest products in order to fulfill basic needs than wealthier households as seen from the higher percentage of relative forest product income. On the basis of use categories, fuel wood was found to contribute highest income in all three income groups. The highest quantity of fodder was collected by the households belonging to Middle Income Group (MIG). The poorer households (LIG) were found to be more dependent on wild fruits and vegetables collected from the forest because they generally lack cash to purchase food items. Key socioeconomic characteristics of the household like age, gender, education level, accessibility to forest, landlessness, land tenure and absence of alternative income sources of forest-dependent households can play important roles in explaining forest use and dependency. In the present study it was found that households owning forest land, cows and goats and those who live nearer to forest have statistically higher total forest product income. In terms of relative forest product income, younger and less educated household heads are more dependent on forest product income. Relative forest income was more in the case of households owning cows. Contrary to other studies on forest use which linked women with high forest dependency and poverty, the present study found that households with more number of female members have lower relative forest income and are less dependent on forest. The Gini-coefficient analysis on different income sources revealed least inequality in income from forest products as evident from low value of Gini coefficient. Income from daily wage and forest products are important in reducing income disparity among the households in the area. In the absence of daily wage income, forest income will have a strong equalizing effect on total income distribution in the area. Further, it was found that Gini coefficient for households with high access toforest was lower than those with low access to forest which suggests that better accessibility and utilization of forest products helps in diminishing income disparity among rural poor.

Traditional forest management systems practised by people helped in conservation of biodiversity in other wise fragile forest ecosystems, whilst meeting the day to day needs of the people in terms of forest products. Based on the findings of this study, it is suggested that the government and development planners need to consider the role of traditional forest management systems in conservation of biodiversity and in meeting day to day needs of rural people, and incorporate these practices in their management and conservation related policies and programmes. Domestication of commonly used wild plant and animal species can be a viable strategy to avoid overexploitation and disappearance of the species in the area as well as other forest products rich regions of the state. The findings of this studies underlines that community forest management contributes towards reducing income disparity among rural households.

STUDIES ON THE IMPACT OF COAL MINE DRAINAGE ON MICROBIAL ECOLOGY OF WATER BODIES OF JAINTIA HILLS DISTRICT

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The objectives of the study are:

To assess the physico-chemical characteristics of the water body in terms of pH, temperature, electrical conductivity, dissolved oxygen, free carbon dioxide, hardness, total alkalinity, total suspended solids and heavy metal content by Atomic Absorption Spectroscopy (AAS).

5. To analyse the impact of water quality on:
    i. Hematological parameters, such as total RBC count, hemoglobin content, total WBC count, surface microstructure and elemental content of blood cells through SEM and EDS.
    ii. Histology and ultrastructure of scale, skin, muscle, gill, kidney, liver, ovary and testis
6. To study the heavy metal accumulation in certain tissues of the fish with the help of energy dispersive X-ray spectroscopy (EDS).
7. To ascertain genotoxicity in the fish with the help of micronucleus assay.

Materials and Methods

Control water body selected for the study was Rural Resource and Training Centre (RRTC), Umran, Meghalaya, where the ponds are managed by trained attendants to restrict entry of pollutants into them. The river Umkhrah was selected for this study and survey was conducted mainly in two locations along its course one at Wah Kaliar (study site I) and the other one at Jingthang Briew (study site II) to assess the differential entry and the effects of the different pollutants. *Channa gachua* (dwarf snakehead) was the fish species selected for this study, since this is was the only fish species found in both the study sites I and II. The measurements of the various water quality parameters were carried out according to the procedure described in APHA (2005). The standard method of U.S. Environmental Protection Agency was used for the analysis of heavy metals in water. Total RBC and WBC count was performed using the improved Neubauer hemocytometer. Hemoglobin content was measured by the acid haematin method or Sahli's method using Sahli's Hemoglobinometer. Histological analysis of the skin, muscle, gill, kidney, liver, ovary and testis of *Channa gachua* from control and polluted sites were analysed. Scanning and transmission electron microscopic study of the blood cells and the tissues (scales, skin, muscle, gill, liver, kidney, ovary and testis) of *Channa gachua* from control and the polluted study sites were performed following the standard methods. Energy dispersive X-ray microanalysis of the blood cells and tissues like scales, skin, muscle and gills were analysed following standard procedure. Micronuclei assay of the blood cells was also performed.

Experimental Findings

The water quality analysis showed swings in pH between acidic pH in winter and alkaline pH in summer at the polluted sites. Conductivity values however for the polluted sites were within acceptable limits. Low oxygen concentrations were recorded at both the polluted sites throughout the year. Water hardness was found to decrease during certain months at study site I. Low alkalinity values at both the study sites during winter months subjected the water body to fluctuations in pH. Total suspended solids recorded at the polluted sites show low values which are unlikely to be stress adding factor for the fishes. Atomic Absorption Spectroscopic analysis of water samples revealed that the concentration of nickel, lead and cadmium were above the permissible limits in the polluted sites and chromium was above the permissible limits only at study site II.

Hematological parameters like RBC counts and hemoglobin contents in fishes from the polluted sites were higher as compared to the control. High WBC counts were observed in the polluted sites as compared to the control. SEM of the blood showed the presence of numerous abnormally shaped RBC in fishes collected from the polluted sites. However, overall poikilocytosis was more pronounced in the erythrocytes of fish collected from study site I. Energy

Dispersive X-ray Spectroscopy of the erythrocytes revealed higher percentage of lead on the erythrocyte of fish from study site I and higher percentage of silicon on the erythrocyte of fish from study site II.

Histological findings revealed abnormalities in all the analysed tissues from both the study sites as compared to the control. Skin of *C. gachua* showed reduction in skin thickness with massive proliferation of mucus cells. Muscles showed distortion in alignment of fibres and focal areas of necrosis. Gills revealed shortening and fusion of lamellae, necrosis, and loss of pillar cells and damaged gill tips. Kidney showed abnormal spacing of Bowman's capsule, presence of melano-macrophage aggregates and pyknotic nuclei. Liver showed degeneration and necrosis, detachment of hepatocytes from hepatopancreatic region. The ovary showed cytoplasmic retraction and atretic oocytes. Testis of fish showed necrotic and distorted spermatogonia, reduction in sperm number and presence of testis-ovo.

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Transmission electron microscopy further supported the histological and SEM findings. The skin revealed loss of cellularity and condensation of nuclear chromatin and breakage of nuclear envelope. Muscle showed irregular arrangement of myofilaments, absence or distortion of T system, distortion of outer mitochondrial membrane. Gills showed deformed nucleus, areas of chloride cell lacking microvilli and proliferation of mucus cells. Kidney showed excessive proliferation of damaged mitochondria and broken rough endoplasmic reticulum. Liver showed less regular compartmentalization of organelles, cluster of secondary lysosomes, damaged mitochondria and less number of rough endoplasmic reticulum. The ovary showed loss of cellularity, under developed vitelline envelope, absence of electron dense materials and deformed nuclei. Testis showed sperm head with detached plasma membrane, degenerated lateral fins of flagellum and condensed chromatin.

Energy Dispersive X-ray Spectroscopy revealed overall higher weight percentage of heavy metals (As, Pb, Fe, Zn, Cd, Al, Cr and Cu) in the tissues (scale, skin, muscle and gill) of fishes collected from study site II.

Increased frequency of micronucleated cells and abnormally shaped erythrocytes were observed in fishes from study site II as compared to those from study site I.

Discussion

The variety and quantity of effluents along with other anthropogenic activities going on at the two study sites reflect the difference in the water quality and the heavy metal concentrations of the water and bioaccumulation in the analysed tissues. The result of this has been reflected on the histopathological and electron microscopic findings.

It is reasonable to believe beyond doubt that the river Umkhrah is a polluted river. However, this study is specifically limited to the effects of the polluted water with varying quantity of discharged effluents at the two study sites along the river and not on any specific pollutant type. The results obtained in the present study provides an open avenue for future interested researchers to explore various work-plans to further analyse the condition of the river Umkhrah and to give a more specific future picture of it and organisms inhabiting it.

Recommendations

In order to reduce the pollution load on the river Umkhrah the few recommendations put forward include (i) stopping the disposal of biodegradable and non-bio-degradable solid wastes, (ii) stopping of direct discharge of sewage, (iii) to relocate the major automobile workshops to an identified place where common effluent treatment facilities may be installed. These should be taken up by different agencies like Civil Administration, Village Durbars/ Urban Affairs, Shillong Municipal Board, Village Durbars etc.

STUDIES ON ECOLOGY BREEDING AND DEVELOPMENT OF THE TREE FROG RHACOPHORUS MAXIMUS GUNTHER IN MEGHALAYA

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Abstract

The thesis incorporates "Studies on ecology, breeding and development of the tree frog *Rhacophorus maximus* Giinther in Meghalaya." *Rhacophorus maximus* belong to family Rhacophoridae. This family comprised of a diverse group of tree frogs, which are mostly arboreal, some with adaptations for gliding. In India the family is represented by five genera, which include *Rhacophorus, Polypedates, Chirixalus, Theloderma* and *Philautus.* However, little information is available on the biology of these rhacophorids in India. On the basis of the fact that there is no comprehensive account on the ecology, breeding and development of *Rhacophorus maximus* in Meghalaya, the present investigation was undertaken to fill in the gap-

Objectives: The present investigation has the following objectives

1. Distribution of *Rhacophorus maximus* in Meghalaya.
2. Study of the breeding behaviour, ecological factors and annual breeding cycle of *Rhacophorus maximus* in Cherrapunjee.
3. Study of the embryonic and developmental stages of *Rhacophorus maximus.*
4. Study of the oral structure and gut in relation to food and feeding habits.
5. Study of the structure of the adult skin: histo-morphology and ultrastructure.

The results of the study are given chapter wise as follows:

Distribution of *Rhacophorus maximus* in Meghalaya

Extensive survey and collections were conducted during the year 2000 - 2003 in different parts of Meghalaya to know the distribution of *Rhacophorus maximus.* The criteria given by Chanda (1994) were followed for taking the morphometric measurements of the frog. In the present investigation, the frog was collected from the following places of Meghalaya.

From East Khasi hills district, the frog was collected from Cherrapunjee (25° 16' and 91°44') with an altitude of 1300 m, Pynursla (25°18* and 91°53') with an altitude of 1320 m, Langkyrdem (25°21' and 91°53') with an altitude of 1560 m, Smit (25°33' and 91°54') with an altitude of 1580 m, Nongkrem (25°33' and 91°52') with an altitude of 1560 m, Mawsmai (25°13'and 91°42') with an altitude of 1100 m, Sheila (25°10'and 91°38') with an altitude of 46 m.

From West Khasi hills district it was collected from Nongstoin (25°31' and 91°16') with an altitude of 1340 m and Balat (25° 11' and 91°22') with an altitude of 15 m.

From Ri-bhoi district it was collected from Umsning (25°45' and 91°53') with an altitude of 770 m. From Jaintia hills district it was collected from Jowai (25°26' and 92° 11') with an altitude of 1320 m, Nongtalang (25° 13' and 91°44') with an altitude of 850 m and Dawki (25° 11' and 92°07*) with an altitude of 44 m.

From East Garo hills district it was collected from Williamnagar (25°30'and 90°37') with an altitude of 260 m, and Rongjeng (25°39' and 90°48') with an altitude of 360 m. From South Garo hills district it was collected from Baghmara (25°11' and 90°39') with an altitude of 30 m and from West Garo hills district collection were made from Tura (25°30' and 90°13') with an altitude of 370 m. Thus *Rhacophorus maximus* is found to be present in different places of Meghalaya ranging from low to high altitude areas.

Breeding behaviour, ecological factors and annual breeding cycle of *Rhacophorus maximus* in Cherrapunjee

Observations on breeding behaviour of *Rhacophorus maximus* was carried out in Cherrapunjee, situated at 25° 16' latitude and 91°44' longitude at an altitude of 1300 m above mean sea level. Breeding behaviour of the frog, like

courtship, spawning and nature of nest construction was studied using photographic documentation. The annual breeding cycle of the frog in Cherrapunjee was studied based on the observations on the breeding behaviour of this frog in relation to the environmental factors like temperature, relative humidity and rainfall. Histology of the testis and ovary during the annual breeding cycle were studied using light microscopy.

The breeding behavior of *Rhachophorus maximus* is influenced by environmental factors like temperature and rainfall. The frog emerged from hibernation with the increase in temperature and with the first few showers of rain in the month of March. The advertisement call of males was observed to be species specific, which was determined by preparing a sonogram of the call using a software tool Soundprobe V 2.69. Each call consisted of 3 notes and the notes are produced with the same intensity from the beginning till the end and are formed of 22 to 23 pulses.

Observations made in this study indicated that *Rhacophorus maximus* is an early breeder. It breeds sporadically for a short period, which lasts for about 6 to 8 weeks after rainfall from the month of March to early May. Both male and female frogs take an active part in nest construction. The frogs construct foam nests in shallow pools, ponds about 2-3 cm above water level and the foam nests always remain attached to vegetation like *Imperata cylindrica and Gleichenia* sp.

During the study period (2001-2003), a total of 75, 92 and 69 foam nests were observed and recorded in the breeding sites. The foam is recorded to be white in colour and varies from 15.5 mm - 20.5 mm in length, 10.2 mm - 18 mm in width and from 2.1mm - 5.5 mm in height. The number of eggs varies from nest to nest and ranges between 653 - 2059 (1351.96±83.07) and there is no correlation between clutch size and the size of the female.

The success of hatching in the laboratory conditions was observed to vary from 28% -78.4% with a mean of 54.15±2.53 % and the egg mortality ranged from 33.5% - 80.1% with a mean of 64.14±2.02 %. Data analysis on breeding males and females revealed that females are larger (79.81±1.25) than males (60.28±1.34; $t = 10.65$; $p < 0.001$) and the number of breeding males outnumber the females at the breeding sites.

The annual breeding cycle of *Rhacophorus maximus* were also divided in to four periods namely the Emerging and Pre-breeding period (early March), Spawning and Breeding period (March - early May), Post-breeding period (mid May - October) and Hibernating period (November - February) based on the behaviour of the frog in relation to the environmental factors like temperature, rainfall and relative humidity. The emerging and pre-breeding period has been designated when these frogs emerged from hibernation in the early part of March, which was followed immediately by the spawning and breeding period, which continued till early May. The post-breeding period was marked by the movement of the frogs away from the breeding sites to trees that were present around the breeding sites. This behaviour was observed during mid May to October and during hibernation (November -February) the frogs were found to hide in rock crevices and sometimes in tree holes.

Formation of spermatids and spermatozoa was found to occur during the winter months. The ovaries exhibited significant differences in size throughout the annual breeding cycle. All females, observed during the pre-breeding period and breeding period (March -May), showed fully enlarged ovaries with many mature oocytes. However, no mature oocytes were found to be present during the post-breeding period.

Embryonic and developmental stages of *Rhacophorus maximus*

The normal table of development of *Rhacophorus maximus* was also studied by rearing the embryos in the laboratory conditions at a temperature ranging from 20°C - 22.5°C. The developmental stages have been divided into 46 stages, including 20 embryonic stages and 26 postembryonic stages as per the criteria given by Gosner (1960). Developmental stages in the present study were divided into 6 major subheadings: (1) Fertilization (2) Cleavage (3) Blastula (4) Gastrula (5) Neurula and (6) Post-embryonic development.

Certain peculiar features were observed during the development. The egg was white in colour and it did not allow morphological differentiation between the animal and vegetal poles. The freshly hatched larvae aggregated vertically beneath the water surface under the foam cover in such a way that their large external gills were spread out horizontally. The tail fin was not transparent as in Gosner's series and remained opaque. The tadpoles were large in size, oval and heavily pigmented and the metamorphosed froglet changed their colour from darkly pigmented tadpoles to green, as a means of their better survibility.

The environmental factors like atmospheric temperature, rainfall and relative humidity recorded during breeding and development, ranged from 22.8°C - 26°C, 27.8 mm -1294.2 mm and 65% - 99% respectively. The physico-chemical factors like water temperature, pH and dissolved oxygen of the three selected breeding sites were also recorded. During breeding, spawning and development (March-May) the water temperature in Site 1, Site 2 and Site 3 ranged between 20.0°C - 22.7°C, pH between 5.8 - 7.0 and dissolved oxygen ranged from 5.5 mg/1 - 11.0 mg/1. In the laboratory conditions, the tadpoles hatched 4 to 5 days after fertilization and completed their development between 62 to 63 days, which was similar to that observed in the natural breeding sites.

Oral structure and gut in relation to food and feeding habits

The oral structure, food and feeding habits of both the tadpoles and adults were studied. Tadpoles were collected from the study sites in Cherrapunjee, gut removed and identification of the samples was facilitated by the work of Edmonson (1959) and for staging of embryos, the criteria given by Gosner (1960) was followed.

The surface structures of the oral disc of the tadpoles were studied using stereoscopic binocular microscope and scanning electron microscopy. The oral disc of the tadpole was observed to be ventral, sub-terminal and the upper labium was provided with a large medial gap and the oral papillae were confined only to the lateral sides. The lower labium was lined with oral papillae. However, in the middle of the lower labium a short mental gap of about three papillae width was found to be present. Keratodont in the tadpoles was found to appear when the operculum formation was completed (stage 25) with keratodont formula of 1/2. Keratodont formula of 1:3+3/1+1:2 were observed at stages 26-31. Fully developed keratodont formula of 1+1:4/1+1:2 were observed at toe development (stages 32-39).

Gut content of the tadpoles consisted of algae, non-algal forms, detritus, vascular plant parts, sand and mud. The algal food items in the gut samples belonged to Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae. Premetamorphic tadpoles were found to be herbivorous consuming mostly algae but prometamorphic tadpoles were found to consume both algae and rotifers. Thus, from these observations *Rhacophorus maximus* tadpoles can be placed in the category of omnivores detritivores. Stomach content of the adults was found to contain mainly terrestrial forms like diptera, hemiptera, arachnida and various insect larvae.

Simultaneously, the histological changes, which was taking place in the intestine in relation to food and feeding of the tadpoles during metamorphosis was studied using Light and Transmission Electron Microscopy (TEM). With the changes in the food and feeding habit, the intestine of the tadpoles was observed to get shortened. The intestine of herbivorous tadpoles was simple, tubular, consisting predominantly of larval epithelial cells. TEM study also revealed the presence of brush border in their apical surface of the epithelium. Islet containing mitotic cells, which were the primordia of adult epithelium, was observed during prometamorphosis. TEM studies further revealed the presence of mitochondria, desmosomes, endoplasmic reticulum and ribosomes in the intestine. At climax, fold formation in the intestine progressed and at metamorphosis the larval epithelium was replaced by the adult epithelium and appeared as several circular folds and finally into zigzag folds assuming the adult characteristics.

The structure of the adult skin: histo-morphology and ultrastructure

Histo-morphological and ultrastructural studies of the skin of adult *Rhacophorus maximus* were also made. The skin of the adult is found to be typical of other anurans. Light microscopy revealed that the epidermis consists of about five to seven layers of compactly arranged epithelial cells: an outer stratum corneum, a stratum granulosum, stratum spinosum and an innermost stratum germinativum. The dermis was observed to consist of two layers, the stratum spongiosum and stratum compactum. Calcium deposits and mucus glands were observed in the skin of both male and female adult frogs.

TEM studies revealed that the stratum corneum was thickened and comified and separated from the non-cornified layer by the intercellular space. The stratum corneum was seen traversed by the intra trans-membranous membrane, which shows connection between the comified and non-comified layers and grooves were found to be present in the comified layer.

The epidermal cells were of various shapes and sizes and some were seen without nucleus. Tonofilaments, ribosomes, prominent desmosomes separating adjacent cell and cell organelles like mitochondria, Golgi bodies, rough endoplasmic reticulum, were observed in the epidermal cells. Other important observations made in the skin of adults

includes the presence of granules producing cells, pigment cells like melanophores, pterinosomes, iridophores and xanthophores, which are responsible for giving colour to the frog to adapt to its terrestrial habitat.

Therefore, this study provide an information about the distribution of this tree frog, *Rhacophorus maximus* in Meghalaya and its ecology, breeding and development in this northeastern part of India and will open up fresh avenues for further research in future.

HISTOLOGICAL, ULTRA-STRUCTURALAND ELEMENTALANALYSIS OF CERTAIN TISSUES OF CHANNA GACHUA (HAMILTON-BUCHANAN) INHABITING THE RIVER UMKHRAH, MEGHALAYA

Dr E.M.Pala,
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Abstract

Water is referred to as polluted when it is impaired by anthropogenic and other contaminants and does not support a human use such as drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities such as fish. Environmental pollution has become a major global problem requiring ongoing evaluation and revision of water resource policy at all levels.

There are numerous sources of water pollution. In developed countries wastewater flows untreated into rivers, lakes and coastal zones; fertilizer use for food production and industrial waste are dumped into waters, human wastes are also disposed where they contaminate existing water supplies. An emerging water quality concern is the impact of personal care products and pharmaceuticals on aquatic ecosystems, since little is known about their long-term human or ecosystem impacts.

Earlier, it was thought that hill stream ecosystem is comparatively less prone to severe pollution, since it is away from hectic human activities, but this is not true today. The most consistent effect of urbanization on stream ecosystems was runoff from urbanized surfaces and municipal discharges. The aquatic biotas of streams are being increasingly stressed by logging and residential developments which are often manifested by changes in water quality that can produce biological responses which alter composition and abundance of resident species.

The state of Meghalaya, in the North Eastern part of India is endowed with rich water resources, which are gradually being polluted because of industrialization, anthropogenic activities and unplanned development. The river Umkhrah, which is the chosen study site, lies at an altitude of about 1600 meters above mean sea level. The sources of pollution of the river Umkhrah include both point and non-point sources.

At present the river Umkhrah is more like a drain than a river, where water is highly contaminated by city garbage and municipal wastes. The number of fish species has also been reduced significantly during the last few decades. Hence, it appears that there is a need to assess the water quality of the river and health status of fish species inhabiting it.

Aims and Objectives

The objectives of the study are:

1. To assess the physico-chemical characteristics of the water body in terms of pH, temperature, electrical conductivity, dissolved oxygen, free carbon dioxide, hardness, total alkalinity, total suspended solids and heavy metal content by Atomic Absorption Spectroscopy (AAS).
2. To analyse the impact of water quality on:
    i. Hematological parameters, such as total RBC count, hemoglobin content, total WBC count, surface microstructure and elemental content of blood cells through SEM and EDS.
    ii. Histology and ultrastructure of scale, skin, muscle, gill, kidney, liver, ovary and testis

3. To study the heavy metal accumulation in certain tissues of the fish with the help of energy dispersive X- ray spectroscopy (EDS).
4. To ascertain genotoxicity in the fish with the help of micronucleus assay.

Materials and Methods

Control water body selected for the study was Rural Resource and Training Centre (RRTC), Umran, Meghalaya, where the ponds are managed by trained attendants to restrict entry of pollutants into them. The river Umkhrah was selected for this study and survey was conducted mainly in two locations along its course one at Wah Kaliar (study site I) and the other one at Jingthang Briew (study site II) to assess the differential entry and the effects of the different pollutants. *Channa gachua* (dwarf snakehead) was the fish species selected for this study, since this is was the only fish species found in both the study sites I and II. The measurements of the various water quality parameters were carried out according to the procedure described in APHA (2005). The standard method of U.S. Environmental Protection Agency was used for the analysis of heavy metals in water. Total RBC and WBC count was performed using the improved Neubauer hemocytometer. Hemoglobin content was measured by the acid haematin method or Sahli's method using Sahli's Hemoglobinometer. Histological analysis of the skin, muscle, gill, kidney, liver, ovary and testis of *Channa gachua* from control and polluted sites were analysed. Scanning and transmission electron microscopic study of the blood cells and the tissues (scales, skin, muscle, gill, liver, kidney, ovary and testis) of *Channa gachua* from control and the polluted study sites were performed following the standard methods. Energy dispersive X-ray microanalysis of the blood cells and tissues like scales, skin, muscle and gills were analysed following standard procedure. Micronuclei assay of the blood cells was also performed.

Experimental Findings

The water quality analysis showed swings in pH between acidic pH in winter and alkaline pH in summer at the polluted sites. Conductivity values however for the polluted sites were within acceptable limits. Low oxygen concentrations were recorded at both the polluted sites throughout the year. Water hardness was found to decrease during certain months at study site I. Low alkalinity values at both the study sites during winter months subjected the water body to fluctuations in pH. Total suspended solids recorded at the polluted sites show low values which are unlikely to be stress adding factor for the fishes. Atomic Absorption Spectroscopic analysis of water samples revealed that the concentration of nickel, lead and cadmium were above the permissible limits in the polluted sites and chromium was above the permissible limits only at study site II.

Hematological parameters like RBC counts and hemoglobin contents in fishes from the polluted sites were higher as compared to the control. High WBC counts were observed in the polluted sites as compared to the control. SEM of the blood showed the presence of numerous abnormally shaped RBC in fishes collected from the polluted sites. However, overall poikilocytosis was more pronounced in the erythrocytes of fish collected from study site I. Energy Dispersive X-ray Spectroscopy of the erythrocytes revealed higher percentage of lead on the erythrocyte of fish from study site I and higher percentage of silicon on the erythrocyte of fish from study site II.

Histological findings revealed abnormalities in all the analysed tissues from both the study sites as compared to the control. Skin of *C. gachua* showed reduction in skin thickness with massive proliferation of mucus cells. Muscles showed distortion in alignment of fibres and focal areas of necrosis. Gills revealed shortening and fusion of lamellae, necrosis, and loss of pillar cells and damaged gill tips. Kidney showed abnormal spacing of Bowman's capsule, presence of melano-macrophage aggregates and pyknotic nuclei. Liver showed degeneration and necrosis, detachment of hepatocytes from hepatopancreatic region. The ovary showed cytoplasmic retraction and atretic oocytes. Testis of fish showed necrotic and distorted spermatogonia, reduction in sperm number and presence of testis-ovo.

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Increased frequency of micronucleated cells and abnormally shaped erythrocytes were observed in fishes from study site II as compared to those from study site I.

Discussion

The variety and quantity of effluents along with other anthropogenic activities going on at the two study sites reflect the difference in the water quality and the heavy metal concentrations of the water and bioaccumulation in the analysed tissues. The result of this has been reflected on the histopathological and electron microscopic findings.

It is reasonable to believe beyond doubt that the river Umkhrah is a polluted river. However, this study is specifically limited to the effects of the polluted water with varying quantity of discharged effluents at the two study sites along the river and not on any specific pollutant type. The results obtained in the present study provides an open avenue for future interested researchers to explore various work-plans to further analyse the condition of the river Umkhrah and to give a more specific future picture of it and organisms inhabiting it.

Recommendations

In order to reduce the pollution load on the river Umkhrah the few recommendations put forward include (i) stopping the disposal of biodegradable and non-bio-degradable solid wastes, (ii) stopping of direct discharge of sewage, (iii) to relocate the major automobile workshops to an identified place where common effluent treatment facilities may be installed. These should be taken up by different agencies like Civil Administration, Village Durbars/ Urban Affairs, Shillong Municipal Board, Village Durbars etc.

SeO_2- PROMOTED SYNTHESIS OF α-α SUBSTITUTED AND α, α-DISUBSTITUTED AROMATIC KETONES AND RELATED COMPOUNDS

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Abstract

The Thesis is divided into the following four chapters:

Chapter 1

Selenium Dioxide: Properties and Synthetic Utility

Selenium is a non-metal belonging to the chalcogen group of elements with properties intermediate between those of sulphur and tellurium. Selenium is rarely found in its elemental state in nature or as pure ore compounds. It is found impurely in metal sulphide ores.

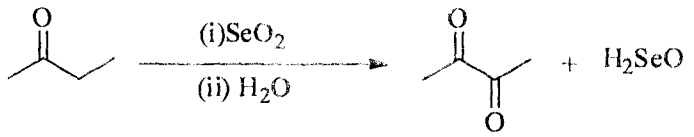
Commercially, selenium is produced as a by- product in the refining of these ores, most often during copper production. Selenium forms two oxides, selenium dioxide SeO_2 and selenium trioxide SeO_3. It dissolves in water to form selenic acid.[1]

Selenium occurs in four valence states: Selenates (Se 6+), Selenites (Se 4+), Selenides (Se 2+) and elemental Selenium (Se 0). **Selenium in the +2 oxidation state forms stable bonds with carbon.** Examples of such compounds are Selenides (R_2Se), Diselenides (R_2Se_2) and Selenols (RSeH). Selenium is used as a catalyst for many organic reactions. It finds vast utility in industrial and laboratory syntheses, especially in organoselenium chemistry. Selenium dioxide (SeO_2) is an important reagent in organic synthesis. One of the reasons for the wide spread interest of selenium is its **specific redox properties.**

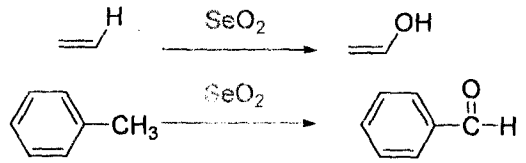
Application to Synthetic Organic Chemistry:

Selenium dioxide **functions as a mild oxidizing** agent over a wide temperature range. The specific oxidizing action of selenium was first noted by **Riley in 1930-1932.**

Any compound having methyl, methylene group or a double bond adjacent to carbonyl group is converted to carbonyl system in the presence of SeO_2 (á-oxidation).[2]



SeO_2 also oxidizes allylic R groups to alcohols and benzylic R groups to alcohols or carbonyl compounds.



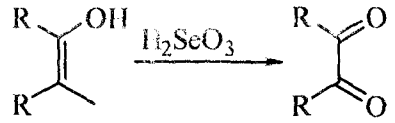
In 1935, Guillemonat proposed the path of selenium dioxide mediated olefin oxidation based on a set of rules :

The oxidation always occurs á to the most substituted end of the double bond.

Whenever a double bond is in a ring, wherever possible, oxidation occurs within the ring.

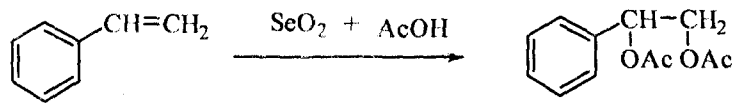
The order for preference of oxidation is $CH_2 > CH_3 > CH$.

Sharpless and Gordon in 1976 carried out the oxidation of an enol by selenous acid to yield diketones.[3]

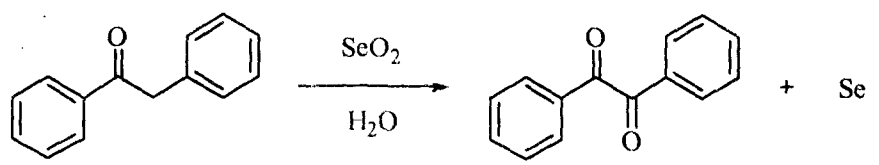


Selenium dioxide is one of the most consistent reagent for the direct insertion of an oxygen atom into an allylic carbon-hydrogen bond.

Tsutsumi *et al*; in 1968 performed the oxidation of styrene with selenium dioxide in presence of glacial acetic acid to produce styrene glycol diacetate in good yields.[4]



In 1960, Corey and Schaeffer conducted one of the first studies on the oxidation of ketones to diketones in presence of SeO_2.[5]



Advantages of using SeO_2 as a reagent in organic synthesis:

The utility of SeO_2 can be broadened due to several properties that these compounds exhibit such as:

- Resistance to **catalytic poisons**
- Ease of application.
- In many reactions particularly liquid phase reactions, elemental selenium or its compounds such as the dioxide, halides or metal selenides may be used directly in unsupported form.
- Elemental selenium or selenium dioxide may also be vapourized into reactant gas streams as vapour phase catalysts.
- Selenium dioxide sublimes at 317°C.

Other important uses of Selenium and its compounds:

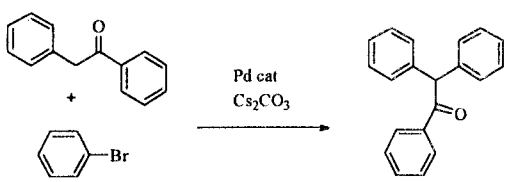
- Colorant: Selenium dioxide imparts red colour to glass.
- Toner: Selenium dioxide is used as a toner in photographic developing.
- Polymer chemistry: Selenium disulphide is used as an inhibitor.
- Shampoo: Selenium disulphide is used as an anti-dandruff agent.
- Cellular function: Selenium salts are toxic in large amounts but trace amounts are necessary for all organisms.
- Component of antioxidant :Such as glutathione peroxidase and thioredoxin reductase.

Chapter II

Reaction of Selenium Dioxide with Aromatic Ketones in the Presence of Boron Trifluoride Etherate: A Protocol for the Synthesis of Triarylethanones

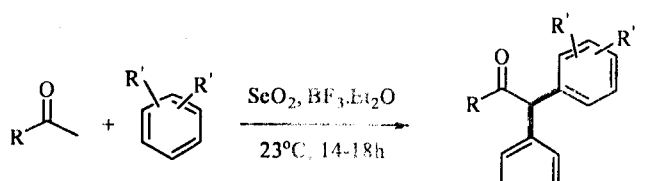
The á-arylation of ketones constitutes a key step in the synthesis of a wide number of complex systems. The last two decades have developed and employed many methodologies for the insertion of an aryl ring next to a carbonyl moiety.

More over some of these works have been reported by using an already monoarylated ketone as the starting material.[5]



The practicality and effectiveness of most of these methods is diminished by the high cost of Palladium catalysts and the time needed to bring about the transformations. Our literature survey revealed that the use of selenium dioxide and $BF_3.Et_2O$ combination for the direct á-arylation of aromatic ketones has never been reported. To our surprise, the use of selenium dioxide and $BF_3.Et_2O$ led instead to the formation of a **diarylated product,** a triarylethanone.

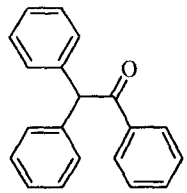
1 equivalent of the ketone is reacted with 1equivalent of SeO_2 in presence of 2 equivalents of $BF_3.Et_2O$ (49%) and 7ml of the substrate benzene.The reaction is stirred at room temperature for 14-18 hours.The use of other Lewis acids such as $AlCl_3$, $SnCl_4$ either gave no reaction or resulted in the formation of multiple products that were difficult to isolate. Boron trifluoride, therefore, appears to be specific to these reactions.



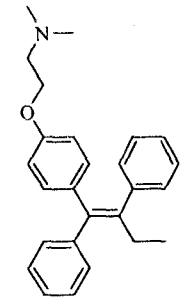
R= Substituted aryl ring
R'= CH_3

Scheme 1

Our literature survey reveals that triarylethanones are structural analogues of the cancer therapy agent tamoxifen. Tamoxifen is a drug in wide spread use for the treatment of breast cancer.[7]



Tamoxifen



Triarylethanone

Conclusion

- The reported method is highly regioselective, first double arylation of the á-carbon atom of aromatic ketones.
- It was carried out without the use of any expensive catalyst but by employing SeO_2 which is a shelf reagent and cost effective.
- This is also a first report of a carbon-carbon bond formation using SeO_2 as an intermediary.

SPECTRAL THEORY & COMMUTATIVE RINGS

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Abstract

The discipline of functional analysis has its origin in the incurable, yet, vital tendency mathematicians have for axiomatization and generalization as applied to the ideas of classical analysis. While the beginning of this abstract can be traced back to nineteenth century, recognition as an important new mathematical discipline had to wait until the 1930s when Vonn Neumanns Mathematization quantum mechanics as well as several clean and concise proofs of important but laborious classical results secured its claims, initially viewed as studying common and distinguishing properties of various spaces of functions. Functional analysis can now be thought of as emanating from marriage of linear algebra and topology resulting in the concept of a topological linear space.

Chapter 1: Inner Product Space- In this chapter a study of inner product on a normed linear space X, with the introduction of the concept of Parallelogram law of Jordan-Von-Neumann , the Schwarz inequality, Hilbert Space and Banach Space.

Chapter 2: Orthonormal Set- study of orthogonal set in an inner product space, Pythogoras theorem, the gram-Schmidt orthonormalization theorem, orthonormal polynomials, Bessel's inequality, Riesz-Fischer Theorem, Parseval,s Formula in Hilbert Space.

Chapter 3: Approximation Optimization and Projection- In this lesson we give some applications of geometric properties of an inner product space to some problems in approximation theory which have a bearing on optimizing certain quantities to some restrictions. Projection and Riesz Representation Theorem, the Unique Hanh-Banach extension Theorem

Chapter 4: Bounded Operators on Hilbert Spaces- Study of bounded operators, sesquilinear functional, bounded sesquilinear functional, Adjoint operator, involution operation, self adjoint operator, normal Operator and Unitary Operator on Hilbert Space.

Chapter 5: Spectrum & Numerical Range-In this chapter we associate a bounded operator on Hilbert Space with two subsets of scalars which are very useful to study various properties of operators. Spectrum and Spectral value of a Hilbert Space, Eigen spectrum, approximate eigen spectrum, eigen vector, Numerical Range of a Hilbert Space, numerical range of self adjoint operator.

Chapter 6: Compact-Self Adjoint Operators- Study of the compactness of an operator and continuity with compactness a strong requirement than continuity.

Chapter 7: orthogonal Projections- In this chapter a study of some simple self adjoint operators is made. Any compact self adjoint operator can be built up from these class of operators. Projection, Orthogonal Projection, establishment that Orthogonal Projections are some of the simplest normal or self adjoint operators on a Hilbert Space. Finite Dimensional Spectral Theorem which establishes that any normal or self adjoint operator can be built up from elementary operators if the space is finite dimensional. Spectral Theorem for Compact Self adjoint Operator.

Chapter 8: Resolutions of Identity- In this chapter the procedure for construction self adjoint operators out of certain families of orthogonal projections on Hilbert space is discussed.

Chapter 9: Spectral Theorem- in this chapter a representation of an arbitrary self adjoint operator on a real or complex Hilbert Space in terms of resolution of identity is given. Spectral Theorem for bounded self adjoint operators.

Chapter 10: Significance of Spectral theorem- in this lesson we consider some applications of Spectral theorem and analyse its importance in analyzing the Spectrum of self adjoint operator on a real or complex Hilbert Space. Square roots of positive operators, polar decomposition of invertible operators.

References : *B. V. Limaye: Functional Analysis, Wiley Eastern limited*

In Commutative Rings only Commutative Rings with identity are dealt with. Below are the chapterwise study of characteristics of Commutative Rings.

Chapter 1: Rings and ideals- in this chapter study of Homomorphisms, Ideals, Quotient rings, Zero Divisors, Characterization of a field, Prime and Maximal Ideals, Local Rings, Principal Ideal Domain is carried out.

Chapter 2: Ideal Theory- Study of Nilradical and Jacobson radicals, Extension and contraction of Ideals.

Chapter 3: Modules- Study of induced homomorphisms, sub modules and quotient modules, Faithful Modules, Annihilator, Finitely generated module, Direct product of Modules, Free Module, Nakayama's Lemma.

Chapter 4: Rings and Modules of Fractions- Study of the Ring of Fractions, Modules of Fractions

Chapter 5: Primary Decomposition- Discussion on Primary ideals, uniqueness Theorems

Chapter 6: Integral dependence and Valuations- Study of Integral Dependence, Integral Dependence and finitely generated Modules, Integral A-algebra, UFD and IntegralDependence, The Going Up Theorem, Valuation Rings, Hilbert's Zero Point Theorem

Chapter 7: Chain Conditions- Neotherian A Module is finitely generated and vice versa.

Chapter 8: Noetherian Rings-Study of Noetherian Rings, Hilbert's Basis Theorem, Primary Decomposition of Ideals in Noetherian Rings

Chapter 9: Artin Rings- Study of Artin Rings, Equality of Nilradical and Jacobson Radical in Artinian Rings, Nilradical is Nilpotent in artinian rings, Dimension Theory, Structure Theorem

Chapter 10: Discrete valuation Rings and Dedekind Domains-

DIVERSITY OF WOOD-ROTTING MACROFUNGI OF EAST KHASI HILLS AND DECAY POTENTIAL OF SELECTED FUNGAL SPECIES

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Abstract

The present work was carried out to study the diversity of wood-rotting macrofungi and decay potential of selected wood-rotting fungal species in East Khasi Hills district of Meghalaya. East Khasi Hills district of Meghalaya covers a total geographical area of 2,748 sq. kms. and lies approximately between 25°07" and 25°41" N Latitude and 91°21" and 92°09" E Longitude. The climate of the district ranges from temperate in the plateau region to the warmer tropical and sub-tropical pockets on the Northern and Southern regions. The temperature varies between mild and moderate in summer (15ÚC - 28ÚC) but in winter it is very cold (-3ÚC - 15ÚC).

In the present investigation, eight different forests stands (four sacred groves and four community forests) of East Khasi Hills were selected for the collection of wood-rotting fungi. These were (i) Mawphlang sacred grove, (ii) Mawsmai sacred grove, (iii) Nongkrem sacred grove, (iv) Swer sacred grove, (v) Laitkor community forest, (vi) Lawbah community forest, (vii) Mawlai community forest and (viii) Pynursla community forest.

The sacred groves of Meghalaya largely fall under the temperate type and are the relic forests evolved through thousands of years. They are located in the public lands set aside for religious purpose under the traditional land use system. It is an unpardonable crime to cut down trees or even pick flowers and fruits from these sacred groves except for cremation and religious purposes, that too, with the permission of the *Lyngdoh* (Priest). Mawphlang sacred grove is one of the few sacred groves that remains undisturbed. It is about 25 km. south-east of Shillong covering an area of 75 ha. at an elevation of 1740 msl and lies at 91Ú44'44" E latitude and 2 25Ú26'38"N longitude. Mawsmai sacred grove is located about 57 km. from Shillong covering an area of about 80 ha. It is situated at 91Ú43' 38"E latitude and 25Ú14'40" N longitude at an elevation of 1185 msl. Nongkrem sacred grove or locally called as 'Law Lyngdoh Nongkrem' is about 14 km. south west from Shillong covering an area of 6 ha. and is situated at 91o 54' 40" E latitude and 25o 29' 30" N longitude with an altitude of 1786 msl. Swer sacred grove is located about 32 km. south of Shillong and has an area of about 12 ha. It is situated at 91Ú47' 58"E latitude and 25Ú25'13" N longitude, at an altitude of 1915 msl.

Community forests are those forests which are under the control and management of the community. They are kept and conserved for use by the community who can collect firewood, leaves and grasses for thatching and herbs and shrubs for fodder as per the forest rules of the community. Laitkor community forest is about 9 km. from Shillong and is situated at 91Ú54'30" E latitude, 25Ú30'51" N longitude with an altitude of 1800 msl. Lawbah community forest is about 75 km. from Shillong and is situated at 91Ú33'43" E latitude, 25Ú14'13" N longitude with an altitude of 942 msl. Mawlai community forest is about 8 km. from Shillong and is situated at 91Ú52'45" E latitude, 25Ú35'50"N longitude with an altitude of 1430 msl. Pynursla community forest is about 49 km. from Shillong. It is situated at 91Ú53' 33"E latitude and 25Ú18' 53"N longitude with an altitude of 1337 msl.

The common tree species found in the sacred groves are *Betula alnoides, Castanopsis hystrix, Cinnamomum glanduliferum, Elaeocarpus lancifolius, Eleagnus pyriformis, Engelhardtia roxburghiana, E. spicata, Exbucklandia populnea, Eurya japonica, Lithocarpus dealbatus, Magnolia pterocarpa, Myrica esculenta, Neolitsea cassia, Persea odoratissima, Pyrus pashia, Quercus dealbata, Q. griffithii, Q.* 3 *glauca, Rhododendron arboreum, Schima wallichii, Symplocos chinensis* and *S. javanica.* In the community forests, the common tree species found are *Betula alnoides, Castanopsis hystrix, C. indica, Cinnamomum tamala, Elaeocarpus lancifolius, Engelhardtia spicata, Exbucklandia populnea, Myrica esculenta, Pinus kesiya, Quercus dealbata, Q. lanceaefolia, Rhododendron* sp., *Schima khasiana* and *S. wallichi.*

Collection of the wood-rotting fungi was done during the period March 2008 – October 2010 involving three wet seasons. They were photographed in the field and all important morphological characters including substrata were noted. The fruit bodies were then brought to the laboratory where close-up images and detailed observation of the fruit bodies were made. Substrata were treated as living trees, logs, tree stumps and twigs. The specimens were preserved

by air drying and liquid preservation and were stored in the Microbial Ecology Laboratory, Department of Botany, North Eastern Hill University, Shillong (India) for future reference. Representative portions of each specimen were used for microscopic studies.

The percentage frequency of occurrence of each fungal species was calculated using the formula (Zak and Willig, 2004). Shannon-Wiener index of diversity, H (Shannon and Weaver, 1949) and Simpson's index, D (Simpson, 1949) were also calculated.

Collected specimens were identified according to standard macroscopic and microscopic characteristics through consultation with appropriate literature (Overholts, 1953; Bakshi 1971; Ryvarden and Johansen, 1980 and Gilbertson and Ryvarden, 1986; Roy and De, 1996; Núñez and Ryvarden, 2000; Sharma, 2000; Ainsworth and Bisby, 2001). Identification was also done with the help of scientists 4 at the Mycology Herbarium and National type culture collection of the Forest Research Institute, Dehra Dun. Host trees were identified in the field or laboratory with the help of experts and herbarium curator.

A total of 80 wood-rotting fungi were identified. 9 species belonged to phylum Ascomycota which included 3 families. The remaining 71 species belonged to phylum Basidiomycota which had twenty families. Maximum number of wood-rotting fungal species belonged to the family Polyporaceae (14 genera, 25 species) followed by Hymenochaetaceae (4 genera, 8 species), Phanerochaetaceae (4 genera, 5 species), Meruliaceae (4 genera, 4 species), Ganodermataceae (3 genera, 3 species), Helotiaceae (3 genera, 3 species), Xylariaceae (3 genera, 5 species), Bondarzewiaceae (2 genera, 4 species), Fomitopsidaceae (2 genera, 3 species), Stereaceae (2 genera, 4 species), Strophariaceae (2 genera, 2 species), Tremellaceae and Gloeophyllaceae, (1 genus, 2 species), while the other families i.e., Auriculariaceae, Bankeraceae, Fistulinaceae, Hericiaceae, Marasmiaceae, Meripilaceae, Nidulariaceae, Physalacriaceae, Schizophyllaceae and Trichocomaceae had one species each. The taxonomical description along with synonyms, classification, substrata, collection sites and distribution of the eighty identified species of wood-rotting fungi from East Khasi Hills district of Meghalaya has been given.

Among the 80 fungi identified, 6 species have been reported to be edible (viz., *Auricularia auricula, Fistulina hepatica, Lentinula edodes, Grifola frondosa, Laetiporus sulphureus* and *Schizophyllum commune*) and 5 species have been reported to have medicinal value (*Auricularia auricula, Grifola frondosa, Schizophyllum commune, Tremella mesenterica* and *T. fuciformis*). 5 The frequency percentage of occurrence was highest in *Microporus xanthopus* with 87.5 %, followed by *Cyclomyces tabacinus, Microporus affinis* and *Trametes versicolor* with 62.5 %. Seven species had 50 % frequency occurrence. Nine species had 37.5 % frequency occurrence. Twenty two species had 25 % frequency occurrence and the remaining thirty eight species had 12.5 % frequency occurrence.

Majority of the identified fungi were white-rot fungi (88.75 %) and only 11.25 % were brown-rot fungi. The brown-rot fungi included *Antrodia albida, Fistulina hepatica, Fomitopsis carneus, F. pinicola, Gloeophyllum odoratum, G. subferrugineum, Laetiporus sulphurous, Nigroporus durus* and *Oligoporus tephroleucus.*

Three species of wood-rotting fungi viz., *Cyclomyces fuscus, Heterobasidion perplexa* and *Humphreya coffeatum* were recorded for the first time from India. *Cyclomyces fuscus* and *Humphreya coffeatum* were collected from Mawphlang sacred grove while *Heterobasidion perplexa* which is a rare species (reported only from Nepal by Ryvarden in 1989) was collected from Mawphlang sacred grove and from Mawlai community forest.

Among the eight collection sites, the undisturbed sacred grove in Mawphlang was found to harbour the highest number of the wood-rotting fungi i.e., 33.13 %, followed by Swer sacred grove (14.11 %), Nongkrem sacred grove (11.04 %), Mawlai community forest (9.82 %), Lawbah community forest (8.59 %), Mawsmai sacred grove (10.43 %) and Laitkor community forest (7.36 %). Pynursla community forest had the least number of species with 5.52 %. 6

NEURAL NETWORK BASED TEXT RETRIEVAL

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Abstract

This thesis describes a new evolvable text retrieval mechanism based on Artificial Neural Networks to retrieve a specified text from a documents body. The architecture is characterised by processing elements and synaptic transmission using the Feed Forward Back propagation model.the objective is to compare the performance of a text search, in terms of speed in neural network based search and a conventional sequential search.To develop a system that is more reliable and fast compared to the conventional techniquies, the network must be highly adaptable.The technique used ensures that the performance of the system in terms of speed of retrieval is independent of the size of the document.Thus neural network approach to text retrieval can be consideered an alternative.

A STUDY ON MODULAR ARITHMETIC

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Abstract

Modular (often also Modulo) Arithmetic is an unusually versa tile tool discovered by Karl Friedrich GAUSS (1777 – 1855) in 1801. Karl Friedrich Gauss in his Disquisitions Arithmetical, a milestone in number theory codified an idea related to some bizarre arithmetic, which he found it ideal for handling questions of divisibility.

The Euclidean Algorithm and the method of back substitution:

Let a, b be a nonzero integer. Using Long Division, choose integer q_o and r_o such that $o \leq r_o \leq b$ and $a = q_o b + r_o$.

Let $n_1 = b$, $d_1 = r_o \geq o$ and choose integers q_1, r_1 such that $o \leq r_1 \leq d_1$ and $n_1 = q_1 d_1 + r_1$. We can repeat this process, at the t-th stage and letting $n_t = d_{t-1}$, $d_t = r_{t-1}$ and choosing integers q_t, r_t for which $o \leq r_o \leq b$ and $n_t = q_t d_t + r_t$. This is possible if $r_{t-1} = d_t \neq o$.

A Binary Euclidean GCD Algorithm: The binary greatest common divisor algorithm is based on four simple facts about positive integers u and v :-(a) If u and v are both even, then greatest common divisor (u,v) = 2 greatest common divisor (u / 2, v/2).

(b) If u is even and v is odd, then greatest common divisor (u,v) = greatest common divisor (u/2,v). (c) As in Euclid's algorithm, greatest common divisor (u,v) = greatest common divisor (u-v, v). (d) If u and v are both odd, then (u – v) is even and |u – v | < maximum (u, v).

Difference and Similarities: Of course there is a good deal of similarities between the two arithmetic's. Most important for both addition and multiplication all the basic properties are preserved

Theorem(Euler): Let m be a positive integer , and let a be an integer relatively prime to m. Then $a^{\Phi(m)} \equiv 1$(mod m).

Theorem(Fermat Little's Theorem): Let p be a prime number. If the integer a is not divisible by p ,then $a^{p-1} \equiv 1$(mod p).Moreover, $a^p \equiv a$ (mod p),for every integer a.

Quadratic Reciprocity:

The linear equation $ax \equiv b$ (mod m) has solution if and only if gcd (a,m) |b. In this chapter we try to find whether or not a quadratic equation $ax^2 + bx + c \equiv o$ (mod m) has a solution and given integer a, can 'a' be a perfect square modulo a prime p. Since we are looking on the group $(Z_m)^* = Z_m^*$.If a is an integer in $(Z_p)^*$ which is a perfect square, then what kind a prime is p?

Chinese Remainder Theorem:Let m and n be relatively prime integers. Let x_1 and x_2 be any integer. Then there exist an integer x such that $x \equiv x_1$ (mod m) and $x \equiv x_2$ (mod n).

Elliptic Curves: An elliptic curve E over a field F is a curve that is given by an equation of the form $y^2 + a_1xy + a_3y = x^3 + a_2x^2 + a_4x + a_6$, $a_i \in F$. Let E(F) denote the set of points $(x,y) \in F^2$ that satisfy this equation, along with a "point at infinity" denoted by $\mathcal{O}$.If K is any extension field of F, then E(K) denotes the set of $(x,y) \in K^2$ that satisfy along with $\mathcal{O}$.In order for the curve to be an elliptic curve it must be smooth. This means that there is no point of E(F") (recall that F" denotes the algebraic closure of F) where both partial derivatives vanish. In other words, the two equations $a_1y = 3x^2 + 2a_2x + a_4$, $2y + a_1x + a_3 = 0$ Cannot be simultaneously satisfied by any $(x,y) \in E(F")$. If F is not of characteristic 2, then we may suppose that $a_1 = a_3 = 0$

Let E be an elliptic curve over the real numbers given by the equation $y^2 = x^3 + ax + b$, a, b∈F, CharF≠2,3. And let P and Q be two points on E.

We define the negative of P and the sum P+Q according to the following rules:1) If P is the point at infinity $\mathcal{O}$, then we define –P to be $\mathcal{O}$.For any point Q we define $\mathcal{O}$ +Q to be Q; that is , $\mathcal{O}$ serve as the additive identity(" zero element") of the group of points. In what follows, we shall suppose that neither P nor Q is the point at infinity.

2) The negative –P is the point with the same x-coordinate as P but negative y-coordinate; that is, -(x,y)=(x,-y).It is clear that the equation (1) is satisfy by the point (x,-y) whenever (x,-y) is on the curve. If Q=-P , then we define P+Q to be the point on infinity $\mathcal{O}$.

3) If P and q have different x-coordinates, then we shall soon show that the line l=PQ intersects the curve in exactly one more point R(unless l is tangent to the curve at P, in which case we take R=P, or at Q, in which case we take R=Q).Then we define P+Q to be –R, that is, the mirror image (with respect to the x-axis) of the third point of intersection.

4) The final possibility is that P=Q. Then let l be the tangent line to the curve at P, let R be the only other point of intersection of l with the curve, and define 2P=-R.(R is taken to be P if the tangent line has "double tangency" at P, in other words , if P is a point of inflection).

The above set of rules can be summarized as:

The sum of the three points where a line intersects the curve is zero.

If the line passes through the point at infinity $\mathcal{O}$, then this relation has the form P+P"+ $\mathcal{O}$= $\mathcal{O}$ where P and P" are symmetrical points), that is P"=-P. Otherwise, it has the form P+Q+R= $\mathcal{O}$, where P,Q, and R are the three points . There is exactly one more point where the line l through P and Q intersects the curve; at the same time we will derive a formula for the coordinates of this third point, and hence for the coordinates of P+Q.

Let (x_1,y_1) ,(x_2,y_2) and (x_3,y_3) denote the coordinates of P,Q and P+Q respectively. We want to express x_3 and y_3 in terms of x_1,y_1,x_2, y_2. Suppose that we are in case 3 in the definition of P+Q, and let $y=\alpha x+\beta$ be the equation of the line through P and Q(which is not a vertical in case3). Then $\alpha = \frac{y_2-y_1}{x_2-x_1}$ and $\beta=y_1-\alpha x_1$.A point $(x,\alpha x+\beta) \in l$ lies on the elliptic curve if and only if $(\alpha x+\beta)^2=x^3+ax+b$.Thus there is one intersection point for each root of the cubic equation $x^3-(\alpha x+\beta)^2+ax+b$.We already know that there are the two roots x_1 and x_2, because $(x_1, \alpha x_1+\beta)$, $(x_2, \alpha x_2+\beta)$ are the points P, Q on the curve. Since the sum of the roots of a monic polynomial is equal to minus the coefficient of the second- to- highest power, we conclude that the third root in this case is $x_3=\alpha^2-x_1-x_2$.This let to the expression for x_3, and hence for both coordinates of $P+Q=(x_3,-(\alpha x_3+\beta))$, in terms of x_1,x_2,y_1,y_2: $x_3=\left(\frac{y_2-y_1}{x_2-x_1}\right)^2-x_1-x_2$; $y_3=-y_1+\left(\frac{y_2-y_1}{x_2-x_1}\right)(x_1-x_3)$,

The case when P=Q is similar, except that α is now the derivative dy/dx at P. Implicit differentiation of equation (3) leads to the formula $\alpha=((3x_1)^2+a)/2y_1$, and so we obtain the following formulas for the coordinates of twice P: $x_3=(3x_1^2+a/2y_1)^2-2x_1$; $y_3=-y_1+(3x_1^2+a/2y_1)(x_1-x_3)$

Elliptic Curves Modulo a Prime: Let p>3 be a prime. Elliptic curves over Z_p can be define exactly as they were over the real (and the addition operation is also defined in an identical fashion) provided that all operations over R are replaced by analogous operations in Z_p. The addition operation on E is defined as follows (where all arithmetic operations are performed in Z_p) : Suppose $P = (x_1, y_1)$ and $Q = (x_2, y_2)$ are points on E . If $x_2 = x_1$ and $y_2 = y_1$, then $P+Q= \mathcal{O}$; otherwise $P + Q = (x_3, y_3)$, where $x_3 = \lambda^2 - x_1 - x_2$, $y_3 = \lambda(x_1 - x_3) - y_1$, where $\lambda = \frac{y_2-y_1}{x_2-x_1}$ if $P \neq Q$ and $\lambda = \frac{3x_1^2+a}{2y_1}$, if $P = Q$.

Finally , define $P + \mathcal{O} = \mathcal{O} + P = P$, for all $P \in E$.

Note that the addition of points on an elliptic curve over $\mathbb{Z}_p$ does not have the nice geometric interpretation that it does on an elliptic curve over the reals , However , the same formulas can be used to define addition , and the resulting pairs (E, +) still forms an abelian group: with neutral element $\mathcal{O}$, + is commutative, and that the inverse element for $A = (x_1, y_1)$ is given by $-A := (x_1, -y_1)$.

(i) For $A = (x_1, y_1)$, $B=(x_2,y_2) \in E \setminus \{ \mathcal{O} \}$ we have $A + A = \mathcal{O}$ if and only if $y = 0$.

(ii) If $A,B \in E \setminus \{ \mathcal{O} \}$ and $x_1 = x_2$, then $A = B$ or $A = -B$.

(iii) This definition is motivated by geometry. If $A,B \neq \mathcal{O}$, then we can take the line through A and B (respectively the tangent to A if A = B). This line intersects the curve E in three points (counted with multiplicities) A,B,C. Then define $A + B := -C$ where C is the reflection of C about the x-axis

(iv) If $(x_1, y_1) = (x_2, -y_2)$, then $A + B := \mathcal{O}$; $-A - B = -(A + B)$; (Uniqueness of the neutral element). If $A + B = A$, then $B = \mathcal{O}$; If $A + B = -A$, then $B = -A - A$; (Cancellation rule). If $A + B = A + C$, then $B = C$, where $A = (x_1, y_1)$, $B=(x_2,y_2)$,$C=(\tilde{x}_2 , \tilde{y}_2) \in E$.

ARTS STREAM

THOUGHT AND REALITY : A CRITICAL STUDY OF HEGEL

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Principal

Abstract

The primary objective of the dissertation is to make a critical assessment of the views of Hegel relating to though and reality. In a general way, Hegel's philosophy is the culmination of the European philosophy beginning from that of Plato. In a specific sense, Hegelianism represents the acme point of Germanic idealism. In turn, Hegel has also influenced different trends and school of philosophy both in the continental and the British universities. But no other philosopher has been so widely misunderstood as Hegel. The logical positivists misunderstood and misinterpreted Hegel. They pooh-poohed Hegel. The so called conceptual analysts also did not spare him. As far as I know, nobody except Findlay has tried to present a sympathetic understanding of Hegel. It is a fact; the so called analysts are exhibiting a wider sense of tolerance towards classical philosophers. Strawson has been a pioneer in this regard. The classical philosophers have to be rediscovered. Strawson's innovative concepts such as revisionary and descriptive metaphysics require us to go back to classical philosophers and rediscover them. To use his words, - the classical philosophers have to be reinterpreted in contemporary idioms. The dissertation has mainly this end in view.

The dissertation consists of six chapters. The first chapter is entitled Introduction. It presents a brief outline of the pervasive intellectual milieu against which Hegelianism took it rise.

The second chapter is entitled Thought and Idea. What is thought? What are ideas? These are important questions not only in Hegel but also in the entire history philosophy. In a way, "thought" constitutes the corner stone in Hegel's philosophy. Is thought a mental process? Are ideas mental contents or copies of object? The empiricist treated ideas as mental contents and copies of objects. What has Hegel to say in this regard? The second chapter is devoted to an analysis of thought and ideas.

The third chapter is entitled Thought and Mind. Descartes regarded thought as constituting the essence of mind. For Descartes, mind is thought. Hegel, following the Cartesian line argues that the essential ingredient of mind is thought. Thought grows and develops. This chapter is devoted to an analysis of Hegel's views on thought and mind and their interrelationship.

The fourth chapter is entitled Thought and the World. This chapter is devoted to an analysis of the Hegelian philosophy of Nature or *Naturphilosophie.* What does constitute the world? How are thought and world related? Hegel appears to be arguing that the world is an expression or unfoldment of thought. What does unfoldment mean in this connection? How does

Hegel escape the charge of solipisism and mentalism? Such issues will be discussed in detail in the chapter under reference.

The fifth chapter will be entitled Logic of Dialectic. Hegel argues that the history of human society, nay the history of the world, is a gradual unfoldment of mind. All history is a history of the mind. Dialectic understanding is the only adequate mode of understanding. It can unravel not only the secret of nature but also of human society. The dialectical understanding has been regarded as the holistic one. Other modes of understanding have been regarded as atomistic and piecemeal. But these modes of understanding are inadequate. Only the dialectic mode of understanding is the adequate one. But what is dialectic? How do we understand it? How does Hegel justify the adequacy of dialectical form of understanding? Such issues are discussed and examined in detail in the chapter.

The sixth chapter is entitled Conclusion. Hegel has been characterized as an idealist, nay, as an objective idealist. What is idealism? How is it different from realism? Are idealism and realism incompatible? Is idealism old fashioned and out dated? Has philosophical analysis adequately replaced idealism as a method of philosophizing? Can idealism be reinterpreted as throwing off some insights to some of the basic questions in philosophy? Such issues have been discussed in detail in the concluding chapter.

DEVELOPMENT OF WOMEN'S EDUCATION IN MEGHALAYA AND INFLUENCE OF EDUCATION ON CERTAIN SOCIAL ATTITUDES OF KHASI WOMEN

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Abstract

INTRODUCTION

Education is regarded as the most significant instrument for the development of the individual as well as for the development and progress of the society. Through development of knowledge , skills, attitudes and values, education helps not only in furthering the material well being of individuals but also enables them to adjust to the changing situations and also to contribute to the development and progress of the society. The Education Commission (1964-66) emphasized that education should be used as a powerful instrument of social, economic and cultural change and as a means for increasing the process of modernization. The most important function of education in the process of modernization can be the change it facilitates in the attitudes, behavioural patterns and social relationships of the people affecting the social structure of communities. Considering the significant role of education in development, equality of educational opportunities for both men and women is essential. However, considering the fact that women have in general lagged behind men in their race for education, the education of women needs more emphasis. Women as vital part of human resources are potential contributors towards development. This can be achieved through education. Moreover educated women can play an important role in the process of modernization because they can pass on modern attitudes and values more effectively to their children right from their childhood stage.

The present study deals with the development of women's education in Meghalaya and the influence of education on certain social attitudes of Khasi women.

REVIEW OF RELATED LITERATURE

The review of related literature pertaining to the development of women's education conducted in India and abroad' revealed certain common trends in the development of women's education in recent years such as increased in the percentage of female literacy, increase access of girls to education, increase in the number of female enrolment at different levels of education and concentration of women students mainly in arts and teaching faculties. These trends are found not only in India but also in different countries of the world.

The review of research literature pertaining to the influence of education on social attitudes of people conducted in India and abroad revealed certain general findings such as education being a significant factor influencing individual and social modernization, besides education, the other general factors influencing modernity attitudes are age, residential background, income and socio –economic status.

RATIONALE OF THE STUDY

The need for the present study was felt because development of education is expected to contribute to the material well being of the people and also act as an important instrument for moulding the behavior and attitudes of the people in a desirable way. So the present study attempted to trace the development of women's education in Meghalaya and to find out the modernizing effects of education on certain social attitudes of Khasi women. Systematic studies on this area have not been conducted in this region. Hence, it needs investigation.

OBJECTIVES OF THE STUDY

The objectives chosen for the study were the following:

(i) To trace the history of women's education in Meghalaya.

(ii) To find out the contribution of the Christian missionaries as well as the government towards the development of women's education in the state.

(iii) To identify the factors that helped in the development and expansion of women's education.

(iv) To investigate the extent to which the select social attitudes have been developed in the educated Khasi women of different age levels, different socio-economic status, and drawn from rural and urban settings.

HYPOTHESES

Fifty two null hypotheses were formulated and tested to examine the relationship between levels of education and modernity, course of education and modernity and also the relationship between the personal-social variables (age, residential background, and marital status and socio- economic status) and modernity.

METHOD and PROCEDURE

Historical-cum-descriptive method of research was adopted for the present study.

The data pertaining to the development of women's education was collected through documentary study and the data pertaining to the influence of education on modernity attitude was collected through the Modernity Attitude Scale (MAS).

A sample of 500 educated Khasi women including working women and students enrolled in various and the North-Eastern Hill University in shilling were selected for the present study. All the selected respondents were given copies of the MAS but only 420 of them responded. Therefore the final sample included only 420 educated Khasi women.

The tools used for the study included (i) Modernity Attitude Scale and (ii) Socio-economic Status Scale.

The Modernity Attitude Scale was originally developed by Anand and Sudhir (1982).It was adapted to Mizoram by Lalrinkimi (1988) and was found suitable for the present study since the Mizos and the Khasis are tribals of the north-eastern region .Only two items related to bride price which were found irrelevant to the Khasi society were deleted and replaced by relevant items and the scale items were subjected to expert scrutiny thereby ensuring the content validity of the scale. The scale contained 80

Single-point statements with modernity –traditional continuum equally divided into five sub-scales: (i) attitude towards religion (ii) attitude towards marriage (iii) attitude towards family (iv) attitude towards status of women (v) attitude towards education.

The Socio-economic status Scale developed by Kuppuswamy (1962) was adopted after modifying the income limits of the original scale taking into consideration the pay structure implemented in the state of Meghalaya following the recommendation of the Second Pay Commission which came into force on 1.1.87.Thus the modified socio-economic status scale was adopted for the present study. The historical data obtained from documentary study was organized and arranged under different headings and presented systematically and chronologically. Percentage was used as a technique for analyzing and presenting the result involving numbers. The t-test was used for the data collected through the Modernity Attitude Scale.

FINDINGS ON THE DEVELOPMENT OF WOMEN's EDUCATION IN MEGHALAYA

The main findings were as follows:

(1) Beginning of women's education-women's education originated in 1843 when Mrs. Lewis of the Welsh Presbyterian Mission started to teach the Khasi girls at Nongsawlia in Cherrapunjee.

(2) Initial problems-Initially the Khasis were quite opposed to women's education mainly because of the fear prevalent at that time that any female who touches a book would be rendered barren. However, gradually when the initial fears proved groundless, the number of girls who started learning increased.

(3) Initial progress- In spite of the initial difficulties, 14 girls were able to read the first khasi reader by the end of 1843, partly due to the efforts of Mrs. Lewis and partly due to the girls own enthusiasm.

(4) *Progress of female literacy-(I)* During the British period, the Khasi and Jaintia Hills district took the lead in female literacy in the composite state of Assam as the available literacy figures revealed. In 1911 the number of literate women per 10,000 was 139 in Khasi and Jaintia Hills and only 29 in Assam. In 1921, it was 294 in Khasi and Jaintia Hills and 57 in Assam.(ii) Female literacy rate in Khasi and Jaintia Hills was above the all India

level since the beginning of the twentieth century till the post-independence period .The census reports of 1901 and 1951 revealed that the percentage of female literacy in Khasi and Jaintia Hills was 4.01per cent and27.63 per cent, while at the all India level it was 0.6 per cent and 12.95 per cent respectively.(iii)According to the 1991 census female literacy in Meghalaya is 44.85 per cent which is above the all India female literacy rate (32.52 per cent).(iv)Of all the districts of Meghalaya, the East Khasi Hills district accounts for the highest percentage of female literacy.(v) Comparison of male-female literacy in Meghalaya revealed that male literacy is higher than female literacy. Male literacy was 34.12 per cent, 37.89 percent and53.12 per cent, while female literacy was 24.56 per cent, 30.08 per cent and 44.85 per cent respectively for 1971,1981, and 1991.

(5) *Growth of educational institutions (1972- 1994)*-There has been a rapid growth of educational institutions in Meghalaya after statehood. The number of primary schools increased from 2683 in 1972 to 4235 , M.E. schools increased from 229 to827, high schools increased from 119 to411, colleges increased from 14 (including 2 girls' colleges) to 28 (including 3 girls colleges), teacher training schools increased from 2 to 3, and industrial training institutes' increased from 2 to 5(including 1 for women). Most of these educational institutions are co-educational.

(6) *Growth of girls 'enrolment (1972-1994)*-(i) Girls enrolment at the school stage increased from 99061 (constituting 46.49 per cent of the total enrolment) in 1972 to 204542 (constituting 48.91 per cent of the total enrolment) in 1991. (ii) At the collegiate and university stage, girls' enrolment increased from 3448 (constituting 35.67 per cent of the total enrolment) in 1974 to 21281 (constituting 44.61 per cent of the total enrolment) in 1994. (iii) Female enrolment on the average is lower than male enrolment at all stages of education during the period 1972 1994. At the primary stage , the percentage of enrolment is 52.13 per cent (males) and 47.87 (females); at the M.E. stage it is 54.73 percent (males) and 45.27 per cent (females);at the high school stage it is 52.70 per cent (males) and 47.30 (females); at the pre-university stage is 59.00 per cent (males) and 41.00 (females); at the degree level is 59.80 per cent (males) and 40.20 (females);at the post-graduate stage is 54.93 per cent (males) and45.07(females); and the research level is 59.61 per cent (males) and 40.39 (females). (iv)Female enrolment has increased in all faculties of higher education from 1974 to 1994. In Arts faculty it has increased from 2921 to 6943; in Science from297 to 1686; in Commerce from 13 to 199; in Teaching from 125 to 284; and in Law from 92 to 412. (v) The proportion of female enrolment to the total has increased in all faculties from 1974 to 1994. In Arts faculty it has increased from 45.70 per cent to 46.70 per cent; in Science from 15.40 per cent to45.40 per cent; in Commerce from 2.30 per cent to 19.30 per cent; in Teaching from 47.20 per cent to 66.80 per cent; and in Law from 17.80 per cent to 31.60 per cent.(vi) Faculty-wise enrolment shows that male enrolment on the average is higher than female enrolment. The percentage of male enrolment in Arts faculty is 53.20 percent, in Science 68.60 percent, in commerce 89.90 percent, in teaching 50.40 percent and in Law 78.30 percent, and the corresponding figures for females are 31.40 percent, 10.10 percent, 49.60 percent and 21.70 percent.

(7) *Examination results*- (i) the pass percentage of girls varies from one examination to another during the period 1974-1994. The pass percentage is low at the H.S.L.C. level (the average being 35.80 percent) and the highest percentage is attained at the post-graduate level (being 87.02 in M.A. and 87.80in M.Sc. examinations. (ii) Comparison of male-female pass percentage from 1974-1994 shows that on the average girls fare better than boys except in B.com. and LL.B. examinations.

(8) *Contribution of the Christian missionaries and the government towards the development of women's education in Meghalaya*- (i) The foundation of women's education in Meghalaya was laid by the welsh Presbyterian Mission in Khasi and Jaintia Hills in 1843, and by the American Baptist Mission in Garo Hills from 1867. (ii) The other missions such as the Catholic Mission, the Ramkrishna Mission, the Seng Khasi , as well as the educated local people have also contributed to the expansion of women's education by setting up educational institutions in various parts of the state.(iii) Till the recent times, the Christian Mission and the community played a key role in setting up and managing schools and colleges. This is evident from the fact that a proportion of primary schools and 90 percent middle/high schools and colleges are under private management. (iv) The state government played a promotional role by extending maintenance grant as assistance towards salary cost of the staff under salary deficit or adhoc scheme.

(9) *Factors contributing to the development of women's education*- The factors which have contributed to the remarkable progress of female education in Meghalaya are: (i) Initiative taken by the missionaries; (ii) favorable atmosphere in the society and the family-where there is no prejudice against women's education; (iii) the government and the voluntary agencies have shown no gender bias in providing education; and (iv) there girls own enthusiasm in education.

FINDINGS ON THE INFLUENCE OF EDUCATION ON CERTAIN SOCIAL ATTITUDES OF KHASI WOMEN

(1) *Levels of Education and overall modernity* – The testing of the first six hypotheses which pertained to the influence of levels of education on modernity attitude revealed significant differences in modernity attitude scores among the following paired comparisons with the respondents in the higher educated group attaining higher mean scores than those in the lower educated group. The t values computed for the mean differences were as follows:

(I) High school educated and graduates ($t=4.05$ $p<.001$)
(ii) High school educated and post-graduates ($t=3.40$ $p<.001$)
(iii) Pre-university educated and post-graduates ($t=4.77$ $p<.001$)
(iv) Pre-university educated and post-graduates ($t=3.78$ $p<.001$)

The results revealed no significant differences (i) between high school educated and pre-university educated and (ii) between graduates and post-graduates.

(2) *Levels of education and attitude towards religion*- The results of the testing of hypotheses 7-12 which pertained to the influence of education on attitude towards religion revealed significant differences among the following paired comparisons with the respondents in the higher educated group attaining higher mean scores than those in the lower educated group. The t values computed for the mean difference among each pair were as follows:

(i) High school educated and graduates ($t=3.51$ $p<.001$)
(ii) High school educated and post-graduates ($t=4,59$ $P<.001$)
(iii) Pre-university educated and graduates ($t=2.42$ $p<.o5$)
(iv) Pre-university educated and post-graduates ($t=3.90$ $p<.001$)
(v) Graduates and post-graduates ($t2.49$ $p<.05$)

No significant in mean scores of high school educated and pre-university educated in their attitude towards religion.

(3) Levels of education and attitude towards marriage-the results of the testing of hypotheses 13-18 which pertained to the influence of education on attitude towards marriage revealed significant differences among the following paired comparisons, with the respondents in the higher educated level attaining higher mean scores than those in the lower level of education, and the t values computed for the mean differences were as follows:

(i) High school educated and graduates ($t=4.62$ $p<.001$)
(ii) High school educated and post-graduates ($t=3.65$ $p<.001$)
(iii) Pre-university educated and graduates ($t=3.45$ $p<.001$)
(iv) Pre-university educated and post-graduates ($t=2.91$ $p<.01$)

The results revealed no significant differences between (i) the high school educated and pre-university educated (ii) the graduates and the post-graduates in their attitude towards marriage.

(4) Levels of education and attitude towards family-the testing of hypotheses 19-24 which pertained to the influence of education on attitude towards family revealed significant differences in the mean scores among the following paired comparisons, with the respondents in the higher level of education attaining higher mean scores than those in the lower educated group, and the t values computed for the mean differences were as follows:

(i) High school educated and graduates ($t=3.04$ $p<.01$)
(ii) High school educated and post-graduates ($t=2.93$ $p<.01$)

(iii) Pre-university educated and graduates (t=4.36 p<.001)

(iv) Pre-university educated and post-graduates (t=3.92 p<.001).

The results revealed no significant difference in the mean scores of (i) high school educated and pre-university educated, and (ii) graduates and post-graduates in their attitude towards family.

(5) Levels of education and attitude towards status of women in society- the testing of hypotheses 25-30 which pertained to the influence of the levels of education in their attitude towards status of women in society revealed no significant differences in the mean scores of the respondents of different educational levels.

(6) Levels of education and attitude towards education- the testing of hypotheses31-36 which pertained to the influence of education on their attitude towards education revealed significant differences among the following paired comparisons, with the respondents in the higher level of education attaining higher mean scores than those in the lower educated group, and the t values computed for the mean differences were as follows:

(i) High school educated and graduates (t=2.55 p<.05)

(ii) High school educated and post-graduates (t=2.54 p<.05)

(iii) Pre-university educated and graduates (t=2.11 p<.05)

(iv) Pre-university educated and post-graduates (t=2.23 p<.05)

The results revealed no significant differences in the mean scores on attitude towards education between (i) high school educated and pre-university educated and (ii) graduates and post-graduates.

(7) Course variation and modernity- the results of the testing of hypotheses 37-42 revealed significant differences in the mean scores of the science educated group and the social science/Humanities educated group with regards to overall modernity attitude (t=3.31 p<.001),attitude towards religion (t=2.02 p<.05), attitude towards family (t=2.04 p<.05),and attitude towards status of women in society (t=3.41 p<.001), with the Science group attaining higher mean scores than the Social Science/Humanities group.

(8) Personal-social variables and modernity- the results of the testing of hypotheses 43-52 which pertained to the influence of personal/social variables on modernity attitude revealed that age and marital status are not significant factors influencing modernity.

Residential background is a significant factor influencing modernity attitude , with the urban group attaining higher mean scores than the rural group (t=3.43 p<.001). Socio-economic status is also a significant factor influencing modernity attitude with the higher S.E.S groups attaining higher mean scores, the difference being statistically significant among low and high S.E.S. groups (t=4.79 p<.001), low and middle S.E.S. (t=3.25 p<.01), and middle and high S.E.S. (t=2.15 p<.05).

However when the groups under each personal/social variable were compared according to their levels of education it was found that the respondents in the high educated group differed significantly in modernity attitude.

IMPLICATIONS OF FINDINGS AND CONCLUSION

The conclusions drawn from the analysis of data implies that there has been a remarkable progress in the field of women 's education in Meghalaya as indicated by increase in educational facilities, increase in the percentage of female literacy, increase in the number of girls enrolment, better performance of girls in the examination and the like. It is also seen that education has proved to be a significant factor in moulding the social attitudes of the Khasi women in a positive direction. The desirable values of modernization such as liberalism, equality, rationality and democratic outlook which are inherent in the traditional khasi society have been reinforced by education. The other desirable values such as scientific outlook, secular outlook, achievement orientation and openness to change have also been facilitated by education. The present day educated Khasi women possess a desirable mix of useful values drawn from the past and the relevant values of modern times acquired during the course of their education. Since the findings of the present study implies that education is an important instrument which helps in moulding the attitudes of Khasi women in a positive direction, it may be suggested that more educational facilities may be provided particularly higher education should be provided so that more girls would get the benefit of modern education.

INDO-SOVIET RELATIONS

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Abstract

Indo Soviet relations after India's independence can be divided into two phases namely passive and active .The period of transition may be marked from 1953 to 1955. The passive phase was reflected when no significance was attached to India's independence by the Soviet Union and there was no direct contact between the Soviet Union and India.However the forging of military alliance between the US and Pakistan brought cold war into the doorstep of India.There was a distinct improvement in the Indo-Soviet relations in 1955 when Nehru visited Soviet Union in 1955 and the historic return visit of Kauschev and Bulgaria in November 1955.

The Indian and Soviet government chose to build their relationship on the basis of convergence in their national interests because of the unfriendly US attitude towards India. There was multifaceted cooperation between India and the Soviet Union in the spheres of economic, military and diplomatic interests. Indo-Soviet cooperation during this period had been mutually advantageous to both the countries despite the diverse social and economic systems and this cooperation had also been conducive to the struggle for ushering in world peace.

REPRESENTATION OF WOMEN IN KHASI LITERATURE

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Abstract

In the first chapter entitled Khasi concept of womanhood, I deal with the traditional role of Khasi women vis-a-vis women liberation movement all over the world.Unlike the women of other countries of the world, Khasi women share equal status with men.Therfore a Khasi thinks that no such feminist movement is applicable to the Khasi society.However, we cannot forget the fact that Khasi women inherited only the Custodianship and not the property.In most cases they inherit only the bad dept.Men are the central figure of the society as they are the maternal uncles who control the custodianship.

The second chapter entitled Khasi womanhood in the idyllic world is sub-divided into two Sections- A and B. A is entitled The good old world of P.E.Swer and S.J.Duncan Hoojan whereas Section B is entitled Realistic Portrayal of the Khasi women.Section A contains my discussion on the ideal Khasi womanhood as depicted by P.E.Swer in his novelette Ka Samla Rilum and S.J.D.Hoojan's play and short story entitled Ka Tiewlarun and Ka Akor kaba tam.

Section B deals with women characters as depicted by D.T.Laloo in his novel Ka Lasubon and D.S.Khongdup's play U Baicit Donshkor. Lasubon and Pherlibon are depicted as simple young women of the present society .Other women characters like Shitala Koina Kortimai and Syntiewbon set good examples of the society.

Chapter Three deals with the social changes prevalent in the Khasi society after the coming of the Britishers .The Britishers' intrusion into the social and cultural pattern of the Khasi traditional way of life brought in its wake many changes which imoeriled the social identity of the Khasi people as distinct from their neighbours.The emergence of the first world war and the second world war are responsible in bringing about all kinds of social evils in the Khasi society.Women being the weaker sex are the first to be victimised.

Chapter four deals with the art of characterisation employed by different writers namely Peace Roy Pariat, S.J.Duncan Hoojan, Leslie Harding Pde, Donbok T.Laloo, Remy Phankon,Gloster S.Rapthap, W.Tiewsoh and Khrawkupar Kharlukhi.The art of characterisation differs from one author to another.

The last chapter is the conclusion chapter containing the results of my findings out of my own investigation.

EFFECT OF INTELLIGENCE, SOCIAL MATURITY AND EMOTIONAL COMPETENCE ON THE ACADEMIC ACHIEVEMENT OF HIGHER SECONDARY SCHOOLS STUDENTS IN EAST KHASI HILLS OF MEGHALAYA

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Abstract

Education has always been used as a powerful instrument of social, economic and political change. Society cannot achieve its aim of economic growth, technical development and cultural advancement without fully harnessing the talents of its citizens. It is generally believed that education is basic to all development. Educationists thus strive to fully develop the intellectual potential of the students and make efforts to see that their potentialities are fully realized and channelized for the benefit of the individual and the society. Education is commonly referred to as the process of learning and obtaining knowledge at school, in the form of formal education. In almost all societies, attending school and receiving an education is extremely vital and necessary if one is to achieve success. In the Twenty-First Century, the value of education has taken on a whole new meaning. Education is an important tool that contributes to several aspects of a person's life in order to take advantage of what have been learned and how to productively fit in in either personal or professional life. Being educated is something that is always being looked at as a positive achievement that feels good and looks good on a resume.

Academic achievement of students is of paramount importance, particularly in the present socio-economic context. The world is becoming more and more competitive. Quality of performance has become the key factor for personal progress. Parents desire that their children climb the ladder of performance to as high a level as possible. This desire for a high level of achievement puts a lot of pressure on students, teachers, schools, and in general on the educational system itself. In fact, it appears as if the whole system of education revolves around the academic achievement of students, though various other outcomes are also expected from the system. Great emphasis is placed on achievement right from the beginning of formal education. The effectiveness of any educational institution is gauged to the extent the students involved in the system achieve and therefore the entire effort of education is geared towards improving the academic achievement of the students.

The role of academic achievement in the educational system in particular and in the development of nations in general is assuming greater proportions. The problem of academic achievement has assumed new proportions in the present time because there are many factors which are responsible for enhancing the academic achievement of the students. This is because of the new demands arising from the rapidly changing societies and also because of the increased aspirations of individuals for economic, cultural and intellectual improvement.

The most important outcome in the educational set-up is the academic achievement of the students. Academic achievement is considered a key criterion to judge ones total potentialities and capabilities. It has been the object of intensive interest and concern and this can be attested by the profusion of studies in this area as well as the opinion of those working with students in various educational settings. One of the recurrent themes to be found in educational research involves an attempt to unravel the complex determinants of academic achievement.

The study of academic achievement of students is of great importance as the efficiencies and deficiencies of students are chiefly determined by the quality of their achievement. Education thus aims at improving the academic performance of students. In modern times the problems of academic achievement is not only the concern of the school but also of the parents. It is the end product of the interplay of a complexity of factors specifically involved in an academic situation. The capacity to meet the demands in the academic field reasonably involve various factors like motivation, interests, goals, aspirations, study habits, etc. Hence the level of achievement of children at any stage depends on the extent to which their natural potentialities have developed or changed. Academic achievement is viewed as adjusted behaviour. The failure of potentially brilliant pupils to reach their maximum is accepted in terms of their inability to adjust to some psychological situations. Stagner (1962) defines achievement as a degree of proficiency or progress made by pupils in the mastery of school subjects. According to Verma and Upadhyay (1981), achievement

is the attainment or accomplishment of an individual in some particular branch of knowledge after a certain period of learning. The achievement score of a student indicates the future success of the individual. A well balanced person is intellectually, socially and emotionally adjusted to the demands of the environment.

1. **Need and Justification of the Study:** It has generally been observed that some children in spite of having high intelligence quotient achieve low marks in their examinations. On the other hand, some children achieve high marks in the examinations even if they do not possess high intelligence quotient. It shows that it is not only intelligence that determines the academic achievement of school children. Though there may be many factors which contribute to the academic achievement as already described earlier, in the present world of competition, social maturity and emotional competence of children play an important role in contributing to the pupils' performance. Social Maturity is a personal and social commitment which influences one's performance. Similarly, emotional stability of an individual leads to a happy peaceful and healthy life which in turn affects one's performance in life. How an individual handles his social responsibility and personal emotions would be a question of immense importance in explaining the growth of personality and his outcome in life.

   It is in this background that the present study has been undertaken to determine whether general intelligence, social maturity and emotional competence has an effect on the academic achievement or not. A study of this nature would definitely help parents, teachers and educationist, psychologists and sociologists in further understanding the mental makeup of the students in connection with their academic achievement. In order to help the students to achieve to the best of their ability, it is first necessary to investigate the various factors which influence academic achievement. If these factors which facilitate academic achievement of students are identified then it may be possible to provide a healthy educational environment and pave the way for students' success and achievement.

2. **Statement of the Problem:** In view of the background as described above, the problem under study is specifically titled as follows:

   "Effect of Intelligence, Social Maturity and Emotional Competence on the Academic Achievement of Higher Secondary School Students in the East Khasi Hills District of Meghalaya"

3. **Objectives of The Study:** The following are the objectives of the study.

   (i) To find out the difference in the level of Academic Achievement, Intelligence, Social Maturity and Emotional Competence of Class XII students with respect to(a) Male and Female (b) Urban and Rural.

   (ii) To find out the relationship of (a) Academic Achievement and Intelligence (b) Academic Achievement and Social Maturity (c) Academic Achievement and Emotional Competence of Class XII Students

   (iii) To find out the difference in correlation of Academic Achievement and Intelligence between (a) Male and Female (b) Urban and Rural Students of Class XII.

   (iv) To find out the difference in correlation of Academic Achievement and Social Maturity between(a) Male and Female (b) Urban and Rural Students of Class XII.

   (v) To find out the difference in correlation of Academic Achievement and Emotional Competence between (a) Male and Female (b) Urban and Rural Students of Class XII.

   (vi) To find out the effect of Intelligence on Academic Achievement of Class XII students when the effect of Social Maturity and Emotional Competence is partialled out.

   (vii) To find out the effect of Social Maturity on Academic Achievement of Class XII students when the effect of Intelligence and Emotional Competence is partialled out.

   (viii) To find out the effect of Emotional Competence on Academic Achievement of Class XII students when the effect of Intelligence and Social Maturity is partialled out.

   (ix) To find out the multiple effects of Intelligence, Social Maturity and Emotional Competence on Academic Achievement of Class XII Students.

4. **Hypotheses of the Study:**

(i) There is no significant difference in the level of Academic Achievement, Intelligence, Social Maturity and Emotional Competence of the Students between (a) Male and Female (b) Rural and Urban Students of Class XII.

(ii) There is no significant relationship between (a) Academic Achievement and Intelligence (b) Academic Achievement and Social Maturity (c) Academic Achievement and Emotional Competence of Class XII Students.

(iii) There is no significant difference in correlation of Academic Achievement and Intelligence between (a) Male and Female (b) Urban and Rural Students Class XII.

(iv) There is no significant difference in correlation of academic achievement and social maturity between (a) Male and Female (b) Urban and Rural Students of Class XII

(v) There is no significant difference in correlation of academic achievement and emotional competence between (a) Male and Female (b) Urban and Rural Students of Class XII.

(vi) There is no significant relationship between academic achievement and intelligence of Class XII students when the effect of social maturity and emotional competence is partialled out.

(vii) There is no significant relationship between academic achievement and social maturity of Class XII students when the effect of intelligence and emotional competence is partialled out.

(viii) There is no significant relationship between academic achievement and emotional competence of Class XII students when the effect of intelligence and social maturity is partialled out.

(ix) There is no significant multiple correlation between academic achievement and the variables of intelligence, social maturity and emotional competence taken together of Class XII students

5. **Delimitations of the Study:** The study is delimited to the regular students of class XII belonging to different types of higher secondary schools & colleges of East Khasi Hills District in Meghalaya under the Meghalaya Board of School Education. (MBOSE), Shillong.

6. **Design of the Study**

(i) **Population:** The population of the present study comprises all the students studying in Class XII in various higher secondary schools and colleges under the East Khasi Hills District of Meghalaya.

(ii) **Sample:** For the present study a sample of 980 students of XIIth Grade were selected randomly. These students were drawn in clusters from 15 higher secondary schools and colleges being selected randomly from the population of the schools and colleges.

(iii) **Tools Used:** In order to obtain reliable data and to process the same in keeping with established procedure, the following tools were used in the present study:

(a) Ahuja's Group Test of Intelligence
(b) Rao's Social Maturity Scale
(c) Emotional Competence by H.C.Sharma and R.Bharadwaj

(iv) **Method of Data Collection:** The investigator first of all took formal permission from the heads of the institutions under study in order to administer the tests to the Class XII students. Prior to the administration of the tests, the investigator met the subjects with a view to establish rapport with them. The subjects were requested to participate whole-heartedly and sincerely while responding to the tests.

In order that the investigation would be fruitful, it was impressed upon the subjects that their co-operation in making appropriate answers to the questions in the questionnaire was vital. Any doubts as to the confidentiality of the responses that were harboured by the subjects were dispelled by the investigator.

The three tests were administered concurrently with a provision for a short break between the tests. The tests were all administered on the same day. Directions as to the procedure to be followed while attempting responses to the various tests were explained in depth and all doubts were clarified .After the investigator was satisfied that the subjects were fully aware as to the correct procedures involved, was the go ahead given for attempting the tests. The sequence followed in the administration of the test was Ahuja's Group Test of Intelligence, Rao's Social Maturity Scale and Emotional Competence by H.C.Sharma and R.Bharadwaj. The entire process of administration of the tests was completed in approximately three hours per school.

The performance of the subjects in the Higher Secondary School Leaving Certificate examination conducted by Meghalaya Board of School Education was taken as the data for academic achievement. The marks obtained by the subjects in the sample were taken from the school and college records.

(v) **Statistical Techniques Used:** The following statistical techniques have been employed to analyse the data.

i. Mean and Standard Deviation
ii. Pearson's Coefficient of Correlation
iii. Partial Correlation
iv. Multiple Correlation
v. Fisher's z
vi. t- test

7. **Findings and Conclusion:** The findings and conclusions resulting from the investigation are given as follows;

I. Level of Academic Achievement, Intelligence, Social Maturity and Emotional Competence of Class XII Students: The research findings with regard to the status of academic achievement, intelligence, social maturity and emotional competence of Class XII are as follows:

(i) **Difference in the level of academic achievement:**

(a) *Between Male and Female Students* : The present study indicates that there is no significant difference in the level of academic achievement between male and female students. This shows that gender does not have any influence on academic achievement of students indicative of the fact that the academic achievement of students is independent of their sex.

In the present study the difference in the academic achievement of male and female was not significant and the reason may be due to the fact that in Meghalaya there is no distinction between male and female children. We can therefore conclude that performance in the academic field is not linked to the gender of the students.

(b) *Between Rural and Urban Students:* The finding in the present study reveals that there is no significant difference in the level of academic achievement between rural and urban students. This implies that locality does not play any role in the determination of academic achievement.

The academic achievement of the students does not depend on the locale because it is the students' will power and industriousness, hard work, diligence and above all responsibility and discipline which all play a very important role in making them successful in their endeavours. Thus we can conclude that locale does not influence the academic achievement of the students.

(ii) **Difference in the Level Intelligence:**

II. Relationship of Academic Achievement with Intelligence, Social Maturity and Emotional Competence of Class XII students: The research findings with regards to the relationship of Academic Achievement with Intelligence, Social Maturity and Emotional Competence of Class XII students are as follows;

(i) *Relationship between Academic Achievement and Intelligence:* Since the early part of the century up to the present day, intelligence has been widely used as a measure to gauge academic achievement. The results revealed that there is a positive correlation between intelligence and academic achievement.

On the basis of the findings of the present study also we can conclude that intelligence and academic achievement are positively correlated. In other words correlation between intelligence and academic achievement is highly significant. This indicates that those who are highly intelligent are likely to have good academic achievement. It also means that the student who is quick to grasp ideas, a fast learner and intelligent is likely to achieve better academically than those who are less intelligent.

(ii) *Relationship between Academic Achievement and Social Maturity:* In recent years social maturity has been found to be an important ingredient of modern civilization and is the essential attribute to the academic performance of the students. Though there is no general agreement in the results but some studies have found a high degree of correlation, some have found a moderate degree and some have found that there was no significance at all.

On the basis of the findings of the present study we can conclude that social maturity and academic achievement are positively correlated. In other words it means that correlation between social maturity and academic achievement are highly significant. This shows that those who are socially mature are likely to perform well academically

(iii) *Relationship between Academic Achievement and Emotional Competence:* In recent years it has been found that emotional competence plays a significant role in the determination of the academic achievement of the students. Many studies have been conducted lately and the results have varied. There are studies which have found a high degree of correlation while others have found only moderate while still others have found no correlation at all. All studies do not agree that there is positive correlation between emotional competence and academic achievement.

On the basis of the findings of the present study we can conclude that emotional competence and academic achievement are positively correlated. In other words the correlation between emotional competence and academic achievement is highly significant. This indicates that those students who are emotionally competent are likely to have good academic achievement. Students who are emotionally competent fare better because skills like self-motivation and self-management of emotions contribute more to academic achievement.

Thus we can conclude that the performance of a student is significantly influenced by their emotional state. Students who perform well possess personal characteristics like assertiveness, independence, self-regard, empathy, social responsibility, optimism, flexibility and stress tolerance. Performance and success of a student depends upon his level of his emotional competence. To cope with academic pressure students need to be emotionally stable in order to meet the demands of every-day life.

Effect of Intelligence on Academic Achievement of Class XII Students when the effect of Social Maturity and Emotional Competence is partialled out:

The present study reveals that there is a significant relationship between academic achievement and intelligence of students even when the effect of social maturity and emotional competence is partialled out. It indicates that intelligence of the students still plays a vital role in determining the academic performance even when the influences of social maturity and emotional competence are controlled. It proves that irrespective of the level of social maturity and emotional competence, intelligence as a single factor continues to have its impact on the academic achievement of the students.

Hence it can be concluded that true relationship between intelligence and academic achievement still exists even after simultaneously controlling two factors viz. social maturity and emotional competence. This goes to show that intelligence on its own has a powerful effect in determining the academic performance of the students.

Effect of Social Maturity on Academic Achievement of Class XII Students when the effect of Intelligence and Emotional Competence is partialled out:

The present study shows that there is a significant relationship between academic achievement and social maturity in students when the effects of intelligence and emotional competence are partialled out. This amply shows that social maturity of the students greatly influences their academic performance even when the influence of intelligence

and emotional competence is controlled. It suggests that irrespective of the level of intelligence and emotional competence, social maturity continues to have its impact on the academic achievement of the students.

Hence it can be conclude that a true relationship between social maturity and academic achievement still exists even after simultaneously controlling two factors viz., intelligence and emotional competence. It indicates that social maturity has a powerful influence in determining the academic performance of the students.

Effect of Emotional Competence on Academic Achievement of Class XII Students when the effect of Intelligence and Social Maturity is partialled out:

The present study reveals that there is no significant relationship between academic achievement and emotional competence of students when the effect of intelligence and social maturity is partialled out. It indicates that emotional competence of the students does not influence their academic performance even when the influence of intelligence and social maturity is controlled. This suggests that emotional competence does not have any impact on the academic achievement of the students.

Hence it may be concluded that no relationship exists between emotional competence and academic achievement when the effect of the two other factors namely intelligence and social maturity are held constant. It indicates that emotional competence does not have much of a role to play in determining the academic performance of students.

Multiple Effects of Intelligence, Social Maturity and Emotional Competence on Academic Achievement of Class XII Students:

The present study shows that there is a significant multiple correlation of academic achievement with the three variables viz., intelligence, social maturity and emotional competence taken together of the students. It indicates that intelligence, social maturity and emotional competence contribute significantly to the performance of the students. Each factor while differentially influencing the academic achievement of students also contributes to the joint effect that the three variables have together. Hence it can be concluded that intelligence, social maturity and emotional competence contribute significantly to the academic performance of the students.

Implications and Recommendations of the Study:

The present study has elicited some important results that have implications upon the scholastic performance of the students. It has helped in comprehending the constraints the students face in the learning process because of different factors which hinder their progress and development.

The fundamental nature of the research findings has facilitated the understanding of the factors like intelligence, social maturity and emotional competence which are thought to be accountable for one's success in life. The findings of the research support the proposition that intelligence, social maturity and emotional competence are significantly correlated to academic achievement.

(i) In the present study it was found that students from urban areas are more intelligent when compared to rural students. This may be attributable to the fact that urban students are exposed to better infrastructure; their parents are usually educated and therefore are able to pass on the information and knowledge collected by them on to their children. The rural students lack in the resources available to their urban counterparts; many lack the advantage of educated parents, most being first generation school-goers, they live in a less stimulating environment and hence lag behind in mental development.

Rural students should therefore be given greater exposure to the stimulating aspects available to urban students. Teachers should work towards nurturing, encouraging and bringing out these attributes in their students. Rural students should, in particular, be given more opportunities to hone their intellectual abilities.

(ii) The present study shows that social maturity in girls is found to be higher than in boys. It further shows that social maturity of females is reflected in their ability and inherent interpersonal skills which facilitates their getting along with other people.

Different kinds of functions should therefore be organized which would provide male students in particular the impetus and the opportunities for sharing responsibilities thereby creating a sense of oneness and unity so that they learn to mingle freely and thus become more sociable. Boys should be groomed to enhance their social capabilities in order that they may learn to interact socially.

(iii) The study indicates that the level of social maturity in urban students is higher than that of the rural students. The compelling circumstances to adjust in the many aspects of social interaction and the guidance available in this context to the urban students may be the reason for the enhanced maturity of the urban students.

Rural students should be exposed to more opportunities and involved in more activities designed to develop their social skills. Teachers and the community as a whole should work together to create an atmosphere conducive for the development of social skills among the youth.

(iv) The present investigation has revealed that there is a significant difference in the level of emotional competence between males and females It is seen that the difference is in favour of males, showing therefore, that the males are more emotionally competent than female students. The study has also indicates that male students are better equipped to understand emotion and express it at appropriate times. Female students are not as emotionally mature when compared to male students.

Identification of the problems is vital so that some pre-emptive measures and solutions to increase the confidence levels of students, especially that of female students may be arrived at by teachers, parents and guidance workers. Hence, there is a need to counsel girls who are the backbone of our society to augment their emotional maturity which can in turn increase their degree of happiness and satisfaction and finally their academic performance.

(v) It has universally been documented that intelligence is the most important single factor influencing achievement. It has also been established in the present study that there is significant relationship between intelligence and academic achievement.

The findings of the present study may be helpful to the teachers, parents, counsellors in understanding the importance of intelligence in influencing academic achievement. Conducive school environment, good rapport between the teachers and the students, continuous assessment may be helpful to promote the intellectual abilities of the students. The school should pay special attention to the students who are academically backward to work as a team and to share ideas and solutions. Hence parents and teachers should help students to live up to their full potential both at school and at home.

(vi) Another important finding of this study is the significant correlation of social maturity to academic achievement. This shows that social maturity constitutes an important constituent of academic achievement. Being socially mature enables one to understand the intricacies of the social world we live in. It aids one to function as healthy adults and be successful in life.

It is through social life that the students slowly develop social competencies. The social maturity of the students is promoted through the process of social interaction with their peer group, teachers, parents and the community. The awareness of the contribution of social maturity to academic achievement may be useful to parents, teachers, and guidance workers as the life of an individual is to a large extent moulded by the society in which he lives. A good and conducive environment will facilitate social maturity of the students which in turn may help in enhancing their academic performance.

(vii) It has been established from these results that there is significant relationship between academic achievement and emotional competence. The result of the present study also implies the need for creating awareness about the emotional competence of the students and the need for managing emotions. This has educational implications for teachers, parents and others associated with students who perform poorly.

Parents, teachers, counsellors should therefore focus on the development and management of emotional competence by encouraging students read illuminating books, involve them in imaginative activities and games etc. thereby creating such an environment which help them to perform well academically.

(viii) The present study shows there is significant difference in the correlation of academic achievement and intelligence between male and female students. Further, we find that this difference is in favour of males. It indicates that the relationship of academic achievement and intelligence is more pronounced in males when compared to females. In other words, it is apparent that intelligence works more effectively to yield high achievement in case of males than females.

The findings of this study may be helpful to teachers and parents in understanding that female students should also be given more attention to promote their intellectual abilities in order to boost their achievement. The teachers may provide special coaching classes, identify the problems that the female students faced in the school and a congenial atmosphere through which students may develop their intellectual abilities. This may help the girl students towards their academic success.

(ix) The study reveals that there is significant relationship between academic achievement and intelligence of students when the effect of social maturity and emotional competence is partialled out. It indicates that intelligence of the students greatly influences their academic performance even when the influence of social maturity and emotional competence is controlled. It suggests that irrespective of the level of social maturity and emotional competence, intelligence continues to have its impact on the academic achievement of the students.

Intelligence has been proved that it greatly influence the performance of the students. It becomes imperative therefore that teachers, parents and administrators guide the students in a manner which help in developing their intellectual abilities so that their intellectual potential contribute to their scholastic performance to a greater extent.

(x) The results of the study show that there is a significant relationship between academic achievement and social maturity of students when the effects of intelligence and emotional competence are partialled out. It indicates that social maturity of the students greatly influences their academic performance even when the influence of intelligence and emotional competence is controlled. It suggests that irrespective of the level of intelligence and emotional competence, social maturity continues to have its impact on the academic achievement of the students.

The life of an individual is greatly moulded by the society in which he lives. The school as a social institution can fulfill the needs of the society hence different kinds of activities like group projects, discussion, dramatic activities or role playing will enhance the social maturity of the students. Home may also be a place where the students are exposed to the various degrees of social interaction, thus helping build up the confidence levels of the students who will thus be equipped to deal with various situations without undergoing much stress.

(xi) The significant multiple correlation of academic achievement with intelligence, social maturity and emotional competence of students indicates that the variables of intelligence, social maturity and emotional competence taken together greatly influence the academic performance of students.

Academic Achievement is one of the most important outcomes in the educational set up. We can therefore say that intelligence, social maturity and emotional competence taken together can enhance the academic achievement of students. Intelligence has been recognised as an important factor for higher chances of success and it also provides insight, and gives direction to the human potential for achieving the goal. Social Maturity of an individual is in many ways related to the development of an individual from the position of complete dependence on others to the status of being an independent responsible member of the society. One can learn to handle the degree of achievement at school or in other stages of life positively. Emotional Competence is a quality that is significant in learning how to cope with emotional situations. Students who are emotionally competent can expand their academic skills because this quality will encourage them to take success or failure in their stride.

In fact, intelligence, social maturity and emotional competence will make students mentally alert, emotionally and socially stable and responsible individuals. The possession of all of these qualities will boost the students' academic achievement and better equip them to cope with everyday life. Educators must strive to raise academic achievement by putting to use their knowledge of the effects of emotions, social maturity and intelligence. Students will develop the ability to think critically and analytically while working on innovative solutions to problems if all these abilities are developed. Academic Achievement will improve in schools if the factors of intelligence, social maturity and emotional competence are given due consideration. Individuals exhibiting higher levels of these traits will be more realistic, mature and will adapt well to changes in their immediate environment. In short, they do well in the various facets of competition and in their occupation. The multiple effects of intelligence, social maturity and emotional competence will provide students with basic skills for success not just in school but ultimately in their personal and professional lives.

AGRICULTURE IN THE HILL AREAS OF MEGHALAYA: A STUDY OF THE ECONOMIC IMPLICATIONS OF ENVIRONMENTAL DEGRADATION

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Abstract

The most important question which humanity faces today is the question of environmental degradation which is alarmingly assuming catastrophic proportions. The ecological crisis is such that it affects all people irrespective of societies and cultures, religions, national boundaries, professions and academic disciplines. Therefore, the study of economics should be able to present a perspective to provide solutions to this problem. As students of Economics in the North-Eastern Region, we talk of our economy as a 'land-based' economy.

In the land or natural world there exists an amazing richness of life expressions in the ever-renewing cycle of the seasons. The inflow and outflow of energy are such that the process is sustainable over an indefinite period of time. And so long as the human processes is integral with the processes of nature, the human economy (land-based) is sustainable into the future.

The problem comes when the industrial mode of our economy disrupts the natural processes and when human technologies become disruptive of earth technologies. In such a situation the productivity of the natural world and its life system is diminished. When nature goes into deficit, then we go into deficit! It is here then that the economists' agenda for the last decade of the 20th century should shift from the traditional discussions on the annual budgetary deficits to the ecological deficits. This is the decline in the gross earth product reflected also in the phenomena of political refugees turning into ecological refugees, i.e. people whose land has become deserts or too depleted in its fertility to continue supporting its human population.

This study is an attempt to analyse Agriculture in the Hill Areas of Meghalaya and looked into the economic implications of environmental degradation in the state.

Objectives of the Study

The objectives of the study are as follows:

1. To investigate into the relationship between economic development and the environment. It involves looking into the global perspective of environmental consciousness and also traces the impact of economic development process on the environment in the country.
2. To study the traditional system of food production viz. *Jhum* cultivation in the hill areas of Meghalaya which presents a bleak picture in the development of the hill areas of the State.
3. To analyse the striking factor of environmental degradation in Meghalaya brought about by indiscriminate deforestation, unsustainable agricultural practices, mining and quarrying activities. It has also looked into the increased loss of one of the vital assets of the environment, i.e. the soil through faulty agricultural activity and unscientific management of the land. It has also tried to present viable alternatives of development that suggest themselves for the sustainable management of the natural resources.

Methodology and Source of Data Collection

The data for this research are mainly drawn from published and unpublished sources both primary and secondary. The official reports both published and unpublished by the Directorate of Economics, Statistics and Evaluation, Directorate of Census Operations and the Forest Department of Meghalaya, have been our primary sources of data. So also the various project reports submitted by experts and consultants of the North-Eastern Council.

Much data have also been drawn from various secondary sources such as books, journals, newspapers, articles, papers and findings of relevant seminars. The data so collected from these sources have been analysed by the help of suitable statistical techniques and the result obtained have been subjected to relevant economic logic.

THE IMAGE OF THE SUFFERING WOMAN : A STUDY OF THE KHASI NOVELS [1963 – 1990]

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Abstract

The Khasi novel started in the second half of the 20th century, much later than either Khasi Poetry or Khasi Drama. It did indeed have a humble beginning when just two novels were published in the 1960's. Since then it has made a rapid stride in its growth in the later part of the 20th century. Literature is said to reflect life, hence human experiences universally encountered by people the world over form much of the basis of all literary works. The novel in particular is an effecting mode of interpreting life. It grows out of life, it is fed by life, it reacts upon life. Thus varied human experiences make up the themes of the novel and the theme of suffering in general and of women's suffering in particular has found an important place in the Khasi novel.

Prominent Khasi novelists such as F.M.Pugh, S,Q,Sumer, B.C.Jyrwa,K.W.Nongrum, L.H.Pde, W.Tiewsoh, D.T.Laloo, K.Kharlukhi and H.W.Sten have depicted women characters with apivotal role in their novels and many of these characters are shown to be victims of the society or the social systems they found themselves in.

F.M.Pugh, S,Q,Sumer have depicted the suffering of woman in her quest for romantic love. Whereas, B.C.Jyrwa and K.W.Nongrum highlighted the dawn of the Khasi novel where suffering of woman characters is of one dimension. Finally, L.H.Pde, W.Tiewsoh, D.T.Laloo, K.Kharlukhi and H.W.Stenhighlighted the coming of age of the Khasi novel where woman characters suffered in the multi-faceted consequences.

BUDGETARY TRENDS OF THE MEGHALAYA GOVERNMENT FINANCES 1972-73 TO 1997-98

Dr Evakorlang Kharkongor
Department of Economics

Abstract

Statement of the Problem

The State of Meghalaya being included as a Special Category State since its formation in 1972 implies that it is not financially viable due to a number of factors. These factors are the remoteness of the state, difficult terrain, low level of infrastructural development, low industrial development etc. which account for the poor resource base of the state. It thus requires assistance and nurture from the Centre to supplement its fragile finances.

Notwithstanding the fact that the state has been receiving financial assistance from the Centre, there have been grave problems in the state's finances over the years which aggravated in 1989 when the filling up of the non-plan needs through central assistance was discontinued due to the resource crunch at the centre. The disproportionate growth in expenditures not matched by an equivalent growth in receipts led to severe distortions in the budgetary equilibrium of the State Government which intermittently lapsed into overdraft in 1994. The unabated growth in expenditures, the increasing amount in debt servicing liability and the failure to channelize funds into productive channels have aggravated the problem. All these factors including the inelastic resource position of the state, points to the seriousness of the situation and any attempt to reduce deficit calls for curtailment of expenditures while ensuring that the developmental process is not hampered.

Taking into account the state's underdeveloped economy, higher investments are needed for every developmental activity. This makes it imperative for efficient mobilisation of resources and judicious application of scarce resources both ensuring financial discipline and avoiding wasteful expenditure. Therefore, the study of the state's finances as

reflected in its budgets during the period of 26 years from 1972-73 to 1997-98 assume greater significance since the budget should not only give expression to the wishes and desires of the people but should also be able to gear up a movement in the desired economic fields and activities.

Methodology and Source of Data Collection

The data for this research covering the 26 years period from 1972-73 to 1997-98 are drawn mainly from published and unpublished sources both primary and secondary. The relevant data of actual figures have been drawn from various Annual Financial Statements and Memoranda of the Budget Estimates of the Government of Meghalaya, Shillong, for the period from 1971-72 to 1999-2000. The various budget speeches of the Finance Ministers of the State, Legislative Assembly Proceedings available in the Meghalaya Assembly Secretariat Library, have also been utilised. The official reports both published and unpublished of the Directorate of Economics, Statistics and Evaluation have also been our primary source of data. Much data have also been drawn from secondary sources, such as books, journals, articles, papers and standard works relevant to the subject were consulted.

The methodology adopted for the study is both descriptive and analytical. The statistical technique of time series have been utilised to analyse the data collected. The variations of revenue and expenditure to the time factor have been computed by fitting simple linear regression equation by the method of least squares. The income elasticity of the various heads of revenues have also been analysed. As many as 45 statistical tables and 3 graphical representations have been presented in the entire work.

The thesis contains seven chapters. It begins by presenting the statement of the problem, the significance, objectives, hypothesis and methodology of the study. It also includes a general review of the important works done on states' finances in India of at least 8 states including the Hill State of Himachal Pradesh which is similarly placed like Meghalaya. It then presents an overview of the different budgets of the Government of Meghalaya for the 26 year period followed by an analysis of the trends and structures of the tax revenues of the state. This is followed by an examination of the trends and structures of the state's non-tax revenues highlighting their importance for additional resource mobilisation. Further, it focuses on the pattern and trend of public expenditure and public debt in Meghalaya bringing out their problems and effects on the economy of the state and a comparative analysis with selected states of the Indian Union. In its final conclusion, it sums up the major findings that emerge from the study.

Major Findings

I. The overview of the different annual budgets of Meghalaya for the 26 year period under study has shown that the Government of Meghalaya has failed to maintain financial equilibrium in the state. The irrational budgetary exercises of the state have been corroborated by the fact that during the 26 year period under study, there were as many as 15 surplus budgets juxtaposed by as many as 11 deficit budgets. The deficit budget means structural imbalances in receipts and expenditure which leads to steady debt accumulation and affects the future sustainability of its budgetary policies. On the other hand, a surplus budget indicates the failure of the Government to effectively utilise its available funds. The overview also validates our hypothesis that there has been a disproportionate growth in expenditure in the Meghalaya Government Budgets not matched by an equivalent growth in receipts.

II. With regard to tax revenue, the Government of Meghalaya is highly dependent on shared taxes from the Centre to meet its ever-growing expenditure. T he Sales Tax and State Excise Duties have been found to be important constituents of tax revenues but the state has not been able to efficiently mobilise revenue even from these sources to the optimum level. The efforts of mobilising from its own tax sources have not been proportionate to the increase in state's income. The income inelasticity of the state's own tax revenue has depicted less than unit elasticity. The wide annual fluctuations and erratic behaviour of these taxes over time besides the low income elasticity of all individual taxes reveal the inherent weaknesses that characterised the tax structure of Meghalaya.

III. As regards non-tax revenues, it was revealed that there has been growing importance of this source to the revenue receipt of the state during the 26 year period under study. The growth rate of non-tax revenues far exceeded that of total tax revenues highlighting its significance in supplementing the weak resource base of the state. A major component of the state's non-tax revenue is in the form of grants-in-aid from the Centre which accounts for more than 90 percent of non-tax revenue of the state for almost every year. The state's own non-

tax revenue receipts form a very small proportion of total non-tax revenues of Meghalaya in comparison with the share of grants-in-aid from the Centre. The efforts of the Government of Meghalaya to mobilise additional resources from its various non-tax sources have been found to be inadequate.

Again the state's drive for mobilising additional finances from its own non-tax revenue sources has not been commensurate with the increases in state income. Besides, the low-income elasticity of the individual components of non-tax revenue sources indicates their low productivity in augmenting the weak resource base of the state. It highlighted that the level of services provided by the state in terms of its social, economic and general service remains relatively low characterising the features of an underdeveloped economy.

IV. The trends and patterns of Public Expenditure of the Government of Meghalaya have considerably increased during the 26 year period under study. The developmental expenditures on the Revenue Account formed a major component of total revenue expenditure. The developmental expenditure on social services far exceeded expenditure on economic services which has naturally led to the industrial under-development of the State. The non-developmental expenditure on the Revenue Account in terms of general services such as administrative services and debt servicing, points to the fiscal deterioration in the state's finances.

As regards the developmental expenditure on the Capital Account, it was revealed that it had increased steadily during the 26 year period under study. A major proportion of expenditure on Economic Services has been incurred on Transport and Communication. The other important categories have comparatively remained neglected. This indicates the lopsided nature and failure of the government to equally divert its attention to all important sectors. The non-developmental expenditures on the Capital Account have been incurred largely for meeting the debt liabilities of the State Government. This validates the fact that Meghalaya is extremely dependent on the loan method of financing its expenditure programmes.

The relationship between Government expenditure and State Income has clearly shown that increases in governmental expenditure have been accompanied by higher increases in income during the 26 year period under study. There is also a high and direct correlation between per capita Government expenditure and per capita income of the State during the 26 year period. The comparative analysis of per capita government expenditure of Meghalaya with the North-Eastern States and the selected states in the rest of India has shown that the per capita expenditure in Meghalaya was on higher side. This signifies the growing importance of the public expenditure programmes of the state to uplift the level of income and standard of living of the community.

V. The trends and patterns of Public Debt of the State reveal that it is a major component of capital receipts of the state. The major source of borrowings of the Government of Meghalaya is in terms of its Internal Debt of which a major proportion is accounted by the Ways and Means Advances from the RBI. This was followed by loans from the market which constitutes an important source of borrowing of the State during the 26 year period under study. The loans from the Centre are another important source of borrowings of the State.

A major proportion of capital expenditure of the State has been incurred on the Internal Debt of the state over the years and which were massive during 1993-94 and 1994-95. The expenditure on the Revenue Account incurred on Interest Payment and debt servicing liability of the Government highlighted that it is a fast growing item of Revenue Expenditure. Further, the comparative analysis of the loan per capita of all the states in the North-Eastern Region as well as the States of Punjab, Orissa and West Bengal has shown that Meghalaya accounted for the highest amount of loan per capita during a period of 5 years (1993-94 to 1997-98) for which comparison has been made. This validates the large extent of loan financing on which the State is increasingly dependent.

Conclusion

The irrational budgetary exercises of the Government of Meghalaya have revealed the imbalances and weaknesses that characterised the finances of the State. The important fiscal issues which characterise Special Category States like Meghalaya are the excessive reliance on Central transfers and low capacity for raising their own revenues. Considering their poor economic situation and weak resource base these states do need greater financial assistance from the Centre. However, the fiscal imbalances that characterise the budgetary operations of Meghalaya cannot be

condoned by its Special Category status. The State Government should strive for various policy initiatives in its budgetary exercises to address to long-term issues in revenue mobilisation, expenditure management and infrastructure development. It should try to improve efficiency in government activities to ensure that fiscal management is consistent with broader economic and social objectives and to promote the overall transparency of public activities.

SOME CENTRAL PROBLEMS IN PHILOSOPHICAL LOGIC

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Thesis is entitled, " **Some Central Problems In Philosophical Logic**". It consists of five chapters namely, (1) Introduction, (2) Universal and Particular, (3) Reference and Prediction, (4) Subject and Predicate, and (5) Conclusion.

In the first chapter, I have given a very comprehensive philosophical survey of philosophical logic. I have also tried to establish that the scope of philosophical logic is much wider than that of any other kind of logic.

In the second chapter, I have discussed the problem of 'Universal and Particular'. I have discussed the views of some ancient philosophers such as , Plato and Aristotle, the views of Thomas Hobbes, John Locke, George Barkeley, David Hume and Immanuel Kant are also discussed thoroughly in this chapter. The contemporary discussions on 'Universal and Particular' are very significant. Therefore, I have taken up the views of Ludwig Wittgenstein, W.V.O. Quine and P. F. Strawson, and scrutinize them very minutely.

In the third chapter, I have analysed the problem of 'Prediction and Reference'. It is no exaggeration to say that this problem is a very important one so far as philosophical logic is concerned. It is worth mentioning that I have given a critical account of Plato's philosophical logic. This account establishes the fact that Plato's contribution to philosophical logic are very important, inventive and original. I have also discussed, M. Schlick, P.F. Strawson, Kripke so as to find a solution to this problem, if at all possible.

The last chapter, entitled 'Conclusion' contains my own views with regard to the said problems to a great extent. This chapter shows, I hope, my understanding of these problems.

There is a thematic unity running through all these problems. There is a unity and connection between 'Universal and Particular' and *'Subject and Predicate'*. The problem of *'Reference and Prediction'* is ultimately connected with the problems of ' Universal and Particular' and 'Subject and Predicate'. A very exhaustive bibliography may be found at the end of my thesis.

ECONOMIC CONTENTS OF THE DECLINE OF THE DIMASA STATE (1773-1830)

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Abstract

The assasination of Raja Govinda by the British annexation marked the end of the Dimasa state which had existed as an 'early state', at least since the 15th century.The decline of the Dimasa state had however started (internal decline) long before 1830and a large number of factors like the transfer of capital from Maiblong to Khaspur, the non-dimasa influence in the court , internal dissensions and revolts and the xternal invasions were responsible for the decline, behind all these are an unseen important factor was the eoconimic decline which had weakened the state proved to be crcuiable intend to discuss in this paper (i)how and why the State passed through an unprecedented economic crisis in the crucial years in its struggle for existence and (ii) the impact of this crisis in the final decline of the State.

MIND-BODY DUALISM: A CONTEMPORARY CRITIQUE

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Abstract

Thesis is entitled "Mind-Body dualism: A contemporary critique". It consists of five chapters. The chapters are:- (i) Introduction; (ii) The Novelty of Descartes' Conception of Mind; (iii) Ryle's attack on dualism; (iv) Identity theory and Functionalism, and (v) Person.

In the introductory chapter, I have introduced the central problems of my thesis. In the second chapter, I have discussed Descartes' conception of mind. Modern Philosophy took a new turn through Rene Descartes. Descartes has one foot in tradition and the other in the new era of Philosophy. He never questions the traditional distinction between substance, essence and accidents and feels that the towering edifice of Scholastic Philosophy needs some modifications. According to Descartes, mind or soul is conceived not as the essence of body but as the substance in its own right. And consequently, he opines that a human being is a combination of two individual substances namely, a body and a mind. The relationship between the two is not the relationship of substances and essence, rather it is the relationship between two substances, and therefore, each of these two substances must have its own essences. And as a result, we find that Descartes' innovation consists in his claim that minds are individual things (substances) and not essences of individual things. Both mind and body possess two different and mutually exclusive properties.

Mind can be defined in terms of one exclusive attribute 'thinking' or 'consciousness' and the body or matter can be defined in terms of one exclusive attribute 'extension'.

However, Descartes maintains that there is some connection between the two, which is, according to him, intuitively known. On the occasion of something happening in the mind a relevant happening takes place in the body. Descartes asserts that there is a pineal gland inside our nervous system where the body and the mind interact with each other and an impression is produced on the occasion of which a conscious act occurs.

We see that Cartesian dualism is the dualism of substances where substance is the basic notion. And after due consideration of this basic notion we find that this dualism of substances, i.e., of the mind and the body is not acceptable. To understand the Cartesian notion of mind I have examined the concepts which emerge as central to his distinction between mind and body. These concepts can be treated as criteria. Two main candidates for the criteria of the mental have received considerable attention today, namely "Privacy" and "Intentionality'. I have examined these two criteria in detail in my thesis. I think that though these two criteria underline some characteristic features of the mental, they are unsatisfactory to serve as the criteria of the mental (consciousness).

Should we infer then that there is no such thing as mental? We have seen even after three hundred years of debate philosophers have not been able to invalidate the Cartesian theory.

After having discussed the Cartesian dualism emphasizing the novelty of Descartes conception of mind, I have tried to justify this conception. However, Cartesian dualism is being discredited in the present century with the advent of the behaviorisms advancing various forms of materialism. These theories interpret the concept of mind in non-Cartesian terms.

The first influential treatment of the concept of mind had been propounded by Gilbert Ryle in his well-known book "The Concept of Mind". I have discussed Ryle's position in the third chapter., Ryle's main contention is that mind is not a substantial entity. By means of an analysis of mental concepts, he comes to the conclusion that the so called mental phenomena can be explained under three heads namely dispositional, adverbial and achievement. He tries to show that items falling under any of these headings do not refer to either a substantial entity or to a process or events other than physical ones. Ryle gives a dispositional analysis of mind by holding that mind is simply the disposition of the body and a person is not composed of two independent individual substances, i.e. body and mind. For Ryle there is nothing private. We should note that mental states are names of a particular pattern of behavior and attribution of intention, desire, intelligence, excitement, fear and so on. They are to be understood as attribution of a disposition to

behave in a characteristic manner under suitable circumstances. A man who hides his thoughts, feeling, wishes, etc could still have a disposition to behave in certain ways. For Ryle, to talk of person's mind is to talk of person's abilities, inclination, capacities, liabilities, etc.

But we see that Rylian behaviouristic account of mental states suffers from some difficulties. It is not natural at all to speak of one's speech or action as identical with one's thought. The thought is distinct from speech or action. Under suitable circumstances it is the thought which brings about action. Mental processes can occur even in the absence of behaviour. One should not ignore the essential feature of consciousness. Feeling of pain and behaviour are not identical. It is wrong to analyze mental predicates behaviourstically. Ryle commits a mistake by denying not only mental substance but also mental events and occurrences.

Ryle's theory is defective and yet the anti-Cartesian movement continues. The other major attack on Descarte's conception of mind has come from those who propound the so called Identity theory, sometimes called reductive materialism, and Functionalism. These theories occupy a prominent place in my fourth chapter.

The idea in the Identity theory of mind is that each type of mental state or process is numerically identical with some type of physical state or process in the brain or inside our central nervous system. Mental states and processes are nothing more than very complicated states and processes in the brain. Mental processes and brain processes are not two different kinds of events but are identical. In this connection, I have discussed U.T. Place, J,J,C. Smart and D.M. Armstrong. I have also tried to show that Armstrong propounds a slightly different form of Identity Theory from that of Smart's. It is possible that there can be mental states without the corresponding behaviour. Mind can be defined as the inner cause of our behaviour and it can be surely identified with the states of the central nervous system. It can be possibly assumed that there must be something 'going on' behind each and every sort of behaviour.

According to Armstrong, this inner principle (mental states/mind), which lies behind every behaviour, is a purely physical account of man and hence can be identified with purely physical states of the central nervous system.

The stand of Identity theory in general is that mental states are identical with the brain processes. Jerome Shaffer points out that if it is so that two conceptually different processes are identical then empirically it must be possible to show this identity by certain evidences. The problem of location is a genuine problem which must be solved before the Identity theory can be regarded as a satisfactory theory of mind. It has been seen that Identity theorists are not certain in describing mental states than in describing the corresponding physical states as it lays to much emphasis on future findings. Besides all these, what I have tried to maintain is that mental phenomena cannot be given a physical base. The ontological status of mental phenomena is not clear. All that we can say is that mental phenomena are attributed to the self in a way which is different from the attribution of the physical phenomena to the self. So, the question of the relationship of the mental and the physical still remains. Functionalism produces powerful arguments against the doctrine of dualism. Functionalism, the heir to behaviourism, differs both from behaviourism and traditional mind-body Identity theory. Functionalism, a different approach to the mind-body problem, concentrates much on the functional role of the mental states mediating between a specified input and output. It studies mental states in terms of their normal causal role as well as their normal behavioural effects. It can rightly be said that manifestation of any behavioural effect involves factors like physical events in terms of bodily movement and characteristic cause of it involves the mental states such as thoughts and desires. Functionalism maintains that mental activity is usually linked with behavioural disposition and also that mental states are, in fact, causes of behaviour.

Though functionalism has succeeded, to some extent, to make us understand the functional role of mental states but it has failed to deal with the phenomenon of consciousness like what is it like to be happy, what is it like to be in pain, etc,. The definition of mental states purely in terms of causal relation which cannot account for qualitative feel of mental states is the central problem with Functionalism. This doctrine, therefore, fails to deal with the mental states adequately.

So far none of the attempts have been successful in rejecting completely dualism as such. There is something which still lingers on. In my thesis I have tried to see if some form of dualism is inevitable in trying to make sense of the human reality. In chapter five I have discussed: What is a person? Here I have discussed P.F. Strawson's views in detail. He believes that though mental and physical processes are exclusively different from one another but these two diverse kinds of predicates are, in fact, attributes of the 'same thing' or are ascribed to or belong to one and the same thing. A person is not only mind, or body but both. A person is a unity of two diverse kinds of subjects: A subject of

experience, for instance pure ego, and subject of corporeal characteristics, for instance body. In other words, a person consists of a subject and non-subject, and therefore, this primitive concept of a person frees us from the difficulties of both Cartesian dualism and the no-ownership theory.

This view of Strawson is, however, unacceptable to us. Strawson in his book 'Individuals', admits that a disembodied person can exist and so dualism is there. Both conceptual and ontological dualism remains. Strawson's theory does not destroy dualism. Dualism emerges from the understanding of the concept of a person. Hamlyn in his book 'Metaphysics', have pointed out that dualism of person and body remains, and of course dualism of mind and body through the understanding of the concept of person. Though, this is not the Cartesian form of dualism, i.e. not the dualism of substances.

In fact, a dualism of or a dualism between self and mind can also be conceived. Some Philosophers, for example, McGinn, in his book 'The Character of Mind' points out that self is a simple mental substance and at the same time, he denied substantiality to mental phenomena (thought, emotion, volitions etc.). This raises a question of a relationship between the self and a mental phenomena since mental phenomena are ascribed to selves and they cannot be explained in physicalistic terms. In other words, the Ontological status of the mental phenomena is neither mental nor physical. Yet, it a attributed to the self which is a mental substance. Thus, there is a dualism between self and the mental phenomena. However, I have not pursued this line of thought. I mention this only to point out that in the broader perspective of the mind-body problem other versions of dualism are also possible even after rejecting the Cartesian dualism.

Conceptually, the distinction still remains. By conceptual distinction it means that in our language mental concepts and physical concepts are incommensurate. At the same time, it does not imply that both mental and physical have two distinct kinds of being. That is, their ontological status remains uncertain.

The conclusion that I have tried to draw is that though the mind-body theory considered as the theory of the relationship between two completely different substances, as conceived by Descartes is unacceptable, yet it has not been sufficiently refuted. Dualism of mind-body in some form or other remains conceptually alive.

A SOCIOLOGICAL STUDY OF A NEPALI EVENING SCHOOL IN JINGKIENG-NONGTHYMMAI

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Abstract

The Shillong the capital of Meghalaya has a number of evening schools. The evening schools such as Holy Child Evening School, Nepali Evening School-Jingkieng-Nongthymmai, St.John's Evening School at Laban, Women's Catholic Evening School and St. Anthony's Evening School have been instrumental in providing the platform for the poor and migrant children to attain school education.

Statement of the Problem

The evening school represents one of the most significant aspects of the movement for the wider use of the school. Though it is not a new feature, there seems to be little knowledge on this aspect among the people in general. It is still being perceived that evening school is simply the extension of the day school. So the problem of the evening school is thought to be the same as those of day school and has hardly been given any particular attention. Little effort has been made to establish evening schools in the country. The studies carried out have also not given much attention to the significance of the evening school and the contributions that these schools make towards education. At present no such study has been done in Shillong focusing on the socio-economic background of the students in the evening school. The sociological studies on the organisational structure, management, functions and contributions of the evening school are yet to be carried out. Therefore, there is a need to examine the nature and functions of the evening school. It is also pertinent to study the socio-economic background of the students in order to understand how the evening school

provides a platform for them to have access to education. Considering the significance of the evening school in imparting education to the children of the deprived sections of the society and taking into the cognizance of the lack of research study on this aspect, the present study makes an attempt to develop a sociological understanding and would concentrate on studying the organisational aspects as well as the socio-economic background of the students in an evening school located in Jingkieng-Nongthymmai in Shillong city.

Methodology

The present study attempts to study the organizational, management aspects of the Nepali Evening School (Nepali Higher Secondary School) located at Jingkieng- Nongthymmai. It also examines the socio-economic background of the students in the evening school.

Nature of the study

The nature of the study was exploratory and descriptive.

Sources of Data

The present study made use of both secondary and primary sources to obtain data. The secondary sources include articles in books, journals, periodicals and magazines. The primary data were collected from the Nepali Evening School.

Respondents

Students, teachers and the Principal of the school, were the respondents.

Sampling

Stratified random sampling technique was used in this study. A total of 50 respondents 25 each from both boys and girls category were selected. The student respondents include students from different classes (class VI to class X). Besides, data were also obtained from 6 teachers who were selected through purposive sampling. The data on parents were collected from the students.

Tools of Data Collection

The technique of schedule was used to collect the data. An interview technique was adopted for the collection of data with selected respondents. The data were collected on the organizational structure and management of the school, the role of the principal, teachers, non-teaching staffs, and the socio-economic background of the students and parents. There were four different sets of schedule used to collect data from four different respondents such as (i) Principal (ii) Office-Bearer's of the managing committee, (iii) Teachers (iv) Students.

Area of study

The present study is about the organizational structure and management of the evening school located in Nongthymmai and the socio-economic background of the students enrolled in this school. Most of the students are from Nongthymmai locality. These students come from both rural and urban areas. The students selected for study are selected from different classes starting from class VI to class X. The school was selected purposively in this area.

Objectives of the Study

The objectives of the study are:

1. To find out the organizational structure and management of the evening school.
2. To examine the socio-economic background of the students enrolled in the evening school.

The thesis is organized into four chapters.

Major Findings of the Study

The Nongthymmai Nepali Evening School which was set up in 1971 is continuing to deliver its responsibilities by encouraging children from socio-economically deprived sections to avail school education which otherwise is difficult for them during the day time. From the modest beginning where the school was operated from a rented house, the school has been able to create the required basic infrastructural facilities. The school is managed by the managing committee duly supported by the academic committee towards the effective functioning of the school. The office bearers of the managing committee along with principal, vice principal and teachers of the school have been working together to achieve the objectives of the school. There exist a coordination and mutual understanding between them as a team to work together collectively and collaboratively towards promoting the interest of the students and the school as a whole.

Enrollment pattern in this school varies from class to class depending on the availability of the number of seats during academic admission. However, it is pertinent to note that the total number of enrollment of students in the evening school is not consistent and it fluctuates from year to year. Although there has been a decline in the total number of students in Nepali evening school during 2011, the school has not lost sight of its commitment to educate the students of the lower socio economic background. Again in 2012 it has been able to maintain the student's strength.

There are several ways and means that the school is able to attract the students from low socio-economic status. The school encourages its teachers to take part in training programmes to upgrade their teaching skills. Various activities such as teaching methods, encouraging students to participate in co-curricular activities, and above all creating an ambiance to learn for these students who do not afford to go to day school. Efforts have been made to generate enthusiasm among the students to continue their study in the school and to develop the best educational outcomes for the socio-economically deprived students.

The teachers in the school play a very important role. They have adopted various teaching techniques and approaches with various material resources such as maps, charts, blackboards, text books and practical demonstration of lessons in the classroom towards promoting interest and attention among the students in the classroom, irrespective of their varying abilities. The teachers treated all the students with respect and provide equal opportunities to learn and they also create an atmosphere which is conducive to the teaching learning process and for the harmonious development of the students .To enhance the skill, though some of the teachers have participated in training programmes, these training programmes are not adequate to prepare the teachers to develop the knowledge and skills they need in a class room.

The students of Nepali Evening School come from diverse social backgrounds i.e age, sex, caste, religion and language. The age of students who have taken admission in the school ranges from 13 to 18. Majority of the students are girls. Though the students are from different communities, most of the students are from Khasi and Nepali communities. Mostly the students are from Hinduism and Christianity. Students from both rural and urban areas have sought admission in the school. The main aim of the school is not only getting more students from a diverse background but also it is making sure that these students get equality of opportunity in learning.

The family background of the students reveal that most of the family are migrants to the city in search for work and living in poverty. Majority of the students, have parents with limited educational background. The economic background of the family are mostly those engaged in labour, construction work, vendors and as domestic workers and their sources of income varies from family to family, depending on the nature of work.

Majority of the students studying in Nepali Evening School remain busy during day time as they are engaged in various income generating activities to add an extra income for the family or for themselves. Students working during the day are earning a livelihood either for the families or to look after themselves. These students come from various backgrounds. They have no educational support or other resources to help them with the schooling.

Those students, who are not working at all, are engaged in other household activities as well as looking after their siblings. Most of the students find it difficult in adjusting to manage in attending school regularly, especially those who work for long hours.

One of the major concerns of the school is the dropout rates as it continues to grow before completing their secondary schooling. The Principal and the teachers made every effort to focus their attention to bring out solutions to increase the retention rate of the students of this evening school to keep them out of child labour and generate an added interest to learn.

There are various constraints faced by the school where the Principal of the school makes arrangements of teacher's selection and regular training programmes. Most of the educational programme suffers in this school owing to less attention given to the recruitment of teachers. Salary given to teachers is exceptionally low. Many of them are forced to abandon teaching, or taking a second or third job to survive. The school's teaching capacity is being hindered by lack of instructional support personnel, and shortage or inadequate of library materials. The school does not have a playground of its own. In the absence of the lack of financial support from the government the school faces financial constraints. However, the school has been managing with its own resources.

To conclude, the Nepali Evening School since its inception has witnessed tremendous achievements to meet the over-all requirements of the school in general and particularly those of the socio-economically deprived section of the community.

WRITING THE OTHER : A STUDY OF RACE, GENDER AND MARGINALITY IN TONI MORRISON'S FICTION

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Abstract

Racial and cultural marginalisation has been to a large extent the story of human history. Under different mechanisms of control and suppression it has taken different forms. Class marginalisation has taken different religious, economic and socio-political forms in the USA as well as in other multicultural countries like India evolving into norms and practices. In the process the marginalised never gets out of the discursive discourse as a subject and s/he gets ensnared in what Adorno calls a practice of hegemonic control. In the process the marginalised loses identity , in a history that is already always appropriated by the dominant group. Thus the discourse of the marginalised performs under a dialectical mode in which loss of history and self -possession result in loss of cultural and other identities. Contesting some of the prevailing assumptions regarding the Afro-American's identity in the melting pot of America Dyson hopes to "disrupt traditional notions of race and interrogate how race, class and gender get constructed in ways that reinforce structures of domination."The discourse of marginality needs to be translated into a discourse of disruption and resistance. Race and gender relations as narrative representations concerns Toni Morrison and she says, "I am a black writer struggling with and through a language that can powerfully evoke and enforce hidden signs of racial superiority ,cultural hegemony and dismissive 'othering 'of people and language which are by no means marginal or already and completely known and knowable in my work."(1993)The discourse of marginality is aligned to the concepts of race and gender in their constructions and deconstructions ,which constitute the core of this thesis.

CONTRACTS IN OUTSOURCING: A STUDY OF DATA PROTECTION AND PROCESSING

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Abstract

Outsourcing is a new business model that have attained policy endorsement at various level ie domestically and international. The emphasis has always been to garner maximum economic advantage in terms of efficiency and cost effectiveness. The dissertation impressed upon the readers of new forms of business arrangements that has become immensely important to business firms. The conventional model of the firm was to focus on the pricing system to match efficiency and economies of scale. Outsourcing to the modern firm is a deviation from the neo-classical understand of the firm, where the boundary of the firms is no longer confined to pricing system which is external to the firm but more importantly to the chains of commands and direction at the managerial level which is exogenous to the pricing system. Outsourcing model inescapably involved transfer of data from one business firm to another. The modus operandi is to

arranged some sort of hricontractual agreement that is not only acceptable to the parties involved but also legally sound. The genesis of having such sound legal arrangement is embedded in the principal-agency theory. Post privatization and liberalization of the economy, Outsourcing is seen as viable form whenever the firm opts for restructuring programme where decisions taken by the managers is crucial to the success of such restructuring agendas. Outsourcing also involves tremendous exchange of data between firms. Data transfer is vulnerable to various manipulation at different stage of processing. In many countries privacy laws have been enacted to protect misused of data. In India the Information and Technology Act 2000 was enacted to cater to the different needs but it is still vague on legal remedies on breach to privacy arising from such misused.

A COMPARATIVE STUDY OF BHOJPURI AND BENGALI

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Abstract

Comparative linguistics is an important area of the science of languages. A comparative study of the relationship between Bhojpuri and Bengali is significant because both are the descendants of the same source, i.e Magadhi Prakrit. Magadhi Prakrit was the language of the eastern part of the country for a long time. It later developed into the modern speeches of the east, i.e Bengali, Oriya, Assamese and Bihari. The Magadhi speeches have been classified into the following three groups:-

1. Eastern Magadhan - Bengali, Assamese, Oriya
2. Central Magadhan - Maithili, Magahi
3. Western Magadhan - Bhojpuri

Speaking of the relationship between Bhojpuri and Hindi, it is evident that these two have developed from two different Prakrits. There is close affinity between Bihari (including Bhojpuri) and Bengali on one hand and Hindi, Rajasthani, Punjabi on the other. The most important factor is that in whichever areas Bhojpuri differs from Hindi, in those very areas it has similarity with Bengali. Well known linguist George Grierson had categorized Maithali, Magadhi and Bhojpuri as a single language. He had kept Bhojpuri and the other two dialects of Bihari, outside the pale of Hindi.

Historically, the inter-relationship of these languages goes back to the Pre-Vedic age. The Aryan language came to India not in a homogenous form, but as groups if dialects spoken by the different Aryan groups, who entered the sub-continent and settled down here. The origin and inter-relationship of these dialects and their development into the modern Indian languages and dialects is one of the most interesting areas of Indo - Aryan linguistics.

The various dialects of Bengali as well as Assamese and Oriya on one hand and the dialects of the Bihari group i.e Maithali, Magahi and Bhojpuri on the other, must have originated from some early form of Indo-Aryan dialect current in the eastern part of Indian sub-continent. This is evident from the phonetic and syntactic similarity as well as common forms and inflexions. This mother dialect, Magadhi along with its western counterpart Andhamagadhi, the source of Eastern Hindi, formed the 'Pracya' or eastern group of dialects in the late old Indo-Aryan and middle Indo-Aryan periods. Some time before its development into Oriya, Assamese, Bengali and Bihari, Magadhi developed certain morphological characteristics which were inherited by the eastern languages. The 'Pracya' (eastern) speech including Magadhi , had remarkable phonetic and morphological differences from the other forms of Indo- Aryan.

The Comparative Study of Bhojpuri and Bengali has been carried out in terms of phonetics and morphology, viz, the nominal declension, the pronoun, the numeral, the verb, grammatical gender distinction, post-position, number, prefix, suffix, etc.

A SOCIOLOGICAL STUDY OF KA NIAM KHASI

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Abstract

In this work an attempt has been made to study the religion followed traditionally by the Khasi society. This is also known as the indigenous religion of the Khasi as distinct from the Christian religion followed by a large section of the population ever since they came in contact with the British in the nineteenth century. However, the Khasi refer to this religion as *Ka Niam Khasi*. We can therefore say that we have tried to understand the beliefs and the practices relating to *Ka Niam Khasi* in the Khasi Society of Meghalaya.

The Khasi society follows matrilineal descent and matrilocal form of residence. The society consists of numerous clans and each clan is divided into a number of matrilineages. Each matrilineage is further divided into a number of domestic groups headed by the senior most female. However, this is commonly referred to as the 'house of the youngest daughter' (*Ka Ïing Khadduh*) of this female. This house is a matrilineal extended family, a domestic group consisting of a woman and her husband with their daughters and the husbands and children of the latter.

The role of the mother's brother is very important in the society as he plays different roles in different situations. Though after marriage the mother's brother has to move over to the house of his wife as per the principle of matrilocal residence yet he keeps a close touch with the house of his sister or sister's daughter and takes active interest in all its affairs. Our concern is with his role in performing various religious rites for his matrilineage. These rites could be rites-de-passage or could be the rites performed to appease the deities in the event of any crisis faced by the matrilineage as a whole or its individual members.

Studies conducted in the field of Kinship in various parts of the world, during the late nineteenth and early twentieth century, have shown that one of the important activities of the domestic groups and the lineage groups in the society was concerned with the performance of religious rites. These domestic groups and the lineage groups act as a corporate group when their members assemble together to perform religious rites.

Every domestic group is a member of a village and each village is multi-clan in composition. It means that different matrilineages from the same clan are scattered across in different village and over a period of time may loose contact with each other. Their common clan name is the only identifier of their solidarity which is very rarely invoked. Of course, the clan identity plays a very significant role at the time of settling a marriage.

Khasi village is a corporate body belonging to the politico-jural domain and is the most active constituent of the traditional political structure of the Khasi society. The other two constituents are the *Raid* and the *Hima*. The former is a federation of few villages, mostly contiguous, and is concerned mainly with solving inter-village disputes. The latter is a much larger entity and consists of a large number of villages located far-and-wide and may also have a number of *Raid*. Religious rites are performed, in the politico-jural or the extra-domestic group domain both by the *Raid* and the *Hima*. However, not all of them do so after the advent of Christianity. Rites as per *Ka Niam Khasi* are performed only by those *Raid* and *Hima* in which no Christian Khasi could be made the Sordar *Raid* or the *Syiem* of the *Hima*.

Religion in the Khasi society (referred to as *Ka Niam Khasi* by the Khasi themselves) is practiced without any scriptures. It is practiced, by way of performance of rites by the domestic groups, single lineages as well as by several lineages coming together in the name of the clan. Rites are performed for the sake of the individuals, domestic group, lineage, clan, village community, a number of villages organising themselves as a single political unit called the *Hima*.

In this work we were conceptually influenced by the ideas of Durkheim, Radcliffe-Brown and Evans-Pritchard. Following Durkheim we treated religious phenomenon as social and divided it into categories: beliefs and rites. The totality of beliefs and their corresponding rites, in the view of Durkheim, constitute a religion. But Radcliffe-Brown stressed more on the rites and gave them a priority over the beliefs in the study of religion. When we consider the rites we adopted Evans-Pritchard's classification of two rites as confirmatory and piacular. Rites-de-passage in the case of the individuals and the rites performed collectively by the community for its welfare belong to the category of the

confirmatory rites. Rites performed in situations of danger in the life of a person or the rites concerning with the moral and physical welfare of the individual are called the piacular rites.

We had set the objectives of the study as follows:

(a) To understand the belief system of the Khasi;
(b) To understand the confirmatory and piacular rituals with reference to the individual and the community;
(c) To understand the role of *Ka Seng Khasi* in the society with reference to *Ka Niam Khasi*.

Fieldwork was carried out in three villages falling under *Hima* Khyrim. It is one such *Hima* which observes annual community rites as per *Ka Niam Khasi*. It needs to be pointed out that the most important feature of *Hima* Khyrim is that no one could become the *Syiem* of the *Hima* unless he was a follower of *Ka Niam Khasi*. The three villages were as follows:

Smit: The total number of households in the village was 1086 and its total population was 5151 person. 34.79% of the population followed *Ka Niam Khasi*.

Laitkyrhong: The village has 393 households with a population of 2254 persons and 68.41% of the persons were following *Ka Niam Khasi*.

Nongkrem: The total number of households was 1216 and the total population was 6395 persons. 22.69% of the people in this village followed *Ka Niam Khasi*.

The data for the study were collected from both the secondary and the primary sources. Secondary sources consisted of books and articles written (both in English and Khasi languages) on the belief system and the rites according to *Ka Niam Khasi*; Souvenirs and other literature produced by *Ka Seng Khasi*, popular articles, and documentaries on *Ka Niam Khasi* rites.

Primary source data were collected from the field by using the techniques of non-participant observation and intensive interviews. Observations were made of various confirmatory and piacular rites; egg-divination rites, rites performed at the level of the *Hima* for the welfare of the *Hima* and its people (*Ka Pomblang*).

In depth interviews were conducted with the male and female elders from different domestic groups and the lineage groups inhabiting the three villages; with the persons occupying the positions of the *Lyngdoh*, the *Myntri*, the *Basan*, the *Syiemsad*, the *Syiem*, *Lyngskor*, *Duhalia*, and other religious officials of the *Hima* Khyrim; various officials of *Ka Seng Khasi* and office-bearers of its different wings and committees. Interviews were also conducted with the knowledgeable persons from the society. Questions, in the interview, were formulated largely in the following areas of enquiry:

(a) belief system according to *Ka Niam Khasi*.
(b) confirmatory and piacular rites with reference to the individual, lineage, and the *Hima*.
(c) historical background of the emergence of *Ka Seng Khasi*, its organisational structure and activities.

Our findings and discussion on the research problem is presented in four chapters as follows:

Chapter I: **Introduction**

In this chapter a brief description of the Khasi society with particular reference to its kinship and traditional political organisation has been discussed. Further in this chapter we have discussed the statement of the research problem and objectives of the study. The chapter also includes a review of literature and explains the methodology followed in the study. A brief discussion on the area of study i.e., Smit, Laitkyrhong and Nongkrem villages under *Hima* Khyrim is presented as the field-setting.

Chapter II: **The Khasi Belief System**

It has been mentioned above that the Khasi religion, both at the level of the belief and the action (rites and rituals), was neither codified nor elaborated uniformly across the Khasi Hills. We then went through the secondary source material and interviewed the followers of *Ka Niam Khasi* in order to understand the Khasi belief system. The second-

ary source materials were available in the form of writings of various Khasi scholars as well as the literature produced by *Ka Seng Khasi* (an organisation of the followers of the Khasi religion).

Khasi conception of God: We found that there was unanimity in the views of various Khasi scholars as well as the people interviewed by us on many attributes of God. Since there were no scriptures, as mentioned earlier, their views were based upon the characteristics attributed to God in the chants used in the performance of various rites.

These scholars were unanimous in their understanding that God was (i) the creator of the Universe; (ii) omnipresent; (iii) omnipotent; and (iv) omniscient. Further, God (*U Blei*) could manifest himself in any form through any sign or symbol. In addition to such beliefs of God the Khasi have developed conceptions of (a) the universe (*Ka Pyrthei Shityllup*); (b) relationship between God and nature; and (c) relationship between God and human beings (in the spheres of kinship, economy, and politics).

The Khasi believe that while God created the human beings he also commanded them to follow a path of righteousness in this world. God also commanded that conduct of a human being, as mortal being, in this world would determine where her/his soul would rest after death. In other words, it means that God prescribed human beings a set of observances (through rites), norms of behaviour, rights, duties, code of morality to follow in this world. All these together constitute belief system in the Khasi religion.

The Khasi believe that no one should perform a rite without its proper and complete knowledge of the procedure. A person who violates this runs the risk of incurring the wrath of God and misfortune may befall him or any of his kin in future.

Such a condition created a big difficulty for the followers of the Khasi religion. We observed in the field that in many instances the families did not have a knowledgeable person to perform the rites. On enquiry we came across a variety of reasons for this. In some cases these families had branched-off from their families of orientation and migrated here thus leaving behind the mother's brother as well as their own brothers. There were cases where the main lineage had fragmented into many branches which moved out in different directions and lost contact with each other over a period of time. We came across such cases as well where the brothers had converted to Christianity after marrying a Christian girl and thus could no longer perform the rites for their lineage under pressure from their church. In one of the cases of death rites that we had observed we found that the mother's brother, who was rather quite young, was not allowed to perform the rite by the other elders and instead they had taken the services of another person who was considered very knowledgeable. The explanation given to us was that since these rites were quite elaborate any mistake by this young person in their performance would cause the soul of the dead to keep hovering in the universe and not reach its destination.

In all such cases the services of some elders from the village or members of *Ka Seng Khasi* were called in, who act as the 'mother's brother', for the performance of the rite.

We have argued that the Khasi belief system establishes a relationship between man and man and man and nature through its conception of God. It also lays down ethical values for the people to put in practice to have a relationship of co-operation and solidarity amongst them.

The Khasi believe in the concept of soul. Soul is considered as eternal and resides inside the human body till the person is alive. The soul of a person who had led a life of righteousness enters the House of God and gets united with the souls of his ancestors and other relatives (who had died before him) residing there. But the soul of a person who had not followed the path of righteousness during the life-time is denied entry into the House of God and keeps wandering in this world. Similar is the fate of the soul of a person for whom the rites after death were not performed properly and completely.

The Khasi believe that wandering all around us they assume the form of spirits some of which could be good or benevolent and others evil or malevolent. They may reside on the hills, forests, streams, etc.

Evil spirits bring misfortune or cause misery to the living beings in various forms e.g. they may cause such diseases on human beings as ringworm, formation of pus in the ears, infertility, lunacy fever, etc.; some others (residing in the forests) may cause twisting in the neck of person cutting wood from a sacred grove.

Chapter III: **The Khasi Religious Rites**

Religious practices involve performance of sacrifice, rites and prayers. In the performance of religious activities, rites have always assumed an important role. There are some rites which are associated with transitional stages in the life-cycle of the members of the society e.g. birth, adulthood, marriage, death. There are also community rites which emphasise basic values of society, which serve and promote social cohesion in the community. Rites are performed at the level of the individual as well as at the level of the group. We have categorised the various types of rites as confirmatory rites and the piacular rites.

Confirmatory Rites: We have included the following four types of rites (three are rites-de-passage; and one is a community rite) under this category:

(a) *Naming ceremony:* A case of naming ceremony was observed in the field. Traditionally the naming ceremony *(jer kyrteng)* is performed in the morning, preferably, before the mid-day. But if the child is born at a time when it is not possible to do so then the ceremony is performed the next day. What we learnt through the interviews was that though everyone observed the condition of conducting the rite before mid-day yet not all the other nuances were uniformly observed by the people. For example, it was not common to have the naming ceremony soon after the birth of the child. We were given several reasons for the delay in the holding the ceremony.

It was observed that the families selected a convenient date to call all family members to attend the naming ceremony. The ceremony being an expensive one it takes a long time for the poor families to save a substantial amount of money for the rite. In one case, by the time the money could be saved, the couple had produced five children without having the ceremony for any child. Ultimately they could save just enough money to go for a simple ceremony for all the children at the same time. The main expenditure is in giving a feast to the relatives both on the paternal and the maternal sides.

(b) *Marriage ceremony:* A case of marriage rites was observed by us in the field. The maternal uncles from the sides of the bride and the groom played the role as *U Ksiang* (go-between) as per the traditional practice in the negotiation prior to the marriage. The main concern in the negotiation was to determine that the proposed alliance in no way breached the taboo on incest in any form. The rites were supposed to be performed by the maternal uncle in the lineage but were performed by a member from *Ka Seng Khasi* as the maternal uncle was too young and was not conversant with the rites. We were told by some of the respondents that in the absence of the uncle the rites were performed by an elderly knowledgeable person in the village. However, now-a-days many people preferred the marriage rituals to be performed by an elderly member from *Ka Seng Khasi*.

(c) *Death rites:* The Khasi believe that the soul of a dead person frees itself from the mortal body and undertakes a journey to the House of God to get united with the ancestors residing there. They believe that in order to facilitate the smooth transition (or transmigration) of the soul from this world to the other world the relatives of the dead were obliged to perform death rites for the dead in a proper manner.

On the day of the cremation a rite was performed in front of the house before taking the corpse to the cremation site in the forest. The rite was usually performed by the eldest male member in the family but in the absence of such a person the rite for the female was performed by an elderly member from the village. This rite was the same for both the females and the males.

In the case of the males a bow and three arrows, without steel or iron arrowheads were put on top of the coffin. The Khasi believe that these arrows will pave the way for the soul and guard the soul against all evil on its way to the House of God where all the ancestors were believed to be residing. The rites performed at the cremation ground were also the same. Again there was a difference in the case of the males. The three arrows were shot in three different directions and the bow was thrown in the fire to get burnt.

It should be pointed out here that death in a village was considered as an event of crisis for the entire village community and the community rising to the occasion comes forward to lend a helping hand to the bereaved family.

(d) *Ka Suit Ka Shor*: The rite of *Ka Suit Ka Shor* constitutes an essential part of various rites performed on many occasions. The Khasi believe that they should seek permission or authorisation from God before performing a

rite. In the case of some other rites they also seek verification from God whether the rite was performed properly and whether the God had accepted their prayers and oblations.

(e) *Ka Pomblang*: *Ka Pomblang* is an annual religious festival performed in the month of November every year for the welfare of the *Hima* Khyrim. The main rite is known as "*Ka Pomblang*" which involves the sacrifice of uncastrated goats (both the sexes) to propitiate the deity "*U Blei Shyllong*" by the *Syiem*. Through *Ka Pomblang* the *Syiem*, on behalf of the people of the *Hima*, expresses gratitude to *U Blei Shyllong* (the ruling male deity of *Hima Shyllong*) and also seeks blessings for the welfare and prosperity of the *Hima* and its inhabitants. These rites are performed by the *Syiem*, *Ka Syiem Sad*, *U Sohblei* Rumnong, *U Sohblei* Mawroh, the *Duhalia* and the *Bakhraw* in the presence of the people of the *Hima*. The rites performed during *Ka Pomblang* (the rite of *Ka Suit Ka Shor*, *Ka Suit Dohkha*, *Ka Jingknia Muhuri*, *Ka Pomblang Iewduh*, *Ka Bujai Blang*, *Ka Ai Bhet*, *Ka Pomblang Khatar Sla*, *Ka Bai Duhim*, *Ka Dung Sning* and *Ka Dorbar sla*) were observed and studied by us.

Piacular Rites: Piacular rites are performed in situations of danger often thought of as being brought about by some wrong committed by the individual or by her/ his family members. The Khasi believe that illness and misfortunes are not simply a natural process, but caused as a result of wrongful acts committed by the individual or by her/ his family members. Rites have to be performed to free oneself from any such malady. Some of the rites could be mentioned as under:

(a) *Ka Rngiew*: *Ka Rngiew* is generally believed by the Khasi to be a sign that reflects the innate personality of the self and provides individuality to a person (of either sex and of any age). It radiates outwards and manifests itself in the overall appearance of a person. Persons looking frail, suffering from ill health, bad luck, misfortunes, failures in their endeavours are supposed to possess a 'weak *Ka Rngiew*' or *Jem Rngiew*. Persons looking strong and in good health, dynamic, lucky, successful in all their endeavours and ventures are supposed to possess 'strong *Ka Rngiew*' or *Eh Rngiew*.

However, the Khasi believe that *Jem Rngiew* could be replaced with *Eh Rngiew* only by the grace of God. For this the person has to make a sacrificial offering of a hen, preferably with white claws, to the God. Such an offering is called *Kaba Ksan Rngiew*.

(b) *Ka Sabuit*: The belief in the existence of evil spirits is very common and still prevalent in the Khasi Hills. *Ka Sabuit* is defined as an evil spirit and the Khasi believe that the person who possessed this spirit could cast sickness on other persons ('evil eye'). A person who had been cast by the 'evil eye' would indicate symptoms of pain in the various parts of the body, signs of allergy and discomfort without any explicit reasons. The only explanation would then be that someone had cast an 'evil eye' (*Ka Sabuit*). It was observed that when a person was suspected to have been caught by *Ka Sabuit*, an elderly person called *U Nongthoh Sabuit* was approached whom the Khasi believed to have the power of word to cast away the evil spell.

(c) *Kynruh Shangkwai*: There is no notion of rebirth in Khasi religion. They believe that the soul, after the death of a person would either enter the House of God to reside with the souls of ancestors or hang around in the universe in the form of an evil spirit. The second option applies in the case of the souls of those persons who had deviated from the path of righteousness during their life time and did not mend their ways or took corrective measures.

The Khasi also believe that if a person dies with some unsatiated desires then the spirit of such a person keeps appearing in the dreams of a family member or may cause an illness which it is difficult to cure. In such a case a rite by the name *Kynruh Shangkwai* had to be performed to make the spirit rest in peace and stop making trouble.

(d) *Ka Shat Pylleng*: When a person suffers from misfortune repeatedly or suffers losses in business inspite of best of efforts then it is a matter of great concern. The Khasi believe that there is always a reason behind every event and therefore the cause of such misfortune or loss has to be determined in order to remedy the situation. For this help is sought from a person who is an expert in fortune-telling. The expert prays to God and tries to receive a message from God in the form of certain sign using egg as the medium.

The Khasi believe that cock is the mediator between man and God and any communication with God has to be through the medium of cock. That is why cock-sacrifice is the most common practice in most of the rites. But in this rite instead of a cock they make use of an egg as the medium. Egg is considered to be part of a hen. However in some cases the diviner (expert) may not use an egg but may sacrifice a cock.

To conclude we could say that in this chapter we have explained the various rites performed by the Khasi on different occasions. The rites have been classified into two categories as per the purpose for which these were performed. We have also explained that the rites were performed at the level of the individual as well as the group or the community at large. The rites performed at the level of the individual were the rites performed to mark the various stages in individual's life-cycle (confirmatory rites) and the rites performed to amend any wrong-doing by the individual (piacular rites). The life-cycle rites also involved the participation of the group (domestic or lineage as the case may be). The rites at the level of the community at large were the rites performed to pay obeisance to the guardian deities of the village and the rites performed at the level of the *Hima*.

Chapter IV: **Ka Seng Khasi**

This chapter deals with the historical conditions leading to the formation of a religious association by the name *Ka Seng Khasi*. This organisation came as a reaction in the Khasi society against gradual but sustained conversion of the Khasi population to Christianity and the adoption of the Western style of life by the Khasi converts to Christianity. It also came up as a reaction to the attitude of the Christian missionaries of looking down upon the traditional practices of the Khasi as superstitious and undesirable. The chapter further explains the organisational structure of *Ka Seng Khasi*.

It carries out its activities through an executive body, known as *Ka Jingialang Pyrkhat Kam* (JPK). *Ka Seng Khasi* strengthens its activities in the villages by encouraging the formation of units (*mat*). Every unit has a general council consisting of all its members (adults of both the sexes from every household following the Khasi faith) in the village.

Two very important types of activities of this association could be identified: (i) performance of rites relating to the different stages in the life-cycle of individuals; and (ii) performance of some community rites. Both these types of rites fall under the category of confirmatory rites. As a matter of fact the rites relating to the various life-cycle stages are to be performed by the eldest male member (mother's brother) in the family. It is believed that these rites should be performed properly and completely otherwise the family might suffer the wrath of God. In view of this belief people have started resorting to the practice of inviting elder members of *Ka Seng Khasi* to perform these rites for them thinking that these elders were knowledgeable persons who would not make mistakes in the performance of the rites. Thus these elders assume the role of eldest mother's brother on such an occasion. The rites for the community are described below:

(a) Rites performed at *U Lum Sohpet Bneng*: The Khasi believe that their ancestors descended on this earth from somewhere above in the skies (where lived the God, the creator) and the place they descended at was a hillock known as *U Lum Sohpet Bneng*. This hillock, located in the present-day Ri Bhoi District of Meghalaya, is considered sacred by the followers of the Khasi religion and a visit to the top of this hillock (an altitude of 1448 ft. above the mean sea level) is considered as a pilgrimage by them. A rite at *U Lum Sohpet Bneng* is performed every year by the members of *Ka Seng Khasi* for the welfare of the Khasi society.

The rite is performed in two phases: *Nguh Ryngkew Basa* and *Ka Jingkiew Pyneh Rngiew*. The former is performed on a mound at an elevation lower than the top of the hillock while the latter is performed on top of the hillock.

(b) *Ka Nguh Ka Dem*: The Khasi believe that they should pay obeisance to God for everything that God had bestowed upon one and all during the whole year. *Ka Nguh Ka Dem* rite was performed before the commencement of any auspicious occasion to seek God's presence and to plead that the occasion takes place in a solemn and dignified manner. In the context of the above, it was observed that before the commencement of *Ka Shad Suk Mynsiem* and *Ka Seng Kut Snem* the elders of *Ka Seng Khasi* performed *Ka Nguh Ka Dem* ritual. Here *U Nongknia* performed the rite of *Ka Shat Pylleng* to seek for divine signs.

We may now conclude by stating that the Khasi religion lays a great emphasis on the notions of morality and righteousness. They believe that the only way to reach the House of God after death was through following

the path of righteousness in their lifetime. The Khasi also believe that God would always be their protector and when approached through prayers and acts of divination would make his presence felt through various signs which the knowledgeable could decipher.

Such a belief system is manifested through the various rites performed under this religion. Thus the rites assume a very important place in their lives. All the life-cycle events were occasions for the performance of rites. Rites are performed to confer social recognition on a new born child, rites are also necessary to sanctify a marriage, and in death, rites are needed to help the soul of the departed to reach its final resting place i.e. the House of God. The Khasi perform rites at the level of the individual as well as at the level of the group. Rites at the level of the group may vary according to the size of the group- from the domestic group representing the lineage to a number of lineages representing the clan, to the village community or the community at the level of the *Hima*.

The rites at the community level were performed to pay obeisance to the guarding deities of the village. But then rites were also performed annually for the larger community residing in several villages and Raids as constituents of *Hima* Khyrim.

We have mentioned earlier that the Khasi religion is not based upon any scriptures nor there is any priesthood in the society. In such a case the situation becomes odd if there was no maternal uncle to perform the rites for the matrilineage. Moreover, some of the rites involve giving of feast which becomes an expensive affair. These were also some of the reasons in our view, among others, motivating people to change their religious faith.

Influence of Christianity raised a situation of crisis for the followers of the Khasi faith. The crisis was deep given the fact that it was non-scripture based religion and the society did not have a class of priests. It was for the mother's brother to conduct the rites for his lineage or the domestic group. Situations started emerging where either the mother's brothers had converted to Christianity or the sisters had converted. The only alternative to save the religion was to device ways for carrying on with the performance of rites. If a person (mother's brother), knowledgeable in the performance of rites, could not be found within the domestic group then he had to be provided from outside (to act as the mother's brother). This was made possible by forming an association of elderly persons conversant with the tenets of Khasi religion and the details of the rites. This is precisely what *Ka Seng Khasi* is doing. But it may be mentioned that the priest as an occupational category has still not emerged in the Khasi society.

REVIVALIST MOVEMENT AMONG THE KHASIS : A STUDY OF CULTURAL AWAKENING

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Abstract

This dissertation is an attempt to give a historical background of the Revivalist movement amongst the Khasis and the catalyst forces of the movement. The study analyses some issues about the Seng Khasi Movement and how it serves to resurrect the indeginous culture facilitating cultural awakening. The cultural and religious awakening found its expression through a literary movement to counteract the growing westernization that led to major social transformation in Khasi-Jaintia Hills. The intellectual scholars through literature delved upon the question of Khasi past and its cultural heritage, rites and rituals and they contributed towards the growth of a new consciousness which may be described as "the Khasi renaissance". In the process, a revivalist trend in the society took root and the Seng Khasi organization culminated. The movement through the Seng Khasi organization strives for preservation, revitalization and rejuvenating the traditions, religion and culture of the Khasis.The revivalist movement plays an important role in moulding and strengthening the unity and solidarity of the Khasis and most importantly in the revitalization of the religio-cultural systems of the Khasis.This work explores the genesis, its nature, composition, ideology, leadership, activities and organization of the movement. A sociological analysis is made to assess the impact of the revivalist movement on the Khasi society as a whole in bringing about a cultural awakening

KA JINGIEIT BAD KA JINGTHREW KA DOH: KA JINGBISHAR BNIAH HALOR KA PAROM U KLEW BAD KA SNGI

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Abstract

Ha kane ka lynnong la wanrah katto katne ki jingkynthoh bad ki jingpashat jingmut halor ki jingshem ha ki lynnong ba sha khmat. Ha ka lynnong - I lah ban ïohi ïa ka spah bym ngad ka parom u Klew bad ka Sngi. Bun ki nongthoh Khasi kiba la thoh ïa kane ka parom ha ka dur ka prose bad poitri. Ki la mih ruh ki jingthoh ha ka English ba la buh ha ka prose. Ka jingmih sha khmat ki nongthoh, ka pyni shai ba kane ka parom ka don ka bor ban ktik ïa ka jabieng bad ka mut ka pyrkhat jong ki. La ïohi ruh ïa bun ki Kritik kiba la pynnoh la u synñiang u bynhei ha kaba bishar halor kane ka parom.

Ka jingïakhing kaba long kawei na ki phang ha kane ka wadbniah la pynrung ha ka lynnong kaba ar. Ka jingïakhing hapdeng ka jingieit bad jingthrew ka doh ka la ktah jur ha ka mut ka pyrkhat jong u Klew. Ha kaba kut la lap ba ka jingthrew ka doh ka jop bad u Klew u noh khongpong thiaw sha ka jingbakla lam ïap, khlem da ïoh ïa kaba u khmih lynti.

Haba phai pat sha ka klim kum kawei na ki phang pdeng ba u B.C. Jyrwa u la wanrah la ïohi kumno ba u la pynrem ïa u Klew halor ka jingpalat jong u ïa ka Sngi. Kane ka long kawei na ki kam pap kam sang ba u Khasi u ñiew. Hynrei kumba la kdew sha khmat, don ki nongthoh kiba ong kum u H.O Mawrie, ba u Klew um shym klim, namar ba u leit ïa kaba dang sotti. Hynrei, haba pynshong nongrim ha ka jingsngewthuh kiba kham bun ki nongthoh, lah ban pynkut nia ba u Klew u la klim. Katkum u B.C. Jyrwa u Klew u la klim naduh ba u la ïapmat watla um pat ïa kynduh ruh bad kata ka samla thymmai. Une u nongthoh u ïohi ïa u Klew ym tang kum u nongklim, hynrei u phiang phiang bam sih, kaba mut u riew awria.

Haba pynshong dor pat halor ka jingbabe bad ka apot u Klew ha ka lynnong kaba saw jong kane ka jingtrei, la shem ba u Klew u la lap dien ïa la ka jingbakla namar ba u khlem pyrkhat arsien shuwa ban ryngkoh sha sla pyrthei. U S.S. Majaw haba u kynthoh halor ka jingbabe u Klew u ong:

Ha ka jingim jongno jongno, ym don ka jinglanot ba kham isangsot ban ïa ka jingim jong kito kiba tang namar bym phikir bym suitñiew ne pyrkhat sani bha.[2]

Ha kane ka wadbniah, la lap ba ym pat don ki nongthoh kiba la thoh ïa kane ka khana ha ka dur ka sawangka ne ka parom mutdur. Ki poim bad ki parom lyngkot kim pat shym lah ban jubab haduh mynta ïa kawei ka jingkylli kumno u Klew bad ka Sngi ki la ïapoikha? Lada la buh ïa kane ka khana ha ka parom mutdur ne ha ka sawangka khlem pep yn lah ban ïohi kham shai ïa ka khana naduh basdang.

KA KIEW ÏING THYMMAI" IN RAID MAWJA: A LITERARY STUDY

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Abstract

INTRODUCTION:

Culture is a very vast subject which invites the attention of many scholars and researchers to delve deep in it varied aspects. When we examine *Khasi* culture, we are made aware of the fact that of the richness of this culture and much research needs to be undertaken in all its aspects. After making a preliminary survey of Mawlyndun Village in *Raid Mawja,* I found the existing rituals of occupying a new house are markedly difference from other places of Khasi and Jaintia Hills and this is the reason that provoked me to investigate and toanalyse this particular area of research, the topic of which is *"KaKiewïingThymmai"* in Raid Mawja: A Literary Study"

SCOPE OF THE STUDY:

Ka *'Kiew-ïingthymmai'* or house occupation in Raid Mawja is an aspect of Khasi Culture, on which no research work has been conducted on by any scholars for an M.Phil or Ph.D degree. Of course many Khasi writers have attempted to document this type of ritual on *kakiew-ïing* among the Khasis, but most of them have concentrated mainly on Khasi upland and only a very few of them have studied this aspect of Culture on the other part of Khasi and Jaiñtia Hills, and *Ri-War* areas in particular. It is therefore, hoped that this work throw more light on this particular aspect of Khasi Culture.

However, since the total area of Raid Mawja is too vast and it consist of many villages, so this study has been delimited only to Mawlyndun village which is one of the villages within Raid Mawja. This is done keeping in mind the time span allowed for an M.PhilProgramme.

ORIGIN OF THE RESEARCH PROBLEM:

I have decided to undertake this topic of research because; I have seen a lot of indigenous practices of the *Khasi* people have become extinct one after another during the last few decades. This is the problem which the indigenous people face. There are many factors that cause these practices to disappear like the influence of Christianity is found to be the main reason for this. Secondly, the process of modernization, globalization, world-wide communication network, etc. have brought many changes in the society where indigenous practices are affected and slowly eroded.

OBJECTIVES:

There are three main objectives for conducting this research. The main objective of this study is to document this indigenous practices, namely *KaKiew-ïingThymmai* as it is still practices in Raid Mawja. The reason for this is the fears of its becoming extinct since a lot ofindigenouspractices in Khasi and Jaiñtia have become extinct one after another during the passage of time.

The second objective for conducting this study is to find out whether there are variations in the practices performed in different part of the Khasi and Jaintia Hills. As stated above, most work on *KaKiew-ïingThymmai*by different writers have concentrated only in the upland areas of Khasi and Jaintia Hills and a few of them documented on the southern slope or ***Ri-War***areas. It is therefore, one of the objectives of this study to examine the difference in the ceremony performed by the people of Mawlyndun from the other parts of Khasi and Jaiñtia Hills.

The third objective for conducting this research is to enrich and to help develop Khasi literature.

METHODOLOGY:

This research is a descriptive and empirical method using the tools below:

a) **Text:** All available texts on "House occupation ceremony" are taken for textual analysis.

b) **Observation**: The researcher also personally observed all the rituals performed on *KaKiew-ïing* atMawlyndun till the final day of the ceremony.

c) **Interview**: Interview were conducted on selected informants of the village, namely village elders, village headman and knowledgeable people of the village. Church elder as well as the practicing members of the traditional religion are also interviewed to elicit information on traditional religion in general and on this practice in particular.

d) **Still Photography:** Still and photographs were also taken during the rituals and ceremonial dances till the final day of the ceremony.

The finding of the research in this study are presented as follow:

INTRODUCTION:

This is an introductory part, which has been divided into three sections and they are as follows:

The first section of this chapter discuss the term 'Culture' and examines the dimension which is related to this study. It was concluded that this term is not an indigenousKhasi word, but it was borrowed from other languages. This term was first derived from the Latin word***'Cultura'*** which means 'to cultivate'. But in modern sense term 'culture' derived from the German term ***'kultur'***which means 'the way people live'.

The section also briefly examined the various explanation on culture offered by prominent scholars such as E. B Tylor, Carol and Marvin Ember, W. A Haviland, Ralp Linton and Adamson Hoebel and many others. From among the Khasi writers, their discussion on 'culture' given by R.T Rymbai, H .O Mawrie, B.L Swer, M. B Jyrwa, SylvanusLamare, P. Kharakor, S. Dkhar and others were also highlighted.

The second section presented a review of all related literature, mainly works of writers such as P.R.T Gurdon, J.N Chaudury, P.K Das Gupta, NaliniNataranjan, N. Catherine Shadap-Sen, H. Bareh, Jeebon Roy, G. Costa, Rabon Singh, SipraSen, S.K Tiwari, S.Lamare, P Kharakor, B.S Rana, M. Lyngdoh, Radhon Singh Berry, I.M Simon and others.

The above writers described the ceremony that Khasi people performed, when they had completed building their new houses and before they occupy it. This ceremony is called *KaKynjohKhaskaiñ*, where five pieces of *Khapiah* or dried fish are put on the floor, *'Ïad-um* or rice-beer is then poured on the pieces and then three of these pieces of *Khapiah*are tied to the rafter. All present then jump up and try to pull the tied pieces to the floor again. Those who are welloff use pork in place of dried fish to be tied on the rafter of the house.

Some of the above writers also mentioned another ritual of the ceremony where a plantain leaf is laid lengthwise from inside the house to the outside through a door. Then after invoking God Almighty to bless the house, an egg is taken and sliced in half on the plantain leaf allowing the yolk to flow down the length of the leaf. Such type of ceremonies are followed by feasting and merry-making.

Lastly, this chapter present the objectives and the methodology of the study.

PREPARATION PRIOR TO THE CEREMONY:

This chapter discuss the preparation of the rituals prior to the ceremony of *KaKiew-iïng* in Mawlyndun. This chapter is divided into three sections.

The first section gives a brief description of Mawlyndun village and its people. This village is said to have received its name from the presence of many large stone in it. Its original name still use by the people of this village and those nearby villages is *Mawlongden*. This village is one of the villages which falls within Raid Mawja jurisdiction. It was first inhabited by the***Khongsdam*** clan. After a while other *Kur* or clans such as ***Khonglam, Rangjem*** and others also came and inhabited in this village.

The second section of the chapter is devoted to the description of the construction of a house in Mawlyndun. It then records all the stages made on the construction of the house, from the time of selecting the site until it was completed. Constructing a house in this village does not differ much from that of any parts of Khasi Hills, for it depends on the amount of money the owner can afford to spend in constructing their houses. On selecting the site of a house, a ceremony is performed where an egg or rice grains are buried on the site. Then they invoked and offer prayers to the *Ka Mei-ramew* and *KaBleiNonghukum*. After a week or so on the day already fixed, they then went to the site and checked if the egg or rice grains are left untouched. If that is so, it is taken as a sign that the site is suitable for building a house.

Then the next process starts where they fell trees and cut bamboos as materials for building their house. The season usually chosen for this starts from the month of November to January. After that they start building the house, which is usually during the month of March. This is the best time for constructing their house for most people are free from their works during this season. At the time of constructing a house, neighbours, relatives and friends all lend a hand to help the owner of the house to build his house, right from the time of preparing the site until the house is completed.

The third section of this chapter gives a description of the preparation made for the rituals. The tools and materials necessary for the rituals of ka*Kiew-iïng* consist of a cock, rice, *slashken*(bamboo leaves), *slaskap*(leaves of the local plant), u Sur, *'ïad-um* (rice beer), *Tyndongsiej*(water container madefrom bamboo), *Khapiah* (dry fish) or pork and Ka*KsingKapadiah*(musical instruments/small and large drum).

RITUAL OF 'KA KIEW-ÏING':

This chapter focused on the rituals of *KaKiew-iïngThymmai* in Mawlyndun. This ritual involves a sacrifice which is thanks giving to God Almighty, the Creator, the Provider who enable them to have their new house. In this ritual, a cock was sacrifies, and a handful of rice, *u slashken, u slaskap, u sur* are used for this ritual.

On performing rites, *u Nongkñia* (a diviner) holds the cock together with *u slashken, slaskap, u sur*in one hand while offering words of prayer. In his other hand, he took a handful of rice and sprinkle it on the cock, then after that, he cut the cock's throat but did not severe it completely. He cuts it in such a way that the cock is left alive. After that, he throw the cock in the midst of the crowd which has already gathered around him. Then the crowd who gathered and surround him danced around the bird and would not allow it to escape from the circle. They continued to dance until the bird became still and died.

CEREMONIAL DANCES:

This chapter was divided into two sections.

The first section presents a narration of a tale traditionally handed down through generations which gives an account as to how*Ka Shad Kiew-ïingThymmai* or ceremonial dances first took place in Raid Mawja.

The second section of this chapter deals with the different stages of *Ka ShadKiew-ïingThymmai*. These ceremonial dances are sometimes called*Ka Shad NiamKiew-ïingThymmai*, and are performed on the ceremony of *kakiew-ïing* or before the actual occupation of a new house. These dances were performed for three consecutive nights, of which nine were performed on the first night alone. These dances are described below:

1) **Ka Shad KyrdemKjat:** Only the male member participated in these dance. These male danced by stamping their feet on the ground twice by their right foot and twice by their left foot at the same time chanting "hoi hoi, hoi hoi".

2) **Ka Shad KanSyiar:**This dance was also performed by adult males only. The dancers formed a circle by holding each other's hand and surrounded the cock and would not allow it to escape from under their feet. They continued to dance round the cock until it became still and died. While the dancers were dancing, one person kept sprinkling clean water on the dancers. This water was kept in *KaTyndongSiej* (a hollow container made of bamboo)

3) **Ka Shad Thynroit:**In this dance, the dancers jumped up rapidly on both their feet while the singer sang a song with a rapid beat so that the dancers could time their feet to the rhythm of the song. In this dance only male members were found to participate.

4) **Ka Shad Tyngkoh:** Six dancers took part in this dance and they are divided into three groups. The first group started the dance, then the second group and finally the third group. The way in which they danced was by hopping on one foot from one end of the house to the other side. They repeated this act for three time. During the dance, one dancer crawled on hand and feet on one side of the room while another leapt over him, running from the other side of the room. After that, the dancers exchange their roles. The one who was leaping over his partner had to crawl on his hands and feet while the other leapt over him while running from the other side of the room. This act was repeated thrice. This act was reported to be an imitation of the mating action of the cock with the hen.

5) **Ka Shad KynjohAhkha:** The Action in this dance is similar to *KynjohKhaskaiñ,* practiced in many other parts of Khasi and Jaintia Hills. The difference is that in Mawlyndun the action of reaching for the *Khapiah* (dried fish) was performed in the form of dancing. Six dancers took part in this dance, two dancers dancing at a time. These dancers dance by leaping up and trying to catch hold and to pull down the fish or pork tied by the rope to the rafter. As one dancer jumped up and tried to pull down the fish, his partner helped by pushing him higher so that he could reach and pull down the fish. This act was repeated thrice.

6) **Ka Shad Lai Kyrwiang:**For this dance everyone male female, children and old people could take part in it. All the dancers held their hand with each other and danced around the circle. They danced around the house by jumping and hopping on their feet all the time. They stopped only when they had completed jumping and hopping three time around the house.

7) **Ka Shad Kyntuid:** There are seven dancers in this dance- four females dancers and three males dancers. One of the female dancers was *KaTymmen*(an old woman) while three others were unmarried young girls. The dance was started by the older woman, then a girl and a male dancer. The woman held the girl, while the girl put one of her hand on her waist and then try to butt the man with her elbow. The man also stretched out his arms and

moved to and fro so that the girl would not be able to thrust at him with her elbow. This dance was also said to be an imitation of a cock while attempting to mate with a hen.

8) **Ka Shad Phawar**: In this dance, a chanter stood in the center while the dancers danced around him. He chanted his *phawar* continuously, reciting in detail how the house was built, from the time when the site was prepared until the house itself was completed. The dancers kept dancing around him while he was chanting. They danced by moving around and jumping up with both their feet at the same time.

9) **Ka Shad Paitbah:** This was the last dance which was performed on the first night. In this particular dance, the dancers mould and jumped as they wish and the dance was accompanied with shouting and singing. The dancers all held hand with each other while they danced.

During the above dances the *Ksing* and *Padiah* (big and small drums) are continuously played with the exception of *Ka Shad KyrdemKjat*. The nine dances described above were performed on the first night ceremony.

The dancing continued for the next two nights. During the second and third night only *Ka Shad Paitbah* was performed. On the third night the ceremonial dance became very crowded because people from nearby villages also came to know that there was a *Shad Kiew-ïing* in that village and those who could come joined in the celebration by participating in the dance.

CONCLUSION:

This is the concluding chapter which summarises the research findings of all the chapters. This chapter also examines the differences between *KaKiew-ïingThymmai* in Mawlyndun from those found in many other parts of Khasi andJaiñtia Hills, as documented by different writers and researcher.

KA KOLSHOR KHASI KUMBA KA PAW HA KI PAROM-MUTDUR JONG U DEWI SINGH KHONGDUP-KA BISHAR BNIAH

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Abstract

Ha kane ka wadbniah, la lap ba u Dewi Singh Khongdup ula long shisha u nongthoh parom-mutdur uba kynsai. Ka jinglah ka jong u ban thoh ïa ka ha ka dur jong ka *prose romance* bad khamtam eh ban thoh ïa ka nobel kaba jrong tam napdeng ki nobel Khasi, ka la kyntiew shikatdei eh ïa ka thoh ka tar Khasi. Kane ka jingwadbniah ka la long tang ïa ki katto katne tylli ki tnat jong ka kolshor Khasi kumba ka paw ha ki parom-mutdur ki jong u. Namar ba ka jylli jong kane ka phang ka long kaba ïar, kumta kan bha shibun eh ïa ki 'riewpule bad wadbniah ba kin ïatih bad kyllur shuh ïa kane ka phang sa ha kiwei pat ki kot jong u la ka long ha ka poitri ne sawangka ruh kumjuh.

Haba shim ïa ka jingbishar kyllum ïa ki rukom long jong ka kolshor Khasi, la shem ba ki la don katto katne ki jingkylla. Ka jingwan buhai shnong jong kiwei pat ki jaitbynriew ka la pynlong ïa ki Khasi ba kin ïakhleh bad ïakyrsum lang ha ka imlang sahlang. Kumta haba la ïashong ïasah ryngkat bad kiwei pat, ka la don ruh ka jingïaai bad jingïashim kylliang ha ka liang jong ka kolshor. Kane ka la kylla long ka daw jong ka jingkylla jong ka kolshor Khasi. Shuh shuh ka jingpyrthuh bud bad ka jingtynneng ïa ka jong kiwei pat ka la long sa kawei pat ka daw jong ki jingkylla. Namarkata, lada phai bad peit sawdong ïa ka rukom im jong ki Khasi, la ïohi ba ki la nang kylla bad ïaikylla katba nangmih ki sngi. Kum ban shu ai nuksa lah ban ïohi ïa ki jingkylla naduh ki rukom ṛiam rukom beit, ki rukom bam rukom dih, ki rukom put rukom tem ki rukom rwai rukom siaw bad kiwei kiwei. Kiba bun na kine ki rukom leh ki dei kiba ki Khasi ki la ïashim kylliang na ka kolshor jong kiwei pat. Teng teng kine ki rukom long jong ki Khasi ki la pynsyier ba ïoh lehse ki klet noh pynban ïa la ka jong ka kolshor tynrai. Hynrei kum ka jaitbynriew kaba tipbriew tipblei, la khmih lynti pat ba kata ka jingshim kylliang, kam dei pat ban long ka daw ban nang pyntroiñ ïa la ka jong ka kolshor. Hynrei ka la dei ban long kaba nangpynriewspah shuh shuh ïa la ka kolshor tynrai. Haba phai sha ka longkur longjait jong u Khasi, la shem ba ki don

katto katne ki jingkylla ha kine ki por bad ki juk kiba mynta. Ki la nang mih ruh bun tylli ki sengkur kiba ju lum ju lang ïa la ki jong ki jong ki kur ki jait. Ka jinglum jong kine sengkur ka long khnang ban ïa ithuh kur ithuh jait bad ban pynneh pynsah ïa ka jingïadei kur dei jait. U nongpynïaid jong kane ka sengkur um dei shuh uta uba ki khot u kñi, hynrei u la dei ban long uno uno u 'riew rangbah uba ki kita ki kur ki jait baroh ki ïa burom bad shaniah.

Ka la don shuh shuh sa kawei pat ka rukom pyrkhat, ba ka jingaijait sha ka kmie ka wanrah pynban ïa ka jingtroiñ bad hiar dor jong ka jaitbynriew. Kumta ha ka snem 1990 ka la mih kawei ka seng ïa kaba la tip kum ka Syngkhong Rympei Thymmai (SRT). Ka nongrim jong kane ka seng ka long ba dei ban ai jait noh sha u kpa ym shuh sha ka kmie. Namar katkum ka jingïohi ka jong ka, ba lada pynneh ïa kane ka dustur jong u barim, ka don ka jingma ka bakhraw kaba ap ïa ka jaitbynriew Khasi. Lehse kum ka jaitbynriew rit paid ha kano kano ma ka por ka lah ban duh jait ne jah rngai noh nangne na sla pyrthei. Hynrei haduh kine ki sngi ba mynta hi, ki Khasi ki dang don hapdeng ka jingïakhing ka bakhraw ban ai jait noh sha u kpa. Ka daw ba kongsan eh hi ka long, lada leh kumta kan wanrah pynban ïa ka sang ka ma khamtam ha ka shongkha shongman.

Haba phai ha ka liang ka synshar ka khadar bad ka bishar jong u Khasi, la shem ba ka riti ka dustur jong u barim ka la nangtroiñ bad nangduhbor katba nang mih ki sngi. Ka leit long kumta namar ba shisien mynnor, ka Ri Khasi bad ka jaitbynriew hi baroh kawei ka la shah ban synshar ha kiwei pat ki bor, kata ha ki dohlieh. Kaba la nang pynshong synjor shuh shuh ïa ki riti ki dustur tynrai jong ka ka long, ynda haba ka Ri Khasi ka la leit ban pynïasoh ïa lade bad ka sorkar India. Kane ka la nangbam kruiñ ha ka liang ka rukom synshar khadar bad ka saiñ hima sima. U Syiem uba ju long kum u nongsynshar ba ha khlieh um lah shuh ban bat ïa kà bor namar ki la don kiwei pat ki bor synshar kaba kham halor ban ïa u. Ka dorbar ruh, naduh ka dorbar shnong, ka dorbar raid bad haduh ka dorbar hima ka la sdang ban duh noh ïa la ki iktiar ba pura. Kine ki bor synshar ba halor kiba kynthup naduh ki bor synshar jong ka Autonomous District Council, kata, ka Khasi Hills Autonomous District Council (KHADC), ka ki bor synshar jong ka sorkar jong ka jylla Meghalaya bad haduh ki bor synshar ka sorkar kmie jong ka ri India. Ka jingwan jong kine ki bor kiba kham halor, ka la wanrah pynban ïa ka jingtroin bad jingduh bor noh jong ki katto katne ki tnat jong ka kolshor Khasi.

Katba nangïaid ki sngi, na ka por sha ka por, ki jingmut jingpyrkhat jong u briew ruh ki la nang kylla. Haba peit khamtam sha kiwei pat ki ri jong ka pyrthei kiba la kham shai kham sngewthuh, ka la don ruh kata ka bhah kyrpang ban nang pynkup bor shuh shuh ïa ki kynthei. Ki kynthei ki la don bynta wat ha ki kam synshar khadar, ki kam said thma said ktien bad ha kiba bun ki bynta jong ki tnat treikam bapher bapher. Kine ki jingkylla ki la wan jia long kumjuh shaduh shane sha Ri Khasi ruh. Ha kine ki sngi ba mynta ki la don katto katne tylli ki shnong kiba la shah ïa ki kynthei ruh ba kin ïashong dorbar. Ha ka jingshisha katkum ka dustur jong u barim, kam ju long ka rukom ba ki kynthei kin leit shong dorbar, namar la ñiew ba kam synshar khadar bad ka kam shong dorbar ka dei ka kam jong u rangbah. Hynrei ka jingkylla stet jong ka por, ki Khasi ruh kim shym la bat pyrkhing shuh ïa ki riti ki dustur jong u longshuwa manshuwa. Namarkata, ha kine ki sngi ba mynta la ïohi ba ki la don katto katne ki jingkylla ha ka liang ka kolshor jong ki Khasi khamtam ha ki rukom synshar khadar. La ïohi shuh shuh ba ha kine ki sngi ba mynta, la jied nongmihkhmat ruh ïa ki kynthei ba kin long ki nongshong dorbar hapoh ka Khasi Hills Autonomous District Council (KHADC) bad kumjuh ruh ha ka dorbar thaw aiñ jong ka sorkar jylla (Meghalaya Legislative Assembly). Kumba ka long ha une u snem 2014 ba mynta, ki la don laingut ki kynthei Khasi kiba la jied da u paitbah ban long ki nongmihkhmat sha ka dorbar jong ka Khasi Hills Autonomous District Council bad sawngut pat sha ka dorbar thaw aiñ jong ka sorkar jylla, ha kaba arngut na ki ki dei ki Khasi. Kane ka pyni shai ïa ka jinglah jong ki ban long ki nongïasaid na ka bynta ka bha ka miat jong ka imlang sahlang. Ka jaitbynriew Khasi ka la pdiang ïa ki katto katne ki jingkylla jong ka kolshor, namar ba ka kolshor hi ka ju kylla katkum ka jingïaid jong ka por. Pynban ki don pat ki bynta jong ka kolshor kiba ka jaitbynriew ki bat pyrkhing bha, kata ïa ka longkur longjait bad ïa ka longkha longman. Ïa kane ka bynta kum ka jaitbynriew, ka dang ïaibat bad ïaiksoh, dang pynneh pynsah bad dang bud hi kumba la buh la seng da u longshuwa manshuwa.

ANNA AKHMATOVA AS AN ELEGIAC POET: A STUDY OF REQUIEM AS AN ELEGY IN RELATION TO THE NORTHERN ELEGIES

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Abstract

Chapter I: **Introduction: The Making and Development of Requiem**

Anna Andreevna Gorenko, or more popularly, Anna Akhmatova, was bora on 23 June 1888 in Kiev, Russia. 1 Harnessing her poetic genius at the early age of eleven, she later adopted I. Annensky and then N. Gumilev as her mentors. Her emotional affinity with Gumilev culminated in their marriage in 1910. Anna Andreevna Gorenko wrote under the pen name of Anna Akhmatova since "her middle-class father had asked her not to dishonour their family name with literary pursuits". 3 She published her first volume of verse, Vecher (Evening) in 1912. Some of her other important works include Chetki (Rosary, 1914), Belaya Stava (White Flock, 1917), Poema Bez Groya; Triptykh (Poem Without a Hero, 1960), Rekviem (Requiem, 1964) and the Northern Elegies, published posthumously in 1985.

The publication of her second book of verse Chetki catapulted her into a prominent literary figure in Russia. Her poems were widely read and soon the Akhmatova "craze" was started, with young lovers quoting extensively from her love poems in their love letters.

Chapter II: **The Elegy, Its Definitions, Conventions and Modern Tendencies**

In the previous chapter a reference has been made to Sharon M. Bailey's statement, which refers to Requiem as an "elegy for Russia". But before any in depth analysis can be made on the nature of the poem, this chapter discusses the Elegy - its definitions, conventions, and modern tendencies - and also a few samples of the different types of elegies to serve as an introductory discussion leading to the next chapter, which proposes to critically analyse Requiem as an elegy with the help of genre criticism.

According to critics of the genre, "There are two possible definitions of the elegy...: one in its traditional sense and the other in its broader, unconventional sense". 11 In the traditional sense of the term, the elegy refers to "an elaborately formal lyric poem lamenting the death of a friend or public figure. It is characterised by a powerful inter-twining of emotion and rhetoric, of loss and figuration, and above all by the movement from mourning to consojajion". It also employs a set, of. conventions 4 introduced by Greek and Sicilian poets and developed at the hands of elegists, from Theocritus to Spenser and Milton.

Chapter III: **Requiem and the Elegiac Mode** This chapter makes use of the definitions and'conventions listed in the .preceding chapter to study the nature of Requiem as a poem of mourning with a view to establishing it as an elegy. In the process the chapter also examines how the definitions and conventions are followed or modified.

Chapter IV: **Requiem and the Northern Elegies: A Comparison**

In the previous chapter attempts have been made to study the nature of Requiem and to show how the poem fits the definition of the unconventional elegy. In addition to this, the poem also follows many of the major conventions of the elegy. But the study of the nature of the poem - undertaken with reference to the definitions and conventions of the elegy - would be more exhaustive if a study with some of Akhmatova's other elegies is also undertaken. This chapter, therefore, undertakes a comparison between Requiem and the Northern Elegies

Chapter V: **Conclusion** Having attempted to study the nature of Requiem and the Northern Elegies as elegies through the use of genre criticism, this chapter undertakes an assessment of Akhmatova as an elegiac poet while also summing up arguments previously made. In making this assessment, the chapter also examines her love poems, many of which have been described by critics like Leonid I. Strakhovsky as "tragic". As he puts it, in these poems, "Akhmatova speaks about...simple intimate and personal sorrow" of love, "love's parting, unrequited love, love's betrayal... feelings of grief, of loneliness, of despair".

INNOVATION FOR PERFORMANCE – A CASE STUDY OF FLORICULTURE IN MEGHALAYA

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Abstract

Innovation means an introduction of something new; it may be an idea, new method, process or product. According to Drucker, innovation means abandoning the old (Peter F. Drucker, 1990). It has many dimensions ranging from scientific, business to social innovation and can be incorporated in product, service or creative education. Innovation is willingness to look on change as an opportunity, which means that innovation does not create change, but it rather exploits it. The neo Schumpeterian School in business economics stresses the importance of innovation as a generic ongoing process inherent in every aspect of modern society (Lundvall, 1992). These innovations do not have to include new knowledge; rather they include a recombination of existing knowledge.

Innovation is the specific function of entrepreneurship. It is the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth. Economic growth is

In the context of Floriculture in Meghalaya, it is learnt that the state has started floricultural activities with humble beginning and in a short span has achieved an appreciable growth in the production as well as value realization. The state government with the help of Central Assistance from the Government of India, had initiated several schemes to lure farmers into entering this industry and this initiative has been instrumental in the development of floriculture in the state. The government undertook various programmes to convert the farmers from traditional farming to precision cultivation or cultivating for commercial floriculture. The Horticulture Department of the Government of Meghalaya in its endeavour to facilitate the growth of floriculture in the State, developed the Hub and Spokes Business Model which is based on the innovative cluster model in the 2000-01. This is the first of its kind in the region.

The cluster concept was developed by Michael Porter. It has gained great support from academics and policymakers worldwide and also in EU policy cycles (European Commission 2007, 2008a, 2008b) and Dutch floriculture as well (Splinter, et al, 2006; Plantum NL, 2010).

According to Porter, Innovation takes place in geographical regions, or clusters, where firms are the drivers of these competitive regions. He argues that the competiveness of nations is being determined by their innovative capacity. He also stresses the importance of location in an era where technological change and globalization has changed economic and political structures. Porter developed a diamond model to conceptualize the cluster theory. He distinguishes four determinants of innovation: factor conditions, the context for firm strategy and rivalry, demand conditions and related and supporting industries. There are many definitions of what a cluster is. This is how Porter (2000) describes the concept of a cluster in an attempt to demarcate its boundaries:

"A cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. The geographic scope of clusters ranges from a region, a state, or even a single city to span nearby or neighboring countries (e.g., southern Germany and German-speaking Switzerland). The geographic scope of a cluster relates to the distance over which informational, transactional, incentive, and other efficiencies occur."The Cluster concept has been greatly criticized for its vagueness in defining and identifying clusters. However, it is still important and commonly used, as it first and foremost a good descriptive tool which ties on the one hand local regions to nations and even incorporates the transnational dimension due to its focus on external trade. Secondly, it brings in the sectoral dimension because clusters are very much linked to a certain sector.

This innovative practice by the Government has created a very good and positive impact on the farmers in terms of returns, creating new economic avenues and thereby enhancing the benefits within a short period to the existing

assets of the farmers. The beneficiaries selected were made more aware of the benefits of cultivation of ornamental crops and through the incentives given in these schemes and have become more motivated especially in the commercial aspects which automatically improves their socio - economic conditions.

This is how Porter (2000) describes the concept of a cluster in an attempt to demarcate its boundaries.

ANALYSIS OF EXPORT PERFORMANCE OF INDIA

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Abstract

Introduction

Generally, economic theory suggests that the development is conditioned by resource endowment. Mankind by dint of their intelligence make value addition to the material available in Mother Nature. India is not an exception. The entrepreneurs of the country make further value addition over potential items and they try to export the same outside the country. It has got an economic significance as well as social ramification because it helps in injection of liquidity in the hand of the exporter and further it fetches foreign exchange and the exportable products are sold to the foreign market in her currency value.

"Necessity is the mother of all inventions". After the Industrial Revolution in Britain, industrial production increased rapidly, their total consumption in Britain was not possible at all and export was full of obstacles and difficulties. Neither cheaper nor faster means of transportation was available. As a result of commercial revolution in Great Britain not only means of transportation but also routes of transportation developed fast. Other facilities have also developed simultaneously. Countries like France, Portugal, Germany and Britain attempted to establish their global trade in different parts of the world but Britain, Portugal and France could succeed in achieving objectives of global trade.

The benefits of the global trade were felt after the World War II but it could not be reaped by the large number of developing countries. Policy makers of the several developing countries took a pessimistic view on using international trade as the engine of growth and adopted, inward looking development strategies, which emphasized import substitution rather than promotion of trade. The negative effect of the inward looking policies on efficiency, productivity and competition had set off a process of rethinking in 1970s among the policy makers. Large number of developing countries especially from East Asia opted for more outward looking policies. Gradually these countries transformed themselves from being producers of labour intensive products to the production of skill and technology intensive products. The economic growth of many countries encourages other developing countries to increase their trade openness. As a result, since 1980's a large number of developing countries have increased their openness towards international trade. The liberalization of merchandise trade and other current account transaction by the host of the countries provided a noticeable thrust to the world trade in 1990's. Simultaneously, at the multilateral level, the successful conclusion of the Uruguay Round of trade negotiations under the aegis of the General Agreement on Tariffs and Trade and the subsequent establishment of the World Trade Organization (WTO) in 1995 created an environment of free trade. Along with other countries India also started a massive economic reform including widening of export front since July 1991. India being a signatory to the WTO, accepted the global trade norms and other rules and regulations. Launching of export reform programmes within the country in July 1992 and joining the WTO in 1995 both coincided with our all-round effort to integrate to the global economy. Taking a historical perspective, before 1947 when India was a colony of the British, the pattern of India's foreign trade was typically colonial. India was an exporter of raw materials and foodstuff to the industrialized countries and an importer of finished products. As a result India could not develop industrialization in the country and faced tough competition from the British. However, after independence, India changed the trade pattern according to the requirements for the economic development of the country. In order to extend its productive capacity at a fast rate, import of heavy machinery and equipment was extremely necessary. Traditionally, developing countries were the exporter of food grains and raw materials. But as soon as the process of industrialization started within the country, the demand for raw materials increased within the domestic economy. The growth of population

increased the demand for food grain within the country and as a result India was looking for an alternate production and export strategy in which she can export her surplus product. India started to withdraw its traditional items of export and gradually established a good market for its manufactured and semi-manufactured commodities.

Defining the Problem

Economic development and foreign trade are most intimately connected. Foreign trade not only records and reflects the developmental pattern of the economy, but also help to accelerate economic growth. As the country moves on the road to industrialization, foreign trade slowly changes pattern from traditional goods to more and more diversified industrial goods. Before independence India was exporting raw materials and traditional primary goods. In 1950-1951 India's share in the world export was 1% and in 1998-1999 India's share in world export came down to 0.6%. Perhaps the reason for this decline in the share of world export was due to hike in domestic demand owing to rise in population. The nation is committed at the same time to ensure food security and food safety for the growing population of the country. India's share in world export trade has been registered during the study period at 0.6% in 1998 ranging up to 0.9% in 2004. This presents a dismal picture in external sector of the economy.

Conclusion

From the research findings it has been gathered that since 1992-1993 the volume of merchandise export gradually increased and the growth rate has shown a positive trend. The percentage share of export to GDP has also increased marginally. The percentage share of export in world merchandise export has shown an increasing trend but the percentage share of merchandise export to world export market compared to our neighbouring countries is very low. The export import ratio was declining gradually but the trade balance has shown negative figures. Government of India has undertaken a series of measures to enhance its share of export. India has participated in regional trading blocs but participation in RTBs has not helped much to increase India's export performance as the trade balance with ASEAN and with BIMSTEC countries has shown negative balance. The trade with SAARC countries showed favourable balance of trade but the share of trade with SAARC countries is marginal compared to total India's export. The economic reform in external trade was intended to give our export a competitive edge by allowing easy flow of investment, technology and capital goods. However the liberalization and export promotion measures taken by government of India from time to time although achieved a partial success could not achieve the targeted rate, as balance of trade continues to be negative.

To enhance the percentage share of merchandise export in developed as well as developing countries, proper marketing strategy should be adopted as marketing is the most important constituent of export promotion. The export strategy should be framed according to market situation and country-wise. The countries where India's percentage share of export has been declining or India's export is facing threats, India should export new products to these countries as new products will be less prone to protectionist threat. Apart from these India should arrange formal business link with developed countries. Exports efforts have to be made in competitive environment, so there is a need of greater customer orientation, production of quality product, providing prompt after sale service, reliability, assurance for continuous flow of goods, competitive price etc. For creating greater awareness among the international buyer market surveys, exhibitions, showrooms and more trade fairs etc. to be organised and delegates be sent.

To conclude, export cannot be side-tracked or ignored, they are an essential requirement for development of an economy like ours. The correct policy in such circumstances is not to maintain any bias against exports, but to promote rapid diversification of export. It is also necessary to explore market opportunities not only in developed countries, but also in other developing countries. In summing up, however adverse the situation may appear because of the presence of constraints, risks and uncertainties generated by protectionism, opportunities for export growth are still there and these opportunities will have to be fully exploited.

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7. NCERT Books Published
New Exploring Science - Part 1, Part 2, Part 3, Part 4, Part 5
Health Education- Part 1, Part 2, Part 3, Part 4, Part 5, Part 6, Part 7, Part 8.

ARTS STREAM PUBLICATIONS

List of publications of Dr K.D.Ramsiej

1. " Ka Mariang ha U Khasi" (1992)
2. "A Guide to Logic" (1997)
3. " Ki Khubor ka jingim" (2005)
4. "A Complete Guide on Epistemology and Metaphysics' (2005)
5. " Khasi Philosophy of Nature' (2006)
6. "A Guide of Ethics" (2006)
7. "A Complete Guide Book to Social and Political Philosophy" (2010)
8. " Thought and Reality: A Critical Study of Hegel" (2013)

List of Publications of Dr(Ms) Ruby Dkhar

1. "Trends in the Development of Women's Education in Meghalaya" in Journal of North East India Education Society . Vol IV-VI; 1995-97.
2. "Influence of Education on Certain Social Attitudes of khasi women in Meghalaya" in Journal of North East India Education Society Vol. VII;2000
3. "Literacy Position Among Women With Special Reference to Meghalaya State" in Adult Education Programmes for Development; Published by Centre of Adult and Continuing Education, NEHU, Shillong-2000.

List of publications of Ms V.R.Solomon

1. Women's Political Participation in Meghalaya Legislative Assembly From 1972 to 2008 ,Women's Wide Canvas: Issues and Challenges; EBH, Publishers, Guwahati, India, 2015. ISBN: 978-93-83252-45-9.

List of publications of Dr (Mrs) S.Pandey

Books:

1. Book titled 'Nibandhkar Dr. Vidyanivas Mishra' published in 1991 by Vishwavidyalaya Prakashan, Varanasi. ISBN: 81-7124-078X
2. Book titled 'Comparative study of Bhojpuri and Bengali' Published in 2003 by Vishwavidyalaya Prakashan, Varanasi. ISBN: 81-7124-343-6
3. Co–author of book titled ' Purvottar ki Sanskritic Pahchan' published by Manav Prakashan, Kolkata in 2011 ISBN: 978-93-80332-13-0
4. Co- author of book titled 'Tat Par Pratiksha ` a translation of poems by Padmashree Prof Temsula Ao, published by Sahitya Akademi in 2012 ISBN: 978-81-260-3238-9

Course Writing :

1. Prepared Post-Graduate course material on **Linguistics (Chapters 24 and 25,MHD 07)** for Vardhaman Mahaveer Open University, Kota(Rajasthan), published by the University in 2009. ISBN:13/978-81-8496-105-8

Articles/Research Papers:

1. Wrote a research paper for a project titled ' The problems of teaching and learning Hindi as a Third language in schools with special reference to Khasi students of Upper Primary Schools, sponsored by Central Institute of Indian Languages, Mysore, 2005.
2. Research paper titled 'Rashtra aur Rashtriyataon ki Ajadi aur Sahyogpurna Sah-astitva published in 'Itihasbodh', Allahabad in April,2006.
3. Research paper on Khasi poet Soso Tham titled 'Soso Tham: Janjatiya Sanskriti evam Prakriti ke Kavi' published in Paraspar,Chattisgarh , in January,2007.
4. Research paper on Garo literature and culture titled 'Garo Janjati: Sanskriti evam Sahityik Paridrishya' published in 'Itihasbodh' Allahabad, in January,2007.
5. Research paper on Khasi poet Soso Tham published in 'Vasudha', the journal of Madhya Pradesh Progressive Writers Association in April-June 2007.
6. Research paper on Khasi language and literature titled 'Khasi Sahitya ' published in Sahitya Academy Publication 'Samkalin Bhartiya Sahitya' in May-June,2007., ISSN:0970-8367
7. Translation of poems of Padmashree Prof T. Ao published in Sahitya Varta, January June, 2007.
8. Research paper on 'Garo Literature' published in Bhartiya Sahitya Kosha, Vol.III ,Ed.Suresh Gautam, Published by Sanjaya Prakashan,Delhi. In 2008 ISBN:81-7453,297
9. Research paper titled 'Purvottar Bharat aur 1857 ka Vidroh' published by 'Vasudha', the journal of Madhya Pradesh Progressive Writers Association in January-March,2008.
10. Research paper titled 'Hindi Sahitya ke Upekshit paksha ki Khoj' published in 'Abhinav Kadam' Mau, Uttar Pradesh., Rahul Sankrityayan Visheshank', in 2008.
11. Prepared research papers in the content list for LIS, India, a National project of Central Institute of Indian Languages, Mysore in 2008 on the topics-
    (i) Language variations - dialectal, regional , social ; caste variation, sub-caste variation, variation based on education and generation.
    (ii) Diaglossic situation – spoken variety/common standard variety/written variety .
    (iii) Argot – slang, technical / buying and selling situation .
    (iv) Register / stylistic / code –judiciary, medical, educational, administrative, religious, literary and scientific.
12. Article titled 'Garo Sanskriti' published in 'Madai' a journal of folk literature published from Bilaspur in 2008.
13. A research paper titled 'Banjara Bhasha aur Lok Sahitya' published in Doaba, Hindi Journal, Patna, in December,2008.
14. Research paper titled 'Garo Sahitya Ka Sanskritik Paridrishya' published in NEHU Journal ,Vol 1, 2007, ISSN;0972-8406
15. Research paper titled 'Garo Janjati ka Sahitya' published in Samkalin Bharatiya Sahitya , a Sahitya Akademi publication, in January-February2009, ISSN:0970-8367
16. Article titled 'Garo Bhasha Ke Apratim Kavi Howard Denisan Momin', published in Rang-Prasang, a National School of Drama publication, in July, 2008.
17. Article titled 'Naga Lok Sanskriti' published in Madai, Bilaspur, in2009.

18. Articles on Naga and Garo culture published in Volumes 4 and 5 of Bharatiya Lok Sanskriti,Edited by Suresh Gautam ,Sanjay Prakashan,Delhi.ISBN:978-7453 297-8

19. Article on Garo language published in Samanvay Purvottar , a journal of Central Institute of Hindi , Agra , in January-March 2010.

20. Translation of poem of Padmashree Prof T. Ao Published in Samanvay Purvottar,a journal of Central Institute of Hindi , Agra , in April-June ,2010.

21. Article titled 'Nagaland :Sanskritik aur sahityik paridrishya published in Samanvaya Purvottar , in July-September, 2010

22. Translation of Kynpham Singh Nongkynrih's poem published in Samanvaya Purvottar ,A journal of Central Institute Of Hindi ,in October – December, 2010

23. Article titled ' Meghalaya ka sanskritic paridrishya" published in Samanvaya purvottar , a journal of Central Institute of Hindi in January-March , 2011.

24. Research Paper titled 'Svatantrata Sangram ke Agradut U Tirot Sing' published in NEHU Journal,2011, VOL IX,no 1 ISSN-0972-8406

25. Translation of Kinpham Sing Nongkynrih's poem published in Samanvay Purvottar, a journal of Central Institute of Hindi,in April- June 2011.ISSN-2231-6132

26. Research Paper titled 'Purvottar Bharat aur 1857 ka Vidroh' published in Samanvay Purvottar ,a journal of Central Institute of Hindi ,in July-September, 2011 ISSN-2231-6132

27. Research Paper titled 'Exploring The Canon: A Study of Post Colonial Women Novelists in Hindi' published in the book titled 'Gendered India',published by Booksway , Kolkata ISBN:978-93-81672-00-6

28. Research paper titled 'Purvottar bharat mein kisan aandolan", published in Abhinav Kadam, Mau ,U.P., 2012 .ISSN;2229-4767

29. Article titled ' Assam ke upakshit jan ki aavaz Indira Raysam Goswami'published in Samanway Purvottar ,a journal of Central Institute of Hindi ,in Jan - Mar, 2012 ISSN 2231-6132

30. Research Paper titled 'Garo ka Sanskritik Paridrishya' , published in Samkalin Bharatiya Sahitya , Sahitya Akademi, November – December, 2012 ISSN 0970-8367

31. Translation of Padmashree Prof Temsula Ao's poem published in Samanvay Purvottar , July – December 2012 ISSN 2231-6132

32. Research Paper titled Svatantrata sangram ke agradut published in Sahitya Vimarsh , an International Research Journal , in Jan – June 2014 ISSN : 2319 -9008

List of publications of Dr D.Bhowmick

1. Ancient Architecture :Impressive,Imperishable and Inimitable in Asian Journal of Multidisciplinary Studies vol II Issue 5,May,2014 ISSN:2321-8819(Online)2348-7186(Print)Impact Factor:0.923(JIF)

2. Nihilism and Post Modernism:Is Gauri in Jhumpa Lahiri's *The Lowland* a Victim of Nihilism in LITT CRIT December Issue 2014

3. Cultural Alienation in Upamanyu Chatterjee's *English, August* in LITERARY CRITERION Vol.XLIV.1 2009

4. Edward Said and Post colonial Feminism , Women Wide Canvas December 2014,EBH Publication.

List of publications of Dr (Mrs) E.Kharkongor

1. Economic Development and Environmental Degradation, jointly authored in Zahid Husain's, Environmental Degradation and Conservation in North East India, ISBN 81 – 7117 – 161 – 3. Omsons Publications, New Delhi-110027, 1996.

2. Horticulture: A Viable Alternative to Jhum Cultivation in Meghalaya, Proceedings Volume, Fourth Conference of NEEA on "Agricultural Transition in the Hill Areas of the North Eastern Region", September 7 to 8, 2001, Shillong College, Shillong.
3. Abstract of the Thesis: "Budgetary Trends of the Meghalaya Government Finances 1972-73 to 1997-98" in Finance India Vol. XVI, No.1, March 2002, ISSN 0970 – 3772, Indian Institute of Finances, Delhi-110052.
4. Sustainability: Redefining Our Future in Annual Magazine, Shillong College, 2004.
5. Entrepreneurship Education- Challenges of Development in the North Eastern Region", (co-editor); Proceedings Volume, National Conference on Socio Economic Development in India with Special Reference to North Eastern Region, May 03-04, 2005, Shillong College Academic Society, Shillong College.
6. Accountability and Performance Appraisal in Higher Education, jointly authored in Proceedings Volume, National Conference on Role of Higher Education for Social Change in India with Special Reference to North Eastern Region, November 21-22, 2005, Shillong College, Shillong.
7. Socio-Economic Development of India with Special Reference to North Eastern Region, (co-editor) Proceedings Volume, National Conference on May 3-4, 2005 Shillong College, Academic Society, Shillong.
8. Striking a Balance Between Quality and Quantity in Higher Education: The Role of IQAC , jointly authored in Souvenir, National Seminar on the Role of Internal Quality Assurance Cell In Quality Enhancement, December 28-30, 2005, Yeshwant Mahavidyalaya, Nanded , Maharashtra
9. Quality Vrs Quantity: Challenges in Higher Education Golden Jubilee Magazine; Shillong College, 2006.
10. Entrepreneurship Development in North East Region with Special Reference to Meghalaya, in Megu, Kangki, Development Issues in North East Region, ISBN 81 – 8324 – 198 – 0, Mittal Publications, New Delhi, 2007.
11. Impact of Assessment and Accreditation of Educational Institutions of Higher Education in India; (co-editor) Proceedings Volume, National Conference on June17 – 18, 2008, Internal Quality Assurance Cell, Shillong College, Shillong
12. Women and Leadership; (editor); 19th June, 2009, Womens' Cell, Shillong College, Shillong.
13. Consumer Behaviour: in Passah, P. M. & Syiem, B.: Micro and Macro Economics (including some issues of the Indian Economy), Prescribed Text Book for Class XII, Meghalaya Board of School Education, MEA, Publications, Shillong, 2008; Reprinted 2011.
14. Business Environment, Taxman Publication, New Delhi, 2010. ISBN 978 – 81 – 7194 – 784 – 3; Prescribed Textbook for Under - Graduates Students in Commerce and Arts Streams, Guwahati University.
15. Trends and Pattern of Social Sector Expenditure in Meghalaya: An Analysis, in Proceedings Volume, 14th Annual Conference of the North Eastern Economic Association, 13th to 15th December, 2012 organized by Department of Economics, Sivasagar College, Joysagar, Assam. (To be published in ISBN).
16. Entrepreneurship Development: Opportunities and Challenges in the North Eastern Region, (co-editor); Proceedings Volume, Regional Workshop on 08th June, 2012, Entrepreneurship Development Cell, Shillong College, Shillong.
17. Sustainable Development through Community Participation: A Case Study of Mawlyngot Village; International Seminar on "Green Economics: The Road to a Balanced and Healthy Economy", Meghalaya Economic Association in collaboration with Rajiv Gandhi Indian Institute of Management, Shillong: 07th & 08th August, 2014. (Submitted for ISBN publication).
18. The Dynamics of Migration: Its Implications on Urbanization with special reference to Meghalaya, International Seminar on "Human Migration in South Asia: Dynamics and Implications", organized by IQAC, Synod College, Shillong, 9th—10th October, 2014, Synod College, Shillong. (Submitted for ISBN publication).
19. Women's Wide Canvas – Issues and Challenges, (co-editor) Eastern Book House, Guwahati, 2015, ISBN: 978 93 83252 45 9.

20. Waste to Wealth: An Analysis of Opportunities and Challenges in Meghalaya (co-author): Regional Seminar on Resource Potentialities and Economic Prosperity: Challenges of the North Eastern Region organized by the IQAC, Sngap Syiem College, Mawkyrwat in collaboration with Meghalaya Economic Association, 14th – 15th May, 2015. (Submitted for ISBN publication).

List of publications of Dr(Mrs) D.Mawroh

1. Book on Representation of Women in Khasi Literature

List of publications of Dr S.Khyriemujat

1. Women in the Khasi Matrilineal Society in *Women's Wide Canvass: Issues and Challenges* (ISBN-978-93-83252-45-9 with Eastern Book House Publication).
2. Ka Pomblang- A Depiction of Khasi polity in the present day(to be published by Department of Political Science, Synod College, Funded by ICSSR,NEHU).
3. Ka Sain Bri: An Analysis of Tribal Land Management(to be published by Department of History,Synod College).
4. Dynamics of Migration and its implication on Urbanization, with special reference to Meghalaya to be published IQAC,Synod College, Shillong with ISBN publication.
5. Empowerment of Woman is Empowering Society, published by Department of Sociology St.Edmund College, in the Department Souvenir,2013.

List of publications of Dr A.Nongbri

1. Book on 'Process of Standardisation of Khasi Language

List of publications of Mr P.Pyrtuh

1. The Ethnopolitic of Ethnicity in North East India, The Political Anvil, Vol.1 No.1. ISSN No.2319-7528, December 2012
2. Women Empowerment through Political Representation in Matrilineal Meghalaya, The Political Anvil, Vol.2 No.1. ISSN No.2319-7528, December 2013
3. Contractual Theory of the Firm: An Institutional Approach to Outsourcing Process, Keanean Journal of Arts, Vol-1 2013. ISSN 2348-1110
4. Mawkhroh, Ibabitnam & Phrangsngi Pyrtuh "Development: A Paradox of Women Empowerment in Meghalaya" in R. P Vadhera "*Development of North East India: Multidimensional Perspective : Vol.1, First Edition 2015*, Published by Manglam Publishers & Distributors, New Delhi, ISBN 978-93-82816-20-1

List of publications of Mr P.Shabong

1. Shat Jingshai. Rilum Printing Press.Shillong,.2005.
2. Harud Ka Ding Ba rhem (A Collection of folktales). Rilum Printing Press.Shillong, 2007.
3. Ki Symboh Ka Imlang Sahlang (Social Studies). Rilum Printing Press.Shillong, 2007..
4. Ka Akor Kaba Tam (Moral Studies). Rilum Printing Press.Shillong., 2007. .....
5. Ka Jingieit bad Jingthrew Ka Doh: Ka jingbishar bniah halor ka parom U Klew bad ka Sngi. Don Bosco Press. Shillong 2011.
6. Namar Ka Ri Ngan tur (Drama), Vanrica Press, Mawkhar, Shillong 2013.

COMMERCE STREAM PUBLICATIONS

List of Publications of Dr S.Sarma

1. Export performance & Export promotion measures *in "A Synoptic look*, Spectrum", Vol II Issue I, special issue on Entrepreneurship Development in small scale Industries Published by the Department of Economics, Dispur College, Guwahati.
2. "Export earnings from NER" An analytical study (1998-2005)" Journal of North Indian Council for Social Science Research. ISSN 0970-7913, Oct 2007.
3. "Analysis of Export performance of India – A comparative study of Pre & Post liberalization Period". Vanijjay-Journal of Commerce, Dibrugarh University. ISSN: 0972-6594.
4. Analysis of Export Performance of India & China: A Comparative study (1992-1993 to 2006-2007). Journal of North East India Council for Social Science Research, vol 33:1, April 2009.
5. "Convergence of Higher Education: Effects on Youth." Globalization. Higher Education & Youth. Edited by Dr. N. Barooah and others. 2010, EBH Publisher (India), Guwahati. ISBN: 978-93-80261-04-1.
6. "Sensex Volatility and Household Investors: A study of the market Crash and Global Financial Crisis." Global Financial Crisis. Edited by M.N. Bhattacharjee, Sankar Sarma and others, 2012. EBH Publisher (India), Guwahati. ISBN: 978-93-80261-66-9.
7. "Regional Rural Bank and its Role in Finance Inclusion: A case study of Meghalaya." Financial Inclusion for Inclusive Growth. Edited by A. Rajmani Singha, 2013. Concept Publishing Pvt. Ltd. New Delhi. ISBN: 13: 978-81-8069-968-9.
8. "Indian Retail Sector and FDI Prospects and Problems." Impact of Foreign Direct Investment In India. Edited by Dr. Subrata Mukherjee, 2013. Manav Prakashan Kolkata. ISBN: 978-93-80332-44-4
9. "Problems and Prospects of Tourism Industry in the State of Meghalaya – An Overview" Tourism Industry in North East India. Edited by Dr. RAjmani Singh and Prof. GP. Prasain,2014. Akansha Publishing House, New Delhi. ISBN : 978-81-8370-4045.
10. Book entitled Fundamentals of Insurance & Risk Management. Global Publishing House, Guwahati- 3, ISBN: (PB) 978-93-81563-18-2. ; (HB) 978-93-81563-19-9.

SECTION II

UGC MINOR RESEARCH PROJECTS

STUDIES OF NITROGEN EXCRETION PATTERN IN DIFFERENT TADPOLE STAGES OF *RHACHOPHORUS MAXIMUS*

Dr(Ms) L.M.Jyrwa,
Department of Zoology

Introduction: Nitrogen metabolism is considered to be one of the most susceptible physiological systems showing adaptive response to environmental variations. Consequently, the nature of nitrogen excretory products in animals has changed with the evolution of vertebrates from water to the land habitat. A major nitrogenous end product which is produced continuously in animals from the catabolism of nitrogen- containing biomolecules such as proteins and free amino acids is ammonia. Accumulation of ammonia *in vivo*, even at a very low concentration, is toxic to animals and therefore it either needs to be excreted promptly from the body or converted to other less- toxic molecules. Aquatic animals excrete ammonia easily into the external environment as this compound has high solubility and there is ample water available for dilution. On the other hand, terrestrial animals have developed enzyme systems for the conversion of ammonia to the less toxic compounds, urea and/or uric acid. Birds and reptiles primarily excrete uric acid whereas mammals are ureotelic, urea being the end product of protein metabolism. Between these permanently aquatic and strictly terrestrial animals are the amphibians, vertebrates which during their life cycle make a transition from an aquatic

to a fully or partially terrestrial environment. Thus, the unique position of the Amphibia in the evolutionary mimicry of the post embryonic development of an ammonotelic aquatic tadpole into a ureotelic terrestrial frog provide a model system for assessing the physiological, biochemical and molecular changes that allow the invasion of land by an aquatic animal.

Metamorphosis in amphibians involves biochemical, physiological and morphological changes which prepare an aquatic tadpole for its transition to a full or partially terrestrial adult. One of the most significant metabolic alterations that occur during the metamorphosis of most amphibians is the shift from ammonotelism to ureotelism.

Rhacophorus maximus belongs to family Rhacophoridae. This family comprised of diverse group of tree frogs, which are mostly arboreal, some with adaptations for gliding. *Rhacophorus maximus* is widely distributed in the North Eastern region of India, particularly in Meghalaya, it is found in almost all districts of the state ranging from low to high altitude areas. *Rhacophorus maximus* is in early breeder. It breeds sporadically for a short period, which can lasts for about 6 to 8 weeks after rainfall from the month of March to early May. The frogs construct foam nests in shallow pools; ponds about 2-3 cm above water level and the foam nests always remain attached to the vegetation. The development stages of this tree frog have been divided into 6 major sub-headings: (1) Fertilisation (2) Cleavage (3) Blastula (3) gastrula (3) Neurula and (3) Post-embryonic development (Fig. 4, Khongwir, 2005).

Some reports are available about the increased activities of the enzymes involved in urea biosynthesis and urea excretion at a time in development during gross morphological changes in the tadpole of various species of amphibian (Cohen 1978); however, there are no reports available about the activities of the enzymes involved in urea formation during the development in *Rhacophorus maximus*.

Thus keeping this in mind, the different tadpole stages in *Rhacophorus maximus* has been selected and to study the transition shift of nitrogen excretion pattern from ammonotelic to ureotelic by elucidating the activity of CPS I which is the key enzyme in urea formation

Experimental set up:

Animal: The foam nests of ***Rhacophorus maximus*** were collected from the natural habitats during the breeding period and the eggs were allowed to hatch in the laboratory conditions (28 ± 2°C). Larval development and nitrogen excretion were examined in tadpoles collected from nests constructed by females in large open plastic tubs (50×39×27 cm) that were filled with damp soil collected from the same temporary pond from which amplectant pairs were collected (Kaminsky *et al.* 1999, 2004). Immediately after hatching batches of tadpoles were transferred to different trays containing pond water where they were allowed to develop. The tadpoles were fed daily with boiled cabbage and liver. Different tadpole stages about five –ten in numbers were be taken and kept in dechlorinated water of one litre and the water were collected for urea and ammonia estimation, after every fixed period of time. Tadpoles were examined under a dissecting microscope and the developmental stage was Classified according to Gosner (1960) Liver tissues were dissected from the tadpoles and processed to study the enzyme activity of Carbomoyl phosphate synthetase I (CPS), the key enzyme of urea cycle.

Estimations:

Ammonia-N and urea-N concentrations from the water samples containing tadpoles were measured enzymatically based on the procedure of Kun and Kearny (1974).

Enzyme assay:

A 10% homogenate (w v^{-1}) of each frozen tissue was prepared in a homogenizing buffer containing 50 mM Tris-HCl buffer (pH 7.4), 0.25 M sucrose, 1 mM ethylene diamine tetra-acetic acid (EDTA), 2 mM $MgCl_2$, 1 mM dithiothreitol (DTT), 3 mM 2-mercaptoethanol using a motor driven Potter-Elvehjem type glass homogenizer with a Teflon pestle. The homogenate was treated with 0.5% Triton X-100 in 1:1 ratio for 30 min, followed by mild sonication for 30 s to rupture the mitochondria. The homogenate was then centrifuged at 10,000 × g for 10 min and the supernatant, used for assaying the enzyme. All steps were carried out at 4°C. The urea cycle-related CPS activity was assayed following the method of Brown and Cohen (1959) with certain modifications.

Chemicals

Enzymes, co-enzymes and substrates were purchased from Sisco Research Laboratories Pvt. Ltd (Mumbai, India). Other chemicals were of analytical grades and obtained from local sources. Double distillation water was used in all preparations.

Statistical analyses

The data collected from different replicates, were statistically analyzed and presented as mean ± S.E.M (n= number of tadpole stages in each set of experiment). Student's t-test was performed to evaluate differences between means where applicable. Differences with $P< 0.05$ were regarded as statistically significant.

Results:

Survey: A thorough survey was made on the location and habitat of *Rhachophorus maximus*. This amphibian was found predominantly in Laitryngew Village, Cherrapunjee which is 53 km from Shillong, although a small population is also in other places of East Khasi Hills district including some localities of Shillong. As reported by Khongwir et al., 2003, *R maximus* was distributed throughout the three regions of Meghalaya (Khasi region, Jaintia and Garo region).

The metamorphosis of the different larval stages during post embryonic development: Like any other amphibians, post-embryonic development is significant as there is a lot of transient changes both physically and biochemically, including the shift of ammonotelism to ureotelism. Comparing with reports of Khongwir, 2005, the developmental stages of *Rhachophorus maximus* were divided into 46 stages, which are included into 20 embryonic stages and 26 post embryonic stages. External gills were observed at the beginning of the post embryonic development (stage 21 to 24). The tadpoles were large in size, oval and heavily pigmented and the tail fin was opaque. However after 12 days of development (Stage 25), gills disappeared and mouth opening was prominent and tadpoles start feeding. Appearance of limb buds was observed in the next stage (Stage 26) which was after 20 days of fertilisation and subsequent stages shows gradual development of the limbs which becomes fully developed in stage 42 (54 days after fertilisation). Resorption of the tail was also observed in the later stages of development and the angle of the mouth has reached the posterior margin of the eye and metamorphosis is completed after 62 days (Fig 4).

Rates of excretion of ammonia-N and urea-N of embryonic and post embryonic developmental stages

The rates of excretion of ammonia-N in the pre metamorphic stages (Stage 21) of tadpoles was relatively more than urea-N with an average of 6.15 ± 0.21 mmoles/g body wt/day whereas Urea-N excretion was only 0.56 ± 0.05 mmoles/g body wt/day. Similar result was obtained at the foot paddle stage (Stage 26) of the tadpoles where ammonia-N concentration was about 4.86 mmoles/g body wt/day than that of urea concentration which was found to be 1.57 ± 0.21 mmoles/g body wt/day. However, the excretion of pattern of ammonia and urea was altered during the metamorphic climax (Stages 40-45) where toes indentation have initiated and formation of fore limbs have begun. The rate of excretion of ammonia-N by the tadpoles was found to be 3.53± 0.21 imoles/g body wt/day and urea-N excretion was found to be 3.92 ± 0.21 mmoles/g body wt/day. This was followed by a further decreased of excretion of ammonia-N which was 2.87± 0.21 mmoles/g body wt/day in Stage 45 of tadpole development as compared to that of excretion of urea which had significantly increased to 9.09 ± 0.21 mmoles/g body wt/day (Fig 1, Table 1).

Changes in the activity of CPS I enzyme in the liver of different stages of tadpoles of Rhachophorous maximus:

The activity of CPS I, a key enzyme of urea cycle in different tadpole stages is shown in table 2 and Fig 3. In tadpole stage 21, the activity of CPS was found to be 1.6 ± 0.31 units/g wet wt in the liver. A slight variation was observed in stage 25 as there was an increase of 1.9 ± 0.21 units/g wet wt, however CPS I activity increased significantly of about 3.5 ± 0.50 units/g wet wt in stage 40, following a further increase of 5.15 ± 0.70 units/g wet wt in the liver tissue in tadpole stage 45.

Conclusion: Post embryonic development in most amphibians involves biochemical, physiological and morphological changes which prepare an aquatic tadpole for its transition to a full or partially terrestrial adult. One of the most significant metabolic alterations that occur during metamorphosis of most amphibians is a shift from ammonotelism to ureotelism (Cohen et al., 1978). Results clearly indicate that there was a transient change of mode of nitrogen excretion along with metamorphic development of the tadpoles. Also the change in the ammonia to urea excretion pattern also corresponds with the change in the activity of CPS I enzyme, a key Urea cycle enzyme. It was also observed that urea

cycle enzymes atleast for CPS I was present in all the post embryonic stages but increases with the development of the tadpoles. Whether there is up regulation at transcriptional level or post transcriptional level during metamorphosis for this key enzyme, a further investigation is required, although CPS I is both regulated allosterically by N-acetylglutamate as well at the gene level (Christoffels et al., 1996; Meiyer et al., 1985). Further reports (Galton et al., 1991) also revealed that thyroid hormones (T_3) that induces metamorphosis in amphibian was also found to induced CPS I mRNA levels which therefore results in the transition change of ammotelism to ureotelism in *Rhachophorus maximus.*

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SYNTHESIS, CHARACTERISATION, BIOLOGICAL STUDIES OF HEAVIER ELEMENTS OF GROUP 15

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The diorganotin(IV) complexes of methyl 2-{4-hydroxy-3-[(2-hydroxy-phenylimino)-methyl]-phenylazo}-benzoate (H2L) were obtained by the reaction of *ortho*-aminophenol, R_2SnO (R = Me, ^{n}Bu, or Ph) and methyl 2-[(E)-(3-formyl-4-hydroxy)diazenyl]benzoate ($H2PL^2$) in ethanol, which led to diorganotin(IV) compounds of composition $[Me_2SnL]_2$ (**1**), $^nBu_2SnL$ (**2**), and Ph_2SnL (**3**) in good yield. The ^1H, ^{13}C, and ^{119}Sn NMR, IR, the mass spectrometry along with elemental analyses allowed establishing the structure of ligand (H2L) and compounds **1–3**. In all the three cases, ^{119}Sn chemical shifts are indicators of five-coordinated Sn atoms in a solution state. The crystal structures of ligand H2L and complexes **1** and **2** were determined by a single crystal X-ray diffraction study. In the solid state, the ligand H2L exists as a keto-enamine tautomeric form. The molecular structure of complex **1** in the solid state shows a distorted octahedral geometry around a tin atom due to additional coordination with an oxygen atom from a neighboring molecule leading to a four-membered ring with Sn-O···Sn-O intermolecular coordination, leading to a dimeric species. On the other hand, complex **2** is a monomer with trigonal bipyramidal geometry surrounding the tin atom. © 2012 Wiley Periodicals, Inc. Heteroatom Chem 23:457–465, 2012; View this article online at wileyonlinelibrary.com. DOI 10.1002/hc.21037

Funded by

- UGC (NERO), Guwahati, India. Grant Number: F.5-248/2009-10 (MRP/NERO)
  RFSMS-UGC, New Delhi, India. Grant Number: F.42-2/Acad/UGC-SAP/Chem/2007-11-13

A STUDY OF NUTRITIONAL STATUS AMONG ADOLESCENT SCHOOL GIRLS IN SHILLONG

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Abstract

The study aims to assess the nutritional status of adolescent school girls in Shillong, India, by different levels of Body Mass Index viz., under weight, normal weight, over weight and obese, with respect to dietary habits and some socio-economic characteristics such as age, place of residence, religion, parents' education, ethnic group, etc. Primary data from 750 girls of age 11 to 18 years were collected from 10 schools by using the method of stratified random sampling under UGC sponsored MRP. In the study, 20.4 percent were found under-weight, 7.2 percent over-weight and 1.9 percent obese. The highest proportion of under-weight was found among the girls of 11 years and the prevalence of healthy-weight status was more among tribes (74.8%) than that among non-tribes (66.1%). Prevalence of under-weight status among primitive Khasi tribes was 16.7 percent. Pearson's Chi-square test indicate that age, religion, ethnicity, parents' education, total children ever born to mother, monthly family income and dietary habits (skipping breakfast, intake of fish, meat, milk, etc.) are significantly associated (p-value <0.05) with the nutritional status.

INTRODUCTION

Shillong is the capital of Meghalaya, one of the smallest states in India and is the headquarters of the East Khasi Hills district situated at an average altitude of 4,908 feet (1,496 m) above sea level, with the highest point being *ShillongPeak* at 6,449 feet (1,966 m) It is said that the rolling hills around the town reminded the European settlers of Scotland. Hence, Shillong is also known as *Scotland of the East.* As per 2011 India census, Shillong has a population

of 314,610. Males constitute 46% of the population and females 54%. Average literacy rate of 86%, higher than the national average of 63.5%: male literacy is 85%, and female literacy is 88%. Khasi tribes make up the majority of the population. All the other north-east Indian tribes, viz. Jaintias, Garos, Mizos etc. as well as a moderate number non-tribes making the city a fairly cosmopolitan.

Adolescence, a period of transition between childhood and adulthood and is one of the most dynamic periods of human development [2]. This period is characterized by an exceptionally rapid growth and is one of the most dynamic periods of human development. Physical, cognitive, social and emotional changes are observed during this period. These changes along with the adolescents' growing independence, search for identity, concern with appearance, need for peer acceptance and active lifestyle can significantly affect their eating behaviors and nutritional status. Rapid physical growth creates an increased demand for energy and nutrients. Nutrients are chemical components derived from food, which help maintenance of body function, body growth and protection of organs of the body; and nutritional deficiencies can lead to many far reaching consequences. Nutrient requirement varies according to age, sex, and phases of life. In girls, middle adolescence growth happens earlier (i.e. during 12-15 years) than in boys (i.e. during 13-16 years). Adolescent girls form a crucial segment of the society and constitute the vital bridge between the present generation and next [3]. In developing countries, anemia is one of the glaring deficiencies in adolescent girls, probably due to low intake of haemopoietic nutrients since childhood and increased demand for nutrients coupled with menstrual loss of iron. So if their nutritional needs are not met, they are very likely to suffer from anemia and give birth to under-nourished children, thus transmitting malnutrition to future generation [4].

The objective of the study is to analyze the nutritional status of adolescent school girls of Shillong according to some socio-economic, anthropometric, demographic, physical activities and dietary factors.

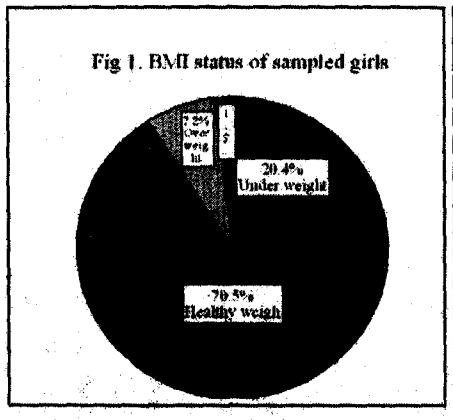
DATA METHODOLOGY

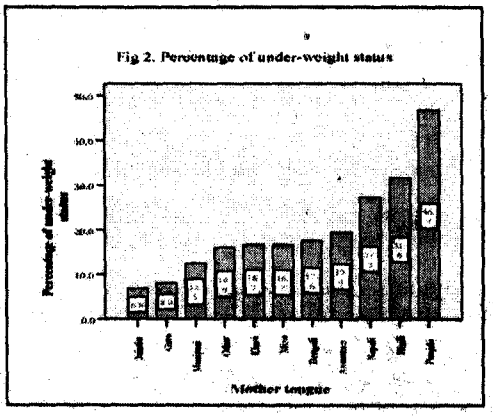
The study is based on the primary data of 750 girls of 11 to 18 years of age from 10 schools of different localities of Shillong. The data were collected using the technique of stratified random sampling. The information on anthropometric, socio-economic and dietary habits was taken and the sample data were analyzed to assess the nutritional status according to age, place of residence, religion, economic status of family, ethnic group, parents' education, mother tongue, food habits, physical activities etc. Different levels of BMI, viz. under-weight, healthy weight, over-weight and obese, was used as an indicator of nutritional status. BMI is calculated by dividing the body weight (in Kg.) by the square of height (in meter); and for children and adolescents, the BMI classification is gender and age specific. The 'CDC BMI-for-age growth chart', developed by National Centre for Health Statistics, USA, was used to classify the individuals into different weight-status categories. The growth chart shows the weight status categories used with children and teens by using age and sex specific percentiles. Descriptive statistics were used for estimation of parameters and Pearson's Chi-square test was used to assess the significant association of nutritional status with socio-economic, dietary and physical activities. SPSS software was used to analyze the data.

RESULTS AND DISCUSSION

The study includes subjects from different ethnic and religious groups. Christianity constitutes the major religious group (45.9%) among the selected students, followed by Hinduism (42.5%), Islam, (7.3%), Sikh (1.2%), Khasi religion (1.1%) and other. Amongst the sampled girls, 50.8% were tribes and 49.2% were non tribes. The findings showed that 20.4 percent were under-weight, 70.5 percent healthy weight, 7.2 percent over-weight and 1.9 percent obese (Fig1). The prevalence of under-nutrition among primitive Khasi tribes was 16.7 percent (Fig2). In the subsequent analysis, because of low cell frequencies, over-weight and obese groups were clubbed into one category. Table1 to table6 give an overview of the findings. The findings show that the highest proportion of under-weight status was from the girls of 11 years (40.4%) and the prevalence of under- weight girls are more among non-tribes (24.7%) than that among tribes (16.3%). As regards religion, the highest proportion of healthy weight has been found among Christians (76.5%) followed by Hindus (67.7%); and the highest proportion of under-nutrition was amongst Muslim girls. So far as dietary habits are concerned, only 5.7% of the sampled

students are vegetarians and the proportion under-weight status is more among them (23.3%) as compared to that among non-vegetarians (20.2%). The findings indicate that 73.7 percent of the girls, who take milk every day, are of healthy weights as against 70.1 percent who never take. About habit of skipping breakfast, 10% of girls skip breakfast every day and 42.7% of them are of under-weight status as against 17.4% who never skip breakfast. In the study, only 13.3 percent of the girls go for exercise or morning walk everyday and the prevalence of healthy-weight status among them is more (72.0%) as compared to those who never do (70.0%).





Information about family income reveals that prevalence of under-weight status is more among the girls of comparatively low-income families and that of over-weight status is more among girls of higher-income families. Pearson's x^2 test statistics reveal that age, religion, ethnicity, dietary habits, parents' education, family income and total children ever born to mother have significant association (p-values <0.05) with the nutritional status.

Table1. Age vs. BMI Cross tabulation

Characteristics	Nutritional status			Total
	Under weight	Healthy weight	Over weight and Obese	
Age (years)				
Less than 12	21 (40.4%)	28 (53.8%)	3 (5.8%)	52 (100.0%)
12 to 13	57 (21.3%)	190 (70.9%)	21 (7.8%)	268 (100.0%)
14 to 15	44 (16.4%)	199 (74.3%)	25 (9.3%)	268 (100.0%)
16 or above	31 (19.1%)	112 (69.1%)	19 (11.7%)	162 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 17.476 with p-value 0.008			

Table2. Religion and ethnicity vs. BMI cross tabulation

Religion				
Hindu	75 (23.5%)	216 (67.7%)	28 (8.8%)	319 (100.0%)
Muslim	19 (34.5%)	30 (54.5%)	6 (10.9%)	55 (100.0%)
Christian	49 (14.2%)	263 (76.5%)	32 (9.3%0	344 (100.0%)
Other	10 (31.3%)	20 (62.5%)	2 (6.3%)	32 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 20.037 with p-value 0.003			

Ethnic group				
Tribe	62 (16.3%)	285 (74.8%)	34 (8.9%)	381 (100.0%
Non tribe	91 (24.7%)	244 (66.1%)	34 (9.2%)	369 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 8.485 with p-value 0.014			

Table3. Food habits vs BMI Classification

Skip breakfast				
Every day	39 (51.3%)	33 (43.4%)	4 (5.3%)	76 (100.0%)
Sometimes	71 (18.8%)	272 (72.1%)	34 (9.0%)	377 (100.0%)
Never	43 (14.5%)	224 (75.4%)	30 (10.1%)	297 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 26.190 with p-value < 0.001			
Fish/ Meat consumption				
Everyday	22 (11.1%)	150 (75.4%)	27 (13.6%)	199 (100.0%)
Sometimes	117 (23.2%)	349 (69.2%)	38 (7.5%)	504 (100.0%)
Never	14 (29.8%)	30 (63.8%)	3 (6.4%)	47 9100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.971 with p-value 0.018			
Milk consumption				
Everyday	28 (14.3%)	143 (73.0%)	25 (12.8%)	196 (100.0%)
Sometimes	94 (21.3%)	311 (70.5%)	36 (8.2%0	441 (100.0%)
Never	31 (27.4%)	75 (66.4%0	7 (6.2%)	113 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.320 with p-value 0.402023			
Fruits consumption				
Everyday	30 (14.8%)	158 (77.8%)	15 (7.4%)	203 (100.0%)
Sometimes	118 (22.0%)	367 (68.3%)	52 (9.7%)	537 (100.0%)
Never	5 (50.0%)	4 (40.0%)	1 (10.0%)	10 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 12.177 with p-value 0.016			
Leafy vegetables consumption				
Everyday	62 (17.0%)	270 (74.2%)	32 (8.8%)	364 (100.0%)
Sometimes	79 (22.2%)	242 (68.0%)	35 (9.8%)	356 (100.0%)
Never	12 (40.0%)	17 (56.7%)	1 (3.3%)	30 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.412 with p-value 0.022			

Table4. Parents' education vs. BMI classification

Mother's education				
Below Primary	29 (27.9%)	69 (66.3%)	6 (5.8%)	104 (100.0%)
Primary to incomplete Secondary	59 (22.4%)	180 (68.4%)	24 (9.1%)	263 (100.0%)
Secondary or Sr. secondary	57 (18.8%)	223 (73.4%)	24 (7.9%)	304 (100.0%)
Graduation or above	8 (10.1%)	57 (72.2%)	14 (17.7%)	79 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 16.912 with p-value 0.010			
Father's education				
Below Primary	3 (13.6%)	17 (77.3%)	2 99.1%)	22 (100.0%)
Primary to incomplete Secondary	73 (29.9%)	156 (63.9%)	15 (6.1%)	244 (100.0%)
Secondary or Sr. secondary	66 (18.1%)	270 (74.0%)	29 (7.9%)	365 9100.0%)
Graduation or above	11 (9.2%)	86 972.3%)	22 (18.5%)	119 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 36.310 with p-value <0.001			

Table5. Family Income vs. BMI Classification

Monthly family income (Rs)				
Less than 10,000	77 (29.3%)	171 (65.0%)	15 (5.7%)	263 (100.0%)
10,000 to 20,000	61 (20.2%)	221 (73.2%)	20 (6.6%)	302 (100.0%)
20,000 and above	15 (8.1%)	137 (74.1%)	33 (17.8%)	185 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 46.596 with p-value <0.001			

Table6. Children ever born to mother vs. BMI

Children ever born to mother				
1 or 2 children	24 (14.0%)	127 (74.3%)	20 (11.7%)	171 (100.0%)
3 or 4 children	60 (18.8%)	230 (71.9%)	30 (9.4%)	320 (100.0%)
5 or 6 children	37 (23.6%)	110 (70.1%)	10 (6.4%)	157 (100.0%)
7 or above	32 (31.4%)	62 (60.8%)	8 (7.8%)	102 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's $\chi^2 = 15.180$ with p-value 0.019			

CONCLUSION

Malnutrition should be completely abolished. The gravity of the study makes it clear that there is a need of well planned strategy to prevent malnutrition among the adolescent girls of the city. In the time of planning, the importance should be given for proper socio-economic and dietary characteristics.

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College Minor Projects

THE ROLE OF KHASI WOMEN IN CHANGING SOCIETY

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Introduction

Change is a normal thing in life and in the life of the society as well. Change requires not only our adaptation but also an adjustment to the various circumstances we meet in life. Rigid or traditional society can no longer exist in toto. Our Society has been greatly influenced by the Westernization and the modernization. As far as women are concerned, the role of women is defined in varied way and in diverse circumstances. The concept of women empowerment has been defined more intensively from the. latter part of the last century. Since 1970 when the economic crisis around the world deepened and the problem of mass poverty, malnutrition, unemployment, imbalances in socio economic development came into the limelight that attention was focused on the unfavorable status of women. Women in India as well as in our society are stllin marginalized and need special focus for the balance and all round development. The study is directed to the nature and condition of Khasi women in the changing aspect of social life

Scope of the Study: The studies about women are gaining momentum day by day. The reasons might be because it is a weak vessel in the society, prevailing prejudice and superstition, custom, demands and crisis, and such other factors. The study includes its scope on the family, school, economic and political environment. Simultaneously, the study considers the various sections hi the society like high and low income group, male and female, parents and children, school and out of school children, and so on. The findings would contribute immensely to the society by exposing the problems and rectifying its problems so that our female counterpart can effectively take part in the various activities in the society and towards developmental works.

Aims and Objectives of the study: The aims and objectives of the survey are

(l) To find out the size of the family among the Khasi society
(2) To fund out the educational status of parents.
(3) To find out the educational statuses of siblings of the respondents families
(4) To find out the rate at of dropped out among the Khasi families
(5) To find out the level of change in relation to the home environment of women
(6) To find out the level of change relating to the education of women environment
(7) To find out the level of change in relation to the economic activities of women
(8) To find out the level of change in relation to the political activities of women
(9) To find out if there is any difference in the awareness level between high and low income groups and between male and female relating the changes in the home environment
(10) To find out if there is any difference in the awareness level between high and low income group and between male and female in relation to the changes in the school environment
(11) To find out if there is any difference in the awareness level! between high and low income groups and between male and female in relation to me changes in the ecònomic activities
(12) To find out if there is any difference in the awareness level between high and low income groups and between male and female in relation to the changes in the political scenario in the society.

Limitation of the Study: The study is limited to the following areas

(l) The study is limited to the Khasi section of the community of Meghalaya.
(2) It is limited to the condition, role and responsibilities of women in the society
(3) Its subject areas is confined only to home, school, economic and political conditions

Population and Sample:

(i) The population and sample is taken,only from the urban colleges that means in particular of colleges located in Shillong city

(ii) Two co-educational institutions and one women college is taken in the study

(iii) Random sampling is adopted in the study.

Tool of the Study:

The tool used in the study is Comprehensive Modernity Inventory (CMI) of Kalia and Alluwalia (1985). It Is of five scale value. It is valid and standardized.

Statistical techniques

Suitable statistical techniques are adopted in the study. The techniques used in the above tool will be taken care of.

Sources:

Primary sources are used by directly administering the tool and secondary' sources can be derived by collecting and incorporating information/data available in the census document, MBOSE results, and Other related information

Abstract Findings

Who are we, we can say that there is a difference between the outlook of male and female on three aspects of life that is, education, political, and xonomic spheres except on home, where the difference is insignificant.

As far as the "B" category is concerned, it seems there is no significant difference between male and female in all those areas under study. But in the case of "A" category, it seems thai it is a difference in all-the areas, except education.

Thus the gap between'the categories "A"' and "B" need to be narrowed down in order to establish a just and equitable society. Similarly, the gap between 'tale and female under category "A" needs to be considered so that a balance growth and development could take place in the society.

The study is very vital in the resent day time. It is necessary to know the factors or areas where women in particuiar and the society in general are lacking. The study reveals that some of the factors that have led to the slow growth and development are the big size of the family, uneducated parents, high dropped out rate, unemployment and so on. When we consider from the overall point of view the following points are drawn

(a) About 73.47 percent of the-respondents are placed at ithe highest category in their perception and involvement in modem educational activities for women.

(b) About 50.43 percent of the respondents are placed in the highest category in their the need for women to take part in politics to meet the present needs and requirements

(c) About 86.08 per cent of the respondent are placed in the middle category in their positive attitude that women should be involved in economic life to meet the present day need

6. About 61.73 per cent of the respondents are in the middle category, saying that the role of women in the change has and should undergo change.Therefore need that Firstly, the belief, practice and system in the society has to be re-evaluated and enhanced to cope with the change in the present day world. Sedoadiy, Authorities should consider that "the gap between the ricjh and the |500r need to be narrowed down and also that the negative attltudi of some fectKHi of the society towards 'women development has to be rectified. Thirdly, Hop. /governmental. organizations in the society have to take up issues Ooncsnrng the poor and downtrodden. Fourthly all individual and all sections of the society should work together to evolve anal effective individual and society where there is dynamism and change toward the right directions. Fifthly, a mechanism has to be created to see that women participate in the developmental process so that we can reap a bright tomorrow.

FORMATION OF THE CREATION MYTH OF THE GAROS

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Certain myths are amongst mankind's earliest attempts to 'explain some of the most profound questions about the nature and origin of the universe. The aim of this project work is this urge to provide a justification, to explain for the workings of nature and history which have been experienced in all human civilizations. Every culture has a creation myth and so the attempts have been made to satisfy our need to understand the universe and our place in it. Themes common to many include a birth original chaos or a previous world, a divine edict when disobeyed brings sufferings to mankind (floods) and the action of the supreme beings. Attempts have also been made through this project work to update and refresh the experiences of people and most importantly to learn from their vast store of invaluable experiences.

The project work begins with the formation of the earth - how people, rocks and plants, animals and all living beings first came to be, including the birth of fire and the death of the mother goddess following the delivery of the fire. Using the normative survey method it has been attempted to discover the idea that myth teaches us about the past in order to build on and move forward to the future. In this regard myth becomes the essence of all morality. However, in doing so it has been found that some barriers arise in giving the significance of myth. At the same time, through discussions and interactions with the people from various fields of Garo Hills, it has been discovered that there are ways and means to overcome these barriers.

In the end, it is important to stress on the fact that the objectives of this entire project will only be attained if we help the society to realize that "Tribal traditions need not be devoted to, or perceived solely as something of the past, but instead be the catalysts for the creative instincts of a people that identify their culture." (Mamang Oai)

ACKNOWLEDGEMENT

At the very outset, I express my sincere gratitude to Dr. M.P.R. Lyngdoh, Principal, Shillong College, Dr. Malay Dey, Vice Principal, Shillong College and Prof K.D. Roy, Vice Principal of Professional Courses, Shillong College for providing all the facilities and encouragement to conduct the project work smoothly.

The worker of this project work, wish to extend a gratefulness to Madam Ruby Dkhar and entire team of the Research Committee, Miss. B. Lyngdoh, Librarian, Shillong College and the entire staff of the Library and the entire staff of Shillong College without whose cooperation this project work would not have seen the light of the day. Last, but not the least, I express my particular thanks to Dr. C.R Marak, Dr. Milton S. Sangma, Mr. Llewellyn R. Marak and Mr. Wilber K. Sangma at large who have directly or indirectly helped me throughout the project work.

INTRODUCTION

In very ancient times people have told stories to explain the mystery of the universe, of creation and destruction, of how people, rocks and plants, animals and all living beings first came to be and the way they grew to understand these mysteries was through stories called myths. Myths are a record of how past people saw the word.

According to Bullfinch 'Myth' does not mean something that is not real or true, but a kind of truth and a kind of reality not communicable by any means other than the symbolic story. For Stitch Thompson, myths are intimely connected with religious beliefs and practices of the people. They may be essentially hero, legends or etiological stories, but they are systematized and given religious significance.

Again Thompson's submission on myth undermines the operational value of myth as a timeless tool for interpreting even secular matters of the past present as well of the future. Myth is a sequence of past happenings as a historian and a timeless pattern which can be detected in the present social structure and which provides a clue for its interpretation a lead from which to infer future development.

The word 'Myth' carries various associations, ranging from false concepts to the ultimate truth. It is an elusive term to explain, nevertheless Myth informs so much of our literature and we need to understand what it is and how it functions. In the simplest sense myth is a story, the term in which the Greeks understand as a tale or a narrative, interrelated cluster of stories dealing with the activities. of gods & goddesses and god like beings. Myth is set in the

remote past which deals with the origin of the universe, gods,human beings. Myths do not exist as unique phenomena but rather are a part of a fully developed elaborate construction of a myth or mythologies.

In every culture from Asia to the Americas creation myths 'exist to explain how the world began and how the first people came to being. Likewise there are many kinds of narratives in Garo culture that use the same general form and tell a story, history, biography, fable, legend, epic & myth. Most of them contain an explaination that describes the beginning of humanity, earth, life and universe often as a deliberate act by one or more deities.

Myth, no doubt is a representation of the past, the understanding that the past affects the present. It has been an inspiration for artistic endeavour; painting sculpture, poetry, music, novels. This shows the power and importance of myths and the potent force they have on people both past and present indeed, They are our mirror that shows our hearts' desire to look into the core of existence and this paper posits that myth will always be important and significant in our lives.

OBJECTIVES OF THE PROJECT WORK

The Present Work Aimed at :

(a) Finding out how the world has been formed, its creation and how all its creatures came into being.
(b) Discovering the renovation of the fire and how men control fire since ancient times.
(c) To examine whether the myth acts as a connection between our past, present and future.
(d) Studying the significance of myth in our lives and whether this significance of myth still exists today.

Limitations of the Study:

(a) There was a paucity of time in conducting the survey which was one of the chief limitations.
(b) The survey was conduct during Puja Vacation and Winter Vacation, so unavaility of the local people is also one of the limitations, as most of the people are on vacation.
(c) Since the project work is based on orality it is not possible to do literal translation and many thoughts, ideas, concepts, Garo idioms, afraid may not be possible to put into translation and still carry their original meaning.

Methodology:

The whole project was carried out by normative survey method. Both primary and secondary data sources were used in the study.

Primary Data Sources:

The primary data was collected through questionnaires and interviews.

I) *Questionnaires:* The questionnaires were prepared keeping the objectives in mind and were distributed to the different people from Garo Hills to get an idea how some new reality came into existence and what is their significance?

Some questions incorporated in the questionnaires are as follows:

Questionnaire

1. Name:
2. Designation:
3. What is a myth?
4. How does the world its creation and all its creatures came into being?
5. Where do we begin?
6. What is the most important thing to start with?
7. How did the first cotton plant grow out of the white feather of a kite?
8. How did the man obtain a grain?
9. Who invented the rice beer?

10. How did the early humans first discover that they could harness and use the fire?
11. What were some of the main uses to which early humans put fire?
12. Why did the groom has been kept in a corner?
13. Is there any importance or significance of myth in our lives?

Interview: The responses filled up by the respondents in the questionnaires were at times vague and to get a proper understanding of the suggestions and ideas given by them I have adopted the technique of interviews. In this context person-to-person discussions were made with some university professors and educationists in addition to the interviews of the people of Garo Hills that were provided questionnaires.

SECONDARY DATA SOURCES: The secondary data sources such as books, journals, newspapers, articles, internet etc. were used in the study.

EXPLANATION:

CREATION:

In many ancient cultures and religions, there are some stories of the creation myth, these myths that normally tell of how the gods created the world and mankind.

BEGINNING:

In the beginning, there was just water and all is covered in darkness with no separation between the earth and the sky. The creator, Tatare Rabuga bears the earth through the goddess, Nostu Nopantu. The earth bore was named Mane Pilte. After all this had happened, one of the goddesses named Ajina Bijina attached this new land to the sky with four strings and she looked after the four corners of the earth. This land was still so wet and tender and so Gorang and Patrang, uncle and brother sowed the seeds of cliffs and "eyeballs of boulders upto Donare Wakchelchik, after getting the command from Nostu Nopantu. Even then the earth looked so bare and barren, so the creator ordered two sisters Tikre Tikse and Gatre Gatse to sow the seeds of variety of plants and trees and so the world became a pleasant place for all living beings giving shade to them. Then she bore the suri, moon and all living beings. Lastly Sre Tonggitchak Gitok Warikkat was born in such a way that caused the death of mother goddess, Susimema Sangkildoma. The funeral of Susimema Sangkildoma ultimately results in the formation of stars and constellations, which can now be seen as the Milky Way. The creator, Dakgipa Rabuga or Ba'bra created humans out of dust beneath the earth and blew life into them.

The general aspect of creation myth as shown in Garo myth is that they always involve the creation of human beings at some stage by god or supernatural entities. By doing this, a connection is established between the everyday world of human beings and the Supernatural world of gods who created the universe. It also establishes the place of human beings in the hierarchy of life inhabiting the universe. Man is placed below god and other supernatural beings but above animals and plants. This aspect shows us the etiological o1t'explanatory function of creation myths. The myth goes on to narrate the cause and effect of death of the ancient tree Siram Racha Bolking Gitel which was born with the earth. The do' mas (large bird) lost their shelter and pressurized other trees to allow them to perch on them. In order to meet the needs of do'mas, a girl named 'GITING' (banyan tree) was born who got transformed into a tree. She was given a choice by her mother Naori Timbori to marry one of the gods, Jarume'a Jabal Pante Okkuangsi Japang Cholsi (God of Cyclone) or Sreonggitchak Gitok Wa'rikkat (God of Fire), Banggri Ajimpa Chonggri Kajimpa (God of Earthquake), or Bil Goera Jakbalnisi Chela Rong'dot Jaktongmanggot (God of Thunder and Lightning) or Airokrak Wachitoktak (God of Rainstorm). She eventually married the Rainstorm god to acquire increase production and fertility.

DISCOVERY OF FIRE:

Human beings have known how to generate, control and use fire since very ancient times. The creation of fire could have been a chance of discovery - Prehistoric man could have acquired fire when a tree was struck by lightning, when a volcano erupted, when a powerful lightning could have set a tree or forest ablaze, or fire making could have been invented by mere coincidence. On a hot summer day a leaf or a twig may have caught fire in the open or may have been aimlessly rubbing against stones, a human being may have generated sparks quite accidentally. It would be

interesting to know how this momentous discovery was made. All the legends and lore of humanity speak of fire and sparks the same way as the myths and pristine poetry of the Greeks or the Hindus do. The one in which Prometheus stole fire from heaven hiding the fire within a hollow fennel - stalks and gave it to man is one of the best known fire myths. The Garos express in their myth the conviction that they received the art of generating and using fire from the Supreme God or from their tribal ancestors.

Susimema Sangkildoma got entangled and stumbled on the funeral pyre of Rabugama Ranangama (the spirit who tasted death for the first time) and conceived a baby. She delivered Sre Tonggitchak Gitok Warikkat (Fire) and died. So, fire was born in such a way that caused the death of mother goddess. Out of rage, Katchi Beari Rangsi Tokkni banished the fire to Bre Nalsa Rado Chichang (the other side of Rado Island). That is why fire dwells beneath the earth and sea. With the fire banished, it becomes inaccessible to cremate the dead body of Susime Sanglildoma. They made him a petition to come back to earth but he refused to appear in any tangible form and hence fire must have seemed very mysterious to early humans. But he employed a method of fire making, that is, by striking flints, (Wal'tot ToteWal'e Ra'aibo). Kindling fire by striking flints or rubbing sticks was not an easy job. It was much easier to keep it burning. So, the humans soon learned to control the fire by keeping it under ashes and blazing it into flames by feeding it with wood and dry grass or bamboos, and this probably led to their transition from nomads to settlers. Fire was undoubtedly one of our earliest conquests of nature. The greatest discovery made by man alone on this earth is the art of making and maintaining fire.

SIGNIFICANT OF FIRE IN GARO MYTHOLOGY:

Fire is significant in the mythology of all cultures because it is universally accepted that without fire humanity would not have survived or evolved hence it is always considered the 'gifts of gods'. If Susimema Sangkildoma would not have delivered the fire humanity would not have survived. The significance of fire in Garo mythology occurs in migration and farming. The Garos have a very distinct traditional belief of having migrated from Tibet. They settled down in Koch Behar about four hundred years ago and they moved to Dhubri and they came into conflict with the local chief who seemed to have enslaved them. Hence while moving from one place to another they were ill treated by the ruler of the region and have to flight with them many a time. The continuous head hunting raids into the surrounding plain areas is one of the recorded history of the Garos and it became their way of life. This lifestyle required a well equipped armory with a well equipped crew and fighting force and therefore the trade of blacksmiths became a very prestigious position within their community, for it was these men who build and made weapons for the warriors. Fire was very precious as it required constant attention and was affectionately kept in a special place - the hearth. With the ability to produce and control fire, humans could not only create heat and light but cook food that were difficult to eat in their raw state. The cooked meat becomes easier to digest and prevented the spread of many diseases. Fire also served as a source of protection against predators; heat in cold times, which allowed humans to migrate over a much larger percentage of the earth's surface. It keeps dangerous animals away from home; firewood could be worked into strong sharp pointed weapons, clay pots could be baked to a stone like hardness and land could be cleared for planting - Bonepa Janepa was the first man who cleared the land for farming. He cut the ancient tree and set it on fire before the monsoons which brought the death of Nambak Me'a Namsang Pante, a servant of Misipa Arajengpa. Out of his bones sprung up randu oThendu (arhaldal) which is a source nutrient to the people and also a medicinal plant. Eventually, the use of fire brought about the birth of civilization based on the smelting and forming of metals. In Garo Mythology, Goera was the god of thunder and lightning. Goera's adges sword, known as Mil'am made thunder bolts when god threw it. He snatched away the sword from his uncle Matchuri, a civet cat and went to heaven. Ajepa, a blacksmith, made the sword for the civet cat for giving him a fragrant smell of wind-breaking (KI.SI SIMILA). He showed it to his uncle by throwing the sword, which is a symbol of lighting. Here, a fire plays an important part in making the sword. Fire, the provider of heat, light and the source of life and growth was the centre of all religious rituals of the ancient Garos. Since fire played a very important part in the social and domestic life of the early settlers it was fed with animal fat and flesh, grains and incense which rose in smoke to reach the gods in the sky. As we have seen how the fire was discovered, those who first mastered the technique of setting dry sticks on fire must have felt fear and a sense of power. It served the people's needs in winter, with its glow; it helped them to see things in pitch dark nights. Fire thus enabled humans to conquer darkness which even in our times, children and adults continue to dread.

In the eighteenth century, Boswell suggested that fire led to cooking and this led to human civilization. But some modern environmentalists were of the opinion that the discovery of fire led to the destruction of rich forests into a vast savannah.

Ovid Writes:"By wind is a fire fostered and by wind extinguished, and by wind extinguished; a gentle breeze forms the flame, a strong breeze kills it, like many significant things in life and nature, there is this irony with fire too."

ORIGIN OF BROOM

A broom is a cleaning device. Since its origin, various types of brooms have come up. A smaller version is called a duster, and it is always made out of the feathers of poultry and other birds like peacock. Flat brooms were invented in the 19th Century made of corn stalks and commonly made with synthetic bustles today. Originally, these were made from natural fibers and are still very much used in India and other Asia Countries. In the developed world, vacuum cleaners have been used in place of traditional brooms, which is just another adaptation for the same purpose, that is, cleaning and sweeping. Brooms have also been long associated with witchcraft and are portrayed as medieval style round brooms. It would be interesting to know the information on the origin of broom according to Garo culture and why it has been kept in a corner of Garo houses.

The story has thus been told that Misi Saljong impregnates the foam of Witre Me'chik Witse Chera Nono Nokang and from this foam a broom was born. Feeling humiliated that she bore the baby broom from her uncle she prefers to stay in the corner. This serves to state the symbolic reason for a wife's commitment to the household chores and also a reminder of her docile nature.

The brooms were home and hand made in Garo Hills. Fibrous materials such as grass, straw or hay, fine twigs of leaves, leaves of coconut & betel nut tress were also used to make refined brooms for sweeping the floor and cleaning the ashes from the fireplace. Bamboo strips were used to tie the broom. Cooking at that time was different from what it is of today. It was done over a large open fire or a huge fireplace in the kitchen, and dust and ashes were part of kitchen life. As wood was carried inside the kitchen for heat and cooking, dust and ashes were often left behind as residue on the kitchen floor. The home made brooms swept clean the hearth and kept the home a more pleasant place to live in. The people of the Garo Hills use the broom not only to keep the households spotlessly clean but it was also seen as a tool for driving away the evil spirits. This is why it was waved over heads of sick person symbolizing the importance of cleanliness to ward off illnesses. Thus brooms should always be in use but not in the evening after sunset because then it is believed that gods will lose their way in their process of blessing people. It is also believed that a little sprinkle of water over a broom can be used over the sleeping person, who can temporarily be transformed #l{;~erSQflinto a tiger (Matchapil'a). The sleeping person thought it to be a firefly and try to grab it. One should be careful while trying out this task.

SIGNIFICATION OF MYTH:

Myth is a story that has significance to all cultures and civilization since the dawn of time. All creation myths answer to deeply meaningful questions held by the society and shares revealing insights of their central world view and the framework for self identity of the culture and individual in a universal context. It is the answers to these questions that are collectively called mythology. The word myth comes from the Greek word 'mythos' which translates a story with a meaning behind it. The term 'meaning' is used in many different senses. Meaning is often defined as the practical outcome of the thing in our future incidents. Thus, to understand a myth is to understand its purpose, its significance. Now, we can grasp the significance of it only when we understand its relation to other things, or its place in the system as a whole. The myths that have been re-told throughout the centuries have always had a moral behind them. The story of Asi and Malja is a powerful tale with a moral, the Nokma or the headman had to collect a crab from the stream for sacrificial rites for Rokkime, a goddess during 'Rugala' or thanks giving ceremony. At that time nobody can go out of the village or do any work. But Asi and Malja went to the jungle to collect firewood. This was an act of irreverence to Misi Saljong, the god of blessing. The profanation resulted in Asi being killed by a tigress and Malja being taken by a mermaid. This story played an important role in the society as a deterrent to bad behaviour.

One of the many functions of mythology was to provide a cosmology, to explain how the world came into being. When we read myth one can find the same basis in a number of different variations.

Another theme is the great flood, the Garo myth accounts for how a great flood had been caused by the feud between Dura Hill and the Songdu River. It is said that the daughter of Dura, Simera was married to Singra River, son of Songdu River (Brahmaputra). The ill match brought the death of Singra and that resulted in a flood which

lasted for seven days and seven nights. In order to save Durama Imbama from destruction, Salgra the sun god became very hot and Balgira, the wind god blew with great force. These myths reflect the constant anxieties of farming communities whose income and livelihoods depended on the flow of the rivers to irrigate their crops and also signifies the necessity of water, air and sun for farming. The ability to gain immortality through drinking the nectar of god is another reccurring theme in world mythology. The Garos also use this basis theme. The creator Oakgipa Rabuga gave the humans nectar to drink (Trop Janggi or Chijanggi Chichri) freely and it depends on the person who consumed it. More quantity of nectar consumed implied that the person survived longer. The ability for humans in mythology to shake off the shakles of their mortal bodies and become immortal shows our quest to become something better than what we are. Our ancestors believed that we could become immortal by taking the nectar of gods and this has allowed the chemists to pursue this resulting not in immortality, but inventions and to discover medicines that have helped humanity to survive for a longer period.

Myth helps us to understand the depths of a society and its people both past and present. In modern society, we can use myth to explore ancient culture. That we still refer to certain myths as examples of how we as individuals and communities should strive to be like, we may be an economically and culturally enlightened society. However, we have the same needs as ever - protection, warmth, food, sex, love, children, happiness, peace and prosperity.

John Campbell writes that "any good story would enchant us and teach us something, but myths are distance that they are potent, timeless tales which inspire and have the power to shape and control our lives"

Conclusion: The stories that we share in myth provides us values, morals and traditions. The tales we tell to children describe our characters. All myths are from a distant past, but what gives the myth an operational value is that specific pattern described is timeless; it explains and allows the past and the subject itself to present interpretation. Thus myths act as a connection, a bridge between our past, present and future creating a constant eternity. With this eternity we are called to learn, understand history, so that we might improve upon it. We can also use myth as a norm to view the culture in detail.

One might consider this inconsequential, but what we are looking at is the idea that myth teaches about the past in order to build on and move forward to the future. In this regard myth becomes the essential code of conduct. It is the driving force behind our cultures and ideals. Myths reflect what has been, what is and what came to be. It is like a mirror that shows our hearts' desire to look into it and that is why it has become so significant in our lives.

J.F. Bierlein elaborates on the fact that idea in his book "Parallel Myths" 1994 by stating 'the primitives' and the 'modern' are not at all that different as we might think the gaps between cultures narrow to reveal what is constant and universal in human experience.

Lastly, we can conclude that with the rapid change in the region, 'these ancient tales need not be perceived solely as something of the past as 'dead' literature, that in the process of documentation all the words are frozen in print and will have reached a dead end.' Those of us who see high moral standards as hope in our society can use the influence of myths of the past on their societies as a basis which will be suitable to our times and to build a better future.

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A STUDY OF THE ATTITUDE OF COLLEGE STUDENTS TOWARDS ABORTION

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INTRODUCTION

1.1 Background

Abortion may be defined as the termination of pregnancy before the fetus reaches the stage of viability, which is at approximately 20 to 28 weeks of gestation. There are cases of abortion which occur accidentally or spontaneously, and there are cases where an abortion is induced or performed purposely, as by a surgeon, it is artificial. In this case an abortion is brought on intentionally. There are some cases of abortion which are considered as legal and some as illegal; or some as moral and some as immoral. In the case of accidental abortion, many thinkers would agree that it is moral, whereas the intended abortion is counted as immoral. On the other hand, abortion is legal when it is passed by the law, like in this country until today, the Medical Termination of Pregnancy Act allows abortion upto 3 months or 12 weeks. But abortion may be legally right and morally wrong. In fact, here we are not interested whether abortion is legal or not, but on the question, "Can abortion be morally defended ?"

According to the liberal view, the just-fertilized egg or the fetus is not a person even after viability; hence the fetus should be disposable upon the mother's request, or in another way, to save the mother's life. To an extreme liberal, the fetus is always an appendix, and may be destroyed upon demand anytime before its birth.

Moving in the opposite direction, the Conservatives hold that the fetus must be a person even before viability. So their position is that the fetus may be aborted before quickening but not after, unless the mother's life is at stake. For the extreme Conservatives, the fetus once conceived, may not be destroyed for any reason, except if that is to save the mother's life.

Noting the above arguments, there is a disagreement as to the value of fetal life in its various stages. So the fundamental question to be best taken is, "When does a human life begin?' or 'at what stage in the development of a human being does it ceases to be morally permissible to destroy it?' According to Wertheimer, the expressions "a human life", "a human being", "a person" are virtually interchangeable in this context. He holds that every member of our species is indubitably a person, a human being at the very latest at birth. But the question that arise is, are we human lives at any time before birth? Almost everyone does agree that life begins right from the time of conception. However, there are people who say that it takes a month or even more after birth for the infant to become a person, and they say that a human being must have self-consciousness, or a personality. However, though they deny that a day-old infant is a person, they admit that its life cannot be destroyed or terminated for any reason that would not equally apply to a two-year old.

According to the liberals, even a previable fetus is a human being, but investigation shows that what the liberals mean is only to distinguish it from other animal's fetuses, and call it alive or living in opposition to dead or inert. The liberals by using the phrase" a human life" do not equally apply that expression as in connection with himself and his friends, rather to human terata, and at least in extreme cases, he is inclined to deny that they are human lives, and to dispose of them accordingly.

The extreme Conservatives defend that human fetus is as much a human being as the infants and adults are. This entire premise given by the Conservatives is unfolded with a simple, relentless logic, every principle of which would be endorsed by any sensible liberal. Suppose human embryos are human beings, their innocence is beyond question, so destroying them is unjustified, except, perhaps, the necessity of saving some other innocent human life. Since similar cases must be treated in similar ways, so abortion of a prenatal child would be justified as the killing of a postnatal child would be justified.

In the Church's view, the fetus is as much a human life as is the parent, both share the same moral status. Hence their view is that killing or taking the other person's life is not a just and decent way. The Church position is that because ensoulment is an unverifiable occurrence, we cannot locate it with certainty, hence abortion at any stage involves the risk of destroying a human life.

At this juncture of argument, the liberals say that it is just a matter of definition whether a fetus is a person. For note, both liberals and conservatives think it wrong to kill an innocent person except when that would be to save other human lives. But one may argue that asking whether fetuses are persons is similar to the question whether viruses are living creatures. The answer to this question is that they are like them in some ways, but not in others.

To this, the Liberals and the Conservatives suffer little indecision, precisely because with the virus we can say that we will, it is unlike the fetus. As regards the virus, scientists can manage nicely while totally ignoring the issue. Not so with the fetus, because deciding what to call it, is equivalent to a serious and unavoidable moral decision.

The question that most people seek to find an answer is about when a human life begins. According to the Liberals, life begins from birth or viability. At birth, the child enters the world, and can be acted upon and interacted with. On the other hand, someone may say that it is only at viability that the child has the capacity to do all those things it does at birth. The Liberals defend their view by pointing the difference between the infant and the embryo. They say that the embryo is different from us, adults, whereas an infant is not. They further say that if we call an embryo a human being or a human life, then presumably we think it as a valuable entity. But they add, what does it have that is of any value? Its biochemical potential to become one of us does not ensure that it is of any real value, especially if neither the mother nor any other interested party wants it to fulfill its potential.

The Liberals are on the firm ground on saying that embryo is of no value if no one has a good reason to want to do anything but destroy it. But the Conservatives say that the embryo is a human being and it is wrong to kill human beings, and that is why we must not destroy the embryo. The argument of the Conservatives that an embryo is a human being is turning the Liberals' argument inside out. While the Liberals stress the differences between disparate stages, the Conservatives stress the resemblances between consecutive stages.

The Liberals ask, "What has a zygote got that it is valuable?" and the Conservatives answer, "Nothing, but it's a human being, so it is wrong to abort it". Then the Conservatives ask, "What does a fetus lack that an infant has that is so valuable?" and the Liberals answer, "Nothing, but it's a fetus, not a human being, so it is all right to abort it". The arguments are equally strong and equally weak, for they are the same argument, an argument that can be pointed in either of two directions: it is we who must point it, and we who are led by it. If we are led in one direction rather than the other, that is not because of logic, but because we respond in a certain way to certain facts. According to the Moderates, the fetus is not a human being, it is a human fetus, and it has a separate moral status just as animals do. A fetus is not an object that we can treat however we wish, but neither is it a person whom we treat as we would wish to be treated in return. Thus, some legal prohibitions on abortions might be justified in the name of the fetus qua human fetus, just as we accord some legal protection to animals, not for the sake of the owners, but for the benefit of the animals themselves.

There is difficulty here to compare fetus with animals. Animals are permissible to be killed for different reasons. But most of us, in general, argue that the later the development stage of the fetus, the more restricted our permission to kill. And most of us think that destroying the fetus is beyond our system of beliefs.

Seeing the above arguments, most of us would agree with the Conservatives and the Moderates. Thus, abortion is unjustifiable. This implies that for us a fetus is as much a human being and has life as the infants and adults do, so it is wrong to terminate the fetus. But on the other hand, one may argue that in case of therapeutic, where by continuation of the pregnancy, the mental or physical health of the mother is endangered, then abortion is morally justified. This discussion of abortion, thus, is open to debate where one may defend it, while others may not. But, to conclude, human life whether it is a fetus or a born one must be protected and valued as much as we can.

1.2 Title of the Study

The title of the study is, 'A Study of the attitude of College Students towards Abortion'.

1.3 Objectives of the Study

The objectives of the study are:

a) To work towards an understanding of the students' awareness of an attitude towards abortion.
b) To investigate into the factors leading to the presence of abortion cases.
c) To project a possible scenario of the vice of abortion cases.
d) To educate the people that abortion is against basic concept of life.

1.4 Methodology

1.4.1 Tool for Data Collection:

In order to gather information for the present study, Questionnaire for the college students was used. The Questionnaire included closed ended questions and TICK MARK only. The questions were used in order to know their opinions relating to abortion cases.

1.4.2 Data Collection:

Data were collected by distributing the Questionnaires to the Degree students of Shillong College only. The quantum of data collected in the Analysis is given in the table below:

Male Students 22 **Female Students** 30

1.4.3 Data Analysis

The data and information collected for the Study were analysed using percentage method. Attempts were made to analyse each item of the responses by giving percentage calculations on the basis of percentage for each item data were interpreted. The procedure adopted in analyzing the data and the findings thereof along with their interpretations were presented in Chapter II.

ANALYSIS AND INTERPRETATION OF DATA

This Chapter deals with the analysis and interpretation of data. The responses to the questionnaires by the college students were classified and analysed. The analysis and interpretation of data collected through the questionnaires have been calculated and results tabulated in percentage. The analysis and interpretation of data have been grouped under the following:

- Abortion can be justified for a woman whose pregnancy makes her suffer.
- Abortion can be justified when pregnancy endangers the woman's health.
- Abortion can be justified for a woman whose child whom she holds in her arms is still small.
- An abortion can be the only solution for a married couple who does not have the means to have one more child at this time.
- Abortions can be justified if for example one could not prevent a girl from wandering.
- An abortion can be the only solution when a couple is not married, they have a stable relation but the young man for example does not have enough means.
- An abortion can be justified when a woman took a pregnancy which was not that of her husband.
- An abortion can be the only solution for a couple who is not married and is not ready to commit, for example, if one of the two is not serious.
- An abortion can be the only solution for a married woman who wants to pursue her (economic) activities.
- An abortion can be the only solution in case of adultery, for example, when a married man makes a young girl pregnant or when a woman becomes pregnant by a young man.

Table 2.1 Abortion can be justified for a woman whose pregnancy makes her suffer

Degree of Interest	Male		Female		Total	
	N=22	(l'll	N=30	(Yo	N=52	%
Agree	14	63.64	8	26.67	22	42.31
Disagree	8	36.36	21	70.00	29	55.77
No Response	0	0.00	1	3.33	1	1.92

According to the above table, 63.64 % male students agree that abortion can be justified for a woman whose pregnancy makes her suffer, whereas 70.00% female students disagree.

Table 2.2 Abortion can be justified when pregnancy endangers the woman's health

Degree of	Male		Female		Total	
Interest	N=22	(1<)	N=30	%	N=52	(Yo
Agree	21	95.45	21	70.00	42	80.77
Disagree	1	4.55	9	30.00	10	19.23
No Response	0	0.00	0	0.00	0	0.00

The above table shows that 95.45% male students and 70.00% female students agree that abortion can be justified when pregnancy endangers the woman's health.

Table 2.3 Abortion can be justified for a woman whose child whom she holds in her arms is still small

Degree of	Male		Female		Total	
Interest	N=22	olll	N=30	%	N=52	%
Agree	5	22.73	3	10.00	8	15.38
Disagree	17	77.27	27	90.00	44	84.62
No Response	0	0.00	0	0.00	0	0.00

The above table indicates that majority (77.27%) of the male students and almost hundred percent (i.e. 90.00%) of the female students disagree that abortion can be justified for a woman whose child whom she holds in her arms is still small.

Table 2.4 An abortion can be the only solution for a married couple who does not have the means to have one more child at this time

Degree of	Male		Female		Total	
Interest	N=22	(Yo	N=30	%	N=52	%
Agree	7	31.82	6	20.00	13	25.00
Disagree	15	68.18	24	80.00	39	75.00
No Response	0	0.00	0	0.00	0	0.00

The above table shows that majority (68.18%) of the male students and majority (80.00%) of the female students disagree that an abortion can be the only solution for a married couple who does not have the means to have one more child at this time.

Table 2.5 Abortions can be justified if for example one could not prevent a girl from wandering

Degree of	Male		Female		Total	
Interest	N=22	°lt)	N=30	o	N=52	%
Agree	4	18.18	5	16.67	9	17.31
Disagree	17	77.27	24	80.00	41	78.85
No Response	1	4.55	1	3.33	2	3.85

Table 2.5 above indicates that 77.27% of the male students and 80.00% of the female students disagree that abortions can be justified if for example one could not prevent a girl from wandering.

Table 2.6 An abortion can be the only solution when a couple is not married, they have a stable relation but the young man for example does not have enough means

Degree of Interest	Male		Female		Total	
	N=22	(Yi	N=30	%	N=52	%
Agree	8	36.36	5	16.67	13	25.00
Disagree	14	63.64	25	83.33	39	75.00
No Response	0	0.00	0	0.00	0	0.00

The above table shows that 63.64 % of the male students and 83.33 % of the female students disagree that an abortion can be the only solution when a couple is not married, they have a stable relation but a young man for example does not have enough means.

Table 2.7 An abortion can be justified when a woman took a pregnancy which was not that of her husband

Degree of Interest	Male		Female		Total	
	N=22	(Yo	N=30	%	N=52	%
Agree	8	36.36	8	26.67	16	30.77
Disagree	14	63.64	21	70.00	35	67.31
No Response	0	0.00	1	3.33	1	1.92

Table 2.7 above shows that majority (63.64%) of the male students and majority (70.00%) of the female students disagree that an abortion can be justified when a woman took a pregnancy which was not that of her husband.

Table 2.8 An abortion can be the only solution for a couple who is not married and is not ready to commit, for example, if one of the two is not serious

Degree of Interest	Male		Female		Total	
	N=22	%	N=30	%	N=52	%
Agree	8	36.36	7	23.33	15	28.85
Disagree	13	59.09	23	76.67	36	69.23
No Response	1	4.55	0	0.00	1	1.92

The above table indicates that 59.09% of the male students and 76.67% of the female students disagree that an abortion can be the only solution for a couple who is not married and is not ready to commit, for example, if one of the two is not serious.

Table 2.9 An abortion can be the only solution for a married woman who wants to pursue her (economic) activities

Degree of Interest	Male		Female		Total	
	N=22	(Yo	N=30	%)	N=52	%
Agree	5	22.73	3	10.00	8	15.38
Disagree	16	72.73	27	90.00	43	82.69
No Response	1	4.55	0	0.00	1	1.92

Table 2.9 shows that majority (72.73%) of the male students and nearly hundred percent (90.00%) of the female students disagree that an abortion can be the only solution for a married woman who wants to pursue her (economic) activities,

Table 2.10 An abortion can be the only solution in case of adultery, for example, when a married man makes a young girl pregnant or when a woman becomes pregnant by a young man

Degree of Interest	Male		Female		Total	
	N=22	(Yo	N=30	(Yo	N=52	%
Agree	6	27.27	11	36.67	17	32.69
Disagree	15	68.18	19	63.33	34	65.38
No Response	1	4.55	0	0.00	1	1.92

This table indicates that 68.18% of the male students and 63.33% of the female students disagree that an abortion can be the only solution in case of adultery, for example, when a married man makes a young girl pregnant or when a woman becomes pregnant by a young man.

SUMMARY OF FINDINGS AND CONCLUSION

5.1 Findings

Based on the analysis and interpretation of data in Chapter II, the major findings of *I* A Study of the Attitude of College Students towards Abortion' are summarized below:

1. It was found that majority of the students (55.77%) agree that abortion is justified in cases where pregnancy makes the woman suffer.
2. SO.77% students are of the opinion that abortion can be justified when pregnancy endangers the woman's health.
3. Majority of the students (S4.62%) disagree that an abortion can be justified for a woman whose child whom she holds in her arms is still small.
4. Both male and female students (75%) disagree that an abortion can be the only solution for a married couple who does not have the means to have one more child at this time.
5. 75.S5% students disagree that abortion can be justified if for example one could not prevent a girl from wandering.
6. It was also found that most students disagree that an abortion can be the only solution when a couple is not married, they have a stable relation but the young man for example does not have enough means.
7. 67.31 % students disagree that an abortion can be justified when a woman took a pregnancy which was not that of her husband.
8. The study revealed that 69.23% students disagree that an abortion can be the only solution for a couple who is not married and is not ready to commit, for example, if one of the two is not serious.
9. Majority (82.69%) of the students disagree that abortion can be the only solution for a married woman who wants to pursue her (economic) activities.
10. It was also found in the study that 65.38% of the students disagree that abortion is justified in case of adultery.

5.2 Conclusion

On the basis of the findings of this study - ' A Study of the Attitude of the College Students towards Abortion', it was found that most of the students agree that abortion is unjustifiable, except in the case when the physical health of the mother is endangered. This ~ implies that human life, whether it is a fetus or a born one must be protected and valued as much as we can.

STUDY OF ADSORPTION OF OXALIC ACID AT DIFFERENT CONCENTRATIONS ON CHARCOAL/RICE HUSK ASH AND HENCE TO VERIFY FREUNDLICH'S ADSORPTION ISOTHERM

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Introduction:

Adsorption is a phenomenon in which particles adhere to the surface of solids, the particles instead of penetrating inside remain relatively more concentrated near or on the surface. In other words, we can say the concentration of one component in the vicinity of the surface is different from that in the bulk. Adsorption occurs because of the unsaturation of the surface or the excess free energy of the surface. Based on the nature of interaction of the adsorbate molecules with the surface of adsorbent, adsorption is classified into two types- Physical Adsorption or Physisorption and Chemical Adsorption or Chemisorption. Physical adsorption occurs when the interaction is vander Waals type, and Chemical adsorption occurs when the interaction is chemical in nature. Generally physical adsorption takes place at low" temperature on a surface i.e it is exothermic process while on the same surface, chemisorption is favoured at a higher temperature. The substance on the surface of which adsorption occurs is the adsorbent and the substance that gets adsorbed is termed adsorbate. The magnitude of adsorption depends upon i) the nature of the adsorbent and its state of subdivision ii) the nature of the adsorbate iii) its concentration or pressure and iv) the temperature.

Known Practical applications of Adsorption

There are innumerable industrial processes starting from the synthesis of ammonia to the manufacture of alcohol or synthesis of petrol, or heterogeneously catalysed reactions which involve the process of adsorption. Most of these catalytic reactions are effective through adsorption of reactants on solid surfaces. The stabilization of colloid through adsorption of ions on the particles is of considerable interest both from the practical and theoretical stand point. The function of gas mask is based on the preferential adsorption of harmful gases present in the atmosphere by the use of suitable adsorbents in order to purify the air from inhalation. The role of charcoal in the recovery of iodine and many dyes from their dilute solution, or its role in the clarification of syrups in sugar industry, etc is based on its adsorption capacity. Adsorption is widely used nowaday in separating and analyzing valuable and minute quantities of component from a mixture. A suitable adsorbent, often used is fmely powdered aluminium oxide, magnesium oxide or charcoal. The principle involved in the process is known as chromatographic method. Another application of adsorption is found in the use of ion exchangers. One such example is water softening by using Zeolites which has the capacity to exchange some of the cations they contain for others in solution. There are several methods to treat the metal contaminated effluent such as precipitation, ion exchange and adsorption etc, but the selection of the treatment methods is based on the concentration of waste and the cost of treatment. Carbon has been the most used adsorbent; nevertheless it is relatively expensive. Cost is an important parameter for comparing the sorbent materials. However, cost information is seldom reported and the expense of individual sorbents varies depending on the degree of processing required and local availability. In general, a sorbent can be assumed as low cost it is requires little processing, is abundant in nature, or is a by-product or waste material from another industry. Activated carbon from cheap and readily available sources such as coal, coke, peat, wood, rice husk may be successfully employed for the study of adsorption of oxalic acid in aqueous solution. In the last few years, adsorption has been shown to be an economically feasible alternative method, the study on the adsorption of gaseous liquid metal has been carried out using rice husk ash (henceforth abbreviated as RHA) as adsorbent. In many cases, RHA shows excellent adsorption capacity compared to other known adsorbents The objective of this study was to explore the feasibility of rice husk ash as an adsorbent as well as to compare the adsorption capacity between rice husk ash against charcoal for the removal of oxalic acid from aqueous solution. Moreover it will help the student in understanding better how different materials are adsorbed differently. The type of adsorption that takes place is mainly the physical adsorption or physisorption. The parameters that influence adsorption such as initial oxalic acid concentration, agitation time were investigated.

Source of Adsorbent:

The rice husk used was obtained from one of the rice mills situated in Ri Bhoi district of Meghalaya. The rice husk is kept and burnt in an open space for 6 hours, it is crushed and thoroughly washed with distilled water to remove all dirt and then dried at 100°C to be of constant weight. The dried husks is sieved in order to obtain in powder form and finally stored in desiccator until it is used.

Apparatus Required:

Electrical shaker, Beakers, Burette, Pipette, Charcoal, RHA, Oxalic acid solutions

Methodology:

Freundlich's adsorption isotherm is an empirical relation showing that the amount of adsorbate per unit mass of adsorbent depends on the concentration or pressure of the adsorbate as shown by the equation,

$$x/m = kC^{1/n} \quad \text{.....(1)}$$

where x = mass of oxalic acid = (Co-C)MV,

m= mass of Charcoal/RHA

M= molecular weight of Oxalic Acid

V = Total volume of solution

Taking log of the above expression,

$$\log (x/m) = \log k + 1/n \log Co \quad \text{.....(2)}$$

Experimental Procedure:

1. Stock Solutions of 0.05 N Oxalic Acid and 0.02 N NaOH are prepared
2. NaOH solution is standardized with standard solution of oxalic acid using phenolphthalein indicator.
3. Oxalic acid solution is taken in four labelled-reagent bottles as follows:

Bottle No	*Volume of Oxalic Acid (ml)*	*Volume of Water (ml)*
1	100	0
2	50	50
3	25	75
4	12.5	87.5

4. In each reagent bottle, 2 gm of charcoal is added and then put in the shaker for at least 2 hours until equilibrium is attained.
5. The bottles are then removed from the shaker, allowed to stand and then filtered.
6. Pipette out 10 ml of the filtrate into the conical flask, add one drop of phenolphthalein indicator and titrate against 0.02 N NaOH solution from the burette till the colour changes to light pink.
7. The titration is repeated for at least twice for each bottle to get two consecutive readings same.
8. The experiment is repeated all over using Rice Husk Ash (RHA) in place of charcoal
9. A graph is then plotted with log *x/m* as ordinate and Co as abscissa when a straight line is obtained making an intercept with the ordinate. The intercept made by the line is measured wherefrom the value of k is calculated. The slope of the line gives the value of n.

Results and Discussions:

The adsorption of oxalic acid in aqueous solution on charcoal and rice husk ash (RHA), were examined by optimizing various physicochemical parameters such as contact time, concentration amount of adsorbent and adsorbate.

Table I & II a) show the data obtained using Charcoal as adsorbent while Tables I & II b) show the data obtained using RHA as adsorbent and the discussions to compare and contrast the results using the two types of adsorbents are of interest in making a choice of selecting the adsorbent for practical purposes.

Table I a) : Concentration of oxalic acid before and after adsorption on Charcoal

Bottle No.	Volumeinml		Concentration of Oxalic acid (N)	
	Oxalic acid	NaOH	before	after
1	10	16.0	0.05	0.0320
2	10	6.6	0.025	0.0132
3	10	2.6	0.0125	0.0052
4	10	1.2	0.00625	0.0011

Table II a) : Amount of adsorbate per mass of adsorbent (x1m) using Charcoal

Bottle No.	Weight of charcoal)	Concentration change of oxalic acid (Co·C)	x=(Co·C)MV	x/m	Logx/m
1	2	0.018	226.8	113.4	2.050
2	2	0.0118	148.6	74.34	1.870
3	2	0.0073	91.98	45.99	1.660
4	2	0.00514	64.8	32.40	1.510

Table I b) : Concentration of oxalic acid before and after adsorption using RHA

Bottle No.	Volume in ml		Concentration of Oxalic acid (N)	
	Oxalic acid	NaOH	before	after
1	10	9.3	0.05	0.0186
2	10	4.1	0.025	0.0082
3	10	1.0	0.0125	0.0020
4	10	0.8	0.00625	0.00002

The above results obtained give interesting observations which are of importance for discussion. Table I a) for all sets using charcoal as adsorbent clearly indicates that there is not much of difference between the concentration of oxalic acid before and after adsorption and in contrast to Table I b) for all sets using RHA as adsorbent showing a large difference in the concentration of oxalic acid before and after adsorption. One point to interpret here is that more amount of oxalic acid is getting adsorbed on to the RHA than to Charcoal surface.

Another observation is that the amount of adsorbate adsorbed per mass of adsorbent is more in the case of RHA than of Charcoal as shown by the different values of x/m for all the four different sets. Freundlich proposed that if adsorption obeys the empirical relation then the plot of log (x/m) Vs Co should be a straight line making intercept with the log (x/m) axis, the

intercept gives the value of and the slope of the line gives the value of n. A graph of log x/m V s Co has been plotted in each case whereby a straight line is obtained in both cases, the straight line makes an intercept on the log x/m axis and the values of k and n are calculated from the graph. In both cases, Freundlich's Adsorption Isotherm is verified, for RHA the

values ofn and k are 0.082 and 30.90 whereas for Charcoal the values are 0.029 and 19.95 respectively.

Conclusion The investigation work led us in finding that RHA would make a better adsorbent than Charcoal, and to add more, the utilization ofRHA in the process of adsorption would be more favorable than activated charcoal in removing oxalic acid and thus is a better adsorbent.

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PHYSICO-CHEMICALAND BACTERIOLOGICALANALYSIS OF RIVER UMKHRAH, SHILLONG, MEGHALAYA, INDIA

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INTRODUCTION

Water is vital for life activities and is indispensible for human existence. It can be obtained from a number of sources like lakes, rivers, streams, ponds etc. Unfortunately, clean, pure and safe water only exists briefly in nature and is immediately polluted by prevailing environmental factors and human activities. This is the reason that the water quality is a current environmental issue worldwide [1, 2]. In many developing countries availability of water has become a critical and urgent problem and is a matter of great concern to families and communities that depends on non-public water supply system [3]. In India, about 36% of urban and 65% of rural population is without access to safe drinking water [4]. Majority of the water bodies are polluted due to discharge of defective municipal sewerage system, effluent from septic tanks and sewage. According to Geldreich [5], other sources that contaminate the water are domestic waste water, storm water runoff, cattle feedlots runoff etc. These effluents contain human and animal faeces along with pathogenic microorganisms. In term of human health, the most dangerous water pollutants are pathogenic micro-organism [6]. These include *Salmonella* sp, *Shigella* sp, *Vibrio cholerae* and *E.coli* [7]. Consumption of water contaminated by these microorganisms poses the danger and risk of water borne diseases like cholera, typhoid fever, diarrhoea and dysentery and other diseases. It is important to note that, two and a half billion people have no access to improved sanitation, and more than 1.5 million children die each year from diarrheal diseases [8]. So, analysis for the presence of water borne pathogens become extremely important to further screen and treat the water to make it fit for human use. The utility of river water for various purposes is governed by physico-chemical and biological quality of the water [9] and therefore an analysis on physico-chemical parameters on river waters was made by many workers [10, 11]. Therefore the assessment of the changes in river communities as a result of the impact of pollution is particularly interesting issues within the framework of aquatic ecology, since running waters are becoming increasingly affected by anthropogenic discharge [12]. In this context, detailed knowledge of faecal pollution of aquatic environments is crucial [13] and therefore, this study is undertaken to assess the physico-chemical properties like pH, alkalinity, biological oxygen demand, chemical oxygen demand and bacteriological components of river Umkhrah in Shillong, Meghalaya, North-east India where many people living on its banks still uses it as a source of water for washing and bathing.

MATERIALS AND METHODS

Study area:

Meghalaya, which is also known as the abode of clouds is one of the states in North-east India. It lies between 25°52 North and 26°102 North latitudes and 89°472 East and 92°472 East longitudes. Shillong is the capital of the state and located at an altitude of 1,496m above sea level with Shillong peak as the highest point (1,966m). There are many rivers and streams in Meghalaya and River Umkhrah in Shillong, is one of them. River Umkhrah originates from Laitkor Peak and runs through many localities of Shillong town like Demthring, Lapalang, Umpling, Polo, Wahingdoh, Mawlai before reaching the Umiam reservoir. Since the river passes across the city, it also serves as a dumping ground for municipal waste that enters the river from different drains causing organic and faecal pollution. In addition, the presence of urban settlement, abbatoir and vehicle repairing centre along its banks further pollute its water by the seepage of domestic sewage, oils, lubricants and other solid wastes. Considering its high pollution level, it is therefore felt necessary to assess the physico-chemical properties and bacteriological components of the surface water during the post monsoon and monsoon with a view to ascertain its human use potential.

Physico-chemical analysis:

The present study was conducted during the month of November 2012 and July 2013. The water samples were collected by random sampling technique from three sites namely Polo, Wahingdoh and Mawlai using sterilized plastic water bottles. A total of nine water bottles of two litres capacity were used for the collection of water sample from the field for the analysis of the physico-chemical parameters (pH, alkalinity, biological oxygen demand, chemical oxygen demand). For the determination of biological oxygen demand and chemical oxygen demand the water samples were immediately fixed after collection to get accurate results. The pH was determined in the field itself using digital pH-meter. The water bottles containing the samples were covered tightly and then kept in an ice-box and brought to the laboratory where they were stored in a freezer (- 15°C) for further analysis. The physico-chemical properties were analysed accordingly using standard protocol [14]. Comparison of the water quality parameters was followed according to ICMR and WHO [15, 4].

Statistical analysis:

The data collected in replicates were analysed using standard statistical analysis.

Bacteriological analysis:

Microbial analysis of water is to check the presence of different groups of microorganisms present in water. This can be done by various techniques. One of the most widely used techniques for checking the total coliform bacteria is the MPN technique [14]. Total coliform and faecal *E. coli* was determined by means of standard coliform fermentation technique including presumptive, confirmed, and completed tests. The tubes and plates were incubated overnight at 37°C, and after incubation, cultures were examined for distinct colonies.

RESULTS AND DISCUSSION

The results of the physico-chemical analysis of the water quality of Umkhrah river from all the three sites are showed in Table1. pH is the measure of the level of hydrogen ion and is one of the most important parameters to study the acidic or basic characters of water bodies. In the present study it was found that in the month of November 2012, the mean pH value in all the three sampling sites, i.e Polo, Wahingdoh and Mawlai ranged from 5.37(± 0.15) - 6.17(±0.11) and in the month of July 2013 it ranged from 6.27(±0.18) - 6.45(±0.2) (Figure1). The study showed that the values of the pH recorded were lower than the standard range of 6.5 to 8.5 [15, 4]. High organic load dumped into the river through various sources and their decomposition leading to acidification might be the reason for the decrease in pH. In this context, the lower pH value could be as a result of contamination by acidic substance [16]. A similar logic was put forward by Offiong and Edet [17] who attributed the lower pH of Akpsbuyo, Cross river basin, South-Eastern Nigeria, due to the presence of humic acid associated with the biological decomposition of vegetation buried in the water body.

Likewise, measuring alkalinity is important in determining the river's ability to neutralize acidic pollution and during the present investigation, the minimum value of alkalinity recorded from the three sites was 92mg/l and maximum value was 196mg/l (Figure 2). It was also observed that the alkalinity value increases from upstream (Polo) to downstream (Mawlai) as has been reported by Murugan [18]. It is important to note that the alkalinity was slightly higher during the month of November 2012 than the month of July 2013. The low water level and the discharge of untreated sewage might be the reason for the higher value of alkalinity during the dry period. The alkaline nature of the water could be attributed to the buffering properties of some inorganic substances [19].

Biological oxygen demand is another important parameters to analyse the oxygen content of the water body required by the aquatic organisms. BOD value recorded from all the sites was very high during the month of November 2012 (Figure 3). This might be due to the untreated sewage that is being dumped into the river that contributed to higher BOD in the river system. Similarly, the biodegradation of organic materials exerts oxygen tension in the water and increases the biological oxygen demand [20]. Ahipathi and Puttaiah [21], reported that open defecation nearby the river and discharge of sewage resulted in higher BOD in Vrishabhavathi river in Bangalore. This might also be a case of high BOD in Umkhrah river because of the faecal matter that drains from latrines that are located all along the banks of the river.

The measure of COD is important to know the quantities of organic compounds in water. It is used to indirectly measure the amount of organic compounds in water [22]. Interestingly, it is used as a useful indicator of toxic and biologically resistance organic substances present in water [23]. In the present investigation, it was found that the COD value was very high with a mean value of 208, 215.8 and 273.25mg/l in the month of November 2012 and 56.3, 56, 73.75mg/l in the month of July 2013 (Table 1 and Figure 4). High COD values clearly show that the water is heavily polluted. The excessive increase in COD values in the river might be due to the non-decomposed or partially decomposed vegetation and activity of microorganisms increased which led to increase in oxygen demand [24]. The increase in COD value may be also attributed to domestic waste and other untreated sewage that are dumped into the river.

Microbiological water analysis is mainly based on the concept of faecal indicator bacteria. Presence of gas and turbidity in the tubes and metallic sheen or pink colour of the colonies with dark centre on the EMB agar found to be positive for Gram negative bacteria all belonging to faecal coliform group. All the samples were contaminated with *E.coli* and *Enterobacter cloacae*. However, during the study period no growth of *Salmonella* sp, *Shigella* sp, *Vibrio cholera* were detected. The presence of coliform bacteria indicates that the water is contaminated with faecal waste and hence the usage of the water could be hazardous to human health because these bacteria cause water borne diseases like dysentery, typhoid fever, cholera and many other illnesses [25]. Therefore, in this context, it is important to note that children under five, primarily in Asian and African countries, are the most affected by microbial diseases transmitted through water [26]. The detection of faecal coliform alone can generally serve as an adequate guide for determining whether pathogenic organisms are present in the water [27].

CONCLUSION

The present study reveals that the physico-chemical and bacteriological parameters investigated were found to be above the permissible limits of WHO. Presence of *E.coli* indicated that the water is polluted with faecal matter, Anthropogenic activities, discharge of untreated municipal sewage, domestic effluent and drains leads to pollution of the river. Considering the pollution level of the water, it is suggested that the water is not suitable for human activities. Therefore the authority and the general public at large should come together to safeguard the river Umkhrah which will result in acceptable water quality and conforms to national and international directives.

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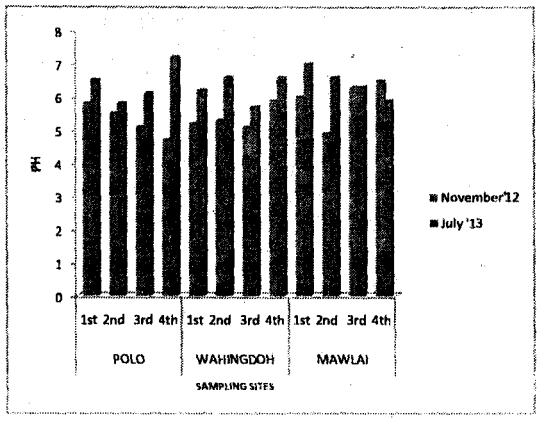

Figure 1: *Graphical representation of pH of three study sites*

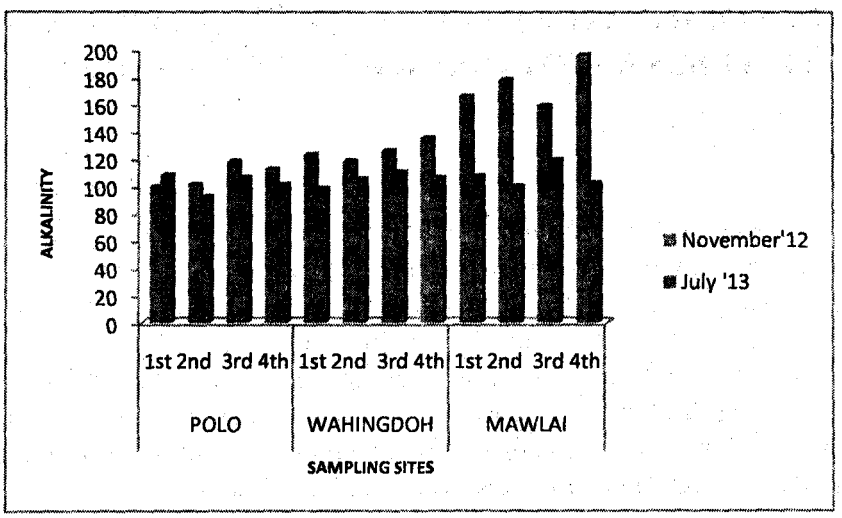

Figure 2: *Graphical representation of alkalinity of three study sites*

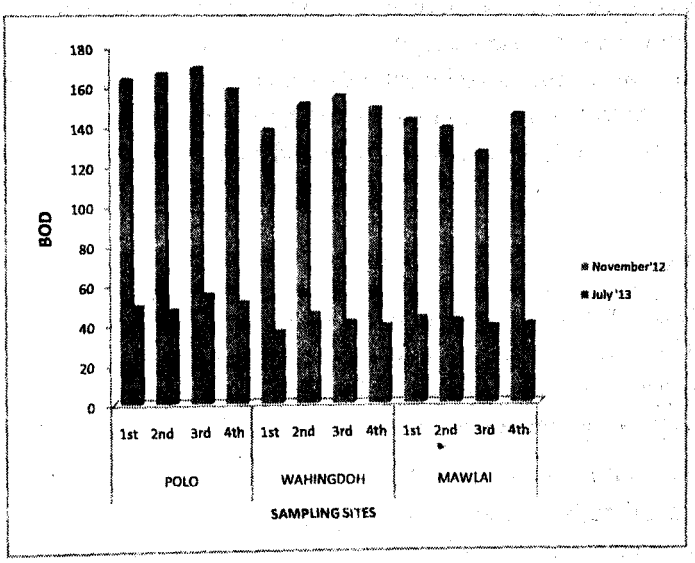

Figure 3: *Graphical representation of BOD of three study sites*

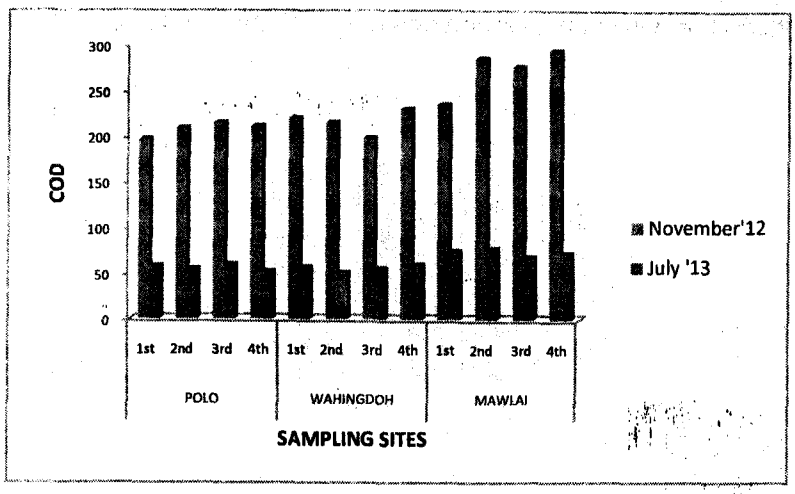

Figure 4: *Graphical representation of COD of three study sites*

GAULTHERIA FRAGNATISSIMA WALL (THE INDIAN WINTERGREEN): ITSTUSES AND MANAGEMENT IN MAWPHLANG

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Gaultheria fragrantissima Wall. or the Indian Wintergreen (Local name -lathynrait) belonging to the family Ericaceae, is an evergreen, aromatic shrub common in central and eastern plateau of Khasi hills, at altitudes of 5,000-6,000 ft. *Gaultheria fragrantissima* is found to be growing profusely in areas around the Mawphlang Sacred Grove. It is also found abundantly in the open community forest adjoining the Mawphlang Sacred Grove. The leaves of the plant have been known to contain oil, known as oil of Wintergreen. In Mawphlang, it has been found that the local people particularly the traditional healers use the leaves of this plant as treatment against rheumatism, arthritis and other ailments of joints. However, it was also found that *G fragrantissima* is not fully exploited and the local people in Mawphlang are not aware of a number of other uses and extraction methods.

The leaves and sometimes the branches are harvested manually by hand picking whenever required. Local people also harvest this plant not only for using it directly as medicine but for selling in other places of Meghalaya where it fetches a fairly high price. The species is still abundant but since it is now a known medicinal plant, it is exploited by herbalists to a large extent even at present. The slash and burn method of cultivation practiced in the hills has also posed a threat to the species, especially its regeneration by natural means. Its protection and conservation is possible through sustainable harvesting along with various safeguards and methods which includes protection from fire and grazing, nurturing the young regenerations, non-destructive harvesting and cultivation of the plant species on a commercial scale by the local people.

1. INTRODUCTION

Medicinal plants are a diverse category of plants directly used from the wild. Of the 2, 50,000 higher plant species on earth, more than 80,000 are medicinal. India is one of the world's 12 biodiversity centres with the presence of over 45000 different plant species. Of these, about 15000-20000 plants have good medicinal value. Approximately, only about 7500 medicinal plant species are traditionally used by the tribals in India (Anonymous, 1994).

Estimates indicate that over three-quarters of the world population relies mainly on plants and plant extracts for health care (Joy, 1998). Medicinal herbs and shrubs are staging a comeback and herbal 'renaissance' is happening all over the globe. The herbal products today symbolise safety in contrast to the synthetics that are regarded as unsafe to human and environment. People are returning to the naturals with hope of safety and security.

About half of the world's medicinal compounds are still derived or obtained from plants (Hamann, 1991). The drugs are derived either from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc.

Some drugs are prepared from excretory plant product such as gum, resins and latex. Even the Allopathic system of medicine has adopted a number of plant-derived drugs which form an important segment of the modern pharmacopoeia. Some important chemical intermediates needed for manufacturing the modern drugs are also obtained from plants. Not only, that plant-derived drug offers a stable market world wide, but also plants continue to be an important source for new drugs.

In India, the state of Meghalaya is considered as one of the treasure trove of Nature, with its richly varied and dense endemic, exotic and cultivated flora. Nature, in its generous abundance, had bestowed on Meghalaya a unique array of vegetation, ranging from tropical and sub-tropical to temperate or near temperate. This is due to the diverse topography, varied and abundant rainfall and differential climatic and edaphic conditions of the State, within small regions. Biotic factors have also played an important role, at places decisive. The state has a total area of about 22,429 sq. km. The northern side of Meghalaya is surrounded by Goalpara, Kamrup, Nagaon and Karbi Anglong districts of Assam, in the east, it is the districts of Cachar and North Cachar hills, also of Assam. The southern and western sides are international borders with Bangladesh. It has 7 districts viz., East Khasi Hills District, West Khasi Hills District, Ri Bhoi District, East Garo Hills District, West Garo Hills Districts & South Garo Hills District. In East Khasi Hills, Mawphlang is considered to be one of the biologically rich and diverse area.

Mawphlang Village, one of the clusters of villages under Hima Mawphlang, is located about 28 km from Shillong on the Shillong-Balat Road and forms the catchments area of 2 major river systems of Hima Mawphlang, namely, Wah Lyngkien and Um Iew River. A Sacred Grove is located along the ridge separating these two Watersheds. The area of Hima Mawphlang is 3500 ha and Mawphlang Village covers an area of over 600 ha, with a population of over 2467. Mawphlang village is comprised of 5 localities, namely, Dong Iewrim, Nongrum, Mission, Mawkohmon and Lad Umrisain.

A majority of the village members survive on subsistence agriculture. As in the case of most villages in the State of Meghalaya, agriculture is the major component of economy. Studies on Mawphlang Village collected and analyzed clearly shows that a majority of the domestic groups of the villages are actually surviving on subsistence economy. The Village has a high growth rate and the average family size ranges from 5-7. This has created a pressure on the availability of natural resource, which has resulted in rampant degradation of community forest (*Law Shnong*) and Clan Forests in order to meet the fuelwood demand. The rampant clearing of forest cover and high rainfall couple with unsustainable natural resource management has transformed large parts of the region into ecological fragile landscape.

The main claim to fame of Mawphlang and its surrounding villages is the existence of a Sacred Grove, which is the best, conserved Sacred Grove of Meghalaya. It is a rich storehouse of floral wealth incomparable to any other type of forests in other regions of the state. The vegetation of the area largely falls under the temperate type and includes the relic forests evolved through hundreds of years. A number of medicinal plants of Mawphlang have been documented by several workers many of which are found in the forests. *Gaultheria fragrantissima* is one of the medicinal plants that have been found in the open forests and other dense areas of Mawphlang region and used by the local traditional healers to some extent.

The initial knowledge contributed by local indigenous communities has gone a long way towards drug development. Exploitation of traditional knowledge of medicinal plants is an ongoing activity the world over. However, with the erosion of the tribal cultures, the traditional healers have become a threatened category. Also the genetic diversity in medicinal plants has diminished due to large scale destruction of their natural location. The over exploitation of medicinal resources in unscientific manner by unskilled labour and poor natural or artificial regeneration have resulted in virtual extinction of certain vital species. Many medicinal plants of this region have already become extinct and many more are struggling for their survival.

Population rise, inadequate supply of drugs, prohibitive cost of treatments, side effects of several allopathic drugs and development of resistance to currently used drugs for infectious diseases have also led to increased emphasis on the use of plant materials as a source of medicines for a wide variety of human ailments.

Medicinal plants in general, are important forest products. They play a vital role not only in the life of the local community but also of mankind as a whole. The study of the local flora and the relationship between the community and their surrounding plant wealth can provide valuable information for better development. Due to the great role that the

medicinal plants play in the lives of humans today, it is therefore proposed to the study about *Gaultheria fragrantissima* (a medicinal plant) so that it can be tapped and managed in a better way. The main objectives of this study are:

- Survey and study on the different uses of *Gaultheria fragrantissima* in Mawphlang, East Khasi Hills District, Meghalaya.
- Its management by the local people.

2. REVIEW OF LITERATURE

Towers *et al.*, (1966) examined twenty-two species of *Gaultheria* for phenols and phenolic acids obtained by hydrolysis of ethanolic extracts and found that most species yielded *p*-hydroxybenzoic, *o*-pyrocatechuic, protocatechuic, gentisic, vanillic, *p*-coumaric, caffeic and ferulic acids.

Polunin and Stainton, (1984) reported that the leaves of *Gaultheria fragrantissima* are medicinally important due to the presence of an active principle compound, methyl salicylate and are used in the preparation of pain balms and perfumes.

Ma *et al.*, (2001) & Khare (2004) reported that the leaves of *Gaultheria fragrantissima* contain ursolic acid and galactoside. Essential oils contain methyl salicylate as a major constituent, which acts as a stimulant, and on external application, provides relief from sciatica, neuralgia, and rheumatism.

Paulsamy *et al.*, (2006) revealed that in the Nilgiris, out of 131 species enumerated, 88 have been recognized as economically important and among them, *Gaultheria fragrantissima* has been suggested for cultivation and conservation so as to reduce the pressure upon the wild population.

First hand information on the herbal remedies practiced by the rural folks of Meghalaya out of which several known herbal plants belonging to 53 genera and 38 families including *Gaultheria fragrantissima* were found to be used by the local medicine men and village folks to cure various ailments (Hynniewta & Kumar, 2008).

Paulsamy *et al.*, (2007) estimated the degree of variability present between the four variants of *G fragrantissima* and identified the characters which are highly correlated with population density.

Msuya & Kideghesho (2009) concluded that the traditional management practices have a significant role in the conservation of biodiversity. This conservation role has a direct connection with human health since most of the plant species have medicinal value, which a majority of the rural people rely on.

Shanmugarajan et al., (2009) reported that *Gaultheria fragrantissima* leaf extract has antioxidant potential against adjuvant induced arthritis in Wistar rats.

Vijayakumar & Paulsamy (2010) studied on the crude and ecological densities of four leaf type variants of the medicinal plant, *Gaultheria fragrantissima* such as ovate, lanceolate, elliptic-lanceolate and oblanceolate leaf type variants were determined in four major shola forests of Nilgiris, the Western Ghats

A study on the culture and ethnobotany of the Jaintia tribal community of Meghalaya was done by Jaiswal (2010) in which it was found that the fruits of *Gaultheria fragrantissima* are eaten raw and its leaves are used for tea.

3. MATERIALS AND METHODS

3.1 *The species*

Gaultheria fragrantissima Wall. or the Indian Wintergreen (Local name – Jalathynrait / lathynrait) belonging to the family Ericaceae, is a much-branched, evergreen, aromatic shrub, 1-3 m height, with orange-brown bark common in central and eastern plateau of Khasi hills, at altitudes of 5,000-6,000 ft. (Fig: 1). Apart from the Khasi Hills, *G fragrantissima* is also commonly found in the Central and Eastern Himalayas and the hills of Western Ghats at altitudes of 1500-2500 m. Leaves are alternate, oblong-lanceolate to elliptic-rhomboid, serrate, gland-dotted; flowers greenish white in axillary racemes; fruits are capsular, globose enclosed in an enlarged fleshy deep blue calyx. *G fragrantissima* is also grown as an ornamental plant in the hill areas.

The flowers are seen in the months of March - May and the fruits in the months of June to July in the hilly areas of Meghalaya (Fig: 2). Fresh leaves are observed all over the year. The fruits are eaten by birds since they are sweet to human taste. The species is very hardy and can withstand cold temperature (-4°C) in the higher altitudes of Meghalaya. Seeds are dispersed by birds and humans only. Pollination is carried out by small Dipterans, Lepidopterans and Hymenopterans. Regeneration is natural by means of seeds, which are treated while passing through the gut of birds. Artificial regeneration is best achieved by means of stem cuttings during summer and coppicing during winter. Insect pests are usually absent but during flowering season Pentatomid and other bugs are seen to be closely associated with this shrub; however, fungal infection is common.

Fig.1. *Gaultheria fragrantissima* in its natural habitat

3.2 *Study site & survey*

The present study has been carried out in the various areas in and around the Mawphlang Sacred Grove as well as the adjoining open community forests of Mawphlang, East Khasi Hills District, Meghalaya (Fig:3).

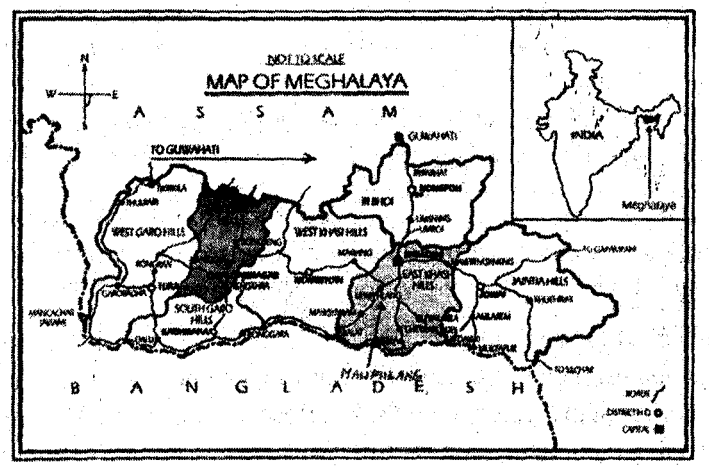

Fig: 3. Map of Meghalaya showing the location of Mawphlang Village

A survey was carried in areas surrounding the Mawphlang Sacred Grove and adjoining open community forest namely, Lum Laitsohphoh, Lumthankanam, Dymiew Blah, Laitlynding and Rangei Mawrap Community forests to find out the distribution of *Gaultheria fragrantissima*. Pictures of the plant species was taken along with the fruits that were seen in the month of July.

3.3 *Uses*

Information on the different uses of *Gaultheria fragrantissima* was collected from the local people of various localities of Mawphlang, particularly the traditional healers of the area and the information given by them was recorded.

3.4 *Management*

The availability of *Gaultheria fragrantissima* in its natural habitat, harvesting methods and its management by the local people of Mawphlang area was studied and monitored keeping in mind the need for sustainable development.

4. RESULTS

4.1 *Occurrence of the species*

Gaultheria fragrantissima was found to be growing profusely in areas around the Mawphlang Sacred Grove. It was also found abundantly in the open community forest adjoining the Mawphlang Sacred Grove. These community forests are namely, Lum Laitsohphoh, Lumthankanam, Dymiew Blah, Laitlynding and Rangei Mawrap community forests (Table:1). One can also see *Gaultheria fragrantissima* growing on the road side of the Shillong – Balat P.W.D. Road along the abandoned Quarry Site situated north of the Sacred Grove. However, it was found that the number of *Gaultheria fragrantissima* is reduced inside the dense Sacred Grove indicating that sunlight plays a vital role on its growth.

Table 1: *Area of the community forests:*

Name of Forest	Catergory of Forest	Area (in ha)	Distance from Road (in Km)	Remark
1. Lumlaitsohphoh CF	Community Forest	90	0.5	Open Forest
2. Lumthangkanam CF	Community Forest	105	0.5	Open Forest
3. Dymniewblah CF	Community Forest	30	0.0	Open Forest
4. Mawphlang Sacred Grove	Community Forest	76	0.0	Dense Forest
5. Laitlynding CF	Community Forest	60	0.5	Open Forest
6. Rangei Mawrap CF	Community Forest	70	0.5	Open Forest
	Total	431	-	-

Note: *Data collected from the local people and ocular survey.*

4.2 *Uses*

The leaves of the plant has been known to contain an oil, called as oil of Wintergreen, the main use is as an anti-rheumatic, anti-sciatica, painkiller, stimulant, carminative, antiseptic, vermicide and as ingredient in perfumery, insecticidal repellents, soft drinks and dentrifices.

However, in Mawphlang, it has been found that the local people particularly the traditional healers use the leaves of this plant only as treatment against rheumatism, arthritis and other ailments of joints. Information was collected from two well known herbal practioners of the region, namely, Mr. Rose Mawlong and Mr. S. Kharkrang on the various uses of *Gaultheria fragrantissima* as a medicinal plant. The method used was found to be simple, in that, the leaves of the plant are plucked, cleaned and boiled. Then the water is taken and used externally for treatment of rheumatism and the other ailments of joints which have been found to be very effective.

In other areas it has been found that the fruits are edible, used as flavouring oil, leaves are also used for tea. The leaves have also been found effective to relieve body pain/ache and as treatment for flu.

The leaves and sometimes the branches are harvested manually by hand picking whenever required. It was also found that no instructions were given to the laborers regarding the method of harvest and it is being done as per the convenience of the person being employed for harvesting.

4.3 *Status of the species*

The species is still abundant at present but the large-scale slash and burn method of cultivation practiced in the hills has posed a threat to the species, especially its regeneration by natural means. Since the species is now a known medicinal plant it is exploited by herbalists to a large extent even at present. Local people also harvest this plant not only for using it directly as medicine but for selling in other places of Meghalaya where it fetches a fairly high price.

4.4 *Market potential (In areas adjoining Mawphlang)*

On distillation, a volatile oil is obtained from the leaves of *G. fragrantissima,* which is identical to the Oil of Wintergreen obtained from *G. procumbens*. The principal constituent of the oil is methyl salicylate which is in very high demand in the market. A hundred gram of leaves yield approximately 0.6% of oil. If the leaves are harvested at the right season from a fully-grown *Gaultheria fragrantissima* shrub, about 10 kgs of leaves can be obtained. The oil yield is approximated at 6gms/kg, therefore, the expected oil yield will be 60gms per shrub. The current market rate of pure methyl salicylate is Rs. 800/- per 100 gms. Considering the abundance of this plant, which at some areas is considered a weed, the income generated from this source can be quite substantial.

Gross profit from one shrub	Rs. 480/-
Labour charges for picking	Rs. 100/-
Power charges for 10 kgs	Rs. 25/-
Net profit per shrub	Rs. 375/-

5. DISCUSSION

Gaultheria fragrantissima is a valuable medicinal plant collected from the wild for using it as a medicine by the local herbalists and also for selling it to other areas. It was found that it is not fully exploited and the local people in Mawphlang are not aware of various other uses and extraction methods. In other areas, steam distillation is being done to extract the oil from this plant. The same can also be done in Mawphlang if the techniques and procedures of processing it are taught to the local people. If the plant is tapped and used in a proper way, it can also help to uplift the economic status of the people in the region.

Since *Gaultheria fragrantissima* is starting to gain importance as a medicinal plant, its commercial exploitation has also started. However if continued commercial exploitation of this plant goes unchecked, it is likely to result in receding the population of the species in their natural habitat in the near future. Vacuum is likely to occur in the supply of raw plant materials that are used extensively by the pharmaceutical industry as well as the traditional practitioners. Consequently, cultivation of these plants is needed to ensure their availability to the industry as well as to people associated with traditional system of medicine in the future. If steps are not taken for the conservation, cultivation and mass propagation, it may be lost from the natural vegetation for ever. In situ conservation alone will not meet the ever increasing demand. It is, therefore, inevitable to develop cultural practices and propagate in suitable agroclimatic regions. Commercial cultivation will put a check on the continued exploitation from wild sources and serve as an effective means to conserve the rare floristic wealth and genetic diversity.

Similarly, with the increasing biotic pressure, the forests are getting degraded and in the process ground vegetation (floras and shrubs) which happen to provide bulk of the medicinal plants in general are also under strain. Reports available indicate that a number of plants are being endangered due to their unsystematic and unscientific collections, over exploitation and destruction of habitat. However, in many cases heavy or continued exploitation risks the regeneration of the natural source population (Heywood, 1991). In the process of collecting medicinal plants the collectors uproot the whole plant.

Certain measures can be taken for sustainable harvesting which includes - (a) Protecting the plants from fire, and (b) Few young leaves should be left on each plant at the time of collection. Sustainable harvesting is possible with various safeguards and methods. Generally, protection from grazing, nurturing the young regenerations, non-destructive harvesting are essential steps that can be taken. Cultivation of *G. fragrantissima* on a commercial scale by the local communities should also be encouraged.

6. CONCLUSION

Fragmentation, habitat degradation and over exploitation have led to the extinction or near extinction of many indigenous plant species. Medicinal plants particularly are vulnerable because they are not only uprooted for development but also commercially exploited. This reduces the individual plant species to such low numbers that the species may not recover and survive in the wild over the long term.

In the case of *Gaultheria fragrantissima,* at present, it is still abundant. But if the harvesting methods and management is not done in a scientific way, there is no doubt that in the near future this plant species will become threatened and endangered.

The ever growing need for more land for human habitation and commercial prospects of extracting and trading, medicinal plants in particular, face a high degree of threat of extinction.

Intensive management of the species in the wild and also cultivating them for conservation and for sustainable utilization *in situ* is necessary. Therefore it is very important that forest lands/ community forests around villages should be properly maintained and managed for maintenance of diversity.

It is extremely important to take steps for its *in situ* conservation by banning its haphazard collection from the wild. Spontaneous use of plants collected from the wild must be limited as far as possible and should be replaced by their cultivation. Rural folks should be encouraged to raise their own ethno-biological gardens or herb gardens in their vicinity to ensure conservation of *Gaultheria fragrantissima* and also the depleting biodiversity in other medicinal or useful plants.

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MAKING OF A PERISCOPE USING PLANE MIRRORS

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A periscope is an optical device for conducting observations from a concealed or protected position. The Periscopes used in this project consist of reflecting mirrors and/or prisms at opposite ends of a tube container. The reflecting surfaces are parallel to each other and at a 45° angle to the axis of the tube. This form of periscope, with the addition of two simple lenses, served for observation purposes.

Introduction

A periscope is an optical device for conducting observations from a concealed or protected position. Simple periscopes consist of reflecting mirrors and/or prisms at opposite ends of a tube container. The reflecting surfaces are parallel to each other and at a 45° angle to the axis of the tube. This form of periscope, with the addition of two simple lenses, served for observation purposes in the trenches during World War I. Military personnel also use periscopes in some gun turrets and in armored vehicles. The Navy attributes the invention of the periscope (1902) to Simon Lake and the perfection of the periscope to Sir Howard Grubb. periscope is very simple: two telescopes pointed into each other. If the two telescopes have different individual magnification, the difference between them causes an overall magnification or reduction.

Early examples Johann Gutenberg, better known for his contribution to printing technology, marketed a kind of periscope in the 1430s to enable pilgrims to see over the heads of the crowd at the vigintennial religious festival at Aachen. Johannes Hevelius described an early periscope with lenses in 1647 in his work Selenographi, *sive Lunae descriptio* [Selenography, or an account of the Moon]. Hevelius saw military applications for his invention. Simon Lake used periscopes in his submarines in 1902. Sir Howard Grubb perfected the device in World War I. Morgan Robertson (1861-1915) claimed to have tried to patent the periscope: he described a submarine using a periscope in his fictional works. Periscopes, in some cases fixed to rifles, served in World War I to enable soldiers to see over of the tops of trenches, so that they would not be exposed to enemy fire (especially from snipers). Periscopes are extensively used in tanks, enabling drivers or tank commanders to inspect their situation without leaving the safety of the tank. An important development, the Gundlach Rotary Periscope incorporated a rotating top, which allowed a tank commander to obtain a 360 degree field of view without moving his seat. This design, patented by Rudolf Gundlach in 1936, was first used in the Polish 7- TP light tank (produced from 1935 to 1939). As a part of Polish-British pre- World War II military cooperation, the patent was sold to Vickers-Armstrong for use in British tanks, including the *Crusader, Churchill, Valentine*, and *Cromwell*. The technology was also transferred to the American Army for use in its tanks, including the *Sherman*. The USSR later copied the design and used it extensively in its tanks (including the T-34 and T -70); Germany also made and used copies. Periscopes proved useful in trench warfare, as seen in the illustrations, representative of action at Gallipoli in 1915. Periscopes allow a submarine, when submerged at a shallow depth, to search for targets and threats in the surrounding sea and air. When not in use, a submarine's periscope retracts into the hull. A submarine commander in tactical conditions must exercise discretion when using his periscope, since it creates a visible wake and may also become detectable by radar, giving away the sub's position. The Frenchman Marie Davey built a simple, fixed naval periscope using mirrors in 1854. Thomas H. Doughty of the US Navy later invented a prismatic version for use in the American Civil War of 1861-1865. The invention of the collapsible periscope for use in submarine

warfare is usually credited to Simon Lake in 1902. Lake called his device the *omniscope* or *skalomniscope*. There is also a report that an Italian, Triulzi, demonstrated such a device in 1901, calling it a *cleptoscope*. In another early example of naval use of periscopes, Captain Arthur Krebs adapted two on the experimental French submarine *Gymnote* in 1888 and 1889. Perhaps the earliest example came in 1888 from the Spanish inventor Isaac Peral on his submarine *Peral* - developed in 1886 but launched on September 8, 1888. Peral's fixed, non-retractable periscope used a combination of prisms to rely the image to the submariner, but his submarine pioneered the ability to fire live torpedoes while submerged. Peral also developed a primitive gyroscope for his submarine navigation.' As of 2009 modem submarine periscopes incorporate lenses for magnification and function as a telescope. They typically employ prisms and total internal reflection instead of mirrors, because prisms, which do not require coatings on the reflecting surface, are much more rugged than mirrors. They may have additional optical capabilities such as range-finding and targeting. The mechanical systems of submarine periscopes typically use hydraulics and need to be quite sturdy to withstand the drag through water. The periscope chassis may also be used to support a radio or radar antenna. Submarines traditionally had two periscopes: a navigation or observation periscope and a targeting, or commanders, periscope. Early navies originally mounted these periscopes in the conning tower, one forward of the other in the narrow hulls of diesel- electric submarines. In the much wider hulls of recent US Navy submarines, the two operate side-by-side. The observation scope, used to scan the sea surface and sky, typically had a wide field of view and no magnification or low-power magnification.

The targeting or "attack" periscope, by comparison, had a narrower field of view and higher magnification. In World War II and earlier submarines it was the only means of gathering target data to accurately fire a torpedo, since sonar was not yet sufficiently advanced for this purpose (ranging with sonar required emission of an electronic "ping" that gave away the location of the submarine) and most torpedoes were unguided. 21st century submarines do not necessarily have periscopes. The United States Navy's *Virginia-class* submarines instead use photonics masts, pioneered by the Royal Navy's HMS *Trenchant,* which lift an electronic imaging sensor-set above the water. Signals from the sensor-set travel electronically to workstations in the submarine's control center. While the cables carrying the signal must penetrate the submarine's hull, they use a much smaller and more easily sealed-and therefore less expensive and safer- hull opening than those required by periscopes. Eliminating the telescoping tube running through the conning tower also allows greater freedom in designing the pressure hull and in placing internal equipment.

Periscope is the next generation of web cam software that lets you use your insight to capture activity in front of your Mac's camera and then save or share that image simply and automatically. Within seconds, you can configure Periscope to monitor a room for motion, sound or on a timer. Periscope will send real-time images to your e-mail, .Mac web page.

Objective:

To understand the basic concepts and properties of light such as, light travels in a straight path; it can be absorbed, reflected and refracted. This project is mainly aim to allow the students to understand how light reflect off from shiny surfaces like mirrors and how mirrors interact with light energy. With this concept people were able to make use mirrors to reflect light.

Procedure to make a Periscope:

I. One tall wooden box 12" in length and two shorter ones 4" in length.

II. Two small plane mirrors square in shape size may be decided by the students

III. Cut one square hole in the narrow side of the box and cut another square hole of the same size on the opposite side of the box.

IV. Using the two plane mirrors fixed them inside the box at an angle 45° in the comers of the wooden box facing each other and directly the two square holes as shown in the figure 1.

V. Fixed two small boxes on the two opening, such that one can used it for viewing through the opening square on either sides.

VI. Once the periscope has been make, the students can now study the main property of light (reflection) and also by changing the angle of inclination of the two plane mirrors what will happen to the image formed.

Conclusion:

From this project, the following points are observed. Light travel in a straight path, it reflects off from any shiny surfaces, light bends or refract when passing from one medium to another, it also diffract when passing through an opening.

WOMEN'S PARTICIPATION IN THE ELECTORAL PROCESS – A CASE STUDY OF THE RECENT ASSEMBLY ELECTION IN LAITUMKHRAH CONSTITUENCY

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INTRODUCTION

Women's participation and representation in politics is the first step towards Women's empowerment and emancipation. Increasing women's political participation is an effective means for promoting more open and democratic societies in which women are full participants and beneficiaries of national development. The Beijing Declaration and platform for action adopted at the Fourth World Conference on Women, convened by the UN in 1995 emphasize the need for member states to "take measures, including, where appropriate, in electoral systems that encourage political parties to integrate women in elective and non-elective public positions on the same proportion and at the same levels as men." Furthermore, in paragraph 190, it encourages states to review the differential impact of electoral systems on the political representation of women in elected bodies and consider, where appropriate, the adjustments or reform of those systems". In India, the history of women's entry into politics can be traced to as far back as during India's struggle for freedom. Even though Indian women had entered the Legislature since 1926, yet a comparative analysis of women's political participation in India today reveals that they are still under-represented and marginalized in politics. Incidentally, 'India the largest democracy lags much behind other countries including its neighbours Pakistan and Afghanistan, when it comes to the participation of women in politics. With only 10.9 percent of women representation in the Lok Sabha and 9 percent in the Rajya Sabha currently, India ranks 99th among 187 countries according to the comparative data by the Inter-Parliamentary Union . The Inter-Parliamentary Union is an International Organisation that works for promoting democracy, peace and co-operation among people in the world, When it comes to Meghalaya. where the people follow the matrilineal system, women are thought to be in a better position than men. However, this is just a myth. Women in Meghalaya are being under-represented in the Legislative Assembly, the District Council and the local durbar .In the matrilineal system, the children adopt the title of the mother's clan, and lineage is traced back through the mother. However, in spite of having a matrilineal system, tradition has debarred the women from participation in the political and administrative affairs, which are considered predominantly the domain of men. Traditionally in the Khasi-Jaintia and the Garo hills women are not allowed to attend the 'Dorbar' or the village council. In fact, the practice of not having women in durbars is still prevalent even today. It is only in a few localities of Shillong that some amount of participation of women at the dorbar is allowed. In fact, it is still unthought-of for a woman to vie for the post of headman in the Khasi society. This discrimination of women from early history has been reinforced in the Khasi psyche so permanently that doing away with it would require a radical movement. Although it is unthinkable for women to succeed in the office of the chief (such as in becoming the Syiem of a Hima or kingdom), in rare circumstances, in the absence of legitimate male rulers, women were accepted as rulers.

In the Khasi and Jaintia hills in particular, until recently, women have not asserted their political and social rights, even though a number of them were nominated to the Khasi states constitution-making durbar in 1949 and to the United Khasi and Jaintia Hills autonomous District Council in 1952. However, at that time, many of them were employed as schoolteachers, doctors, and employees in government offices. We may recall that in the pre-independence period, women were largely excluded from taking any leading role in social, political, or cultural organizations. This is reflected in the meeting of the males of the khasi states and the Khasi-Jaintia Young Men Assosiation in the twenties. Incidentally,

even the Seng Khasi, which was formed on November 23, 1899, was led by 16 young men. It was only in the sixties that the women of the khasi hills came together under the banner of Ka Synjuk Kynthei, which was till then the only Khasi women's social and cultural organization.

This women's organization brought out a quarterly magazine Ka Rympei (The Hearth). However, they have not taken up any real women's issues. In four of the volumes that are available, the magazine centered around health care, kitchen's tidbits, education, social welfare activities and others. It is interesting to note that in one of the articles written by Jormanik Syiem, former Syiem of Hima Mylliem entitled Ka Kyrdan ki Kynthei Khasi (status of Khasi women) the central focus was on women as the homemaker and their excellent performance in the academic and professional lines besides their services to the cause of health and education, This therefore, shows that traditionally, women in these hills enjoyed autonomy only in home making and domestic management. They occupy apart from that, a marginalized position both at the social and political levels.

In the pre-independence period, the Government of India Act 1935 gave women the right to vote. The Act also provided for representation of women by reservation of a seat from the Shillong constituency in the then Assam Legislative Assembly. This was known as Shillong women seat. The Act also permitted women to contest for general seats. Hence, in 1937, two women contested from the Reserved ' constituency and Mavis Dunn Lyngdoh was declared elected and was inducted as a minister twice into the Md Saidulla ministry (1939 to 1941 and 1942-1945). She was the first women from the north-east to become a minister. In 1946, Assembly election four women contested from the reserved constituency and Bonnily Khongmen was declared elected. She was elected the Deputy speaker of the Assam Legislative Assembly in 1952.

After India got her Independence, the first parliamentary election to the Lok Sabha was held in 1952. In this election, three candidates from the autonomous district constituency of the then undivided Assam contested for Lok Sabha seat. Bonnily Khongmen the only woman candidate was elected and she became the first and the only women from Assam to be a member of the Lok Sabha in 1952.

It is interesting to note that after 1952, the only other khasi women to contest in the Lok Sabha election was Elizabeth Laitphlang in 1998 but was unsuccessful.

When we look at the history of women's participation in the Assembly elections in Meghalaya from 1972 onwards, *we* find that the number of women who contested was very insignificant. The percentage of women candidates was never more than six percent. The number of women who were elected was also very insignificant. In the first election to the Meghalaya Legislative Ass embly in 1972, nine women came forward to contest in the election, however only one was elected from Garo hills. In 1978, only one out of seven women candidates was elected. In 1983 no woman candidate was returned though eight of them contested. In 1988 out of three women candidates two were elected, one from the Khasi hills and the other from the Garo hills. In 1993, seven contested but only one was successful from the Khasi hills. In 1.998 election, out of 15 candidates, three were elected, two from Khasi hills and one from Garo hills. In 2003 election, 14 women contested but only two were elected, one each from Khasi hills and Garo hills. With the untimely demise of Mr Thrang Hok Rngad, the sitting MLA from Laban constituency, a bye election was held in 2004. In this election, his widow contested and won the seat. Thus, the number of women legislators rose to four in the house of sixty. In the history of Meghalaya politics, we find that the most number of women who contested was in the last election' held in 2008. In this election, 19 women contested but only one, Ms Ampareen Lyngdoh, was elected from Laitumkhrah constituency on UDP ticket. However due to her resignation shortly after the elections, a bye-election was held again in 2009. It is interesting to note that in this bye-election the same woman candidate contested from another party and still won the elections.

Even though the state of Meghalaya has reached its 38th year of existence yet, the number of women participating in active politics is still very less. At present only one seat out of sixty in the state legislative Assembly is occupied by a woman. Again, we see that only very strong women would choose to challenge men in our matrilineal society. This is not only an irony but also a sad fact.

The objective of this present project is to trace the contours of women's participation in Meghalaya as a whole, and in the constituency of Laitumkhrah in particular. The project aims to accomplish this by eliciting the response of the general public towards their participation in politics; analyzing the success rate of women participants in politics, with

special reference to Laitumkhrah Constituency and; arriving at an estimate of the future prospects of women's participation in politics based on the findings of the present project.

Year	*INC*	*APHLC*	*HSPOP*	*NCP*	*POIC*	*HPU*	*uoe*	*POM*	*MOP*	*BIP*	*SP*	*UP*	*INO*	*Total*
1972		2											7	9
1978	3	1											3	7
1983	3	2			1								2	8
1988	1	1											1	3
1993	2					1				2			2	7
1998	3		2				3	1		1	1		4	15
2003	4		2	2			1		1	2			2	14
2008	3			2			3		3	1		4	3	19
Total no of women put up by parties so for	19	6	4	4	1	1	7	1	4	6	1	4	24	82

Source: General Election Results and Statistics- Election Commission of India Research Project on Women's Participation in Politics

Methodology Adopted

The present project conducted as case study of the Laitumkhrah Constituency to gather data and to gauge the general public's response to women's participation in the MLA Elections pertaining to the Constituency. The Laitumkhrah Constituency is situated right at the heart of the city arid is the educational hub of Shillong, as well of the state of Meghalaya. It is inhabited by a cross-section of people from different racial and cultural backgrounds. This Constituency has witnessed much social and political changes and development in recent years. In th e sphere of politics, this constituency has witnessed a .number of women participants in the MLA elections since 1978. The first ' woman participant to have contested for election then was Usha Bhatacharjee. She contested the election from the Indian National Congress but failed to make an impact in the election. The most recent elections saw the entrance of yet another woman candidate in the person of Ampareen Lyngdoh who contested twice, in 2008 and 2009 in the MLA election and the subsequent bye election- from the UDP and the Congress party respectively. It is noteworthy to mention here that she was successfully elected in both the elections.

In order to gauge the present political scenario about the Laitumkhrah Constituency, a survey was conducted with a set of specifically designed questionnaires. These questionnaires were designed in such a manner that data were collected on relevant issues such as:

(i) People's participation in local politics,
(ii) their *views* and opinions of the present political scenario,
(iii) their reactions and responses to the participation of women as candidates in elections and
(iv) the possibility for the induction of m ore women candidates into the Legislative Assembly in the near future.

To *avoid* any kind of lopsidedness in the gathering and analyzing of the data collected, people from different educational and occupational strata were selected and interviewed through the questionnaires. These people included

students, homemakers, businesspersons, present and retired *government* employees, academicians, politicians, and members of non-governmental organizations and of the local *village* dorbar. The collection of these primary data was also supported by a substantial research of secondary data present in the form of news articles, essays on the Election process and women participation in politics and other available material.

The data collected were individually studied and observations were made of the respondents' comments and inputs given to the questions asked through the questionnaires. These questionnaires were further analysed collectively to form a working picture of the present scenario of the Laitumkhrah Constituency. Here, the most consistent and reliable responses were taken into account and interpreted accordingly. It is interesting to note that there appears to be a consensus in the response of the public about the need to encourage or discourage the participation of women in the elections and the potential of women to contribute to the growth and development of the state in general and the constituency as a whole.

Interpreting -the Data

It is imperative that a background of the political history be present at the outset of this chapter so that the present analysis and interpretation of the data collected is made within the context of the political changes and developments that have occurred in the , Laitumkhrah Constituency. In doing so, it is hoped that the impact of the project's finding is brought out clearly. The first ever state assembly elections were held in 1972 soon after Meghalaya became a full fledged state. There were no women candidates contesting at the elections then from Laitumkhrah Constituency. However, this was to change soon in the next legislative assembly elections in 1978, where Usha Bhattacharjee CINC) made her entry into politics by contesting in this election. Unfortunately, she failed to garner the support of the public of the constituency. In 1983, yet another woman candidate, Ms. Tiplut Nongbri CINC), made her foray into politics by contesting in the elections. She also met the same fate as the first contestant, losing the election to her male counterpart. After this, there was a gap of one term where the next election saw no woman candidates in the local elections from Laitumkhrah Constituency. Ms Ivoryna Shylla, was to be the next woman candidate to file her nominations for the 1993 elections, contesting from the SJP.

Continuing the losing streak of women participants in this constituency, Ms Shylla was not immune from it as she followed the fate of her predecessors. In what could be termed as a significant change in the election scene in the Laitumkhrah Constituency, two women candidates contested the elections in the year 1998. Ms Margaret Rose Mawlong and Ms Naramai Langstieh contested the elections-

Year	*INC*	*APHLC*	*HSPOP*	*NCP*	*POIC*	*HPU*	*UOP*	*POM*	*MOP*	*BJP*	*SP*	*UP*	*INO*	*Total'*
1972														0
1978	1													1
1983	1													1
1988														0
1993										1				1
1998			1				1							2
2003														0
2008							1							1
2009 Bye-election	1													1
Total no of women put up by parties so far	3		1				2			1				7

The analysis of the data collected from primary sources has provided *valuable* insights into the present political scenario of the Laitumkhrah Constituency following the recent developments in the state and in the constituency itself. Responses *received* through the questionnaires *reveals* that a majority of the respondents kept track of the *government's* performance through the newspapers on a daily basis. The knowledge of this fact ensures that the data collected for the purpose of analysis is acquired from ' people who are not only aware of the developments in state and local politics, but who are actively interested in keeping abreast of what is happening around them, primarily because they were concerned about the welfare of the state as a whole. These informed respondents felt that the changes taking place in local politics were not significant enough to excite any kind of social or political interests. There appears to be a growing consensus in the electorate, as far as the target Constituency is concerned, that women participation in politics in the 21st century should be encouraged as their presence in state and local politics could bring in new and fresh inputs into the policymaking and· policy implementation process. Most of the respondents felt that the participation of women in politics would bring positive changes in the state's administration. It is safe to conjecture here that perhaps at the initial stages of women participation in politics, they were considered either unfit or not worthy enough to represent the constituency at any *level* of politics, There is *however,* a change *observed* coming in this regard as responses received reveal that more and more of the public in the target constituency are beginning to see women as qualified enough to be elected as representatives to the Meghalaya Legislative Assembly. Surprisingly, the most prominent reason for this change in opinion and *views* lies in the fact that many people are seeing women as more honest, sincere, transparent, highly qualified, approachable, accountable and less corrupted than their male counterparts. Having said that, *however,* it does not imply that all women are perfect compared to men. A section of those who responded , positively towards women participating in politics also *revealed* their fear that their presence would impede the smooth function of the state. The reasons' underlying this fear is the fact the respondents also felt that women may be ruled by their emotions and their• fickle-mindedness. Others see the danger of gender biasness coming into play. Still a few of the respondents see women just as capable of being corrupt as their male counterparts. In spite of the possible changes that women could bring to local polities, many feel that the effectiveness of those (women representatives) who has been elected to the Meghalaya Legislative Assembly has been insignificant and negligible. The cause for their ineffectiveness could be attributed to the fact that they have always been a minority group in the assembly and for this reason have been sidelined or overlooked. This' most certainly does not augur well for women participation in state and local politics. On a lighter vein many admitted that they would rejoice if Meghalaya were to have a woman Chief Minister for a change. They remarked that perhaps a woman Chief Minister could bring in the much needed change, stability and development in the state that has not come to fruition under the leadership of male Chief Ministers. With the passing of the Bil l, a number of questions have been raised on the ability and capability of women as policy and decision makers. A member of the NGO, Act Now For Harmony and Democracy (ANHAD) which launched Campaign Reservation Express, in support of the Women Reservation Bill observed that the same questions regarding the ability of women as representatives and policy makers should also be put forward to men. According to them, there should be no discrimination between men and women. They have pointed out that reservation for women in Panchayats and local bodies has facilitated the entry of millions of women into the political arena. These women have faced tremendous odds to enter into the electoral fray; many of them are role models for their community and all women per se. Their presence has brought many important women's issues on the agenda of panchayats and local bodies. This positive experience therefore needs to be strengthened and replicated at all levels. In Meghalaya too, the same apprehensions have been raised by many people regarding the bill. It is interesting to note that majority of the people interviewed, reacts positively towards women's participation in politics not only in Laitumkhrah Constituency but in Meghalaya as a whole. They felt that with more women participants, they would be able to influence and bring a new perspective in policy and decision making which will bring about the much needed change and development. Women in Meghalaya are largely politically passive though they are socially active. Even though many women are involved in the women's wings of the various political parties, yet they have not emerged as leaders at the party level. However, if Reservation Bill manages to get through the Lok sabha, there is hope that more women will be encouraged to participate in active politics. Unless women are part of the decision ' making process, real issues will not be addressed and hence it will hamper the progress and development of the state and nation as a whole.

GREEN MARKETING PRACTICES FOR SUSTAINABLE DEVELOPMENT: A CASE OF STAR CEMENT MANUFACTURING COMPANY LTD

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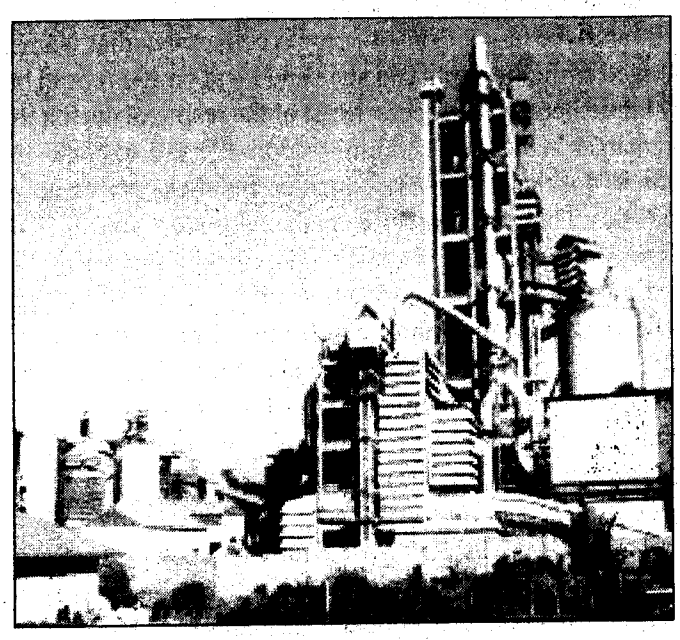

STAR CEMENT MANUFACTURING COMPANY LTD,
Lumshnong, Jaintia Hills, Meghalaya

Introduction to Green marketing:

The fact that businesses are physical systems which exist within a finite and vulnerable physical environment, has until recently, largely been ignored as a management and marketing issue. Green marketing furthers the evo-lution of marketing beyond societal marketing, to embrace society's increasing concern about the natural environment. The management process is responsible for identifying the needs of the customers and society and delivering the same in an environmentally friendly, sustainable and socially responsible way.

According to UN forecasts, the world's population could reach 8 billion as early as 2015, a 60% increase from 1985 levels. This would mean that just to restrict the rate of environmental damage to current levels, there would have to be a drastic adjustment either in the standard of living that we enjoy, or in the environmental impact of the technologies used to satisfy our demands for goods and services. If mankind were- to continue- current rates of population growth, consumption and methods of production, then by 2030 critical natural resources would last less than a decade more, and humankind would generate 400 billion tons of solid waste each year.

(Ken Peattie and Martin Charter, Green Marketing, 2000, CIM)

The second factor is the arrival of a new generation of more environmentally literate consumers, employees and investors.

Green demand and green marketing is likely to evolve in three phases:

a) *Substitution-* Characterized by green consumers differentiating between products on the basis of per perceived eco-performance, much confusion over concepts and terminology, and with a great deal of sales and public relation activity dressed up' as green marketing. The results has been increasing consumer cynicism, as demonstrated by Gerstman and Meyers' third annual- environment survey finding that 91% of U.S. consumer rated marketers as the least concern about the environment. There has also been a great deal of 'spot lightning', the

singling out of particular industries, companies and products for praise or condemnation, sometime with little relation to the actualities of eco performance- . Environmental improvements are often limited to end-of- pipe changes to production systems, the substitution of damaging ingredients such as CFCs and the elimination of excess packaging.

b) *Systemization*-The establishment of BS7750 and ISO 14001 standards for Environmental Management Systems and the EC Enclosable Scheme should move the entire 'game' on to a new plan of recognized performance criteria and evaluation. Business will move towards the- redesign of products and production system, and the implementation of environmental reporting and management systems. Better information for consumers will allow more information and provision for the recycling of products will become standard practice, and governed by ncreasingly stringent legislation.

c) *Societal change*-Within societies, concern about the environment is generally increasing and is being reflected in a number of ways including:

i. *Changing values:* Social attitudes towards the environment have changed, so that it is perceived as vulnerable, valuable and in need of protection. This has been reflected in changes in the values associated with products and their features. For e.g. Kodak's disposable camera therefore was transformed into a recyclable camera.

ii. *Pressure group activity:* The 1980's show a considerable increase in the size;budgets and sophistication of environmentally relate d pressure groups. For example the companies that have found themselves the targets of high -profile campaigns include Shell and McDonald's. The 1990's has been characterized by companies such as McDonald's adopting a partnerships, rather than adversarial, relationship with environmental groups.

iii. *Media interest:* An increasing amount of media output is devoted to nature an environmentally related messages an examples of poor eco performance are a favorite target for investigative journalism. As Mulhall (1992) notes 'The massive impact of instant media in accelerating the massage of gross environmental incompetence by our leaders can be summarized in three letters - CNN ,It means that a company's reputations can destroy globally in one-day'.

iv. *Political and legal interest:* The environmental agenda of green political parties has been increasingly absorbed by mainstream political parties, and this has led to an increase in the volume and rigors of the environmental legislation that companies must respond to. Companies that relied on mere compliance risk being left behind by the upward 'ratcheting' of legislation. In the USA, the trend towards forcing CEO's of polluters to make personal court appearances, and in some cases jailing them, has helped to focus corporate minds.

v. *Public opinion:* ED surveys tracking publics attitudes to the environment for more than 15 years have revealed that a majority of people are increasing concerned about the state of the global and national environment (in both the- short and the long term) and also consider that protecting the environment and preserving natural resources are essential to economic development.

On particularly sensitrve issues all of these dimensions of increase societal concerned can combine to present any companies involved with a considerable strategic, marketing and public relations challenges, as Shell discovered when trying to decommission the Brent Spar oil rig.

II. Scope of Green Marketing:

- *New market opportunities*- 'Green consumers' is growing concern with the climate change. Going green enables the company to compete on the basis of strong eco- performance and by tapping into customer demand for greener product.
- *Differentiation opportunities*- To be branded product must be differentiated. Products are differentiated on the basis of form, varying features, performance quality, etc. Going green enables the company to differentiate their products on the basis of their environmental impact. Products can be promoted as green products.

- *Opportunities for cost advantages-Although* conventional wisdom associates good eco- performance with investment and increased costs, this is partly a reflection of the 'end-of-pipe' methods used(since adding a catalytic converter onto a car can only increase its costs). Investment using a more radical, clean technology approach is being shown to be capable of reducing material and energy inputs, and cutting inefficient pollution and waste.
- *Niche opportunities-A* niche is a more narrowly defined customer group seeking a distinctive mix of benefits. Marketers usually identify niches by dividing a segment in to sub segment. By going green, the marketer is targeting the most environmentally aware consumers. This segment of the market is rapidly growing with the rapid rate of climate change.

III. **Tools of Green Marketing:** Green marketing incorporates a broad range of activities, including product modification, changes. to the production process, packaging changes as well as communicating through advertising and public relation, in short these are tools used in marketing .To begin our discussion, it would be appropriate to start with a discussion on the 5Ps in the context of green marketing.

a) *Green product:* Environmental concern is creating demands for new products (such as pollution control equipment) and is causing existing products to be reconsider an in many cases redesigned, reformulated or produced differently. The impact on the products will vary across market. In some cases such as automobile industry (for e.g. Maruti 800 has to be phased out from the market since it could not meet the legislation norms), changes in response to the green challenge are widespread. In others, financial services or computers, example of change are more sporadic.

i. *Raw materials:* The raw materials required for manufacturing the products should

be environmental friendly, for example in manufacturing green cement fly-ash, biomass energy are used and concrete is recycled to build dams and bridges etc.

ii. *Process:* The process involved in manufacturing a particular product . should use a green methods or technology, for example in green cement industry the following methods are adopted at the different stages of the green cement manufacturing process:

Quarrying: Constructing walls around the mining area to prevent the flow of polluted water to the nearby river *Manufacturing:* Fixing filter bag for capturing dust resulting during the process of manufacturing cement.

Packaging: Using eco-friendly packaging, for example in cement industry plastic bags are used which are recyclable.

iii. *Product design:* The Product should be design such that, reducing the amount of materials required and saving power. For Environmental safety, recycling is required as part of product designs ensuring the selection of materials and design that can be effectively recycled. The challenges in developing a total green product are to improve eco _ performance while producing acceptably comparable levels of functionality and service, at a competitive price. This approach involves adopting cleaner technologies that design out waste in the manufacturing processes, rather than using end of pipe solution which inevitably represent an added cost.

Design

- Choice of materials.
- Extraction of raw materials.
- Materials manufacture.
- Use ofrecyc l ed of materials.
- Transport of materials and components.
- Manufacture of components.
- Packaging.
- Transport.

- Operation.
- Durability.
- Reliability.
- Detergent use.
- Water use.
- Collection, transport.
- Recycling
- Landfill, incineration

b) **Green Packaging:** Packaging has been and obvious starting point for many companies' green marketing efforts, since packaging an often be safely reduce without expensive charges to core product or production processes and without a risk of disaffecting customers. Reducing and recycling is also a key feature of green packaging. The company must satisfy the following conditions for designing a green pack:-

- They should observe if the production of the packaging material have an adverse effect on the environment like, if the material comes from a scarce or seriously declining sources, and ifthe production of the material is energy-intensive.
- They should design or choose packaging where the materials can be easily re-used or recycled and the combination of the materials used for packaging must not creates difficulty for recycling.
- They should ensure that appropriate training be given to the designer, marketer, advertiser, packaging engineers, etc.
- They should ensure that the pack, the information and the overall appearance encourages the efficient use ,reused and disposal of the contents and the pack. Consumer education materials and advertising should be considered as and accompanying option to the pack.

c) **Green Pricing:** Going green may affect the cost structure of a business with a knock-on effect on prices, particularly if pricing is on a 'cost-plus' basis. Developing new sustainable raw materials sources, complying with legislation, writing off old, 'dirty' technology, capital expenditure on clean and the overt head associated with greening the organization can impose a heavy cost burden.(These extra cost are often spoken of as a green premium, although in reality they represent the removal of a subsidy provided to products by the environment and the failure to address the environmental cost) however, these can be counter-balanced by the savings made by reducing raw materials and energy inputs, by reducing packaging, by finding markets for by -products and by switching to lead -free distribution if cost are looked at holistically and managed on a portfolio basis, then wider eco-efficiency process benefits, can counterbalance the cost of greening to make a positive contribution to profitability. Consumer demand for green products can also allow for the addition of a green price premiums, as applies to free- range eggs. However, marketers should exercise caution in taking advantage of such opportunities, as any suggestion of profiteering may undermine the development of a credible green image taking advantage of such opportunities, as any suggestion of profiteering may undermine the development of a credible green image.

d) **Green Logistic:** A great deal of the environmental impact of products relates to the fuels consumed and materials used and wasted in transporting products to customers. One of the predictions about the transformation towards a sustainable global economy is a return to an emphasis on more localized production and distribution.

The following are the key components of green logistic strategy, which Star cement can implement for reducing their costs:

- They should implement belt conveyor for bringing In the raw materials to the manufacturing unit from the mining area.
- They should develop centralized distribution which can bring environmental benefits such as reduce vehicle movements and a reduction in transit packaging.
- They should establish the policy and targets and aimed at reducing vehicle emission impacts.

- They should insist that logistics sub-contractors operate and environmental policy consistence and commission their own comprehensive environmental audit.
- They should implement promotion of environmental awareness both within the company logistic departments and its sub-contractors.

(Ken peattie and Martin Charter, Green Marketing, 2000, CIM)

e) **Green Promotion:** Many companies have sought to promote themselves and their products through explicit or implicit association with the environment and good eco-performance. There has been considerable concern over whether or not much of the green promotion (particularly advertising) being used is misleading. However, given the complexities of the issues involved ,messages that are bought straight forward enough for consumers, yet sufficiently comprehensive and qualified to satisfy regulators and activists , can be hard to create.

Environmental issues is an area where there are important opportunities in combining with corporate communication efforts, and where a communications approach based on openness and education more than promotion will often pay dividends.

By going green, Star cement can promote itself and its product as green product through:

- *Advertising:* Advertise in way that the product lends themselves to convince and distinct their green images from the other product.
- *Sales promotion:* Provide incentives to consumers to change their purchasing and product use decision in favor of green products and the environment.
- *Personal Selling:* Sales force should be aware of the environmental implications of the company and its products and processes.

IV. **Introduction to cement industry:** By definition, cement is a fine grey powder which sets after few hours when mixed with water; and then hardens in a few days into a solid strong material. Virtually all the cement produce globally is mixed with sand, aggregate and water, and used to make concrete and mortals Cement is a key infrastructure industry. It is second only to water, as the most consumed substance on earth, with nearly 3 tons use annually by each person on the planet .Cement is the critical ingredient and concrete locking together the sand and gravel constituents in an inert matrix. It is therefore a critical part of meting society's needs for housing and basic infrastructure such as bridges, roads, water treatment facilities, schools and hospitals.

Cement industries is responsible for over 3% of carbon emission. This study aims to define a consistent approach to the selection and use of fuels/alternative fuels, raw materials and necessary technological changes in the cement industry, built upon the principles of sustainable development and processing of waste- materials. To promote this approach and associated good practices throughout the industry we have to study the current practices in the cement industry with respect to green management and also provide some possible suggestion of how can the industries adopt the green practices in different aspect of production.

Potential of industrial Ecology Practices in cement Industry: The following criteria have been developed to assist the industry in determining if the current potential IE (Industrial Ecology) practices will assist in long-term sustainable development. The proposed structure in part 3 considers the options and tradeoffs inherent when implementing projects that have both positive and negatives.

1. *True partnership*- the relationship should be an active collaboration between two or preferably more industries seeking to preserve the environment and benefit society in a way that is financially positive to all partners operations.
2. *All benefit* -The benefit of the relationship should be significant for all industries involved. It should not be a service (such as waste disposal) that one is providing the other with relatively small environmental and social value.

Rather, the environmental, financial, and social benefits should be shared at a significant level. The others partners should compensate partners who receive small or even negative financial benefit to the extent that the overall net financial viability of the system in enhanced by their collaborations. Social benefits of IE (Industrial Ecology) should be measured and included in the project assessment.

3. *Waste management (pollution prevention) hierarchy*—the relationship should follow the principles of pollution prevention; that is, it should promote prevention of waste e generation first, then reuse recycling, and finally environmentally -sound treatment as a last resort. Energy recovery from waste materials is essentially treatment. Exceptions should be judged using appropriate system analyses tools such a life cycle assessment and life cycle costing.

4. *Zero waste*- Ideally, the goal should be "zero waste" from the organizations involved, either explicitly or on a system level. The partnership should seek to reduce waste output to zero by making it a useful input or others and to reduce resource use by using other facilities unneeded materials.

5. *Quantitative benefits* -the relationship should result in quantitative benefits, such as emissions reduction, financial savings, and lower natural resources usage. While quantities benefits are important, the partnership should be substantial enough to have specific savings and improvements to the environment and the balance sheet. Quantitative social benefits, such as net co2 emission, virgin material resource use, and landfill like extension, should be included.

6. *Innovation and tools*- the savings should result from an innovative development or relationship, such as new technology ,tools ,management framework, or partner fmding strategy(Intemal or extemal).These new technique will promote creative thinking and new ideas with in the industries wanting to implement IE. 7. Location and Relationship-The facilities that are participating in an industrial eco-system can be co-located (neighbors) or distantly located, owned by the same parent company (sisters) or unrelated, new construction design for IE or exiting plants that are retrofitted. Any of these combination works, although each has its own benefit and challenges.

V. **Current trends in the cement industry:**

a. *Global Scenario:* The total global consumption recorded in 2006 was measured at 2568 Mt, or 2.568 billion tones again of some 9.6% on 2005 totals. By 2007 total consumption had moved up to 2763 Mt, representing a lower annual gain of 7.6% over the previous year. The global financial collapse which reverberated throughout much of the world in 2008, had an immediate impact on the global cement sector, and although cement consumption growth was to continue, moving higher at 2857Mt for the year, the annual upward change over the previous year is now recorded as slowing to just 3.4%.

The worrying, although hardly surprising news for 2009 indicates a further slowdown in global demand growth, sliding to+ 1.7 %, brought about by sizeable consumption losses across North America and throughout much of Europe. Even china has not been immune from such trends with growth recorded at single figures rather than above the 10% level.

Over the period 2000-2008, compounded annual growth in cement consumption is noted at 7.2%, some 3-4 percentage points higher than the long term global average calculated over the past 20-30 years. As mention earlier, the data for 2008 suggest that the global cement industry may now be showing the first signs of a return to such long term growth trends.

Indeed, if one begins to factor in a higher accountability to global warming and a necessity to limit co2 emission over the next decade and beyond, we might one day even come to view this current decade as a high peak in global cement consumption levels. Clearly, much will depend on what goes on within china, which now makes up almost 50% of global consumption totals. As highlighted in the report, china again continues to dominate world rankings, with consumption levels rising from 1200 Mt in 2006 to 1390Mt in 2008.

Such gains are, however, slowing and perhaps indicative that longer -term Chinese cement consumption growth could also be much more limited. China's per capita cement consumption now already stands at over 1000kg somewhat high by world standards, and especially when compare to the world's number two most populous country, India which now has a per capita cement consumption of only 150kg. On a positive note, china is now actively scraping a sizeable percentage of its older polluting production units and beginning to take a more serious stance towards global warming issues. Carbon dioxide (C02) is the primary greenhouse gas that drives global climate change and is the only greenhouse gas emitted by the cement industry in a significant amount. The cement industry emits approximately 5% of global, manmade C02 emissions. When all greenhouse gas emissions

generated by human activities are considered, the cement industry is responsible for approximately 3% of global emissions. Due to the unique nature of the product it manufactures, the cement industry currently emits 0.73 to 0.99 kilograms of C02 for every kilogram of cement produced. At any emission rate within this range, current proposals to curb C02 emissions will profoundly affect the activities and finances of the industry. Future proposals will likely call for far more significant reductions.

(Hargreaves D. 01 may 2009, international review and world business council/or sustainable development, March 2002)

b. *Cement industry in India:* In Indian, this industry has been de controlled from price and distribution on 1st march, 1989 and de-licensed on25th July, 1991. However, the performances of the industry and prices of cement are monitored regularly. The constraints faced by the industry are reviewed in the infrastructure coordination committee meeting held in the cabinet secretariat under the chairmanship of Secretary (Coordination). For the development of the cement industry "Working Group on cement industry" was constituted by the planning commission for the formulation of ten five year plan. The working Group has projected a growth rate of 10% for the cement industry during the plant period and has projected creation of the additional capacity of 40-62 million tones mainly through expansion of existing plants.

(www.dipp.nic.inlindustrvlcement.htm).

The Indian cement industry comprises of 132 major Cement plants with a combine install capacity of 166.73 Mt, out of these 23 are in Andhra Pradesh. Actual cement production in 2002-2003 was 116.35 million tones as against a production ofl06.90 million tons in 2001-2002, registering a growth rate of 8.84%. Major players in cement production are Ambhuja cement, J&K cement and L&T cement. Apart from meeting the entire domestic demand, the industry is also exporting cement and clinker. The export of cement during 2001-2002 and 2003-2004 was 5.14 million tones and 6.92 million tons respectively. Export during April- May, 2003 was 1.35 million tons. Major exporters were Gujarat Ambhuja cement ltd. and L&T ltd. The planning commission of 10th five year plan constituted a 'working group on cement industry 'for the development of cement industry.

The working group has identified following thrust areas for improving demand for cement: • Further push to housing development programs; Promotion of concrete highways and roads; Use of ready-mix concrete in large infrastructure project.

Further, in order to improve global competitiveness of the Indian cement industry, the department of industrial policy and promotion commissioned a study on the global competiveness of the Indian industry through an organization of International repute, viz. KPMG consultancy Pvt. Ltd. the report submitted by the organization has made several recommendations for making the Indian cement industry more competitive in the International market. The recommendations are under consideration. Cement industry has been decontrolled for price and distribution on 1 st March 1989 and de-licensed on 25th July in 1991.However, the performance of the industry and prices of cement are monitored regularly. Being a key infrastructure industry, the performance and constraints faced by the industry are reviewed in the infrastructure coordination committee meetings held in the cabinet secretariat under the chairmanship of secretary (coordination). Technological upgrading and assimilation of latest technology has been going on in the cement industry. Presently 93% of the total capacity in the industry is based on modem and environment-friendly dry process technology and only 7% of the capacity is based on old wet and semi-dry process technology. One project for co-generation of power utilizing waste heat in an Indian cement plant is being implemented with Japanese assistance under Green Aid Plant. The induction of advance technology has held the industry immensely to conserve energy and fuel and to save raw-material for the production of cement.

(www.economywatch.comlbusiness-and-e)

c. *Cement industry in Meghalaya:* Cement industry in Meghalaya is growing in a rapid rate with the annual production of 0.53 million tons. The major players are Star cement (CMCL), Topcem, Jaintia cement, and Mawmluh Cherrapunjee (MCCL) with MIS JUD cement, Aphonic cement, and Amrit cement under construction. Meghalaya has a rich reserved limestone of 16000 Mt which is the third largest in the country which has the Coal content of 53% and coal deposits of 640 million tons with a calorific value ranges between 6500-7500 k.cal/

kg. The state government offers subsidies such as, on cost of infrastructure, transport, training, and power. The central government has since declared that new units in the north-eastern region will be eligible for exemption from income tax for a period of five years from the date of commercial production. *(Singh R.D. Eastern Panorama Magazine,*

www.easternpaiwramii.inlindex.php)

- Liberalized State Industrial Policy providing attractive incentives/subsidies with Single Window Clearance facility. Meghalaya provides incentives like tax holiday, etc.
- Industrial Estates/Areas, Export Promotion Industrial Parks (EPIP) and Growth Centers set up at strategic locations within the State Special tax incentives/concessions for export-oriented units and investment in key infrastructure areas

So far, coal mining in Meghalaya is unscientific in nature. Recently the supreme court have band the unscientific way of coal mining and this band will have an effect to the industries located in this area as they are all dependent on the local vendors for these resources.

Legislations passed in India regarding Co2 emission, The Air (Prevention and Control of Pollution) Rules formulated in 1982, complementing the above Acts is the Atomic Energy Act of 1982, which was introduced to deal with radioactive waste. Water (Prevention and Control of Pollution) Act, 1974, Air (prevention and Control of Pollution) Act, 1981.All the industries operating in India have to follow these acts while operating. A ready market in the North East and the neighboring countries like Bangladesh has attracted many investors in the industries thus lead to over exploitation of mineral resources, environmental pollution and rampant unscientific mining practices

VI. **Introduction to case:** The concentration of many cement manufacturing units in Meghalaya has lead to the exploitation of minerals resources in order to meet the needs of the industry. As a result, we are witnessing the depletion of mineral resources like coal and limestone. In addition the practices of coal mining are unscientific resulting to the degradation of the environment.

Waste and emissions produce by this industry has lead to the further choking of our environment

VII. **Objectives of the study:**

1. To study the current practices in the cement industry.
2. To study the feasibility of green marketing practices in the cement industry 10 Meghalaya.
3. To define a consistent approach to the selection and use of fuels/alternative fuels and raw materials in the cement industry. To built upon the principles of sustainable development and processing of waste- materials. We will promote this approach and associated good practices throughout the industry.

VIII. **Methodology:**

Case: To achieve the above objectives, we have selected cement manufacturing company Ltd. (Star Cement) Lumshnong. Star Cement is the largest producer of cement in North -Eastern region, easily accessible and it produces the best quality of cement in the region, for which they have been awarded continuously for the year 2007 and 2008.

We have collected the primary data through industrial visit, and interviews. Secondary data we have collected data through the internet, newspapers, magazines and journals to evaluate the plant SWOT (Strength, Weakness, Opportunities and Threats) and TOWS (Threats, Opportunities, Weakness and Strength) matrix.

IX. **Case Study**

Star Cement: Star cement is an ISO 9001 certified company which is the largest manufacturer of cement in the northeast of India. The plant is located at Lumshnong, 125 km from Shilling, spreading over 40 acres of land. It begins its operation in 2005.

At star cement, quality is of paramount importance with a 24 hour automated camera in the burning zone and automatic rotor-packer machine. The plant has state of the art dry process rotary kiln technology that ensures manufacturer of high-grade ordinary Portland cement and Portland Pozzolana cement with its superior product and harnessed commitment star cement within a short span has made a significant in-road in the north-eastern market.

The total production capacity of the plant is 1800 tons per day. The plant produced two types of cement viz., PPC (Pozzolona Portland Cement) and OPC (Ordinary Portland Cement).

X. **ENVIRONMENTAL ANALYSIS:** Political, Economic, Social, and Technology (PEST) analysis

a) **Political:** Star cement will enjoy the privileges given by the state industrial policy providing attractive incentives/ subsidies with Single Window clearance. It will enjoy the special incentives given by the central government for investing in Meghalaya .On the other hand it will have to conform to the various environmental laws and regulations passed by the government such as:

Air (prevention and control pollution Act; 1981).To counter the problems associated with air pollution ,ambient air quality standards were established, under the 1991 act .The act provides means for the control and abatement of air pollution . The act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to air pollution. Under the act establishing or operating of any industrial plan in the pollution control area requires consent from state boards. The boards are also expected to raise the area in air pollution control area, inspect pollution control equipment, and manufacturing processes. National ambient air quality standards (NAAQS) for major pollutants were notified by CPCB in April 1994. These are deemed to be levels of air quality necessary with an adequate margin of safety to protect public health vegetation and property (CPCB 1995 sited in Gupta 1999).the NAAQS prescribed specific standard for industrial, residential, rural and other sensitive areas .industries -specific emissions have also been developed for iron and steel plants, cement plants, fertilizers plants, oil refineries and the aluminum industries. The ambient quality standards prescribed India are similar to those prevailing in many developed and developing countries.

Star cement has to conform to the air prevention and control act 1991 which prohibit the use of Polluting fuels and substances. This will lead the firm to look for alternative fuel such as the use of biogas plant and reduce the use of coal. The use of biogas plant will lead to low production due to the unavailability of raw materials for the biogas plant. Besides the firm has to restructure its entire plant if it has to use biogas plant. This will involve a huge investment for buying the technology to meet the standard of the country and state pollution control boards. Other factors including in the political are:

i. **Unscientific mining of coal:** At present coal is extracted unscientifically. Recently Parliament has made a proposal to do a way the unscientific mining of coal. The scientific mining of coal will require huge afitount of investment for buying technology for mining purposes. This will lead to shortage of coal supply to the cement plant. It will also raise the price of coal which will in turn increase the price of cement leading to low demand.

ii. **Pressure groups:** Pressure groups play an important role in the state. They stand for the right of the local people, influence the government in policy making and proper implementation of different policies. Star cement has to meet the demand of Pressure groups such as hiring suppliers, distributors, conservation of rivers and forests, and providing employment to the local people. It restricts the firm to hire skilled and efficient Labour from outside the state.

iii. **Tax holiday and subsidies:** To attract more investors the state government and central government have provided many subsidies to these investors. Tax holiday is one of the subsidies offer by the government which is valid from March 2009 to March 2015. The government also' provides different subsidies such as existing infrastructure, social amenities like residential colony, dispensary, shopping complex, school and guest house. As per Northeastern Industrial and Investment Promotion Policy (NEIIP) 2007, the unit will be eligible for excise duty exemption, income tax exemption, capital investment subsidy, interest subsidy, comprehensive insurance and transport subsidy.

b) **Economic:** Economics refer to all forces which have an economic impact on business. Such as production, infrastructure, national income, per capita income, these will make up the total economic environment. With the development of this company herein Meghalaya will bring a very useful task to the people and can make more effort on its economic growth. Star cement will raise the par income capita and the GDP of the state. It will do away with the unemployment of the youth to a certain extent; the disposable income of the people will increase. Star cement will contributes to the development of infrastructure of the country by producing cement which is the most important material for construction purposes. With the hike in fuel prices especially diesel will have an immediate impact on the suppliers as well as distributors costs which ultimately increase the price of cement. 20 Inflation in the economic _nd hits the industry directly because the demand decreases with the downturn in the disposable income of the people. The change in the climatic conditions affects the storage of raw materials and the finished products. To prevent the raw mattrials and the finished products from being affected by the climatic conditions, the firm' ~as to maintain a required temperature for storing the raw materials and the finished products. For example cement is very sensitive if proper storage is not maintained it will turn into hard substance.

c) **Social :** With the coming of star cement there will be movement of the labor from the different places leading to the changes in the lifestyle of the people to purchase the eco- friendly product as they are more concern about the environment and health conscious. The population of Meghalaya is 23, 18,822 (2001 census), Area 22429 sq. km, and literacy rate is 22.7 %(2001 census).Since the population of Meghalaya is growing rapidly along with literacy rate, so people are becomes more aware and conscious of their rights and environment. They started to realize the necessity to conserve environment and prefer eco- friendly products and boycott products which have direct or indirect impact on the environment. In order to influence the public to buy the product and to gain a public trust, Star cement have to develop a good relationship with the media to present a good image of the company. Star cement have to involve itself in social activities such as making a contribution to the charitable trust, setting up school and health centers, tree plantation, organizing and financing cultural activities and sponsoring sports and events. These activities require huge amount of money. If the public does not response positively it will cause a huge lost to the company.

With the fear of natural disaster such as earthquake, People prefer to have a house build devoid of cement materials. This will lead to low demand forcement. In order to produce the desired quality of cement, the company has to study and make a research of the markets to find out the opinion of the public regarding the quality require by them. This requires a lot of time and money to be spent.

With the rise in the income level of the people, demand for the cement will increase due to capability of the people to construct huge building for more

d) **Technology :** Star cement will have access to the new and up- to-date technologies through the various schemes/ subsidies and incentives given by the government. On the other hand the factory will stop operat~ with the breakdown of the machineries due to the unavailability of the spare parts within the state New technology used in cement industry: Cement industry has made a tremendous stride in technological up gradation and assimilation of latest technology. At present 93% of the total capacity in the industry is based on modem and environment-friendly dry process technology and only 7% of the capacity is based on old and wet semi dry process technology. Some of the new technologies are:

The Eco-cement testing plant: Eco-cement is a new technology adopted by MITI'S "High Grade Processing of Consumer Industry Waste !Research & Development of Effective and Applicable Technologies" the main feature of Eco-system are as follows:-

- *Prolonged landfill site usage:* The landfill site's reclamation burden is greatly reduced because incineration ash is for completely recycled as natural resource.
- *Completely decomposes dioxins:* High temperature calcinations at 1350°C completely decompose dioxins contained in incinerator ash.
- *Collection of heavy metals:* Heavy metals contained in incinerator ash collected by an adjoining heavy metal collector facility can be gathered as metals contained within calcimined fly ash and reconstituted as a raw material through reclamation processes in a refinery, thus reducing waste from Eco-cement manufacturing facilities to Zero.

- *Energy conservation:* To turn incinerator ash into a raw material, calcinations is done at a temperature around 100°C lower than the calcifying temperature for normal cement. These results in saving energy around 10% and reduce C02 than normal cement.

(Ebaracorporation, Tokyo japan, http://www.ebara.co.ip)

XI. **Process:** Raw Materials, sources and quantity used or required ~n the production of cement are given in the table below:

Raw materials	Sources
Limestone	Local
Coal	Loc~
Sand	Local
Gypsum	Bhutan
Fly ash	Guwahati / west Bengal
Clay	Local
Slag	Guwahati / west Bengal

Energy used by Star Cement is hydro electric power supplied by MeSEB and captive thermal power plant with a capacity of 41MW. The main process routes in the manufacturing of are:

a. Quarrying.
b. Raw materials preparation.
c. Fuels preparation.
d. Clinker burning.
e. Mineral additions preparation.
f. Cement grinding.
g. Cement dispatch.

a. *Quarrying:-* Raw materials such as limestone, marl, and Clay/shale are extracted from quarries which, is located close to the quarry site and transported to the cement plant for intermediate storage, homogenization and further preparation. In star cement, raw materials like limestone, clay, etc. are quarried by the company itself from the nearby areas.

b. *Raw materials preparation:-* After intermediate storage and pre-homogenization, the raw materials are dried and ground together in defined and well-controlled proportions in a raw mill to produce a raw mill for the dry and semi-dry process The resulting intermediate product - i.e. raw mill or raw slurry (or their derivatives)- is stored and further homogenized in raw mill silos, storage bins or slurry basins to achieve and maintain the required uniform chemical composition before entering the kiln system.

c. *Fuels preparation:-* Fuels preparation - i.e. crushing, drying, grinding, and homogenizing - usually takes place on site. Specific installations are required such as coal mills, silos and storage halls for solid fuels, tanks for liquid fuels, and the corresponding transport and feeding systems to the kilns. The thermal fuel consumption is largely dependent on the basic process design applied in the burning of clinker.

Fig: Coal mill house

d. *Clinker burning:-* The prepared raw material ("kiln feed") is fed to the kiln system where it is subjected to a thermal treatment process consisting of the consecutive steps of drying/preheating, calcinations (e.g. release of C02 from limestone), and sintering (or "cJinkerisation", e.g. formation of clinker minerals at temperatures up to 1400 *DC).*

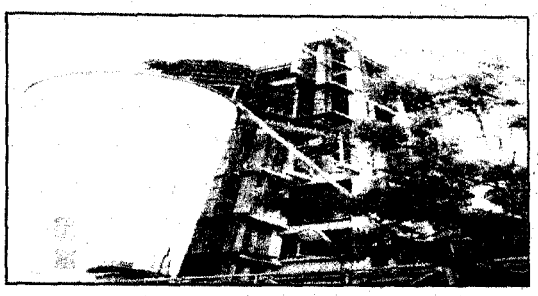

Fig: Heat controller

The burnt product "clinker" is cooled down with air to 100-200 *DC* and is transported to intermediate storage. The kiln systems commonly applied are rotary kilns with or without so-called "suspension pre-heaters" (and, in more advanced systems, "pre-calciners") depending on the main process design selected. The rotary kiln itself is an inclined steel tube with a length to diameter ratio between I 0 and 40. The slight inclination (2.5 to 4.5 %) together with the slow rotation (0.5-4.5 revolutions per minute) allow for a material transport sufficiently long to achieve the thermal conversion processes required. Exhaust heat from the kiln system is utilized to dry raw materials, solid fuels or mineral additions in the mills. Exhaust gases are de-dusted using either electrostatic precipitators or bag filter systems before being released to the atmosphere.

Cement grinding:- Portland cement is produced by inter grinding cement clinker with a few percent of natural or industrial gypsum in a cement mill. Blended cements (or "composite" cements) contain other constituents in addition such as granulated blast-furnace slag, natural or industrial Pozzolana (for example, fly ash from thermal power plants), or inert fillers such as limestone. Mineral additions in blended cements may both be inter-ground with clinker or ground separately and mixed with Portland cement. Grinding plants may be located remotely from the clinker production facility. The different cement types have to be stored separately in cement silos prior to bagging and dispatch.

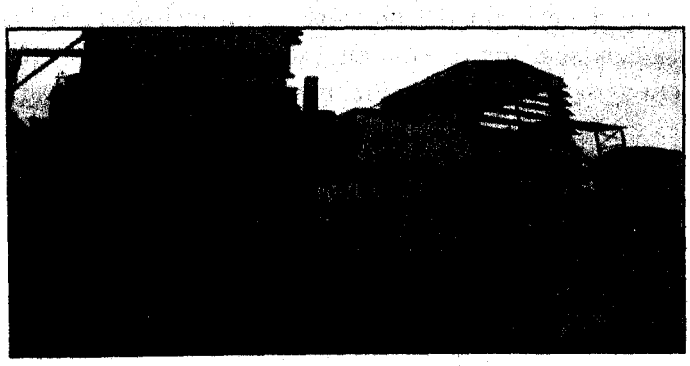

Fig: Cement silo

f. *Mineral additions preparation:-* Mineral additions from natural or industrial sources intended to be used in blended cements may need to be dried, crushed or ground in separate installations on site. Separate "grinding plants" where mineral additions and blended cements only are produced may also be located remote from the clinker production facility.

g. *Cement dispatch:-* Cement may be shipped as bulk cement or - usually to a lesser extent - packed into bags and palletized for dispatch. Transport methods used (i.e. road, railway, waterways) depend on local conditions and requirements,

Transportation Star cement depends solely on road transportation.
Competitors: The competitors of Star cement within the Eastern region are as follows:

1. Topcem Cement Private Ltd. located in laintia Hills, Lumshnong, with advance dry process rotary kiln technology has the capacity of 3000 tons per day. They have a captive power plan of lOMW.
2. Jud cement Private Limited; which is under-construction in laintia Hills, Wahiajer, plans on expansion which involves clinker capacity from 0.3mpta to 1.65mpta and cement capacity to 2.54mtpa capacity and a captive power generation unit of capacity 2*20 MW. 3. Holcim (Assam) a Switzerland based cement giant, plans to ship around 3000 tones or 60000 bags of cement to Guwahati.
4. MCCL (Mawmluh Cherapunjee Cement Limited):MCCL(Mawmluh Cherapunjee Cement Limited) is located in sohra. Mawmluh Cement plant and limestone mining project Rs.62 crores with acapicity of 6 hundreds tons per day.

Star cement is using the Integrated Management System (IMS) Product quality- The ISO 9001 (QMS) quality policy is a formal statement from management, closely linked to the business and marketing plan and to customer needs. The quality "policy is understood and followed at a level and by all employees. Each employee needs measurable objectives to work towards IS090Ql includes:-

- A set of procedures that cover all key processes in the business;
- Monitoring processes to ensure they are effective;
- Keeping adequate records;

Checking output for defects, with appropriate and corrective action where necessary;

- Regularly reviewing individual process and quality system itself for effectiveness and
- Facilitating continual improvement.

Protection of environment- The ISO 14000 (EMS) is a series of environmental management standards develop and published by the international organization for standardization (ISO) for organization. The IS014000 standard provides a guideline or framework for organization that needs to systematize and improved their environmental management efforts. The ISO 14000 standards are not designed to aid the enforcement of environmental laws and do not regulate the environmental activities organizations. This ISO specifies requirement of an environmental management system (EMS) for small to large organizations. An EMS is a systemic approach to handling environmental issues within an organization. Safety and Occupational Health- The ISO 18001 (SAOH) was created via the concerted effort from a number of world's leading national standards bodies, certification bodies and the main driver for this was to try to removed confusion in the work place from the proliferation of certifiable. The main aim of occupational health is to promote and maintain of the highest degree of physical, mental and social well being in all occupations, prevention among workers of departures from health caused by the working concern, protections of workers in the employment from risks resulting factors and adverse to health. Placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities and to summarize the adaptation of work to man and of each man to his job.

Special Features-

- Very good quality of limestone which contains 52% Calcium compared to other states of India which is only up to 45%. This provides Star Cement with the advantage of obtaining much high quality cement as compared to other states.
- Coal used by star contains I 5-25 % ash and 3.5 % sulphur ~ Quality control system: Star uses a Press Pellet Machine and Total Cement Analyzer to control the quality of cement.
- Uniformity of raw materials, i.e., there is a constant flow of raw-materials from various suppliers.

Manufacturing par excellent: Star cement prides itself on its highly evolved manufacturing method, a complex yet efficient system that seamlessly mesh human expertise with advanced technology. The plant procures high quality clinker from reputed international manufacturers. The manufacturing process combines the latest Japanese and German technologies with management expertise to ensure high standards of operation and maintenance.

Raising the quality bar: Star cement superior standards frequently set industry benchmarks, whether it is the quality of materials, sophistication of the manufacturing technologies, or the final product itself.

This uncompromising approach to quality has well recognized by the customers as well as leading industry organizations.

XII. **Precaution taken by Star Cement:**

1) Prevent dust by reducing blasting intensity and providing back filters.

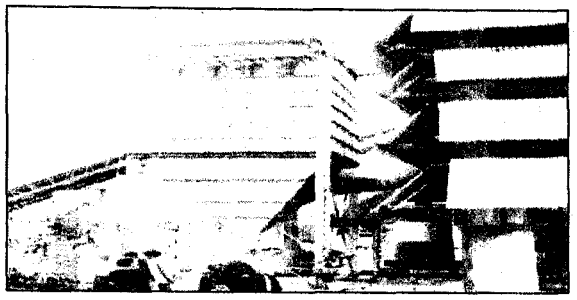

Fig: Back Filter

2) Using Eco - friendly explosive item in order to reduce dust as well as noise pollution.
3) Preventing the flow of water from mining areas to the river through building of check Dams.
4) Noise management by keeping sensor wherever required within the plant.
5) Implementation ofISO 9001, to maintain standard quality.
6) Implementation of ISO 14001, to maintain the environmental management.
7) Automatic control of quality in case of any defect in the Mixing of substances.
8) In cement packing section ventilation are provide for Packing hall .Back filter are also provided in all cement Packing system.
9) Plantation of 15,000 trees in the company quarries of lime stones.
10) Treating of domestic waste water and reusing it for watering of the plants.

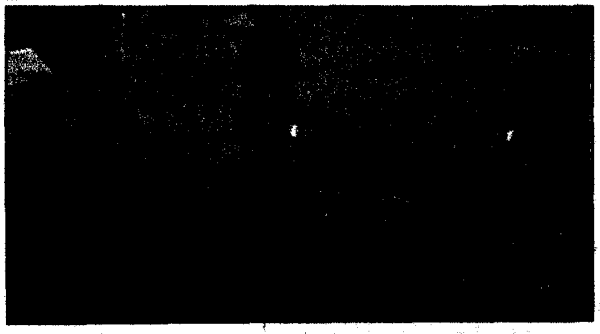

Fig:B.O.D.Incubator

Fig: Respirable Dust Sampler

XIII. **Strength, Weakness, Opportunities and Threats (SWOT) analysis:**

a) Strength-

- Availability of raw materials
- High brand image in the market
- ISO 9001-2000
- Eco-friendly production

b) Weakness-

- Lack of power.
- Lack of skilled labor.
- Insufficient raw materials.
- Lack of infrastructure.

c) Opportunities-

- High demand in the market
- Emission reduction credits
- Use of alternative, low-carbon fuels
- CO_2 capture and sequestration or possible resale

XIV. -Tows **Matrix:**

d) Threats-

- Competition within the market.
- Competition from outside the market.
- Unavailability of spare parts in the state itself.
- Possibility of imposed technological control.

	Opportunities:	Threats:
	I) High demand in the ma$.!set. 2) Emissions reduction credits. 3) Used of alternatives low-carbon fuels. 4) C02 capture and sequestration or pos\ible resale.	I) Competition within the market. 2) Competition from outside the market. 3) Unavailability of spare parts, 4) Possibility of imposed technology control. 5) Lack of infrastructure.
Strength: I)Availability of raw-materials (Locally). 2) High brand image. 3) IS09001-2000. 4)Eco-friendly production	Maxi-maxi Strategy(SO): I) Increase the production capacity. 2) Improve on the company's strength and production.	Maxi-mini Strategy(ST): I) Promotion. 2) Pricing. 3) Used of eco-friendly technology.
Weakness: I) unsustainablity of power. 2) Lack of skilled labour. 3) Insufficient raw-materials.	Mini-maxi Strategy(WO): I) Bio-mass energy. 2) Conveyor belt (Inbound logistic). 3) Backward integration. 4) Recycling of concrete.	Mini-mini Strategy(WT): I) Shift to more sustainability energy (Bio-mass). 2) Training (Local people) & recruitment from outside the state. (Based on the Legislation of the government). 3) Inventory management.

6) Star cement can provide tpaining program for the current/unskilled labor for improvement. For specific post/jobs which involve highly specialization they can recruit from outside the state keeping in mind the policy and legislation provided by the government.

7) In order to meet the material requirement of the company, a proper inventory management should be set up.

XVI. Suggestions:

a. *Guidelines for the selection of fuels and raw materials:* The operator should develop a fuels and raw materials evaluation and acceptance procedure that includes the following features:

- In clinker burning process, exhaust heat from the kiln system can be utilized to dry raw materials, solid fuels or mineral additions in the mills. And by using Bio- Mass as a substitute for fuel in the kiln system. The raw material for biomass can be collected from domestic waste, rice husks, and agricultural waste.
- In case of quarrying, Star cement can implement the suggestion of using modern computerized methods available to evaluate the raw material deposits and to optimize the long-term and short-term production schedule.
- Each material supplier should be required to prepare a sample of fuel or material, which will be used to evaluate the fuel or material before delivering it to the plant.
- This should include a datasheet detailing the chemical and physical properties of the fuel or material being supplied, information on relevant health, safety, and environmental considerations during transport, handling, and use, and a typical sample of the material. It should also specify the source of the particular shipments being made.
- The sample's physical and chemical characteristics should be tested and checked against specifications.

b. *Guidelines for key areas of operations:* Installation design General design considerations

- Assess operations for health and safety risks or concerns to ensure that equipment is safe and to minimize risks of endangering people or installations, or damaging the environment.

Use appropriate procedures. to assess risks or hazards for each stage of the design process. Only competent and qualified personnel should undertake or oversee such hazard and operability studies.

- Carefully consider plant layout to ensure access for day-to-day operations, emergency escape routes, at;d maintainability of the plant and equipment.
- Apply recognized standards to the design of installations and equipment. Any modification to installations and equipment should meet requirements set in the .standards, Thoroughly evaluate existing equipment refitted for a different service from a safety and performance
- Stand point before resuming commercial production.
- Document modifications to installations and equipment. Reception and storage of materials
- Establish suitable and safe transfer systems from transportation to the storage area to avoid risks from spillage such as fugitive emissions or vapor displacement. Suitable vapor filtration and capture equipment should be in place to minimize impact to the reception point and surrounding areas from unloading activities.
- Assure that storage facilities fit their purpose. Appropriate storage for liquids should meet relevant safety and design codes for storage pressures and temperatures.
- Solid materials handling systems should have adequate dust control systems.
- Storage design should be appropriate to maintain the quality of the materials: for solids, prevent build-up of old materials; for liquids, mix or agitate to prevent settlement, etc.
- Design transfer and storage areas to manage and contain accidental spills into rainwater or firewater, which may be contaminated by the materials. This requires appropriate design for isolation, containment, and treatment.
- Appropriate storage for liquids should have adequate secondary containment. Material handling and feed systems
- Handling systems and feed systems should be appropriate to the fuel and raw material used. The feed systems should allow stable and controlled input of materials to the kiln.
- The operator should assess risks from fugitive emissions; equipment failure modes and appropriate safeguards should be incorporated into the design to prevent environmental pollution, health, and safety problems. Delivery and on- site transport
- Use appropriate vehicles and equipment to transport fuels and raw materials.
- Personnel involved in transportation should be adequately trained and qualified.

- The transport provider (including in-house transport) should document maintenance and operator training. Selection and reception of materials Select fuels and raw materials only after the supplier, and the chemical and physical properties and specifications of the materials have been clearly identified.
- Stop vehicles carrying fuels and raw materials upon arrival at site and make the necessary identifications. Slid! vehicles should be weighed in and out of the site.

  Deliveries should be recorded.
- Check documents relating to vehicles carrying waste and determine their compliance with site acceptance specifications and regulations. Document checks may cover waste certificates, transport certificates, etc. A vehicle found not to comply should not be allowed to enter the site.
- Instructions for unloading, including safety and emergency instructions, should be provided in due time to vehicle drivers.
- Sample and analyze vehicle loads once on site according to the frequency and protocol defined in the site control plan; check agreement with site specifications according to the plan of control.
- Fuels and materials can be accepted once their properties are confirmed to agree with specifications.

	Conventional raw materials		Alternative raw materials		
	High limestone	Natural gypsum	Fly ash	Slag	Synthetic gypsum
Wet basis	50,000 t	120,000 t	150,000 t	400,000 t	2,30,000 t
Moisture	9.6%	7.5%	0.2%	5.4%	4.5%
Dry basis	45200 t	111000 t	149700 t	378400 t	219650 t

Fig: Temperature for Storage of raw material

c. *On-site handling and storage:*

- There should be written procedures and instructions in place for the unloading, handling, and storage of the solid and liquid fuels and raw materials used on site.
- Relevant employees should be trained in the company's operating procedures, and compliance with such procedures should be audited regularly.
- Storage facilities should be operated in such a way as to control emissions to air, water, and soil.
- Designated routes for vehicles carrying specified fuels and raw materials should be clearly identified within the site.

  Appropriate signs indicating-the nature of materials should be in place at storage, stockpiling, and tank locations.

d. *Guidelines on Employee training Safety, health, environment and quality:*

- As fresh concrete and mortar-continue to be alkaline, however, persons handling it must wear suitable protective gloves, and take precautionary skin care measures all the same. This combination of measures is the only way of effectively combating allergies to chromate
- The company should develop and implement appropriate documented training programs for employees to be trained in issues relevant to their jobs. New employees should be trained during an induction process.
- Such training programs should be given to contractors and, in some instances, suppliers. Personnel reporting to work on site for the first time should be trained through a site induction program.
- Training records should be kept on file.

(www.wbcsd cements .org/health. asp.)

e. *The training program should include the following:*

- General and job specific safety rules;
- Safe operation of equipment;
- Details ofthe site emergency plan;
- Procedures for handling alternative fuels and raw materials;
- Use of personal protective equipment.

f. *Guidelines on Stakeholder communications and engagement:* We earn our license to operate from our stakeholders, particularly those who work on our sites and live in communities around them.

As well as building goodwill, working with local groups, national NGOs, and regulators can result in better informed and more business that is effective planning. It can be particularly useful in addressing local environmental and social issues. Effective, open, and transparent communication with stakeholders is essential if we are to playa responsible role in society's waste and resource management systems. We recommended that companies and sites develop and implement a stakeholder engagement program and policy that includes specific reference to the use of fuels and raw materials. Site managers may choose to work with their local or regional headquarters to develop and implement this program. It should contain the following elements.

g. *Guidelines on Stakeholder identification and analysis:* The site or company should identify its main stakeholders, and understand their expectations of and their relationship with the company and the cement industry locally, nationally, and internationally. Site -community engagement program At site level, management should provide opportunities for stakeholders to express their concerns, listen to and understand those concerns ,and build ,trust with the community through active engagement Reporting performance Building trust with stakeholders requires both transparency and accountability in company and site operations.

The production of regular reports on performance in areas of interest helps to provide key stakeholders with the information they need to make a fair and balanced judgment of the company's or site's activities and performance.

(Guidelines for the selection and use of fuel and raw material in the cements manufacturing process, December 2005, world business council for sustainable development)

Recomendation:

Modernization and technology up-gradation is a continuous process for any growing, industry and is equally true for the cement industry. The Indian cement industry today is by and large comparable to the best in the world in respect of quality standards, fuel and power consumption, environmental norms, use of latest technology and capacity. The productivity parameters are now nearing; the theoretical best and alternate means, like alternate fuels and raw materials have to be found to ensure further improvement in productivity and reduced production costs. Cement industry being energy intensive, the energy conservation and alternate cheaper, renewable and environmentally friendly sources of energy have assumed greater iraportance for improving productivity. The major challenges confronting the industry today are raging insecurity in indigenous fuel availability, perennial constraints like higher ash content, erratic variations in quality of indigenous coal and inconsistent power supply with unpredicted power cuts. Keeping these challenges in view, the efforts by the industry towards energy conservation and finding alternate cheaper, renewable and environmentally friendly sources of energy are given utmost importance. Our implementation for STAR CEMENT towards reducing costs, emission reduction, and recycling of co2, alternative fuel and raw materials, is through:-

1. *TECHNOLOGY CHANGE:* Cement industry has made tremendous strides to technological up gradation and assimilation of latest technology. At present 93% of the total capacity in the industry is based on modern and environment-friendly dry process technology and only 7% of the capacity is based on old wet and semi-dry process technology. There is tremendous scope for waste heat recovery in cement plants and thereby reduction in emission level. Star cement must implement a co-generation from waste heat for utilization in the plant. Besides, the Japanese cement industry is using other superior technologies by utilizing solid waste for producing

eco-cement. Technology transfer in the field of energy conservation and environment protection will help to improve efficiency of the star cement industry on the other hand the induction of advanced technology will help the industry immensely to conserve energy and fuel and to save materials substantially.

2. *NEW CEMENT BURNING TECHNIQUE:* F AKS or Fluidized Bed Advanced Cement Kiln System from KHL is an innovative technology in cement burning, must be implement by star cement which will help in replacing the conventional rotary kiln system. Some of the features are:
3. *TECHNOLOGY AND INNOVATION:* Together with a harmful of other industries, the star cement industry is in the spotlight of the current international climate change agenda to develop solutions to reduce harmful green-house gas (GHG) emission. New plants are being built using best available
   a. *High flexibility in fuel choices:* Various coals are available, from low calorific value to low volatile coal such as petroleum coke.
   b. *Better thermal efficiency:* 10-25 per cent reduction in heat consumption due to the configuration of the burning and cooling process by utilizing the fluidized bed reactor.
   c. *Low environmental impact:* 10-25 per cent reduction in co2 emission, 40 per cent or more reduction in NOx emission.
   d. *Superior. changeover productivity:* Shorter changeover production time compared with conventional systems.
   e. *Economical advantages:* 10-30 per cent of construction cost saving and around 70 per cent reduction in installation space, lower maintenance and running cost compared with conventional systems.

A PROGRESS REPORT ON A PROJECT ENTITLED "POSSIBLE CYTOTOXICITY AND GENOTOXICITY EFFECTS OF A NEEM BASED PESTICIDE, NEEMASTRA ON MERISTEMIC CELLS OF *ALLIUM CEPA*"

Dr Lucy Mary Jyrwa and Mrs Deisa Nora Shabong
Department of Zoology.

The cytotoxic and genotoxic effect of neem based pesticide Neemastra (90 % neem oil extract and 10 % other inert compounds) was studied using Allium cepa test model. Based on EC50 curve, different concentrations of Neemastra were taken for conducting the experiment. It was found that the biopesticide inhibits the growth of the root length of the onion roots and it is concentration as well as time dependent. Cytological assayed on the root tips showed a decrease in the mitotic index with increased in interphase stage of the cells along with increased abnormalities. Bridges and fragments were numerous indicating clastogenic effects and laggard chromosomes indicating spindle poisoning. **Keywords:** Neemastra, Azadirachtin, mitotic index, chromosomal aberrations 4

1. **Introduction:** Neem plant (Azadirachta indica A Juss, family: Meliaceae) have proved to be a potential biopesticide, where the leaves and seed extract of this plant have been showing deleterious effects on insects [1]. The leaf extract contains a large proportion of azadirachtin (C35H44O16), a steroid akin to tetranortriterpinoid, as well as other isoforms and compounds such as azadirachtanin, azadirachtol, isoazadirone, isoazadiridide, epoxyazadiracdione, nimocinolide, isonimolide, epinimbin, nimbiene, nimocinol, nimbandiole, melianin A and B, melianone and many other unidentified constituents [2,3]. The active principle alone is seldom as effective as the whole extract and therefore commercial preparations of neem-leaf extract are used rather than the isolated azadirachtin. Pesticides based on neem extracts have many effects on insects and pests and it has been used, particularly as an anti-feedant, anti-attractant, or repellant [4], as an ecdysone inhibitor [5] and as oviposition deterrent and sterilant [6]. Moreover, the products of neem in different formulations are being extensively used for their supposedly non pollutant and environmentally friendly nature, and are also being used for the treatment of a large number of diseases [7]. However, it was reported that this biopesticide of indigeneous medicinal importance has been found to be genotoxic in both somatic [8] and germinal [9] cells in murine in vivo systems. The Allium cepa assay is an efficient test for chemical screening and in situ monitoring for genotoxicity of

environmental contaminants. The test has been widely used to study genotoxicity of many pesticides revealing that these compounds can induce chromosomal aberrations as chromosomal breaks and exchanges in root meristems of A. cepa [10, 11]. Since neem oil is use as herbal pesticide under the product name Neemastra in India, it becomes important to study the side effects of this pesticide in plants which are the non target sites of the pesticide. Keeping the above information in mind, the present study was taken to assess the possibility of inhibition of cell division (toxicity) and chromosomal aberration (genotoxicity) by a neem based pesticide under the name Neemastra (90 % neem oil extract and other inert compounds) in Allium cepa root tips. 5

2. **Materials and Methods:** Onion bulbs of nearly equal weight (10-20g) were used and adventitious roots were obtained by placing the base of the bulbs in separate conical flasks filled with filtered water kept at a temperature of 25 ± 0.5 °C. Control bulbs were incubated in filtered water. A Commercial neem oil pesticide (Neemastra containing 90 % neem oil extract and 10 % inert compounds, Swaroop Agrochemical Industries) was purchased from a local dealer. The pesticide was diluted with filtered water at different concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 % for experiments. In order to determine the concentrations necessary for the genotoxicity test, root growth was monitored over 96 h. Between 20 and 30 roots were used at each concentration of Neemastra, and the average of root lengths were measured and used for calculation of percentage growth of exposed roots with respect to the control. These values were used to produce a dose–response curve. The length of the roots of both controlled and treated bulbs were measured periodically for 24 h, 48 h, 72 h and 96 h. After exposure, the roots of each of the controlled and treated bulbs were cut and fixed in ethanol–acetic acid (3:1 v D v) at 4 °C for 24 h, then stained with acetocarmine (Sisco Research Laboratories Pvt Ltd, Mumbai) and placed on clean slides. Individually, the darkly stained meristem portion was cut with a razor blade and squash preparations of eight to ten roots were examined for each concentration. The frequency of aberrant cells was determined on the basis of the total number of computed cells and the number of dividing cells. The mitotic index (MI) was evaluated from 1000 cells per root, using the formula:

$$MI = (\text{total cells in mitosis}) / (\text{total cells counted}) \times 100$$

3. **Statistical analysis:** The data obtained from different experiments in replicates, were analysed using suitable statistical methods.

4. **Results**

4.1. *Root growth measurement 6* The effect of different concentrations of neem based pesticide on longitudinal growth roots was analysed (fig 1 and table 1). 1% neem based pesticide arrested growth after 24 h, without apparent root death. At concentrations of 0.4, 0.6, 0.8 and 1.0, %, the root growth was reduced compared to control roots. These findings indicate that neem based pesticide causes inhibition of root growth in a concentration dependent manner. Further, inhibition of root growth by neem based pesticide is time dependent, because longer the roots were exposed to different concentrations of pesticide more is the inhibition (fig 1 and table 1). Complete inhibition was observed after 72 h of exposure to the pesticide.

4.2. *Effect on the Mitotic Index (MI)* As shown on table 2 and fig 2, results revealed that there was a decrease in the MI of exposed roots and the decrease was significantly dependent on the concentration and time of treatment. It was observed that the mitotic index in controls were 3.2, 12.7 and13.2 with respect to the time of exposure of 24 h, 48 h and 72 h. On exposing the roots of the onion bulbs to different concentrations of the pesticide, the MI was found to reduce significantly with time as compared to the controls.

4.3. *Chromosomal aberrations:* Results of the microscopic analysis of the treated *Allium cepa* root tips are summarised in table 2. Figure 3 shows that chromosomal aberrations were induced at all the tested concentrations and were statistically significant ($p<0.05$). Various types of chromosomal aberrations, such as chromosomal fragments, bridges, stickiness and dispersed metaphase were recorded indicating the genotoxicity of the Neemastra pesticide. Chromosomes with disturbed spindles and fragments were also present in appreciable amounts. Bridging of the chromosomes was quite common at anaphase stage (fig 3-6 and table 2). Vacuolization of the cytoplasm and rupture of cell membranes were seen in many cells following treatment at higher concentrations (1% Neemastra) as shown in fig 6.

5. **Discussion:** Our findings suggest that neem oil inhibits longitudinal growth of the roots and the inhibition was time dependent as it was observed that with increase time exposure there was a delay in the growth of the roots. This probably indicates the cytotoxicity of the 7 biopesticide on *Allium cepa* where cell division of the meristemic cells of the root tips was slowed down. Further, the result indicates that Neemastra causes inhibition of root growth in a concentration-dependent manner as it was observed that with an increased concentration of the pesticide, the growth rate of the root tips decreased significantly. In our study, the inhibitory effect of neem oil pesticide was correlated with the mitotic index (MI). It was noted that MI in the control was much higher than the treated ones. Thus, neem based pesticide mediated reduction in the MI may result in an inhibition in root growth with increased cell numbers in the interphase. It was reported that the cytotoxic effect of neem oil is believed to be affecting spindle protein or chromosome packaging [8], which can be the same in this case. Chromosomal abnormalities increased about many folds in the cells of treated root tips (table 2) which could be partly responsible for the reduction in the MI and retardation in root growth. Chromosomal aberrations explained as genotoxicity are normally accompanied by some growth restrictions [12]. In *A. cepa*, whenever chromosome aberrations occurred, there were always certain growth restrictions as was observed in this experiment. Also frequent were the bridges and fragments: such anomalies (i.e. the induction of chromosomal fragments and bridges at anaphase) give an indication of mutagenic events in the cell [13]. It is clearly evident from our study that changes in the MI and chromosomal aberrations in the meristem are inversely related (table 2). The genotoxicity of neem oil has been reported in the testes of mice [8] although chromosomal abnormalities have not been calculated. High incidence of synaptic disturbances and numerical variations in chromosomes confirms the cytotoxicity of the extract which is in full agreement with the observations made in mitotic chromosomes [8, 14, 15]. Results from our study showed at high concentration of the pesticide there were disruption of the cell membranes along with vacuolization and nuclear pycnosis. This may be due to the fact that the neem derived pesticide might cause cell death via the activation of apoptotic pathway following significant membrane damage as reported earlier [16, 17]. 8 It has been reported that neem and its derivatives work as systemic insecticides; it is absorbed into the plant and carried throughout the tissues to be ingested by insects when they feed on the plant. This may make it effective against phloem feeders like *N. lugens* [18, 19]. However; though neem derived pesticides proved effective against the insect pests our study proves it to be hazardous to plants where there is deteroriation in the growth of the plant due to the cytotoxic and genotoxic effects of neem derived pesticide. Azadirachtin which is one of the main components of the neem plant, based upon its computer automated structure evaluation [20], is supposed to act as a genotoxic carcinogen due to the presence of furan moiety having the biophore O-CH= which incidentally occurs in many known genotoxic carcinogens including aflatoxins. Most of the toxic chemicals that produce genotoxic effects have been known to form reactive oxygen species as well as electrophilic free-radical metabolites that interact with DNA to cause disruptive changes. It has been suggested that during metabolism of Azadirachtin, electrophillic ions and radicals are produced, interacting with nucleophillic sites in DNA and leading to breaks and other related damage in the latter [21]. Moreover, enzymatic biotransformation of the leaf extract of *Azadirachtica indica* has been been suspected to produce metabolites and free oxygen radicals [22] in a manner similar to other xenobiotics, including damage to spindle apparatus and to cause unequal distribution of the chromosomes, leading to mitosis disruptive changes. Raizada [23] on the other hand, have reported that azadirachtin alone has not shown any adverse effects in rats. Further, it was reported that the pure compound azadirachtin, the unprocessed materials of neem plant, the aqueous extracts and seed oil are safe to use as an insecticide. Conversely, the non-aqueous extracts turn out to be relatively toxic, suggesting that the other compounds than azadirachtin are responsible for the toxic effect [24]. In conclusion, although neem derived pesticides like Neemastra exhibit toxicity and genotoxicity as shown in our results, further research on the actual cause is yet to be identified. However, one cannot deny the potential danger of such pesticides and cannot 9 e ignored in view of the long term genetic hazard on the agricultural plants as well as on man.

Acknowlegement: This study was supported by Shillong College, Shillong to the Department of Zoology. The authors express gratitude to the Research and Funding Cell of the college for financing this study.

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WILD EDIBLE FRUITS OF MAWSYNRAM & ITS ADJOINING AREAS

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INTRODUCTION

Ethnobotany refers to the study of the interrelationship between human beings and plants (Jain 1986). The basic requirements of human beings i.e. food, clothing and shelter are primarily obtained from plants. The tribal people living in this part of the world have a very close interrelationship with nature and have developed an indigenous knowledge on the utility of plants for domestic, medicinal and commercial purposes. The traditional knowledge related to the use of natural resources has been recognised as one of the important assets inherited through generations by the tribal community (Johari & Karki). Fruits are nature's gift to mankind. They are not only delicious and refreshing but also provide nutritional and economic security to the poor masses in the rural areas. From ancient times, wild fruit plants played a very important role in the livelihood of the rural community. They contribute significantly to the nutrition and serve as alternative to staple food during period of food deficit, are a valuable supplement for a nutritionally balanced diet. Although the use of wild fruits has recently decreased, many people in rural areas still use them extensively as a supplement to their basic food requirements, some are preserved for use during period of scarcity, they are sometimes sold in the urban market and are then in competition with exotic fruits (Manyafu, 1971).

Extensive studies have been carried out by many workers on the wild fruits in many parts of India. A study by Sankaran et al., 2006 have documented and gathered valuable information on the wild edible fruits of Tripura. Karuppusamy et al., 2011 dealth with the antioxidant activity of selected edible fruits of Karnataka, Valvi et al., 2011 identified and documented the food value of wild edible fruits of Kolhapur district of Maharashtra. Seal, 2011 gave an account of the antioxidant activity of four wild edible fruits of Meghalaya, Jeeva et al., 2011 focussed on the ethnomedicinal potential of Myrica esculenta in the subtropical forests of Meghalaya, Patel et al. ( ) discussed the necessity to domesticate Elaegnus latifolia, an under utilised fruit of N.E. India. Though a documentation on the tribal knowledge of wild edible plants of Meghalaya by Kayang, 2007 and an account of wild edible plants used as vegetables by the rural folks of Meghalaya by Wankhar et al., 2013 has been carried out but a documentation of wild edible fruits of Meghalaya is still lacking. Moreover these delicious resources are in danger of being lost in areas where environmental transformation is taking place due to urbanisation and industrialisation leading to destruction and loss of habitat. Forests which are the main storehouse of a variety of wild fruits are receding at an alarming rate due to deforestation, making wild fruit trees severely prone to overexploitation and extinction. Therefore, the present study mainly focuses on the wild edible fruits

utilised by the people of Meghalaya with reference to Mawsynram and its adjoining areas, with an aim to document them and also to assess their value so as to preserve the knowledge based associated with wild fruits and at the same time to enhance the economy of the rural poor.

The study aims at documenting the wild edible fruits of Mawsynram and its adjoining areas. The richness of the flora and the absence of a comprehensive account of any of the ethnic groups of Meghalaya, even of such a geographically world famous area like Mawsynram, prompt us to undertake the present study on wild edible fruits of Mawsynram and its adjoining areas.

Review of Literature

Jadhav V.D. Mahadkar S.D. and Valvi S.R.(2011) deals with the identification, documentation and ethnobotanical exploration with respect to food value of the wild edible plants from Kolhapur district in Maharashtra, India. A total of 50 wild edible plants were surveyed, the edible parts of which included fruits, flowers, leaves, tubers and inflorescence. This study revealed that the use of these wild forms of fruits, flowers and tubers has declined and therefore special attention should be paid to them in order to maintain and improve this important source of food supply.

Sankaean, M., Prakash, J., Singh, N.P., and Suklabaidya, A.(2006) gave an account of forty wild edible fruits of Tripura along with their uses. This study revealed that fruits play a vital role in providing nutritional and economic security to the poor masses in the rural areas. Though many wild fruits grow naturally in the wild, but only a few have been commercially cultivated. Proper collection, improvement and agrotechniques for these fruit crops is lacking and hence emphasis should be given to exploration and collection, in-situ and ex-situ conservation methods, research on nutritional and anti nutritional properties, product development and marketing of these fruits crops.

A study by Kayang H. (2007) on the tribal knowledge of wild edible plants of Meghalaya, Northeast India has documented and highlighted the tribal knowledge on the use of the different plant parts viz. roots, tubers, stems, leaves, flowers, fruits and seeds of 110 wild edible plant species used by the three dominant tribes i.e. Khasi, Jiantias and Garos of Meghalaya This study that the tribals are consuming the edible plants in raw or cooked form.

Patel et.al. (2008) gave a detailed account of the morphological and chemical constituents of Elaegnus latifolia giving emphasis on its cultivation and stressing on the need for its domestication as the fruit has a great potential because of its hardy nature, early bearing, high yielder and various uses of the ripe fruit by the local people.

Rajasab, A.H., and Mahamad, I. (2009) have documented the folk knowledge of 51 species of edible wild plants of North Karnataka Local people use leaves, stem, flowers, seeds and roots in their diet.Of the 51 species, 27 species belonging to 24 genera produce edible fruits (eaten raw or cooked), sixteen species belonging to fourteen genera produce edible leaves and four species belonging to four genera produce edible flowers,three species belonging to three genera produce edible seeds. The root extract of one species (Hemidescus indicus) was used to prepare soft drink. This study noted that some of these species serve as food during famine and it stresses on the necessity to bring these plants under organized agriculture as new crops to increase their production and utilization and also on the importance to preserve the diversity of wild edible plants as they pocess an immense nutritional and medicinal value.

Valvi, S.R., Deshmukh, S.R., and Rathod, V.S. (2011), have done an ethnobotanical survey with respect to the food value of 30 wild edible fruits in Kolhapur district. A majority of these fruits were eaten raw when ripe, some unripe fruits are used as vegetables and pickles. This study contribute the database of traditional knowledge of wild fruits as food.

Karuppusamy, S., Muthuraja, G and Rajasekaran, K.M. (2011), this study has established and determined the antioxidant activity of six lesser known edible fruits from Western Ghats of India. The data obtained shows that the anthocyanin, ascorbic acid, total phenolics and flavanoids levels were significantly higher in the methanol extract of Mahonia leschenaultia, Takeda fruits, Gaultheria frag and Rubus ellipticus fruits were also found to have significant amount of phytochemicals. M. leschenaultia fruits had highest antioxidant activity when compared to all the other fruit extracts.

Jeeva, S., Lyndem,F.G, Sawian, J.T., Laloo,R.C., and Mishra,B.P. (2011) found that the regeneration of Myrica esculenta a potential ethno medicinal tree species in the subtropical forests of Meghalaya. Is highly influenced by anthropogenic distur bances. The study indicated that overexploitation of M. esculenta may cause threat to the species with extinction from the wild, therefore there is an obvious need to explore non-timber forests products so as to

minimize the pressure on any particular species by providing alternatives to a species leading to sustainable utilization of genetic resources.

Seal, T. (2011) analysed the antioxidant activity of four wild edible fruits (viz. Morus indica, myrica esulenta, M yrica nagi, Parkia roxburghii, Prunus nepalensis and Terminallia bellerica) of Meghalaya and the result of this study indicate that the nutritional values and mineral content of these wild fruits under investigation were richer than that of commercial fruits and very much comparable with the various wild plants reported earlier. This study did give an account of ethnobotanical importance of the wild edible fruits under investigstion.

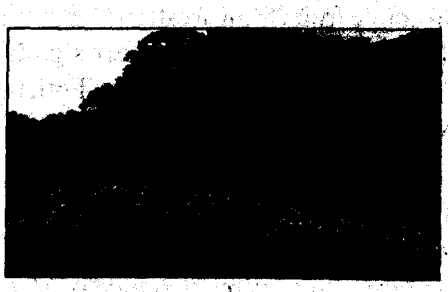
Study area

Mawsynram a village in the south-west corner of the East Khasi Hill district of Meghalaya is located at 25°18'N latitude and 91°35'E longitude, and at a distance of 65 km from Shillong, the state capital. It is situated on a flat piece of land which juts out like a peninsula into the surrounding gorges about 670 m deep on either side. The altitude of Mawsynram is marked at 1423m above sea level. It has a total area of 440 sq km and a population of 54,109 as per 2011 census of India, 2011.The Umiew or the Umiam river marks the eastern boundary of Mawsynram while the river Umngi forms the western and the northern boundary. It represents a small part of the highland commonly called the Shillong Plateau, significantly marked by flat-topped hillocks, deep gorges, narrow valleys and a few rivers with numerous streams, rivulets and waterfalls. The prominent hillock in the area is the Symper peak and the Kyrphei peak. The area as a whole exhibits highly uneven topography with the east, south west and half of the middle part of the plateau sloping towards the plain areas bordering Bangladesh referred to as "Riwar". The general slope of the area is towards the south.

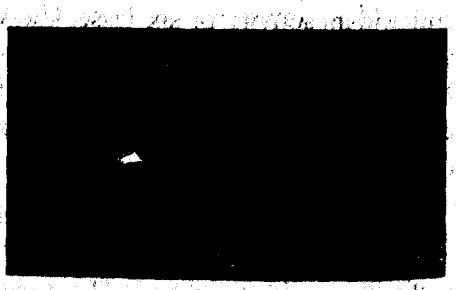
The area experiences a sub-tropical highland climate with an extraordinary rainy and lengthy monsoon season. Mawsynram has earned the name of being the wettest place on earth receiving an average rainfall of 14672.04 mm per annum. The sudden rise of the hills in the south is responsible for the heavy rainfall. The climate of the area is very much influenced by its topography and is controlled by seasonal winds like the south-west monsoon and the north east winter winds as in other parts of the country. Though it is located in the domain of tropical monsoon but due to its high altitude it seldom gets truly hot in Mawsynram except in the Riwar areas bordering Bangladesh which are fairly warm. The area has been subjected to a high degree of weathering due to its geographical location and climatic condition. The soil thus formed is mainly residual and alluvial type, they are generally sandy and calcareous in composition. The vegetation can broadly be grouped under the Tropical type, Deciduous type, Bamboo forest and grasslands. Tropical Evergreen Forests exhibit clear storied nature with dense and impenetrable herbaceous undergrowth. Tropical Moist and Dry Deciduous Forests are much more extensive in this area and include many economically important trees as well. Bamboo forests are not natural but appear in jhum fallows of 15-20 years and often form pure patches at places. Bamboo also appear in comparatively older forest having some gaps in the canopy. Grasslands are not a climax type but represent seral community. Grasslands covering large areas can be seen throughout Weiloi, Mawphlang, Mawsynram. Another striking aspect of the vegetation in Mawsynram and its neighbouring areas are the scattered strand of tree fern Cyathea sp.and Pandanus furcatus. This appears to favour limestone habitats.

The area of study is Mawsynram and its adjoining areas which include villages like Tyrsad, Kyrphei, Umlangmar, Weiloi, Rangsohkham, Laitsohum, Phlangsynnei, Janiaw, Lawbah, Hatmawdon, Mawkaphan. (Fig 1). The villages vary in their demographic size with Mawsynram village having the highest number of household and highest population size of all the villages in Mawsynram, while Rangsohkham village has the smallest population size and number of households (Table 1).

Part of the vegetation surrounded by Pandanus furcatus



Part of the vegetation at Umlangmar



Mawsynram market

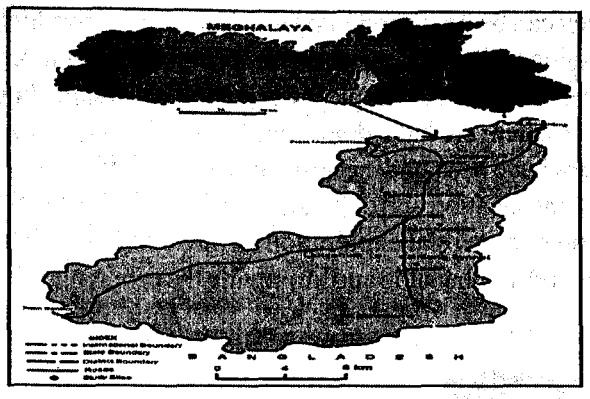


Fig. 1- Map of Mawsynram showing the locations of 12 study sites.

Table 1- Demographic profile of the 12 villages of Mawsynram (Census of India 2011)

Sl. No.	Name of Villages	No. of Household	Population	No. of Individuals per household
1	Mawsynram	503	2663	5.3
2	Tyrsad	264	1403	5.3
3	Kyrphei	93	516	5.5
4	Umlangmar	87	459	5.3
5	Weiloi	140	753	5.4
6	Rangsohkham	7	26	3.7
7	Mawkaphan	72	407	5.7
8	Janiaw	10	48	4.8
9	Phlangsynnei	74	371	5.0
10	Laitsohum	46	216	4.7
11	Lawbah	231	1280	5.5
12	Hatmawdon	36	178	4.9

Methodology:

This study is based on survey and field work conducted during 2011-2012 in the villages in and around Mawsynram. A comprehensive study of wild edible fruits was undertaken to document their uses, local names, distribution and other important information. An effort was made to visit the same locality in different seasons. Information on the wild edible fruits was recorded by interviewing the local people. Local weekly markets at Tyrsad, Mawsynram, Lawbah and Hat Mawdon, were visited from time to time to study the availability of these wild edible fruits in different seasons and also to gather information. Live specimen and available photographs were shown for local identification. Key informants were consulted to locate and collect these fruits and during field work the informants were requested to accompany to the field and show the plants. These fruits were then identified with the help of regional and local floras, the specimens were counter checked from the herbarium of The Botanical Survey of India, Eastern Circle, Shillong. Plant specimen and fruits are being preserved as herbarium as well as bottled specimen and kept in Botany department of Shillong College for future references.

Results and Discussion:

From the survey conducted a total of 60 species of wild edible fruits belonging to 40 genera under 28 families were collected and recorded with their family, local names, habit, flowering & fruiting and uses. The results of this study also showed that out of a total of 60 species, the most commonly used species belong to trees (35 species; 59.32%), followed by shrubs (15 species; 25.42%), climbers (9 species; 15%) and herb (1species; 1.69%) (Fig. 2). Some of these wild edible fruits are very popular among the local people and contribute as an important food item in the daily diet of the local people. The findings of this study revealed that the picking of these from the nearby forest is a popular leisure activity, collected and utilised for domestic and household purposes. Fruits like Citrus indica, C. macroptera, C. medica, C. grandis, Docynia. indica, Morus australis, Myrica esculenta, M. nagi, Prunus nepalensis, etc are very much in

demand in the local markets as they can be processed into jams, wine and juice which are also exported to other states in the country. Some of the wild edible fruits are rare, worth mentioning here is Gironniera reticulata, another rare fruit is Stropanthus wallichii which is lesser known to people in most parts of the state. Lesser known wild edible fruits like Mahonia pycnophylla, Toddalia asiatica, etc have dual significance as food as well as medicinally. The economic potential of many of these wild fruits have been under estimated, though many of the indigenous people have identified their economic potential but yet domestication and cultivation of these has not been carried out. Therefore there is an urgent need for documentation and commercial exploration through value addition products so as to increase their marketing potential and demand thereby enhancing and improving the economic status of the rural people.

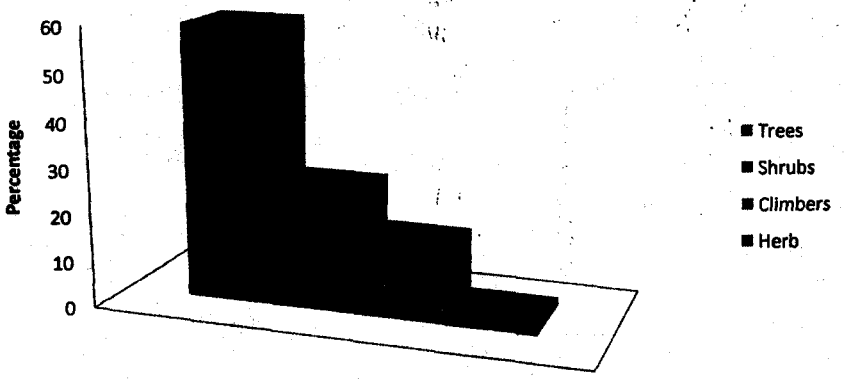


Fig. 2 Distribution of wild edible fruit species in different life forms

Conclusion

The current study described the traditional knowledge of the local people of Mawsynram and its surrounding areas on the usage of wild fruits particularly in their food habit. As a result, documentation of these fruits is very important so as to assess and help preserve the local knowledge of these indigenous people. Furthermore, the economic potential of many of these wild fruits have not yet been explored thoroughly. Sustainable utilization of threatened fruits is equally an important issue that needs to be addressed. Severe biotic intrusion and deforestation have threatened the survival of many of these wild edible fruits which were once very common, for example the population of Artocarpus lakoocha has drastically reduce due to felling of timber and poor seed germination. Hence, there is sufficient scope for investigation in this field so as to study their restoration and proliferation methods so as to improve and help in their production. Currently there is no conservation plan for many of these threatened wild edible fruits and this field offers ample scope for investigation and research. As a result, protection of these species is of vast significance and stress should be given through awareness programme for proper compilation, restoration and proliferation methods and sustainable use of these wild edible fruits. Further, such studies not only help the scientific area but also the region and the tribal society as well.

Presentation of data

The plants are documented with their botanical names in an alphabetical order. A detailed description of these wild edible fruits along with their common English name, local name, family name and their uses are given below.

1. *Agapetes obovata (Wt.) Hk.f. (Family: Vacciniaceae)*

Synonym	:	Vaccinium obovatum Wt.
Local name	:	Soh lieh
English name	:	
Description	:	A much branched epiphytic or lithophytic shrubs which is endemic to Meghalaya. Leaves obovate-elliptic,rounded or obtuse at the tip. Fruits globose slightly flattened at the top, greenish cream in colour.
Fls.&Frts	:	Aug-March.
Uses	:	Ripe fruits are eaten especially by children. Considered to be good for stomach.

2. *Agapetes variegata (Roxb.) D.Don (Fam:Vacciniaceae)*

Synonym : Ceratostema variegatum (Roxb.)
Local name : Jalamut
English name : Bell heather
Description : Terrestrial or epiphytic shrubs, bark greyish brown, very common in southern slope of Khasi and Jaintia hills. Leaves broadly elliptic, glabrous. Flowers pinkish- red. Berries reddish to purplish-black.
Fls.& Frts : Nov-April
Uses : Fruits are edible. Flowers have sweet-sour taste and eaten raw or made into chutney or cooked with fish.

3. *Aporusa dioica (Roxb.)Muell. (Fam:Euphorbiaceae)*

Synonym : Alnus dioica Roxb.
Local name : Soh khyrwiat
English name : Common aporosa
Description : A tree with thin bole and lax crown, bark blackish or dark grey. Leaves elliptic-lanceolate. Capsules ellipsoid.
Flrs.&Frts : Nov-May
Uses : Ripe fruits are edible.

4. *Ardisia griffithii C.B Clarke (Fam:Myrsinaceae)*

Local name : Soh shyi
English name :
Description : A small tree with greyish bark, stout. This plant is endemic to Meghalaya, frequent in ever green primary forests as an undergrowth. Leaves broadly elliptic-lanceolate, glabrous. Flowers pink. Fruits globose, black when ripe.
Flrs.&Frts : May-Dec
Uses : Black globose fruits are edible.

5. *Ardisia solanacea Roxb. (Fam:Myrsinaceae)*

Synonym : A.humilis auct.non.Vahl
Local name : Soh parong
English name : Shoebutton
Description : Shrubs. Leaves obovate-oblong or elliptic,glabrous. Flowers pinkish. Fruits subglobose, blackish.
Flrs.&Frts : Jun-Feb
Uses : Black reddish fruits are edible.

6. *Artocarpus heterophyllus Lamk. (Fam:Moraceae)*

Synonym : A.integrifolius L.
Local name : Soh phan
English name : Jackfruit
Description : A large evergreen tree with oval dense crown, bark dark grey, blackish-brown, scaly with white patches. Leaves obovate-oblong, glabrescent. Receptacles greenish, obovate, cylindric; mature ones sharply pointed, tubercled.
Fls. & Frts. : Feb-Oct.
Uses : Fleshy ripe fruits are largely eaten.

7. *Artocarpus lakoocha Buch.-Ham (Fam:Moraceae)*

Synonym :
Local name : Soh ram

English name : Monkey jack

Description : A tall tree with large, leathery deciduous leaves. The orange-yellow male flowers and reddish female flowers of lakoocha are borne separately on the same trees. Fruits are nearly round or irregular, from 5 to 12 cm in diameter and have a velvety surface. The lakoocha fruits are dull-yellow with pink tinge and sweet-sour pulp. Fruit yield can be up to 80 kg/tree with fruit weight ranging from 200 to 350 g.

Fls. & Frts. : Feb-July.

Uses : Ripe fruits are eaten which look like jackfruit but smaller in size. Seeds are also roasted and eaten. Seeds are eaten in constipation. Seeds are ground, mixed with water and taken.

8. *Baccaurea ramiflora, Lour. (Fam: Euphorbiaceae)*

Synonym : B. sapida (Roxb.) Muell.-Arg.

Local name : Soh ramdieng,

English name : Burmese grape

Description : A middle size evergreen tree with compact, oval crown. Leaves oblanceolate-elliptic. Flowers yellow. Fruits ovoid-globose, yellow, pulp rose coloured.

Fls.&Frts : June-July

Uses : Fruits are sweetish and edible, eaten raw. Bark is chewed in constipation.

9. *Carallia brachiata (Lour) Merr. (Fam-Rhizophoraceae)*

Synonym : Diatoma brachiata Lour

Local name : Soh syllih

English name : Carallia

Description : Trees or shrubs, crown compact, dense, oval, bark dark brown. Leaves oblong-obovate, gla brous and shining above. Flowers greenish yellow. Berry globose, pink or red.

Fls.&Frts : Nov-Mar

Uses : Ripe red coloured fruits are eaten.

10. *Castanopsis indica (Roxb.)DC. (Fam:Fagaceae)*

Local name : Soh ot rit

English name : Chestnut

Description : Evergreen large tree with much spreading, umbrella-shaped crown, bark greyish brown, very common in Meghalaya, in evergreen forests throughout the state. Leaves oblong-elliptic. Cupule densely covered with spines, brown when ripe.

Fls.&Frts : Sept-Dec

Uses : Nuts are eaten raw and very popular among the Khasis.

11. *Citrus assamensis R.M.Dutta & Bhattacharya (Fam:Rutaceae)*

Local name : Sohsying

English name : Ginger lime

Description : A fairly tall tree with an open growth habit bearing medium length thorns. Leaves are elliptical and have a faint ginger odour when crushed. Flowers white, fruit is ovoid, yellow green when ripe with a smooth skin and a vestigial nipple.

Flrs.&Fruits : Mar-Nov

Uses : Aromatic spherical fruit is edible. The rind has ginger like aroma.

12. *Citrus grandis (L.) Osbeck. (Fam:Rutaceae)*

Synonym : C.decumana L.

Local name : Soh myngor

English name : Pummelo or Shaddock

Description : Spreading round topped, almost thornless tree. Leaves are large with broadly winged petiole, lower surface of the leaf is pubescent particularly the main vein. Flowers white, large, crowded in short axillary cymes. Fruits large sized, sub-globose in shape with thick and spongy rind, the edible part may be white or pink, fruits sweet and juicy.

Flrs.&Frts : Aug-Jan

Uses : Large sized fruits are sweetish-sour in taste and are edible; colour of pulp may be yellow or pink. Fruit is considered to kill intestinal worms if eaten in sufficient quantity

13. *Citrus latipes DC (Fam:Rutaceae)*

Local name : Soh kymphor shrieh

English name : Khasi papeda

Description : A medium tree, branching almost from base, densely foliaged, branchlets spreading with spines. Leaves unifoliate with a winged petiole, wings oblong, tapering towards base, often larger than lamina. Flowers sweet scented, ovoid in buds, purplish tinged. Fruits globose to oblate, de pressed on both ends, yellowish with pitted surface.

Flrs.&Frts : July-Oct.

Uses : Acidic fruits are edible.

14. *Citrus macroptera Montr. (Fam:Rutaceae)*

Local name : Soh kwit.

English name : Malanesian papedas

Description : A small evergreen tree widely distributed in the lower altitudes. Leaves large,petiolar wing as wide and long as the lamina.Fruits round with oblate surface and with little pulp vesicles

Fls.&Frts : Aug-Jan

Uses : Fruits used by local tribals for medicinal and cooking purposes. Fruit juice is taken to get relief from stomachache. The juice of the fruit is mixed with a little lime and mustard oil and applied on the foot and forehead during fever. The rind is sun dried and cooked with meat or fish, its rind portion is also used for culinary purposes as flavouring agent, the fruit is also pickled.

15. *Citrus medica L.(Fam:Rutaceae)*

Local name : Soh mad

English name : Citron

Description : This species is indigenous to the north east,found growing wild in the Khasi hills of Meghalaya.It is a small bushy thorny shrub. Leaves oblong - lanceolate, aromatic, spines are straight. Flowers are white, usually tinged with red. Fruits oblong and obovoid, green when immature,yellow when ripe and highly aromatic.

Fls.& Frts : Nov-March

Uses : The fleshy mesocarp of the fruit is sweet, eaten fresh; also acid juice of the fruit is taken. Leaves are boiled in water and the water is taken as bath to get relief from cold, influenza and joint pain, very effective. Leaf decoction is also used for bathing newborns and infants.

16. *Citrus sinensis (L.) Osbeck (Fam:Rutaceae)*

Synonym : C.limetta Risso

Local name : Soh nairiang

English name : Sweet orange

Description : A medium size tree,branchlets angular when young, spinous. Leaves unifoliate with narrowly winged petioles, wings oblong and broad on either side. Fruits medium-sized, subglobose to oblate, surface smooth, pitted, glossy, greenish-yellow to orange.

Flrs.& Frts : April-Dec

Uses : Greenish yellow coloured fruits are edible. The fruits are a rich source of antiscorbutic vitamin.

17. *Coix lacryma- jobi L. (Fam:Poaceae)*

Local name : Sohriew
English name : Job's tear.
Description : An annual or perennial grass.Culms erect, robust. Leaf blades linear-lanceolate. Utricle ovoid to cylindrical, usually bony, shiny, white, bluish or gray-brown, sometimes with apical beak.
Flrs.& Frts : Jun-Dec.
Uses : Cowry shape grains are edible and taste almost similar to maize. Half ripe seeds are cooked like rice. Soup is prepared by boiling the grain in water and is found to be very tasty. The grains are also used in the preparation of beer.

18. *Docynia indica (Wall.)Decne. (Fam-Rosaceae)*

Synonym : Pyrus indica Wall.
Local name : Sohphoh khasi
English name : Indian crab apple
Description : A moderate size deciduous tree found throughout the Khasi hills. Leaves ovate-lanceolate. Flowers white. Fruit pyriform pome with a smoth surface and has an acid taste.
Fls.&Frts : July -Oct
Uses : Fruits has quince like flavour and is eaten raw or boiled or pickled or cooked.Cooked fruit is mixed with powdered chilly and eaten.

19. *Duchesnea indica (Andr.)Focke. (Fam:Rosaceae)*

Synonym : Fragaria indica (Andr.) Wolf.
Local name : Soh shiah khlaw.
English name : Wild strawberry.
Description : A creeping perennial pubescent herb with epigeal rooting stolons. Leaves in rosette 3-foliate. Flowers solitary,yellow. Achenes black,resting on bright red receptacle.
Fls.&Frts : Mar-Aug
Uses : Fruits are edible. Eaten especially by children.

20. *Elaeagnus conferta Roxb.(Fam: Elaeagnaceae)*

Synonym : Elaeagnus latifolia
Local name : Sohshang
English name : Silver berry/ wild olive
Description : A large evergreen straggling or scandent shrub, sometimes spiny. Leaves obovate-eliptic, base narrowed, silvery shining beneath. Flowers off white or cream coloured. Fruits pinkish or yel lowish, ovoid-ellipsoid.
Fls.&Frts : March-May
Uses : Succulent ripe fruits are edible,eaten raw or pickled. Ripe fruits are also used for making chutney. Fruit pulp is used for making jam, jelly and refreshing.

21. *Elaeagnus pyriformis Hk.f. (Fam:Elaeagnaceae)*

Local name : Soh khlur
English name : Silver berry
Description : A scandent or straggling shrub with spreading branches, very common in open grasslands and along forests margins. Leaves obovate-elliptic, base narrowed, shining silvery beneath. Flowers long,coppery scaly. Fruits small, long, pyriform,yellowish red when ripe, covered with coppery scales.
Fls.& Frts : Nov-April
Uses : The small fruits are sweet and pulpy and are edible.

22. *Elaeocarpus floribundus Bl. (Fam:Elaeocarpaceae)*

Local name : Soh khyllam
English name : Indian olive
Description : A tall evergreen tree with greyish-brown bark. Leaves ovate-elliptic, glabrous. Flowers white. Drupe light green, externally resembling an olive, oblong, smooth, rounded at both ends, flesh pleasantly acid.
Flrs.& Frts : Mar-Dec
Uses : Green coloured fruits are edible. It is usually pickled raw or boiled.

23. *Elaeocarpus lancifolius Roxb. (Fam:Elaeocarpaceae)*

Local name : Soh khyllam snieh
English name :
Description : A middle size evergreen tree with spreading dense crown. Bark geyish-brown. Leaves elliptic-lanceolate, glabrous or almost so. Flowers white, small, buds lanceolate. Drupes ovoid, green with faint yellow specks.
Flrs.& Frts : Mar-Dec
Uses : Fruits are edible. Timber used for tea chests, poles and charcoal and also for fuel.

24. *Elaeocarpus prunifolius (C.Muell) (Fam:Elaeocarpaceae)*

Local name : Soh khyllam eit blang
Description : A small evergreen tree with grey bark and slightly rough outside.Leaves oblong-lanceolate, glabrous, shining above. Flowers white. Drupe long, oblong-ovoid, slightly rugose.
Flrs.& Frts : Feb-Oct
Uses : Fruits are edible.

25. *Emblica officinalis Gaertn (Fam:Euphorbiaceae)*

Synonym : Phyllanthus emblica Linn
Local name : Soh mylleng
English name : Gooseberry
Description : Small or middle sized tree,usually with a crooked stem. Leaves linear-oblong; Flowers minute, white or yellowish. Fruits globose, greenish or yellowish green.Very common in Meghalaya.
Flrs.& Frts : Mar-Aug
Uses : Fruits are eaten raw or made into pickles and juice. Fruits are eaten raw as stomachic and as a source of vitamin C. Bark is ground and the paste are applied to cuts and wounds as styptic. Juice extract is taken to get relief from gastric problem and high blood pressure.

26. *Flacourtia jangomas (Lour).Raeusch. (Fam: Flacourtiaceae)*

Synonym : Flacourtia cataphracta Willd.
Local name : Sohmluh
English name : Coffee plum
Description : A middle size tree, bark cinnamon brown, nearly smooth, armed with compound spines at basal portion. Leaves ovate-lanceolate, glabrous. Flowers grenish-yellow or white,fragnant. Fruits globose, dark purple.
Flrs & Frts : March-Oct.
Uses : Fruits are acidic and edible.

27. *Garcinia cowa Roxb.ex DC (Fam:Clusiaceae)*

Local name : Soh ryngksan
English name : Cowa mangosteen

Description : A middle size evergreen tree, bark greyish brown.Leaves acuminate, reddish when young. Flowers yellow. Fruits long, ovoid, globose, often obscurely globular, beaked, reddish when mature.

Flrs.& Frts : Mar-Sept

Uses : Fruit is acidic in taste and is edible. The acidic fruits are locally used to cure dysentery and stomach trouble, usually dried and preserved.

28. *Garcinia xanthochymus Hook.f.enT Anders (Fam:Clusiaceae)*

Local name : Soh khyllung

English name : Egg tree/ Sour mangosteen

Description : A small or middle sized tree with sombre-green foliage and a deep narrow crown. Bark dark brown exfoliating in small flakes. Leaves oblong-lanceolate, shining on both surfaces. Flowers dull-white. Fruit pointed, crowned by the persistent stigmatic lobes, green, golden yellow when ripe.

Flrs.& Frts : Mar-Jan

Uses : Fruit is acidic in taste and is edible.

29. *Gironniera reticulata Thw. (Fam:Ulmaceae)*

Synonym : Gcuspidata (Bl.)

Local name : Soh brai

Description : A very large evergreen tree with buttressed roots with dark brown bark. Leaves ovate-oblong, dark green,shiny above. Flowers minute, greenish yellow. Fruit a drupe, long, ovoid, beaked and one seeded,yellowish colour but turns brown when ripe.

Fls.&Frts : May- Dec

Uses : Ripe fruit is edible and consume fresh or made into pickle.

30. *Gynocardia odorata R. Br. (Fam: Flacourtiaceae)*

Local name : Sohliang

Description : A middle sized evergreen tree, bark grey. Leaves oblong, glabrous. Flowers yellow. Fruits indehiscent, depressed globose with a thick, hard lenticelled rind, seeds immersed in pulp.

Fl.&Frts : Mar-Jan

Uses : The boiled seeds are cut into thin slices and eaten, commonly sold in the market. Bark is powdered and mixed with little water to make a paste which is applied to affected part in leucoderma.

31. *Hodgsonia macrocarpa (Bl.) Cogn. (Fam: Cucurbitaceae)*

Synonym : H.heteroclita (Roxb.)

Local name : Soh mynther

Description : Lianas. Bark is grey which is extremely bitter. Leaves ovate, glabrous, pale beneath. Flowers brown villous, yellow tinged within. Fruit reddish-brown, depressed globose, grooved and to mentose, flesh hard and bitter. Common in Meghalaya, climbing over the dense canopy of evergreen forests.

Fl.& Frts : Feb-Nov

Uses : Kernel of the seed is eaten after roasting. A kind of chutney is also made with the kernel.

32. *Holboellia latifolia Wall. (Fam:Lardizabalaceae)*

Synonym : Stauntonia latifolia.

Local name : Soh lyngkait.

English name : Sausage vine.

Description : It is a fast-growing, twining, evergreen climber with mid-green, ovate leaves, bark greenish-brown.The leaves have 3-5 leaflets, glabrous and shining above. Flowers fragnant, green to pinkish-purple. Flowering may be followed by large, purple sausage-shaped fruits.

Fls.&Frts : March-Nov
Uses : Ripe fruits are eaten.

33. *Mahonia pycnophylla (Fedde) (Fam:Berberidaceae)*
Synonym : Mahonia nepalensis (non DC.)
Local name : Soh niang mat.
English name :
Description : A small tree with grey brown bark, wood yellow.Leaflets ovate-oblong, remotely spinous. Flow ers yellow. Fruits purplish when ripe, ellipsoid or globose. This plant can be easily marked by the spinous serrate leaves which are clustered at tips and the ubranched nature of plants.
Flrs & Frts : Sept-March.
Uses : Ripe fruit is edible, sour in taste. The bark and leaves are used as medicine for eye diseases.

34. *Melastoma nepalensis Lodd (Fam:Melastomataceae)*
Synonym : M.normale D.Don
Local name : Sohklong
English name :
Description : A shrub or small tree. Stem reddish, densely hairy. Leaves ovate-lanceolate, hairy above, densely silky or villous beneath. Fruits truncate, pulpy.
Fls.&Frts : Jun-Dec
Uses : Edible, insipid, black coloured ripe fruits taste like blackberry.

35. *Meyna spinosa Roxb.ex Link (Fam-Rubiaceae)*
Synonym : Vangueria spinosa Roxb.
Local name : Sohmon
English name :
Description : Middle sized tree often armed with short spines. Leaves ovate-elliptic; flowers greenish white; drupes yellowish when ripe and become brown when fully ripe.
Fls.&Frts : Oct-Dec
Uses : Fruits are eaten fresh or dried. Fully mature fruit gives an intoxicating effect(it has a sweet alcoholic aroma and is also used for wine making in combination with other fruits) Spine is used for pulling out small splinter embedded in skin, as it is considered to have antiseptic property.

36. *Morus australis Poir. (Fam-Moraceae)*
Synonym : Morus indica Thunb.
Local name : Soh langdkhur
English name : Common mulberry
Description : A small or middle sized tree, branches spreading, bark brown.Leaves ovate-orbicular, glabrous at length. Male spikes green, cylindrical, female subglobose. Fruits shining, blackish purple.
Fls.& Frts. : Feb-July
Uses : Purplish ripe catkins are fleshy and sweet, is edible and consume fresh. Processed product include jam and other preserves.

37. *Myrica esculenta Ham.ex Don (Fam:Myricaceae)*
Synonym : M. farquhariana Wall
Local name : Soh phiebah
English name : Box Myrtle
Description : A middle sized evergreen tree. The trunk is crooked and irregularly branched. Leaves oblong-oblan ceolate. Fruits long, ovoid-oblong,tubercled, green when immature and turning yellowish red when ripe, soury.
Fls.&Frts : Oct-July

Uses : Green coloured juicy fruits are edible,is one of the tastiest wild fruits of Meghalaya and use as an aromatic,a stimulant,an astringent,carminative.Ripe fruits are also pickled. Fresh juice in raw condition is given in dysentery. Fresh bark is ground into powder and put in aching tooth to get relief from toothache.

38. *Myrica nagi Thunb. (Fam: Myricaceae)*

Local name : Soh phienam
English name : Box myrtle
Description : A middle sized evergreen tree. Leaves oblong-oblanceolate. Fruits long, small, globose tubercled, green, turning red, soury.
Fls.&Frts : Oct-July
Uses : Fruit is edible and good for fresh juice and pickle preparation.

39. *Passiflora edulis Sims.(Fam:Passifloraceae)*

Local name : Soh brap
English name : Passion fruit.
Description : Climbers. Leaves ovate-deltoid, tendril generally simple. Flowers pale yellow or white;fruit globose,purplish or blackish when ripe. Common in Meghalaya.
Fls.&Frts : June-Nov.
Uses : Ripe fruits are edible. Leaves are chewed to keep blood pressure under control. Leaf juice is given in dysentery.

40. *Pinanga gracilis Blume (Fam: Arecaceae)*

Synonym : Areca gracilis Roxb
Local name : Soh laper
English name : Himalayan Pinanga palm
Description : A small slender shrub.Stem thick. Leaves sparingly pinnate, petioles and sheaths scurfy. Fruits ellipsoid, smooth, scarlet or orange-red.
Fls.&Frts : Jan-Dec.
Uses : Ripe fruits are taken as mastigatory.

41. *Prunus jenkinsii Hk.f (Fam:Rosaceae)*

Local name : Soh iong khlaw
English name :
Description : A tall tree with dark grey bark. Leaves oblong-lanceolate. Flowers white. Fruits ovoid, yellow tinged with red.
Fls.&Frts : Oct-Mar
Uses : Ripe fruits are sour and edible.

42. *Prunus nepaulensis (Ser.) Steud. (Fam:Rosaceae)*

Synonym : Padus nepalensis Schneid.
Local name : Soh iong
English name : Khasia cherry.
Description : A middle size to large deciduous tree with greyish or dark brown bark. Leaves ovate-lan ceolate. Flowers white. Fruits fleshy with big, hard seed, blackish purple when ripe. Pyrenes smooth, hard.
Fls.&Frts : Nov-Aug.
Uses : Ripe fruits are eaten and also used for making jam, squash, beverage, juices and wine. Rich in iron and vitamin C.

43. *Pyrus pashia D.Don (Fam:Rosaceae)*

Local name : Soh shur
English name : Wild pear
Description : A middle size deciduous tree, often thorny when young. Leaves ovate-lanceolate, glabrous when mature. Flowers white. Fruits globose, depress at apex, has brownish spots on its surface,dark brown when ripe.The fruit resemble pear but differs in colour and quality.
Fls.&Frts : March-Nov.
Uses : Ripe fruits are eaten and also used for wine making .

44. *Pyrus pyrifolia (Burm.f.)Nakai. (Fam;Rosaceae)*

Local name : Soh phoh nongkhlaw.
English name : Sand pear.
Description : A large tree reaching a height as high as 40ft, with a spreading rounded crown. Usually blooms in spring and the tree is almost completely covered with white flowers. Fruit is large round with a course skin, if allowed to ripe on tree it rots.
Fls.&Frts : Apr-Aug.
Uses : Yellowish green coloured, globose fruits are largely eaten.

45. *Rhus javanica L. (Fam-Anacardiaceae)*

Synonym : R.semialata Murr.
Local name : Soh ma
English name : Nut gall
Description : Small to middle sized deciduous trees with grey warty bark. Leaflets ovate-lanceolate. Flowers yellow, greenish-white. Fruits ovoid,orbicular, pink when ripe. Very common throughout Meghalaya particularly in secondary forests, open lands and forest margins.
Fls.&Frts : Aug-March.
Uses : The fruit is edible and consume fresh.Sour fruits are used for catching fishes by local people. Roots are powdered and mixed with double the amount of water and is given in colic. Fruits are eaten raw as stomachic. Seeds are dried, powdered and given in digestive disorder.

46. *Rubus ellipticus Smith. (Fam: Rosaceae)*

Local name : Soh shiah
English name : Asian wild raspberry
Description : A large straggling, thorny shrub with pinnately 3 foliage leaves. Stem greenish clothed with prickles and reddish hairs. Fruits orange yellow, succulent and one of the tastiest wild fruits in the hills.
Fls&Frts : Jan-June
Uses : Ripe fruits are edible, tasty and highly nutritive.

47. *Rubus niveus Thunb. (Fam; Rosaceae)*

Synonym : R.lasiocarpus Sm.
Local name : Soh khawiong.
English name : Ceylon raspberry
Description : A large spreading thorny shrub very common as an undergrowth in pine forest and along forest margins. The stem is brownish red, covered with sharp hooked thorns. Leaves elliptic-lan ceolate. Flowers red or pinkish, fruit ovoid globose, purplish black at maturity, juicy and sweet with small seeds.
Fls&Frts : Mar-Oct
Uses : Ripe fruits are edible.

48. *Rubus rosifolius Sm. (Fam: Rosaceae)*

Local name : Sohchiria
English name : Forest bramble
Description : A straggling or subscandent shrub, branchlets purplish, sharply dense prickly. Leaves ovate-oblong. Flowers white. Fruits oblong to sub-globose, orange-yellow or scarlet.
Flrs&Frts : Jan-Feb
Uses : Ripe fruits are edible

49. *Rubus rugosus Sm. (Fam:Rosaceae)*

Synonym : R.moluccanus Hk.f.
Local name : Sohnep
English name : Keriberry
Description : A straggling or sub-scandent shrubs, prickles short, straight or slightly curved. Leaves ovate orbicular, densely grey velvety. Flowers yellow or yellowish white. Fruits sub-globose, red.
Flrs&Frts : June-Oct.
Uses : Ripe fruits are edible. Root is ground into a paste and applied to cuts for blood clotting and to prevent swelling.

50. *Solena heterophylla Lour. (Fam:Cucurbitaceae)*

Synonym : Zehneria umbellata Thw.
Local name : Soh khaiblei.
English name : Clasping stemmed solena
Description : Stems angular. Flowers yellowish-white or dull white. Fruits oblong, subangular, red.
Fls.&Frts : July-Jan.
Uses : Ripe fruits are edible.

51. *Stropanthus wallichii A.DC. (Fam:Apocynaceae)*

Local name : Soh rengblang
English name : Goat's horn creeper
Description : Climbers. Leaves oblong-lanceolate, glabrous, shining above, pale beneath. Flowers pale yel low, purplish-red veined. Fruits long, divaricate, green.
Flrs&Frts : May-Oct.
Uses : Sour fruit is eaten. Latex, obtained by removing the petiole from the stem, is applied to insect sting or mosquito sting for relief.

52. *Syzygium jambos (Linn) Alst. (Fam:Myrtaceae)*

Synonym : Eugenia jambos Linn
Local name : Soh khongwa
English name : Plum rose/ Water apple
Description : Middle sized handsome trees, usually branching from near the base. Leaves oblong-lanceolate. Flowers white or dull white. Berries yellowish to pink tinged, yellow or white when ripe.
Fls.& Frts : July-May.
Uses : Ripe coloured fruits are edible, the peel is also made into pickles

53. *Syzygium tetragonum (Wt.) Kurz. (Fam:Myrtaceae)*

Synonym : Eugenia tetragona Wt
Local name : Soh thiangum
English name :
Description : A tall tree with white or greyish bark, often with lack patches. Leaves oblanceolate, glaucous beneath. Flowers white, fragrant. Fruits long, globose, orange yellow or red.

Fls.& Frts : July-May.
Uses : Globose ripe fruits are edible.

54. *Tetrastigma obovatum (Laws.) (Fam :Vitaceae)*
Synonym : Vitis obovata Laws.
Local name : Soh langnar
English name :
Description : An evergreen climber,tendrils simple. Leaves obovate-elliptic,5foliate. Flowers greenish yel low. Berries globose-ellipsoid, black.
Fls. & Frts : May-Oct.
Uses : Ripe fruits are edible

55. *Toddalia asiatica (L) Lamk.(Fam: Rutaceae)*
Synonym : Toddalia aculeata Pers.
Local name : Soh sat.
English name : Orange climber
Description : A large prickly climbing shrub. Leaflets oblong-lanceolate, trifoliate with a common petiole, emitting a very strong aroma. Flowers yellowish-white or yellow, aromatic. Fruits globose, yellow when ripe, highly aromatic.
Fls.&Frts : Sept-Oct.
Uses : Ripe fruits are edible

56. *Trichosanthes tricuspidata Lour. (Fam:Cucurbitaceae)*
Synonym : T.palmata Roxb.
Local name : Soh lynshang.
English name : Redball snakegourd
Description : A large woody climber with tendrils. Leaves simple, deeply palmately lobed, very variable. Male flowers white, in racemes with large conspicuous bracts. Female flowers solitary, white. Fruit a large globose berry, red. orange-streaked.
Fls.&Frts : June-Nov.
Uses : Ripe fruits are edible

57. *Vaccinium griffithianum Wt. (Fam: Vacciniaceae)*
Local name:Khasi: Sohryngkham.
English name : Griffith's blueberry
Description : A small bushy shrub, much branched. Leaves elliptic-lanceolate, glabrous above and sparsely hairy beneath.Flowers white or creamy. Fruits globose berries, brownish red when ripe.
Flrs & Frts : March- Oct.
Uses : Ripe berries are edible.

58. *Vaccinium serratum Wight (Fam:Vacciniaceae)*
Synonym : V.donnianum Wt.
Local name : Soh stem
English name : Saw leaved whortleberry
Description : An epiphytic shrub. Leaves crowded at apex of branchlets, lanceolate. Flowers greenish-white, in terminal or subterminal racemes. Berries globose.
Fls.& Frts : Jun-Jan.
Uses : Yellowish berries are edible .

59. *Viburnum foetidum Wall. (Fam:Caprifoliaceae)*

Local name : Sohlang

English name : Mapleleaf Viburnum

Description : A small size shrub or tree,bark greyish or dark brown.Leaves elliptic-lanceolate, sooth on the upper surface and hairy beneath.Flowers white. Fruits drupes, ellipsoid, acidic, bright red when ripe.

Flrs.&Frts : June-Nov.

Uses : Ripe fruits are edible and used as fishing bait.

60. *Willoughbeia edulis Roxb. (Fam:Apocynaceae)*

Local name : Sohbrap khlaw.

English name : Edible willughbeia

Description : A woody climber exuding milky juice,tendrils long branched. Leaves oblong, redish brown beneath. Flowers yellowish cream coloured. Ripe fruits are orange coloured, sub globose in shape, inside which the crimson red coloured seeds are embedded in the mushy pulp.

Fls.&Frts : May-Dec.

Uses : The pulp attached to the seeds is sucked,sub-sweetish in taste.

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PRODUCTION OF CITRIC ACID BY ASPERILLUS NIGER USING CITRUS FRUIT WASTE

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INTRODUCTION

Citric acid is a weak organic acid found in citrus fruit. It is a good, natural preservative and is also used to add an acidic (sour) taste to food and soft drinks. In biochemistry it is important as an intermediate in the citric acid cycle and therefore occurs in the metabolism of almost all form of life. Sometimes a high concentration of citric acid can damage hair, bleach it and can cause skin and eye irritation. The excess citric acid is metabolized and eliminated from the body. It also serves as an environmentally benign cleaning agent and acts as an antioxidant (Aysegul and Christian, 2003). Chemically, citric acid shares the properties of other carboxylic acid. When heated above 175°C, it decomposes through the loss of carbon dioxide and water.

The worldwide demand of citric acid is about 6.0×10^5 tons per year and it is bound to increase day by day (Karaffa and Kubicek, 2003). With an estimated annual production of 1,000,000 tons (Khadijah-Al-Khadir, 2011), citric acid is one of fermentation products with the highest production level worldwide. The food industry consumes about 70% of total citric acid produced, while other industries consume remaining 30% (Khadijah-Al-Khadir, 2011). From this point of view, it is necessary to use inexpensive and readily available raw materials for industrial production processes. Biotechnological production is advantageous over chemical synthesis in that way we can utilize raw materials such as fruit wastes and can selectively produce citric acid in an economic way.

Many microorganisms have been evaluated for the production of citric acid including bacteria such as *Bacillus licheniformis, B. subtilis, Corynebacterium* spp. (Kapoor *et al.*, 1983), fungi such as *A. niger, A. awamori, A. foetidus, Penicillium restrictum* (Kubicek, 1998). Yeast such as *Candida lipolytica, C. intermedia* and *Saccharomyces cerevisiae* (Kamzolova *et al.*, 2003). However, *A. niger* a filamentous fungus remained the organism of choice for citric acid production due to ease of handling, its ability to ferment a variety of cheap raw materials, and high yields (Schuster *et al.*, 2002).

Globally citrus fruit production was estimated as 120 million tons per year. India ranks sixth in the production of citrus fruits in the world and proportionately citrus fruit wastes are also generated in million tons per year. The north-eastern region of India has been described as one of the major centres of diversity of citrus fruits, with Meghalaya leading the region in both area and production. However, lack of effective disposal of wastes which after extraction of juice, were dumped indiscriminately leads to environmental pollution and health problems to human beings. This studies aims to explore the possible use of available wastes for the production of citric acid and also to minimize the environmental pollution. Hence, we have selected citrus fruit wastes as the raw materials as these materials are abundantly, easily available and also inexpensive. Citrus fruit wastes are rich in cellulosic materials along with low sugary substrates and the organism producing citric acid utilize these cellulose and sugars efficiently to produce citric acid.

OBJECTIVE

The objective of this study is to adopt the use of different fruit waste as a cheap medium for the production of citric acid by using *Aspergillus niger*.

PLAN OF WORK

Keeping in view on the above objective, the following studies shall be carried out:

i) Survey and Identification of citrus fruits available in Shillong market
ii) Isolation and Identification of fungal species i.e. *Aspergillus niger*
iii) To study the citric acid production by *Aspergillus niger* in the different fruit waste
iv) Data compilation

MATERIALS AND METHODS

Pre-treatment of fruit peels: Pre-treatment of the different raw materials i.e. fruit waste peels bought from the local market in Shillong was done following the method of Khadijah-Al-Khadir (2011) and Belzawar *et al.*, 2013. In this process, different citrus fruits (Khasi Mandarin, Pineapple, Pomelo) bought from a local market in Shillong, were used in the present study. Fruit peels were oven-dried at 60 °C for 2 h and cut into 5 mm mesh size.

Isolation and Identification of Isolate: Isolation and Identification of Isolate was done following the method of Pandey (1992) and Khadijah-Al-Khadir (2011). The isolated fungal strain was screened from the soil sample by serial dilution technique. The dilutions were inoculated by the spread plate technique on potato dextrose agar (PDA) and incubated for 30°C for 48 hours. The fungal cultures obtained in this primary screening were identified by observing under the microscope and sub-cultured on the selected media. The selected media for screening of Citric acid producers was Czapeck dox agar with bromocresol green as the indicator. The mycelial growth which showed yellow color zones around them were selected as the citric acid producers. These colonies were stained and identified under the microscope as *Aspergillus niger*. After identifying it as *Aspergillus niger*, it was transferred to PDA slants and preserved for the further use.

Inoculum Preparation:

1. Spore Suspension: *Aspergillus niger* were grown on potato dextrose agar plates at a temperature of 30°C for 5 days. After the incubation the plates were washed with sterile 0.1% of tween 80 solution to collect the spores. Spore suspension was collected in sterile tubes and preserved for further use. 1ml of this suspension is used as the inoculum.
2. Intact Mycelium: *Aspergillus niger* strains were grown on potato dextrose agar plates at a temperature of 30°C for 5 days. From these agar plates the discs were inoculated in 250 ml Ehrlenmeyer flasks containing Potato dextrose broth and incubated for 72 hours at 30°C till the mycelia mat develops and this mycelial mat was used as the inoculum.

ESTIMATION OF SUGAR BY PHENOL SULPHURIC ACID METHOD

Total residual sugar of fruit peels and pulps of the different fruits were estimated calorimetrically by phenol sulphuric acid method. Colour intensity was measured using spectrophotometer at 490 nm (Dubois *et al.*, 1956).

SUBSTRATES AND SACCHARIFICATION:

The saccharification and fermentation medium consisted of distilled water and 5% substrate. **Substrates:** Selected raw materials i.e. khasi Mandarin, Pineapple and Pomelo peels and pulps were used for the production of citric acid. The amount and size of the substrates used in the fermentation are given in the following table:

Sl no.	Substrate	Particle size of the substrate	Amount used
1.	Khasi Mandarin	1 x5 mm	5g/100ml
2	Pineapple	1 x 5mm	5g/100ml
3	Pomelo	1x 5mm	5g/100ml

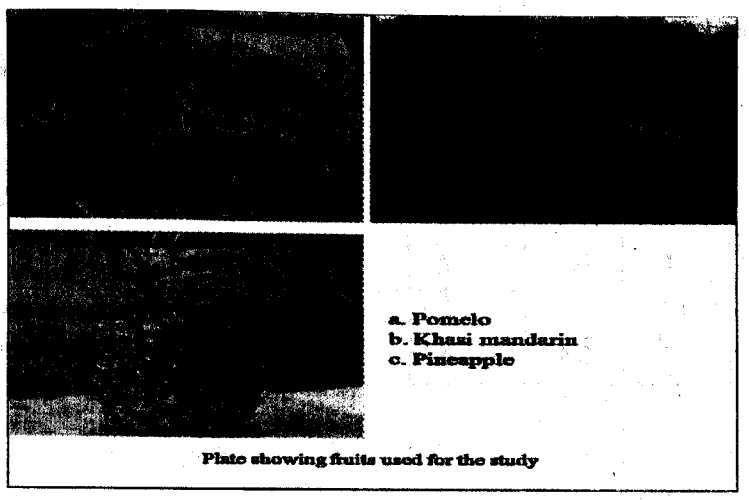

Plate showing fruits used for the study

Autoclaving / Sterilization (Hydrolysis): Fermentation experiments were performed in 250 ml Erlenmeyer flasks containing 100 ml distilled water and 5% of the substrate. The particles of the substrates were taken into a 250 ml Erlenmeyer flasks containing 100 ml double distilled water and they were cotton plugged and sterilized at 15 lbs for 15 minutes at 121° C. After autoclaving the initial sugar was estimated by 3,5 DNS method.

To check the efficiency of intact mycelium and spores of *A. niger* in fermentation of citric acid, the fermentation studies were performed in two sets i.e. Set I and Set- II. Set –I was carried out with spore suspension as inoculum and set –II was carried out by intact mycelium as inoculum.

Set-I: 1ml of the inoculum (spore suspension) was inoculated in all the flasks and incubated at 30°C.

Set-II: One intact mycelia mat about 7 cm in diameter was inoculated in all the flasks and incubated at 30°C. The fermentation process was performed for 6 days.

Every 48 h samples were collected and subjected for estimation of left over sugar by 3,5 DNS method of Miller, G L. (1959) spectrophotometrically. Citric acid was determined titrimetrically (AOAC, 1995) by using 0.1 NaOH and phenolphthalein as indicator and calculated as % according to the formula:

$$\% \text{ citric acid} = \frac{\text{Normality x volumeof 0.1 M NaOH x equivalent weight of citric acid x dilution factor}}{\text{weight of sample (g)x 10}}$$

RESULTS

During the fermentation, the sugar content of the medium was reduced by *A. niger* and the amount of citric acid production increased in proportion with the sugar utilization. The obtained results were presented in tables 2 and 3.

Set-I: In this experiment, germination of spores and gradual development of mycelium was observed in all the flasks, particularly in the flasks containing peels. However, little amount of citric acid production was recorded. From the 3rd day there was an increase in the growth of mycelium and increase in the production of citric acid was observed. Highest yield was recorded on the 6th day (Table: 2 and Fig: 1).

Set – II: A similar trend was observed in the second experimental set except in the development of biomass and yield. Comparatively more biomass was developed and more production of citric acid was observed right from the second day onwards (Table 3 and Fig 2).

Table 2. Citric acid production by *Aspergillus niger* (Spore suspension)

Substrate	Initial sugar	Initial citric acid	Citric Acid Produced and Loss of Sugar					
			Day 2		Day 4		Day 6	
			CA	LOS	CA	LOS	CA	LOS
Mandarin Peel	14	0.6	2.2	7	4.5	6	5.3	3.2
Pineapple Peel	11	0.3	3.1	5	6.8	5	8.3	3.1
Pomelo Peel	18	1.1	3.3	13	7	6	13.2	4
Mandarin Pulp	25	3.4	4.2	18	12	8	7.2	3.8
Pineapple Pulp	28	0.9	4.9	18.7	19	11	9.7	3.9
Pomelo Pulp	43	2.3	13	21	29	19	44	7

NB: CA- Citric Acid; LOS- Loss of sugar

Table 3. Citric acid production by *Aspergillus niger* (Intact mycelium)

Substrate	Initial sugar	Initial citric acid	Citric Acid Produced and Loss of Sugar					
			Day 2		Day 4		Day 6	
			CA	LOS	CA	LOS	CA	LOS
Mandarin Peel	14	0.6	3.1	12	6.8	10.2	8.3	6.4
Pineapple Peel	11	0.3	1.7	11.2	6.8	9.8	8	5.9
Pomelo Peel	18	1.1	3.3	11	8.2	7	17.1	5
Mandarin Pulp	25	3.4	7	19.8	6.2	15.2	14.4	10.5
Pineapple Pulp	28	0.9	14	18.9	8.5	13.8	21.6	6.9
Pomelo Pulp	43	2.3	22	33	54	14	55.2	5.3

NB: CA- Citric Acid; LOS- Loss of sugar

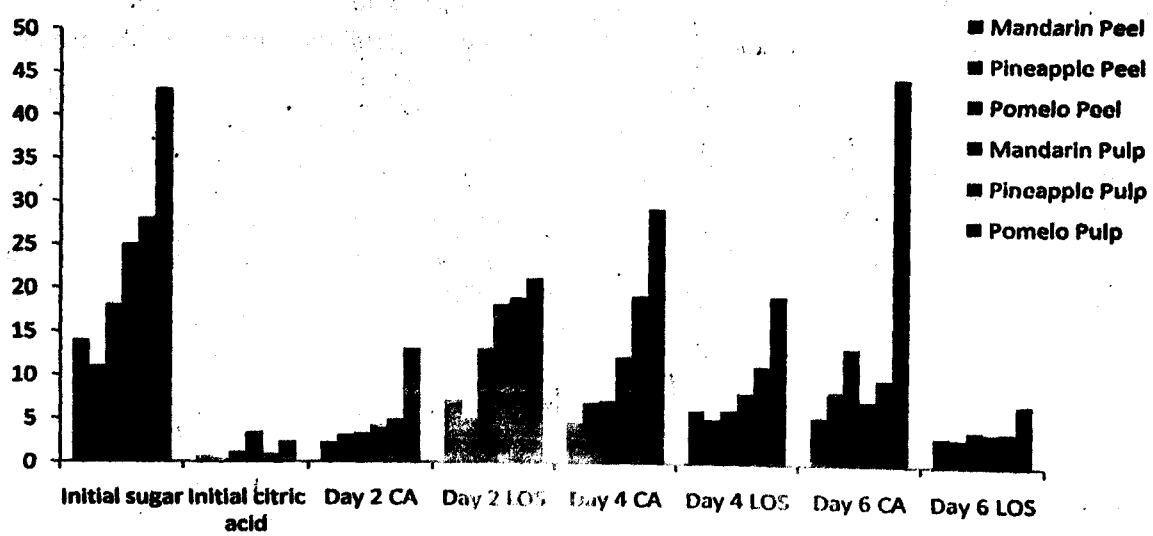

Fig. 1. Trend of citric acid production using *Aspergillus niger* (spore suspension)

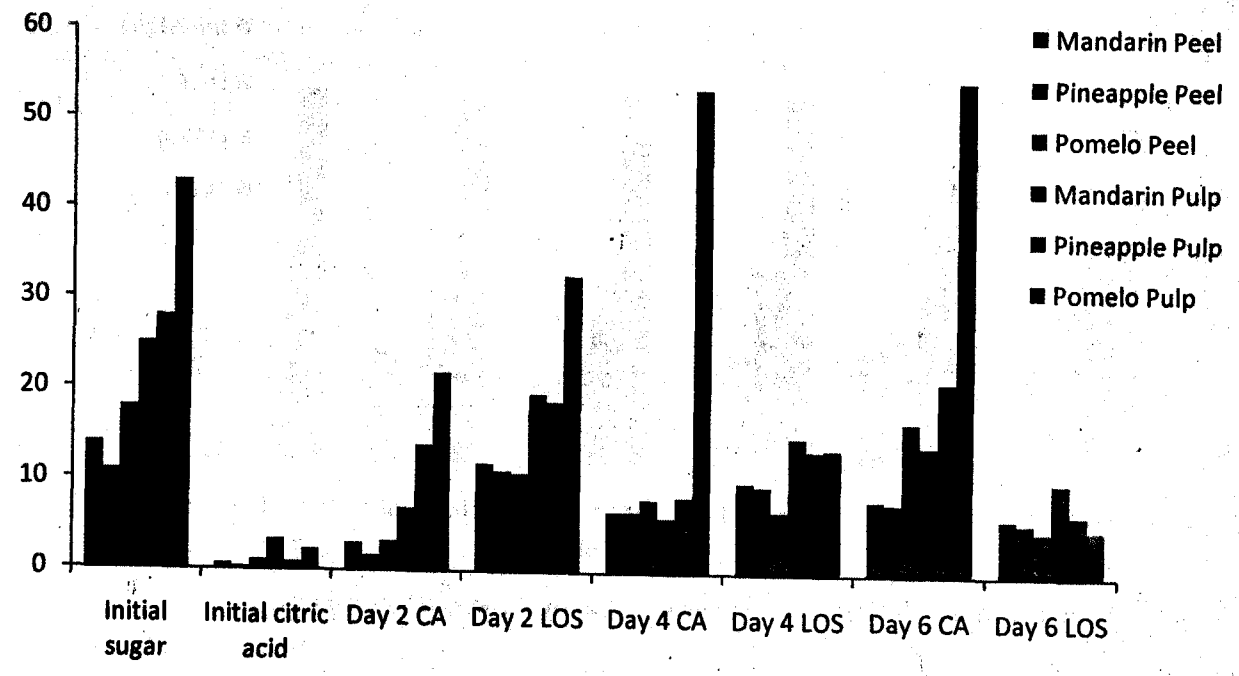

Fig. 2. Trend of citric acid production with *Aspergillus niger* (intact mycelium)

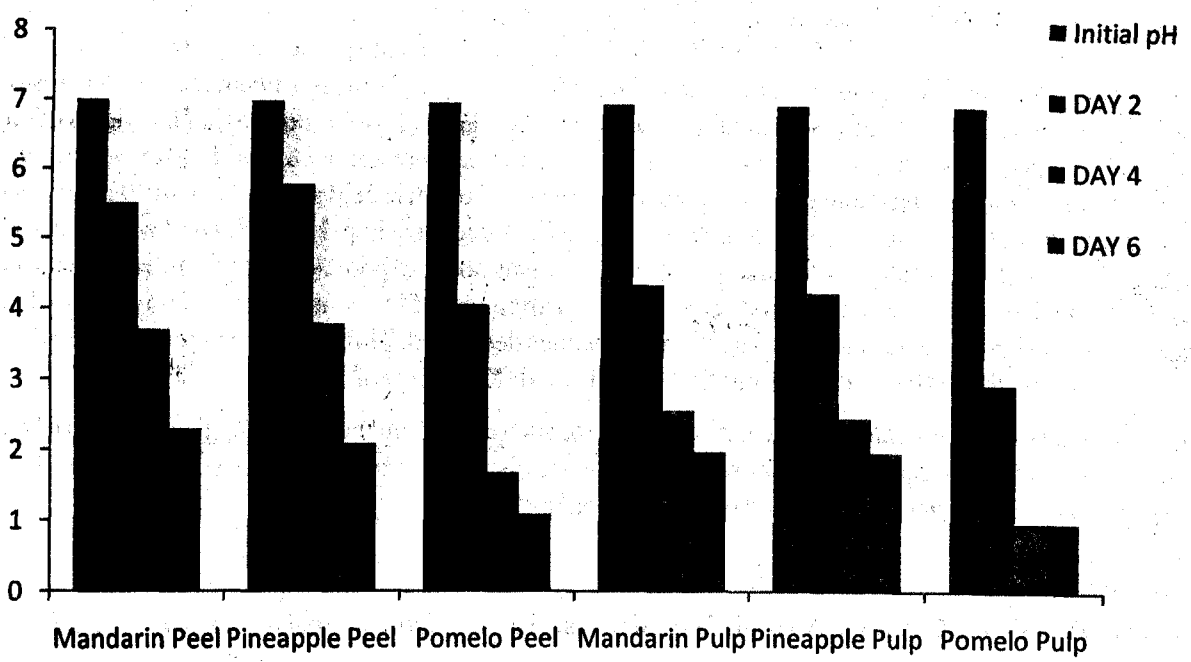

Fig.3. pH values during citric acid production by A.niger (Spore suspension)

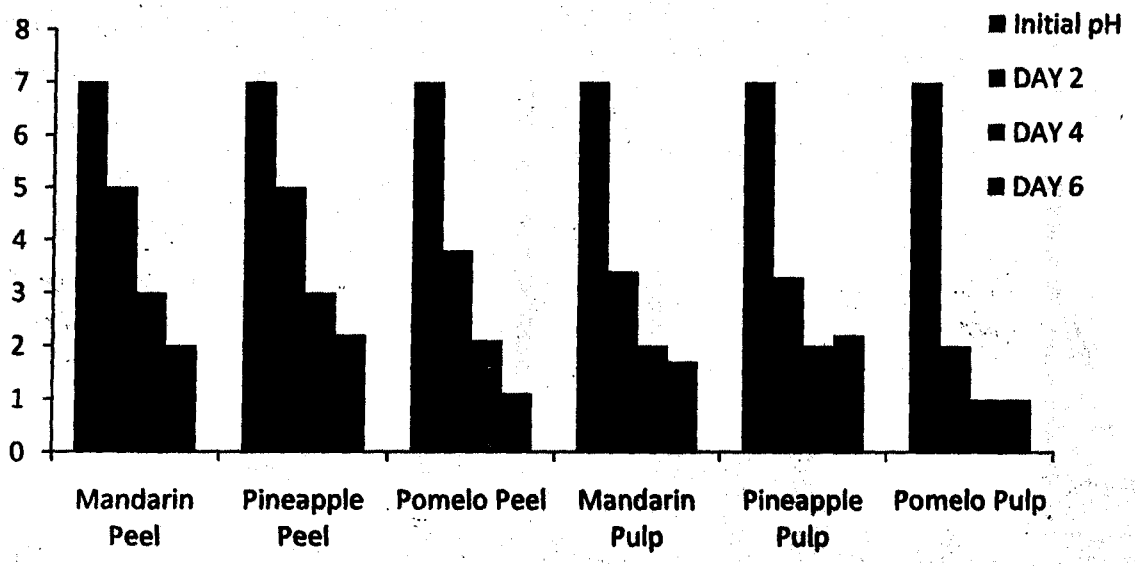

Fig.4. pH values during citric acid production by *A.niger (intact mycelium)*

Discussion

The results presented in the above tables show that comparatively efficient fermentation took place in Set– II where intact mycelium was employed for the fermentation of citric acid. This could be due to the reason that in Set I where we utilized spore suspension as inoculum, *Aspergillus niger* first utilized the sugars for their growth and then only for fermentation purposes. This is also in accordance with Khadijah-Al-Khadir et al. (2011). As expected, *A.niger* grown in flask with the substrate having the highest sugar concentration i.e. Pomelo (peel and pulp), yield the highest concentration of citric acid followed by khasi mandarin and pineapple.

In the present study, a parallel relationship was also observed between citric acid production and the consumption of sugar. This result agreed with the report of El-Holi and Al-Delamy (2003) that the production of citric acid approximately paralleled the consumption of sugar. At the end of the fermentation process a significant reduction in residual sugar in all the three fruits peels and pulps was obtained. Hang and Woodams (1986) reported that the yields of citric acid from apple and grape pomace based on the amount of sugar consumed were about 88% and 60% respectively. In this work, based on the amount of fermentable sugar consumed, the yield of citric acid was more than 90 Biomass is a fundamental parameter in the characterization of microbial growth. A decrease in pH from 7.0 to 2 was observed in flasks having mandarin and pineapple, while a decrease from 7 to 1 was noted in pomelo after the fifth day of fermentation (Figure 3 and 4). Normally, citric acid production occurred after 24 h of fermentation, this study shows that as incubation time increased more citric acid is produced and pH values decreased. Thus, the drop in pH observed during the process was due to the formation and accumulation of citric acid (Kareem *et al.*, 2010).

In conclusion, this study indicates that the use of fruit waste such as peel and pulp for fungal production of citric acid might represent an efficient method of minimizing fruit waste disposal problems and concomitantly producing organic acids of valuable importance for food and pharmaceutical industries.

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ASSESSING MICROBIOLOGICAL SAFETY OF DRINKING WATER IN SHILLONG, MEGHALAYA

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INTRODUCTION

From a public health perspective, access to sufficient clean and safe drinking water is a crucial issue (WHO, 2003). The quality and safety of the drinking water continues to be an important public health issue, due to its potential to cause waterborne outbreaks associated with drinking water, particularly in sensitive and immunocompromised populations [Reynolds et al. 2007]. Clearly, point-ofuse water quality is a critical public health indicator. The safety of drinking water can be monitored in a number of ways because the constituents of drinking water (such as chemicals and microbes) which can compromise human health can be measured directly. The reason for monitoring drinking water quality is to determine whether the water supply system is being operated correctly, implying that the water is safe for drinking or not.

According to Kornacki and Johnson (2001) E.coli was used as an indicator to indicate the contamination of water by fecal material and, consequently to alert for the potential presence of enteric pathogens. Indicator microorganisms survive better and longer than the pathogens with a uniform and stable properties and may easily be detected by standard laboratory techniques. The standard was however changed to total coliform in 1915, by the US Public Service, based on the premise that all coliforms were of equal value as indicators of fecal contamination.

Despite the fact that large freshwater supplies are available in many regions of the world, safe drinking water often remains a limited resource. In Shillong city, the capital of Meghalaya, the water supply distribution system was

governed by two agencies i.e. the Public Health and Engineering Department (PHED) and Shillong Municipal Corporation. PHED uses surface water sources (streams/rivers) whereas Municipal Corporation uses ground water sources (springs) for organized drinking water supply. In areas beyond the PHED networks, some Dorbars developed small water schemes supplying the water through stand posts. Small springs are also used by nearby residents to meet their water needs. Households without access to public or private services depend upon supply made tankers or purchase water from private vendors/ operators or depend on private bore wells or hand pumps (NEERI, 2005). However, concerns have been sometimes raised about the quality of these sources as except for disinfection, no other treatment was given to the water before supplying it to the public. Moreover the different sources used for water supplies run through communities who used these water bodies not only for drinking but also for laundry and other recreational activities. Hence, the interest to investigate both the physico-chemical and bacteriological status.

PLAN OF WORK

Keeping in view of the above, the following plan of work shall be carried out-

1. Water samples will be collected from various sources of drinking water in and around Shillong city.
2. Isolation and assessment of microbial components and physico-chemical analyses of the water sample collected.
3. Suspected colonies of coliform groups will also be identified on the basis of morphological, cultural and biochemical characteristics.
4. The relationship of microbial population with the water physico-chemical characterstics will be determined

MATERIALS AND METHODS

Sample collection and analysis

Six sampling sites were chosen. Water samples were collected from point of use from different community locations. Descriptions of the sampling locations are shown in Table 1. Surface water samples were collected from six sites (S1-S6) from September 2014 to March 2015. Water samples were collected into plastic bottles previously cleaned by washing with detergent, thoroughly rinsed with tap water, soaked in 10% HNO3 solution overnight, and finally rinsed with deionized water and dried in an oven. At the sampling sites, sample bottles were rinsed three times with the water sample before filling. The samples were kept in an ice box and transported to the laboratory immediately and stored in the refrigerator at about 4?C prior to analysis.

The pH of the water samples was measured on the field using digital pH meter. The experimental methods for other parameters such as dissolved oxygen (DO), sulphate, nitrate, are carried out as outlined in Standard methods for examination of water and waste water (APHA, 1998). All reagents were analytical grade and instruments were precalibrated prior to measurement. Replicate analyses were carried out for each determination to ascertain reproducibility and quality assurance.

Table 1. Names of sampling source, sample-collection sites, and their sampling code

Type of water	Location	Sampling Code
State Agencies	Laitumkhrah	S1
	Laban	S2
Public Vendors	Jaiaw	S3
	Mawlai	S4
Private source	Thangsning	S5
	Laitkyrhong	S6

Bacteriological examination

The bacteriological examination of water samples includes most probable number (MPN) of Total coliforms (presumptive coliforms, faecal coliforms and faecal streptococci) (MPN/100 ml water) using the Multiple Tube Fermentation Technique (APHA, 1998). Suspected colonies of coliform groups were also identified on the basis of morphological, cultural and biochemical characteristics.

Statistical analysis

Statistical analyses of the results at each site were carried out using both Microsoft Excel 2007 Edition and Statistical Package for Social Science (SPSS) 1.30 for windows software. All errors were calculated at the 95% confidence level.

RESULTS AND DISCUSSION

The range, mean, and standard deviation of physico-chemical parameters in various water samples are presented in Table 2. The water samples exhibited an alkaline to slightly acidic pH. The mean pH values of water samples varied between 6.28±0.6 at site S4 and 8.25±0.1 at site S5 during the sampling period. No significant difference was noticed in the observed pH ranges at each site and the variation due to change in sampling location was also not significant. The pH values of most of the samples are well within the limits prescribed by BIS (1991) and WHO (2006) for various uses of water including drinking and other domestic supplies. All of the values of pH obtained for the water samples fell within this range but were slightly above the natural background level of 7.0. This increase in pH of the water samples above the normal background levels may be due to the presence of dissolved carbonates and bicarbonates which are known to affect pH of almost all surface water (Chapman, 1996). The measurement of electrical conductivity is directly related to the concentration of ionized substance in water and may also be related to problems of excessive hardness and/or other mineral contamination. The conductivity values in water samples vary from 11 ±17 to 24±6.9 ?S/cm during the sampling period with the highest recorded in S5.

Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them. Alkalinity plays an important role in controlling enzyme activities. In the present study, alkalinity value in the water samples varies from 12±3.8 to 24±5.7 mg/L during the sampling period. No sample of the study area crosses the maximum permissible limit of 600 mg/L. TH varied from a minimum of 11.9 ±3.3 mg/L to a maximum of 14.7 ± 2.4 mg/L in samples from S2 and S5, respectively. World Health Organization (WHO) recommended safe permissible limit for TH is 100-500 mg/L. TH was within permissible limit in all the samples, since the study area is free from industrial pollution, the hardness was observed quite low.

Dissolved Oxygen (DO) is a very important parameter of water quality and an index of physical and biological process going on in water (Agarwal, 1996). In the present study, the DO levels did not differ significantly from one location to another ($p < 0.05$), being lowest in the samples from S4 with a mean value of 5.1±0.7 mg/L in site and highest at 6.5±0.58 mg/L in S2. DO is of great importance to all living organisms. It may be present in water due to direct diffusion from air and photosynthetic activity of autotrophs.

The nitrate content in the different water samples varies from 0.1±0.04 to 0.41±1.1 mg/L during the samling period with all samples falling within the desirable limit of 45 mg/L for drinking water supplies (WHO, 2006 and BIS 1991). As such, the water from different sources does not pose any nitrate hazard to humans. Its concentration above 45 mg/L may prove detrimental to human health. In higher concentrations, nitrate may produce a disease known as methemoglobinemia (blue babies) which generally affects bottle-fed infants. Repeated heavy doses of nitrates on ingestion may also cause carcinogenic diseases.

Table 2: Range, Mean and SD of various physico-chemical characteristics of water samples during the sampling period

ameters	pH	Electrical conductivity	Alkalinity	Total Hardness	Dissolved Oxygen	NO_3	Cl	SO_4
e	7.01-7.81	10.0-16.9	15.6-21.1	9.0-15.5	4.0-8.4	0.07-0.86	8.0-8.1	4.2-6.2
)	7.39±0.02	18±5.4	17.0±2.41	12.6±2.44	6.2±1.44	0.3±0.29	8±0.1	4.8±0.6
e	7.2-7.92	11.4-18.9	15.3-23.0	9.4-15.0	2.0-15.0	0.09-0.44	7.6-10.3	3.8-6.2
)	7.37±0.3	14±3.3	17.0±2.13	11.9±3.31	6.5±0.58	0.3±0.12	8.7±3.7	5.0±0.9
e	6.25-6.92	8.6-11.3	17.0-23.1	9.0-16.2	5.2-6.5	0.01-0.17	5.8-6.1	3.9-6.1
)	6.44±0.6	10±1.7	15±11.10	12.9±2.4	5.6±0.58	0.13±0.11	6.7±1.4	5.0±0.5
e	6.10-7.21	10.0-12.1	7.9-17.4	10.0-17.2	4.2-5.7	ND-0.25	4.0-7.2	5.1-9.0
)	6.28±0.6	11±1.7	12±3.81	13.3±2.8	5.1±0.7	0.1±0.04	5.3±1.1	5.5±0.7
e	7.57-8.76	22.6-29.1	17.0-32.4	11.4-19.0	4.4-6.4	0.09-0.06	17.6-19.6	5.2-8.3
)	8.25±0.1	24±6.9	24±5.72	14.7±2.41	5.9±0.24	0.4±0.09	18.1±17.1	5.5±0.7
e	7.1-8.1	19.9-28.0	12-22.4	13.4-15.2	4.3-7.5	0.02-0.56	13.6-18.1	4.8-9.2
)	7.33±0.9	22±5.3	19±1.41	14.0±3.1	6.1±0.3	0.41±1.10	13.7±1.6	6.3±1.6
	6.6-8.5		400	100-500	7.0	45	250	250

NB: "±" Standard deviation (SD)

Chloride varied from a minimum of 5.3±1.1 in S4 to a maximum of 18.1±7.1 in S5. The limits of chloride have been laid down primarily from taste considerations. A limit of 250 mg/L chloride has been recommended as desirable limit for drinking water supplies (BIS 1991; WHO 2003). However, no adverse health effects on humans have been reported from intake of water containing an even higher content of chloride. Sulphur is utilized by all living organisms in the form of both mineral and organic sulphates. Sulfates recorded a mean minimum of 4.8±0.6 mg/L from S1 and maximum of 6.3±1.6 mg/L from S6. These levels were lower than WHO permissible levels. The dominance of chloride over sulfate could be mainly due to domestic and anthropogenic point sources (Ansa-Asare and Asante, 2005; Karikari and Ansa-Asare, 2006).

Bacteriological parameters

Bacteriological contamination of drinking water has remained one of the major problems in the country in rural as well as urban areas (Kahlown, Tahir, & Sheikh, 2004; Abid & Jamil, 2005). Due to leakage of pipes, pollution from sewerage, biofilm formation in the distribution system, intermittent water supply, and human activities the chemical and biological contamination is likely to occur (Tahir & Bhatti 1994; Sajjad & Rahim, 1998; Chandio, 1999). To protect the consumers health it is of crucial importance to establish drinking water quality standards and criteria that are chemically balanced and medically safe (Health Services Academy, 2008).

The enumeration of total coliform bacteria from drinking water of different water samples is important since the presence of bacteria of fecal origin reflects the deteriorating bacteriological quality of drinking water. In the present study the number of coliforms was recorded highest in site S6 and lowest in S2 (Table 3). According to WHO drinking water quality standards there should be no coliform as well as fecal coliform present in 100 ml or 0 colony forming units (cfu) per 100 ml (Health Services Academy , 2005). However, the result of our study is far from WHO standards and therefore, water under study was not suitable for drinking purpose.

Biochemical analysis of various isolates from the sampling sites are given in Table 4. High prevalence of E. coli observed in this study in sites S3 and S4 was indeed indicative of other pathogens isolated among which are the heterotrophic aerobic bacteria, which are predominantly faecal coliforms, possibly from human or animal excreta (Anazoo and Ibe, 2005). Other coliforms such as Klebsiella sp, Enterobacter cloacae, Serratia sp, Citrobacter sp, Staphylococcus sp and Pseudomonas sp species isolated in drinking water increases the possibility of the presence of

pathogenic bacteria. In terms of public health significance, E. coli has frequently been reported to be the causative agent of traveler's diarrhoea, urinary tract infection, haemorrhagic colitis and haemolytic uraemia syndrome, while Klebsiella is associated with pneumonia and upper respiratory tract infection. Presence of pathogenic bacteria like Pseudomonas and Staphylococcus in water also, may cause acute to severe disease on getting suitable host and condition (Fewtrell and Bartram, 2001; Kistemann, et al. 2002 and Mishra et al. 2009).

Table 3. Analysis of total coliform count by MPN test. (Cappuccino and Sherma, 1996)

Sampling code	No. of tubes test positive			MPN index per 100ml
	5 of 10ml each	5 of 10ml each	5 of 10ml each	
S1	4	2	0	22
S2	4	1	0	17
S3	5	5	2	540
S4	5	4	3	280
S5	5	5	4	1600
S6	5	5	5	2400

The pollution at source level was highest at site S5 and S6 because the storage tanks were open and uncovered, and not protected from human and animal activities. The storage areas were bushy and grassy; plants and grass were present in storage ponds, rodent burrows, and bird's habitats were very common. These unhygienic conditions may have the contribution in regular transmission and growth of E. coli in such waters. The results are in agreement with the data given by Hunter et al. (2003) in which it was reported that the drinking water quality in most of the developing countries was very poor with 100000 fecal coliform or Thermotolerant coliform per 100 ml of drinking water.

Ma et al., 2013 also suggested that appearance of coliforms, as well as enterococci, in water samples could be due to the high concentration of iron caused by iron pipes corrosion which leads to the formation of biofilms. Formation of biofilm, which represents a complex organomineral deposits with a diversified microbial community, as a result of attachment of free-floating microorganisms in drinking water to a surface of pipes is significant problem as disinfection with chlorine appears to be a relatively ineffective procedure against microbes present in biofilms (Mathieu et al., 2009; Gosselin et al., 2013).

Table 4: Culture, biochemical identification of isolates from different sampling sites

Sites	Grams Reaction	MR	VP	Urease	TSI	Indole	Citrate	Gas Production	Catalase	Oxidase	Motility	Isolates
S1	-	-	-	-	-	-	+	-	+	+	+	*Pseudomonas* sp
	-	-	+	-	-	-	+	+	+	-	+	*Enterobacter cloacae*
S2	-	-	+/-	+	-	-	+	+	+	-	-	*Klebsiella* sp
	-	-	+	+	-	-	+	+	+	-	+	*Enterobacter cloacae*
	-	-	+	+		-	+	+	+	-	+	*Serratia* sp
	-	+	-	-	+/-	-	+	+	+	-	+	*Citrobacter* sp
S3	-	+	-	-	-	+	-	+	-	-	+/-	*E.coli*
	-	-	+/-	+	-	-	+	+	+	-	-	*Klebsiella* sp
S4	-	-	+	-	-	-	+	+	+	-	+	*Enterobacter cloacae*
	-	+	-	-	-	+	-	+	-	-	+/-	E.coli
S5	-	-	+/-	+	-	-	+	+	+	-	-	*Klebsiella* sp
	-	-	-	-	-	-	+	-	+	+	+	*Pseudomonas sp*
S6	-	-	+/-	+	-	-	+	+	+	-	-	*Klebsiella* sp
	+	+	+	+	+	-	-	+	+	-	-	*Staphylococcus sp*

NB: "+" Positive; "-" Negative

Statistical analysis:

Correlation coefficient was calculated so as to determine the relationship between total coliform and feacal coliform with various physico-chemical characteristics of water samples collected from Shillong (Table 5).

Table 5. Correlation coefficient (r) values between total coliform and various physico-chemical and water samples in the different sampling sites ($p<0.05$)

es/ ieters	pH	Electrical conductivity	Alkalinity	Total Hardness	Dissolved Oxygen	NO_3	Cl	SO_4
: TC	0.61	-	-	-	-	0.66	0.77	0.88
: TC	-	-	0.71	0.68	-	0.86	-	0.90
: TC	0.86	-	0.81	-	-	-	0.97	-
: TC	-	-	0.61	0.81	-	0.76	-	0.68
: TC	-	-	-	0.80	0.88	-	0.61	-
: TC	-	-	-	-	-	0.74	-	0.66

In Site S1, total coliform was found to be positively correlated with pH (0.61, p? 0.05), nitrate (0.66, p? 0.05), chloride (0.77, p? 0.05 and p? 0.01) and SO4 (0.88, p? 0.05, p? 0.01 and p? 0.001). Total coliform showed a significant positive correlation with, alkalinity (0.71, p? 0.05), SO4 (0.90, p? 0.05, p? 0.01 and p? 0.001), total hardness (0.68, p? 0.05) and nitrate (0.86, p? 0.05) in S2. In S3, total coliforms was positively correlated with pH (0.86, p? 0.05, p? 0.01 and p? 0.001), alkalinity (0.81, p? 0.05) and Chloride (0.97, p? 0.05, p? 0.01 and p? 0.001). In Site S4, total coliform was found to be positively correlated with alkalinity (0.61, p? 0.05), total hardness (0.81, p? 0.05 and p? 0.01), nitrate (0.76, p? 0.05) and SO4 (0.68, p? 0.05 and p? 0.01). Total coliform showed a significant positive correlation with, total hardness (0.80, p? 0.05, p?0.01), DO (0.88, p? 0.05, p? 0.01 and p? 0.001), chloride (0.61, p? 0.05) in S5, while in S6 total coliform was positively correlated with nitrate (0.74, p? 0.05 and p? 0.01) and SO4 (0.66, p? 0.05 and p?0.01). Though numerical variation was observed in the water samples the one-way analysis of variance (ANOVA) between different sampling sites did not show any significant variation at p?0.05 at all the different parameters.

Although the physical and chemical parameters were below recommended standard for each were positively correlated with the faecal coliform content of the surface waters, thereby confirming coutinuous pollution from both point and diffuse sources. Negative health effects have been detected in association with the use of raw or poorly treated waste water for irrigation, recreational activities and other purposes (Crowther et al. 2001).

CONCLUSION

The results indicated that most of the physic-chemical quality parameters of the water sampled were within the WHO limits for drinking water and, therefore, may be suitable for domestic purposes. In contrast, the bacteriological quality of the water points, as suggested by the fecal coliform and E. coli counts, far exceeded the WHO standard for potable water. In general, the bacteriological quality of the water was unacceptable, and would pose serious health risks to consumers who use them without treatment. The poor bacteriological quality was due to direct contamination by animal and human wastes.

RECOMMENDATIONS

Keeping in view the quality of drinking water of area under study following recommendations have been made-

- The drinking water under study should be boiled before drinking as reported cases of waterborne bacterial pathogens in drinking water is alarming.
- Government agencies, private vendors and local communities or Dorbars should fulfill its basic complacence of providing safe drinking water to community.

- The regular chlorine disinfection treatment of drinking water may be ensured.
- The quality of drinking water may be checked in light of drinking water guideline established by WHO and Bureau of Indian Standards (BIS)
- The source of drinking water may be protected from un-necessary human and animal access.
- The general cleanliness and hygiene of water main storage reservoirs may be maintained.

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DIVERSITY AND ABUNDANCE OF INSECTS AT NONGRIM HILLS, SHILLONG

Shri Holystar Horam and Dr. S. Khongwir
Department of Zoology

AIM AND OBJECTIVE

The objective of this study is to determine the diversity and abundance of the insect fauna at spread eagle falls (Nongrims Hills). The study also aims at creating awareness among the local population for their preservation and protection.

PLAN OF WORK

MATERIALS AND METHODS:

Insects of different species were collected by using Nets, forceps, insects pins, polythene bags, and hand gloves. Proper care should be taken during the collection to avoid injury and prevent decolouring of wings.

Different methods of netting and trapping collecting were conducted during the course of the study. Collection occurred in several locations to obtain representatives samples of different insects presents in the area. The collected specimen were then photograph using digital camera. The collected specimens were brought to the laboratory for pinning and identification. The detailed identification was based on comparison with the specimens presents in the zoology department of the college. The specimens were then placed in either insect display cases or cardboard insect boxes for preservation and kept in the zoological museum present in the department of zoology for future reference.

INTRODUCTION:

Insects are unique in their own way and have an important ecological role for survival of life on earth. Insect diversity is indeed an intrinsic part of the earth's ecosystem. The science that deals with the study of insects is called ENTOMOLOGY. Insect are the most diverse group of organism on the planet with over 1 million describe species (Gullan & Cranston 2005) In addition, insect are a valuable venue for biological controlled of invasive and exotic species. The knowledge of biological processes is important for the advancement of as science as a whole as well as public and ecological sustainability, because insects are so numerous they have an important impact on our environment and our lives (Gullan & Cranston) Meanwhile, there are many species that are yet to be describe. Study of diversity and abundance of insect is of vast important. Given all the support for the importance of insects to our ecosystem and our lives, it is critical that all people have access to awareness, and knowledge of insects. Insects are crucial for such ecosystem functions as nutrient recycling, pollination, seed dispersal, maintenance of plant community composition and structure, food for vertebrates, and maintenance of animal communities via transmission of diseases of large animals and predation and parasitizing of smaller animals (Gullan & Cranston 2005)

Furthermore, Many insect are beneficial to mankind and they also help in pollinating the plants. Some of them have been useful in medicine and scientific research. But a few insects are nuisance and cause problem, resulting pests in agriculture crops and stored product, and some transmit diseases to human and other animals (Triplehom & Johnson 2005).

RESULTS AND DISCUSSION

The collected insects were as follows:

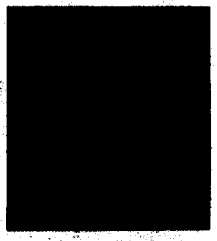

Fig: (1). *Gryllotalpa brachyptera*

Gryllotalpa brachyptera: It belong to class Insecta and Order Orthoptera. It is commonly called as mole crickets. They are tan-coloured, crickets like insects that feed on plants roots. The abdomen is rather soft, but the head, forelimbs, and prothorax are heavily sclerotised.

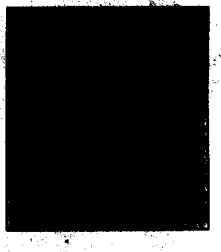

Fig: (2). *Lyptynia hispanica*

Lyptynia hispanica: It belongs to class Insecta and order Phasmatoda. It is commonly called as stick insect or walking stick. It has elongated and twig like in appearance, sometimes with leaf like structure. Their natural camouflage can make them extremely difficult to spot.

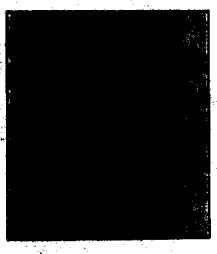

Fig: (3). *Nasutitermes costalis*

Nasutitermes costalis: It belongs to class Insecta and order Isoptera. These are commonly called as wings termite swarmers or alates reproduction that leaves the nest to start new colonies. Termite has two sets of wings that are equal in length and almost double the length of the termite's body. Termite wings range from pale almost translucent, in colour to gray or brown.

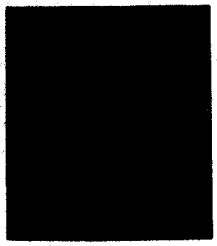

Fig: (4). Forficula auricularia

Forficula auricularia (earwigs): It belongs to class Insecta and order Dermaptera. Earwigs are elongate, slender, flattened, insects with a dark body and prominent forceps like cerci at the end of the abdomen.

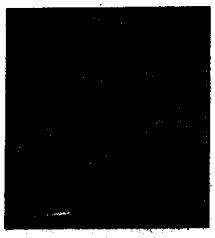

Fig: (5). *Black stick bugs*

Hemiptera (black stick bugs): It belongs to the class Insecta and order Hemiptera. The whole body of this bug is black in colour.

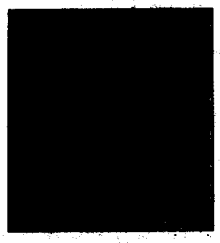

Fig: (6). *Shield bugs*

Hemiptera (shield bugs). It belongs to class Insecta and order Hemiptera. This insect can easily identified, because of the whole body is covered by shield. When it alive the body is orange colour with a series of black spots.

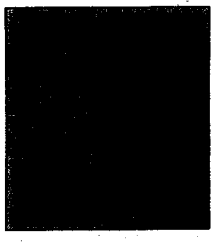

Fig: (7). *Polistes metricus*

Polistes metricus: It belongs to Class Insecta and Order Hymenoptera. It is commonly called as paper wasps. Abdomen is black and the thorax dark reddish brown with black lines.

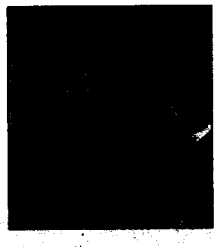

Fig: (8). *Physopelta gutta*

Physopelta gutta (largid bugs): It belongs to class Insecta and Order Hemiptera. They are close to family Lygaeidae. The wings have distinctly two black spotted and the body is black and red.

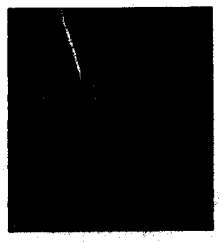

Fig: (9). *Tetrix subulata*

Tetrix subulata: It belongs to Class Insecta and Order Orthoptera. This is commonly called as pygmy grasshopper look like miniature short horned grasshopper. The species are small brown, gray, or moss-green and related to true grasshopper.

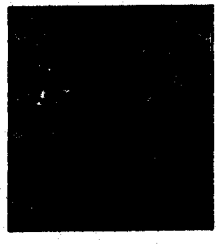

Fig: (10). *Vanessa cardui*

Vanessa cardui: It belongs to Class Insecta and Order Lepidoptera. These butterflies are commonly called as Painted lady. They are medium sized butterflies with a wingspan of two inch. The top side of their wings are orange with black blotches and white spots. Underneath, wing colour is a beautiful combination of pink, brown, olive, black, and white.

Fig: (11). *Phaedyma columella singa*

Phaedyma columella singa: It belongs to Class Insecta and Order Lepidoptera. This butterfly is one of the many black and white "sailor" species which occur in several genuses in the sub-family Nymphalinae. The short banded sailor is the only representative of its genus Phaedyma.

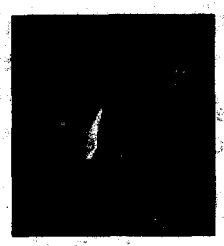

Fig: (12). *Pieris napi* (male)

Pieris napi (male): It belongs to Class and Insecta and Order Lepidoptera. They are look like other white butterflies. The commonly name is Green-veined white butterflies. The male has only one distinct spots on each forewing, and the underside hind wings are pale yellow with the veins highlighted by black scales giving a greenish tint hence green-veined white.

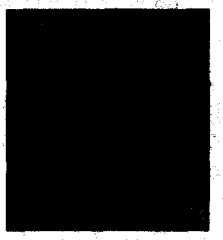

Fig: (13). *Hemiargus ceraunus*

Hemiargus ceraunus: It belongs to class insecta and order Lepidoptera. The upper side of the male has light blue with a darker narrow body and the female dark brown, often with wing bases blue. Under side has gray, both wings with a row of dark post median dashes.

Fig: (14). *Pieris napi* (female)

Pieris napi (female): It belongs to Class-Insecta and Order-Lepidoptera. These butterflies are like that of male, except that the female has two spots on each forewing and the vein on wings of the female are usually more heavily marked.

Fig: (15). *Apis mellifera*

Apis mellifera (honey bee): It belongs to Class Insecta and Order- Hymenoptera. It has tiny hair covering the bee's body, allowing for pollination when the bees moveon to another flower.

Fig: (16). *Simosyrphus grandicornis*

Simosyrphus grandicornis: It belongs to Class Insecta and Order- Hymenoptera. It is commonly called as hoverflies mating in flight. The body is yellow stripes and black in colour.

Fig: (17). *Neoconocephalus sp*

Neoconocephalus sp: It belongs to class Insecta and order Orthoptera. They are commonly called as cone-headed grasshopper. The body is green in colour having long wings and long antenna and inhibits trees, bushes or shrubs.

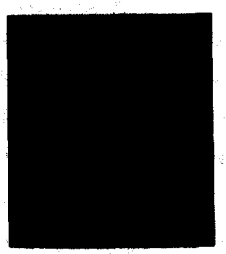

Fig: (18). *Pelopidas sp*

Pelopidas sp: It belongs to the class insecta and the Order Lepidoptera. The body is olive brown in colour and it has small rather indistinct whitish semi-transparent spots. They are commonly called as Branded Swifts or Millet Skippers.

Fig: (19). *Bees*

Hymenoptera (bees): It belongs to the class insecta and order Hymenoptera, name refers to the wings of the insects. The bee is very much similar to the honey bee except the size of the body and they have usually two pairs of wings.

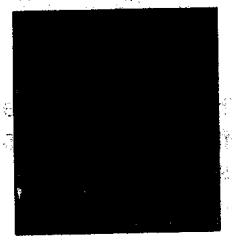

Fig: (20). *Butterflies*

Lepidoptera (butterflies): It belongs to Class Insecta and order Lepidoptera. This butterflies are small in size, the body is cover with a hairy and the upper portion of the wings has a beautiful bluish in colour and the underneath wing has yellowish in colour after death.

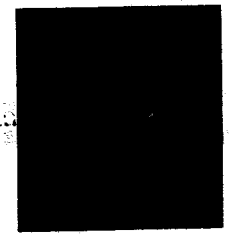

Fig: (21). *Musca domestica.*

Musca domestica: It belongs to the class Insecta and order Diptera meaning two wings. Body is greyish with 4 narrow stripes.

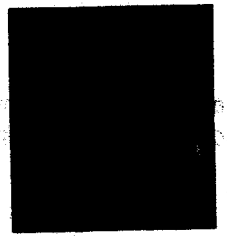

Fig: (22). *Calliphora vomitoria*

Calliphora vomitoria: It belongs to class Insecta and order Diptera. The blue bottle fly or bottle bee is a common blow fly found in most area of the world. It has slightly larger than the house fly. The head and thorax are dull gray and the abdomen is bright metallic blue with black markings. Its body and legs are covered with black bristle like hair.

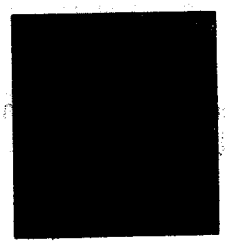

Fig: (23). Blue beetle

Coleoptera: It belong to class Insecta and order Coleoptera. It is commanly called as blue beetle. The head is orange with medium antenna and the wing have green in colour.

Discussion

Results of this study show that this area has high diversity and abundance of insect fauna. The majority of insects found in this area were Order-Lepidoptera. This is because the Families of this species occurred most of the time in this study. We observed that the Pieris napi were the most common and the greatest number of insect species at this area. This could be the reason why the number of insects higher at some places compared to the other place. Furthermore, the light intensity was higher at some places during the time of sampling. The collected Orders were nocturnal during the trap collection within the few days of expedition.

Most of the insects in this study were collected manually or visual search method. Similar phenomenon has been reported New Yolk. They found 94% of the ants species were collected by using a combination of little sampling and hands collection. They also started that these collection methods are sufficient to determine the species richness. However, King and Porta (2005) shows that the hand collection was the least efficient method for estimating an index of combined abundance and richness. In contrast, trapping was the least successful collecting method in this study because it is usually for the crawling insects on the ground. But I try my best to obtain my goal. Extremely low and high temperature, rainfall and vegetation cover have been reported to influence the population density of insects (Nummilin 1996, and Wardle and Barker 1997). These needs will comprise, at the very least, food and suitable climatic conditions,

and may also include shelter from disturbance and natural enemies. From this study, the area may still considered to have a diverse and numerous insect fauna in a city area and the this study is the first comprehensive list of insects in the Nongrims Areas. Hopefully, there will be further research study on the insect biodiversity and taxonomy in this area, in order to get better and comprehensive information on those aspects to be documented for future reference.

REFFERENCE

- **Dr. S. Khongwir** Department of Zoology Shillong College Shillong.
- Gullan, P.J., & Cranston, P.S. (2005).
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- Diversity and abundance of insects species at Kota Damansara community Forest Reserves, Selangor (Khadijah A.R.., Azidah A.A and Meor S.R. Instiyute of Biological Science,Faculty of Science, University of Malata,50603 Kuala Lumpur, Malaysia.)
- Triplehom & Johnson (2005).
- Abdulah & Shamsulaman (2010)
- http:// en.m.wikipedia.org/insects/wiki/.
- hhttp://www.google.co.in/search.

A QUALITATIVE STUDY OF SOIL SAMPLES FROM SELECTED STATES OF NORTH-EAST, INDIA

Shri Shanti Bikash Chakma & Dr S. Khongwir
Department of Zoology

INTRODUCTION

The basic principles of soil formation, physico-chemical properties of soil and various conditions which govern plants growth and organisms inhibited. The problems of soils and their corrective measures, method of soil formation, soil survey in different regions and their interpretation for land use, the basic job of a soil scientist who must know the best use of soil that he encounters. Soil acts as an engineering medium, a habitat for soil organisms, a recycling system for nutrients and organic wastes, a regulator of water quality, a modifier of atmospheric composition, and a medium for plant growth.

Soil is a particles of mixture of rocks, dead organic matter, chemicals, etc., which is formed on the outer surface of earth. Soil is a living body passing from an embryonic state to a mature state. Moreover, the soil is composed of both plants and animals matter. The term soil is derived from the Greek named as " Solum" which meaning the floor. It is found in all the three states such as solid, liquid and gas. Study of soil formation, geographical distribution and origin is known as Pedology. The person who studies soils is known as pedologist. Most pedologist still believe in defining soil briefly as the outer weathered layer of the solid earth crust. Soils contain rocks and minerals- minerals are naturally occuring substances with distinct physical and chemicals properties such as quartz (SiO_2), calcite ($CaCO_3$), orthoclase ($KAlSi_3O_8$). Rocks are mixer of minerals.

Soil science has two basic branches of study: edaphology and pedology. Pedology is focused on the formation, description (morphology), and classification of soils in their natural environment, whereas edaphology is concerned with the influence of soils on organisms. In engineering terms, soil is referred to as regolith, or loose rock material that lies above the 'solid geology'. Soil is commonly referred to as "earth" or "dirt"; technically, the term "dirt" should be restricted to displaced soil.

The greatest influence on plant nutrient availability is soil pH, which is a measure of the hydrogen ion (acid-forming) soil reactivity, and is in turn a function of the soil materials, precipitation level, and plant root behaviour. Soil pH strongly affects the availability of nutrients.

The topography, or relief, is characterized by the inclination (slope), elevation, and orientation of the terrain. Topography determines the rate of precipitation or runoff and rate of formation or erosion of the surface soil profile. The topographical setting may either hasten or retard the work of climatic forces.

Steep slopes encourage rapid soil loss by erosion and allow less rainfall to enter the soil before running off and hence, little mineral deposition in lower profiles. In semiarid regions, the lower effective rainfall on steeper slopes also results in less complete vegetative cover, so there is less plant contribution to soil formation. For all of these reasons, steep slopes prevent the formation of soil from getting very far ahead of soil destruction. Therefore, soils on steep terrain tend to have rather shallow, poorly developed profiles in comparison to soils on nearby, more level sites.

In swales and depressions where runoff water tends to concentrate, the regolith is usually more deeply weathered and soil profile development is more advanced. However, in the lowest landscape positions, water may saturate the regolith to such a degree that drainage and aeration are restricted. Here, the weathering of some minerals and the decomposition of organic matter are retarded, while the loss of iron and manganese is accelerated. In such low-lying topography, special profile features characteristic of wetland soils may develop. Depressions allow the accumulation of water, minerals and organic matter and in the extreme, the resulting soils will be saline marshes or peat bogs. Intermediate topography affords the best conditions for the formation of an agriculturally productive soil.

Soils have different types but the soil found in North-East are as follows:- **Red soil-** formed by weathering of the metamorphic rocks. **Alluvial soil-** formed by the residual alluvial formed by the rivers. **Literate soil-** formed by weathering of literate rocks. **Black soil-** volcanic origin, lava soil due to disintegration of basalt. **Sandy soil-** due to deposit of sand. **Clayey soil-** due to mud and clay.

WORKPLAN

The samples are collected from different regions to differentiate the physical properties of soils in order with the pH, Texture, Temperature, Soil arthropods, Moisture, Colour, Sulphur and Phosphate.

OBJECTIVE

It is to study the soil importance in agriculture, the soil organisms inhabited, for students knowledge and other purposes. There are numerous methods to know about soils properties. By knowing the pH of soil, it can determine the acidity and basicity and at which concentration plants grow. The temperature may be different at different altitudes and regions.

MATERIALS

Test tubes, litmus papers, blank papers, carry bags, tray, bowl, Procleain dish, rod, thermometer, camera, incubator, hook, holder, knife, distilled water, balance, printer, etc.

PREFACE

Soil property has to observe for agriculture purposes and for several scientific identifications. Many organisms dwell in soil according to their favourable situations. Soil is a media where all organisms reproduce and develop with the help of air and water.

As soil resources serve as a basis for food security, the international community advocates for its sustainable and responsible use through different types of Soil Governance. Soil acts as an engineering medium, a habitat for soil organisms, a recycling system for nutrients and organic wastes, a regulator of water quality, a modifier of atmospheric composition, and a medium for plant growth. Since soil has a tremendous range of available niches and habitats, it contains most of the earth's genetic diversity. A gram of soil can contain billions of organisms, belonging to thousands of species. Soils can effectively remove impurities, kill disease agents, and degrade contaminants. Typically, soils maintain a net absorption of oxygen and methane, and undergo a net release of carbon dioxide and nitrous oxide. Soils offer plants physical support, air, water, temperature moderation, nutrients, and protection from toxins.

SOIL COLLECTED	AREA LOCATED
SAMPLE A	Located in Lummarie, Laitumkhrah (Shillong), Meghalaya
COLOUR	Dark Brown
PH	8.3 (blue colour)
TEXTURE	Gravel- maximum Sand - medium Silt - maximum Clay - minimum
SAMPLE B	Located in Rngi Jynriew, Upper Nongthymmai, Meghalaya
COLOUR	Brown
PH	5.5 (pink colour)
TEXTURE	Gravel- minimum Sand- minimum Silt- maximum Clay- minimum
SAMPLE C	Located in Govalpara, Guwahati , Assam
COLOUR	Black-brown
PH	8.4 (blue colour)
TEXTURE	Gravel- minimum Sand- minimum Silt- maximum Clay- minimum
SAMPLE D	Located in Madariting, Shillong, Meghalaya
COLOUR	Reddish
PH	8.1 (blue colour)
TEXTURE	Gravel- minimum Sand- minimum Silt- maximum Clay- minimum

TEXTURE

Soil texture refers to the relative proportions according to their sizes or soil separate such as gravel, sand, silt and clay. Texture denotes the size of individuals soil particles, structure refers to the manner in which these individual soil particles are grouped together to form clusters of particles called aggregates.

1. *Gravel-* These are separated by screening before determining the texture. Gravel do not supply any nutrient to crops.
2. *Sand-* Sand particles consists of small pieces of primary not weathered rock fragments. They are the heaviest and coarsest of the mineral particles. Sand particles do not supply any nutrient for crop growth as they do not store nutrients.
3. *Silt-* Silt particles are bigger than clay particles but smaller than the sand particles. They can hardly be seen by the naked eye. They hold plant nutrient better than sand particles but not as well as clay. Silt particles allow water and air to pass readily, yet retain moisture for crop growth. However, silt soils are low in organic matter and the surface crusts are easily formed after rains.
4. *Clay-* Clay particles are the smallest of all particles found in soil. They cannot be seen by the naked eye. Many of them are too small to be seen under the microscope. However, they are visible under the ultra-microscope. They are the most active part of the soil and hold plant nutrients well. Clay has a high moisture retention capacity. However, a soil with large amount of clay may present difficulties and turn out to be impermeable to air, water and plant roots. Clay is sticky when wet, dries out slowly and is hard to work with and may become cloddy with cultivated.

METHODS FOR DETERMINIG TEXTURE

The amount of different soil separates can be determined in two ways:-

1. By separating them from each other in the laboratory by mechanical analysis. It is accurate method.
2. By estimating the texture by feeling the soil between the thumb and forefingers.
3. By making a small hole net or the grains separator. This applied in case of dry soil.
4. In case of wet soil, a little amount of soil is taken and make into ball shape, then press the ball shape soil with the help of two fingers, if the soil after pressing broken into pieces it is contained the maximum amount of sand or gravel, if the soil remains into ribbon form and long and flexible it contained maximum silt and clay.

pH

pH is a measure of the soil's acidity or alkalinity. pH is usually measured as a scale of 1-14, though the tester may not include this entire range. A pH of above 7 indicates alkaline soil. A pH below 7 indicates acidic soil. The soil pH is a measure of the acidity or alkalinity in soils. pH is defined as the negative logarithm (base 10) of the activity of Hydronium ions (H^+) in a solution. In water, it normally ranges from -1 to 14, with 7 being neutral. A pH below 7 is acidic and above 7 is alkaline. Soil pH is considered a master variable in soils as it controls many chemical processes that take place. It specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. The optimum pH range for most plants is between 5.5 and 7.0, however many plants have adapted to thrive at pH values outside this range.

METHODS TO MEASURE SOIL PH

1. The test tubes are taken and filled with the different soil samples.
2. Distilled water to be added which is neutral, should not test with rain water because it is slightly acidic. Tape water or underground water is slightly basic.
3. The litmus paper is deep in the test tubes which distilled water is added.

4. Each test tubes litmus changes the colour of litmus, if it changes to purple or violet is a pH near 7 i.e., neutral, pink means the soil is acidic i.e., pH is between 1 and 7. The more acidic is brighter than pink.
5. Blue or green is a pH between 8 and 14 i.e., alkaline. The brighter green is more alkaline.

OBSERVATIONS

a. Sample A : when blue litmus paper is dipped in soil solution (distilled water + soil sample) change does not occur. But when red litmus is dipped changes to light blue.
b. Sample B : when blue litmus is dipped, colour changes to light pink.
c. Sample C : when red litmus is dipped, colour changes to light blue.
d. Sample D : red litmus changes to light blue colour.
e. Sample E : red litmus changes to light blue colour.
f. Sample F : red litmus changes to light blue colour.

RESULTS

SAMPLE A = Basic, pH is 8.3
SAMPLE B = Acidic, pH is 5.5
SAMPLE C = Basic, pH is 8.4
SAMPLE D = Basic, pH is 8.1
SAMPLE E = Basic, pH is 7.9
SAMPLE F = Basic, pH is 8.0

PHOSPHORUS

The main source of phosphorus in soil is apatite mineral-hydroxy apatite $[Ca_3(PO_4)_2]_3CaCl_2$, fluor apatite $[Ca_3(PO_4)_2]_3CaF_2$. Phosphates are also held on the surface of hydrated iron oxide and possibly hydrated aluminium oxide. Soil contains some phosphorus in organic combinations such as phytin and nucleic acid which release phosphates on decomposition. Very large amounts of phosphorus are present in soil but only a small part of it is available to crops. The phosphorus availability maximum when the soil is neither acidic nor alkaline.

Phosphorus is present in all living cells and is a constituent of cell nucleus. Plants grown in poor phosphorus soils have small root system and leaves, and their growth is stunted. It helps in the formation of seeds and fruits specially legumes.

DETERMINATION OF PHOSPHORUS

The particular forms of phosphorus which will be present in soils depend upon pH of the soil. As the pH increases from 5.5 to 7.5 available phosphorus runs from $H_2PO_4^-$ to $H_2PO_4^{2-}$ ions. Phosphorus depends upon organic transformation.

Phosphate present in soil reacts with ammonium amolybdate to form phosphomolybdic acid which in presence of stannous chloride ($SnCl_2$) is reduced to blue colour complex. The colour complex so formed shows maximum absorbancy at 690 nm.

Phosphorus is one of the most important nutrients required by all organisms for the basic procedures of the life. It is a natural element found in rocks, soil and organic materials. Phosphorus in soil is usually found in the form of phosphate (PO_4^{-3}) either as soluble inorganic phosphate ions, as soluble organic phosphate (i.e., a part of a soluble organic molecule), as particulate phosphate (i.e., as part of an insoluble organic or inorganic molecule) ar as mineral phosphate (i.e., as part of a mineral grain as found in a rock or sediment). Orthophosphate is the most stable kind of inorganic phosphate and is the form used by plants.

REQUIEMENTS

Soil samples, 0.002 (N) H_2SO_4, standard phosphate solution (0.01mg/ml), distilled water, ammonium molybdate, stannous chloride (2.5%), filter paper and glass wares—conical flasks, glass rod, measuring cylinder, pipette and spectrophotometer.

EXTRACTION OF PHOSPHATE FROM SIL SAMPLES

1 gm of oven dried soil was taken in a conical flask and to it 200ml of 0.002 (N) H_2SO_4 was added. It was mixed for 1 hour after which the solution was filtered and the filtrate was used for estimation of phosphate.

PROCEDURES

1. Take different volumes of standard phosphate solution (1, 2, 3, 4, 5 &6 ml) in different conical flask in duplicate.
2. Make the volume in each conical flask to 50 ml by adding distilled water.
3. For blank, take 50 ml of distilled water in a conical flask.
4. For unknown soil sample, take 50 ml of the filtrate in a conical flask.
5. To each of the conical flasks, add 2 ml of ammonium molybdate and mixed thoroughly.
6. Then add 2-3 drops of stannous chloride, mix and take the optical density at 690 nm in a spectrometer.
7. Plot a standard graph with the amount of phosphate in mg along the x-axis against the O.D value along the Y-axis and from the standard graph, find out the concentration of phosphate in the different soil samples.

TABULATION

Table 1

No. Of Obs.	Volume of standard phosphate (ml)	Volume of water (ml)	Amount of phosphate (mg)	Volume of ammonium molybdate (ml)	Amount of $SnCl_2$ (drops)	O.D at 690 nm	Mean O.D at 690 nm
1	1	49	0.01	2	3	0.05	0.05
2	1	49	0.01	2	3	0.06	
3	2	48	0.02	2	3	0.10	0.10
4	2	48	0.02	2	3	0.10	
5	3	47	0.03	2	3	0.16	0.16
6	3	47	0.03	2	3	0.16	
7	4	46	0.04	2	3	0.20	0.20
8	4	46	0.04	2	3	0.21	
9	5	45	0.05	2	3	0.25	0.25
10	5	45	0.05	2	3	0.25	
11	6	44	0.06	2	3	0.30	0.30
12	6	44	0.06	2	3	0.30	
13 (blank)	0	50	0.00	2	3	0.00	0.00
13	0	50	0.00	2	3		

Table 2.

Soil samples	No. Of obs.	Volume of filtrate (ml)	Volume of ammonium molybdate (ml)	Amount of $SnCl_2$ (drops)	O.D at 690 nm	Mean O.D at 690 nm
A	1	50	2	3	0.25	0.26
	2	50	2	3	0.27	
B	1	50	2	3	0.97	0.93
	2	50	2	3	0.89	
C	1	50	2	3	0.18	0.17
	2	50	2	3	0.16	
D	1	50	2	3	0.42	0.43
	2	50	2	3	0.45	
E	1	50	2	3	0.84	0.85
	2	50	2	3	0.87	
F	1	50	2	3	0.57	0.57
	2	50	2	3	0.58	

Results:

Amount of phosphate in soil samples are

Sample A= 1 mg/litre

Sample B= 3.72 mg/litre

Sample C= 0.6 mg/litre

Sample D= 1.6 mg/litre

Sample E= 3.4 mg/litre

Sample F= 2.2 mg/litre

SULPHUR

Sulphur is absorbed by plants mostly in the form of bivalent SO_4^{2-} anion and as SO_2 gas which is not a common situation. Sulphur is found in organic forms in a number of plants like onion, garlic, cabbage, turnip, etc., and is constituent of a number of amino acid crystine, methionine and other compounds like glutathione, thiamine and biotin. It may be translocated from older leaves to new leaves.

Sulphur is essential for the formation of nodules on the roots of the legumes. The deficiency of sulphur retards the plant growth and results in uniform chlorosis which affects all the leaves excepting the tips. Its deficiency also retards cell division and fruiting in some trees. In case of deficiency it can be supplemented by sulphur powder, gypsum or sulphur containing fertiliser like ammonium sulphate.

A variety of organic and inorganic S compounds occur in soil-plant-water systems. In most of the soils most humid and semi-humid regions, the organic sulphur compounds accounts for 95% of the total sulphur. The proportion of organic and inorganic sulphur in a soil sample, however, varies widely according to soil type and depth of sampling.

METHOD TO DETERMINE SULPHUR

Wet Chemical Methods

Total Sulphur in mineral soils may range from < 20 mg kg^{-1} in sandy soils to > 600 mg k^{-1} in heavy texture soils. Organic soils may contain as much as 0.5% S. Most soils, however, contain between 100 and 500mg (S) kg^{-1}.

The methods available for accurate determination of total S in soils involve two steps: (i) conversion of the various Sulphur compounds in soils to one form, either by oxidation to sulphate (dry or wet procedure) or by reduction to sulphide (conversion to sulphate is more common than conversion to sulphide); and (ii) determination of the sulphate or sulphide produced.

Various techniques have been employed to oxidize soil Sulphur to sulphate. One of the most widely accepted procedures is fusion with Na_2CO_3 and an oxidizing agent. This method is based on wet oxidation of the soil Sulphur under alkaline conditions, because wet oxidation procedures are more convenient than ignition techniques for conversion of soil Sulphur to sulphate (particularly for soil extracts), and use of alkaline oxidation should not involve the risk of gaseous loss of Sulphur (as H_2S, SO_2, or SO_3) associated with use of acid oxidants under certain conditions. Several methods are available for determination of the oxidized sulphur.

Of the various colorimetric methods recommended for determination of sulphate, the procedure developed by Johnson and Nishita (1952) is the most sensitive and accurate method available. A modification of the apparatus developed by Johnson and Nishita is shown in Figure A. This method involves reduction of sulphate to H_2S by a reducing mixture containing HI, HCOOH, and H_3PO_2. The H_2S thus liberated is absorbed in a buffer containing $Zn(OAc)_2$ and NaOAc and subsequently treated with *p*- aminodimethylaniline sulphate and ferric ammonium sulphate reagents for methylene blue colour development (Gustafsson, 1962). TEMPERATURE OF SOIL

Soil temperature is the warmth of soil which checks in order to grow plants, gardening, etc. It is simply measured with the help of soil thermometer. It may be varies during the day and the night. During day the sun rays warm up the soil surface and at night chill it. It also varies in different regions and altitudes. Most of scientists believe that the raise in altitude of 1 metre, there is difference of 10^0C fall in temperature.

OBSERVATIONS

SAMPLE **A**= 13^{0}C
SAMPLE **B**=12.7^{0}C
SAMPLE **C**=18^{0}C
SAMPLE **D**=11^{0}C
SAMPLE **E**=15^{0}C
SAMPLE **F**=21^{0}C

MOISTURE

Moisture refers to the presence of a liquid. Moisture also refers to the amount of water vapour present in the air.

The need to measure water content of products has given rise to a new area of science, aquametry. There are many ways to measure moisture in products, such as different wave measurement (light and audio), electromagnetic fields, capacitive methods, and the more traditional weighing and drying technique.

HOW TO DETERMINE SOIL MOISTURE

Determination of soil moisture is important and it can be done in different ways or many methods:-

Gravimetric method: This method is most simple and consists of drying a known weight of moist soil in an air oven at a temperature of 105^0 c until all the moisture is driven off and a constant weight is obtained.

Per cent moisture=Loss in weight/Dry oven weight (dry weight) X 100

Or

Moisture percentage (%) = Loss in weight/ Heated (dried) X 100

It is tedious and slow process as it needs weighing and drying, etc,. Moreover, the result expressed is on weight basis. From the view point of degree of saturation of pore space with moisture, the water capacity is more readily visualised if expressed on volume basis.

METHODS

1. The soil samples are taken in procleain dish and measured before heating.
2. The incubator is placed at a temperature of 105^{0}c above boiling point.
3. The soil samples heated continuously and stair.
4. The soil samples dried for 30- 35 minutes each until dried completely or no water.
5. Then the soil samples weigh again after dried.
6. The moisture percentage is calculated and noted.

SAMPLE	HEAT (joules)	TIME (minutes)	WEIGHT OF SAMPLE (microgram)		DIFFERENCE (microgram)
			Initial	Final	
A	300	35	200	180	20
B	300	35	300	282	18
C	300	35	350	340	10
D	300	35	64	58.51	5.49
E	300	35	79.01	73.53	5.48
F	300	35	70.25	67.46	2.76

CALCULATIONS

MOISTURE PERCENTAGE= loss in moisture weight/ Dry oven weight X 100

SAMPLE A= 20/180 X 100

=11.11% of moisture

SAMPLE B=18/282 X 100

=6.38% of moisture

SAMPLE C= 10/340 X 100

=2.94% of moisture

SAMPLE D=5.49/58.51 X 100

=9.38% of moisture

SAMPLE E= 5.48/73.53 X 100

=7.453% of moisture

SAMPLE F=2.76/67.49 X 100

=4.08% of moisture

SOIL ARTHRPODS

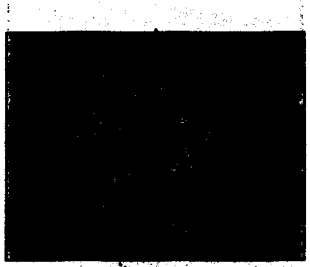
Many bugs, known as arthropods, make their home in the soil. Arthropods are invertebrates, without backbone and they have exoskeleton. Arthropods range in size from microscopic to several inches in length. They include insects, such as spring tails, beetles and ants; crustaceans such as sow bugs; arachnids such as spider and mites. Myriapods are

centipedes and millipedes. Some arthropods are predators, herbivores and shredders and fungal feeders. Soil arthropods eat fungi, worms, or other arthropods.

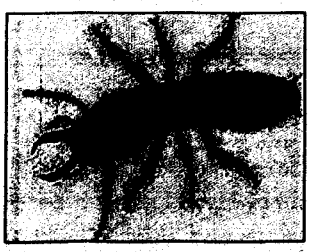
Millipedes: These myriapods are found in cultivated land of Shillong (Laitumkhrah), Bijoypur (A.P) & Bishnunagar (Assam). There are two mellipedes are observed during the site view. They are also called Diplopods because they having two pairs of legs on each body segment. They are harmless to human but most millipedes protect themselves from predators by spraying odour from the glands. Their body colour is brown in colour.

Centipedes: They are also found in Shillong (Rngi Zynriew) but with very few numbers. Only one centipede is observed. They fed on plant roots and can harm crop if their numbers are more. They have varying number of legs according with their body size and length. They have odd number of legs. They are carnivores and they lack pigmentation and white in colour. They are found in dead wood, inside log and in soil.

Beetles: Beetles are insects. They are common in all three states. They are abundant with time especially in flowering seasons and found in cultivated gardens, in pumpkins leaf, etc,. They have two pairs of wings. They are the prey for vertebrates like fishes, birds, reptiles, insects, etc.



Ants: They are common in all the three states. They are abundant in all regions except in water. Some feed on dead debris, insects, soil, etc,. They form colonies and stay in a society and hence called as super organisms or unity organisms. Some are with stings to defence from the attack on them. When they sting a slightly paining is due to the acetic acid they produced from their glands. They do harm to crop, vegetation, house building, etc. Some are useful for cultivation and agriculture. They having six legs (insects), a head and abdomen which is bigger than their head. They can carry 50 times of their body weight and their leg is very strong so that they can run quickly.

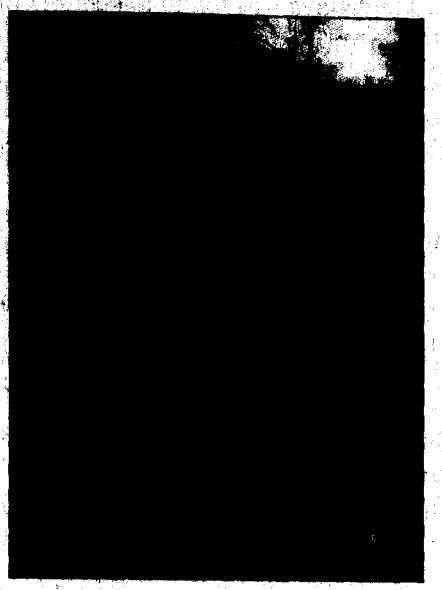


Mites: Only one is observed during the site view (Rngi Jyngriew, Meghalaya). They are small irritating insects. They irritate to human skin that cause intense itching. They are rare but can be found in some regions. Eg. Clover mite, house dust mite, itch mite, etc., they cause harmful to human and very severe itching which later swallow and turn into red due to chemical that they present in their fluid.

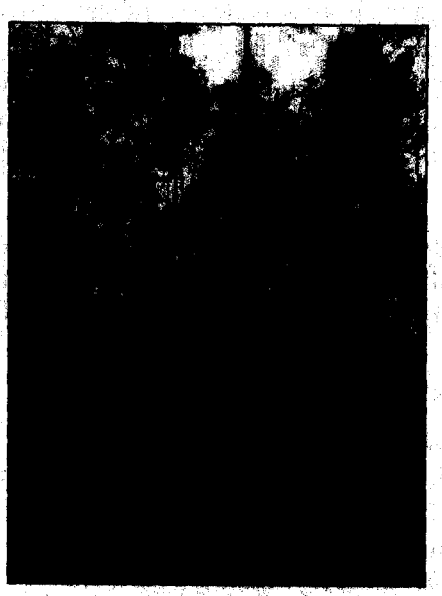
Earth worm: They are common in all the three states. They are segmented, long, cylindrical and under soil dwelling organisms. They burrow through the soil and are also called farmer friendly organism because they make the soil fertile. They are found worldwide. They feed on soil live and dead organic matters.

Earthworms are hermaphrodites—each individual carries both male and female sex organs. They lack either an internal skeleton or exoskeleton, but maintain their structure with fluid-filled coelom chambers that function as a hydrostatic skeleton.

SITE VIEW



Lummarie, Laitumkhrah (Shillong), Meghalaya



Madariting, Shillong, Meghalaya

Rngi Jynriew, Upper Nongthymmai, Meghalaya

Bijoypur 1, Changlang, Arunachal Pradesh

Goyalpara, Guwahati, Assam

Bishnunagar, Dibrughar, Assam

CONCLUSION

From the results, it clearly indicates that soil collected from Meghalaya was found to be more than the soil samples collected from Assam and Arunachal Pradesh. Also, the soil from this state was found to be more acidic than the other samples. Precipitation pattern of the region may also affect the moisture content of the soil and since Meghalaya receives an abundant annual rainfall than the other two states, it becomes obvious that the moisture content of the soil sample is higher in the state of Meghalaya. Acidity of the soil may be due to the presence of sulphur, phosphorus and also due to the presence of carbonates.

The property such as pH, texture, colour, temperature, moisture, arthropods, phosphorus and sulphur are observed and all regions have different property. This makes soil different in compositions and varies in climate conditions. The principle climatic variables influencing soil formation are effective precipitation and temperature, both of which affect the rates of chemical, physical, and biological processes. The temperature and moisture both influence the organic matter content of soil through their effects on the balance between plant growth and microbial decomposition.

In case of temperature, the Assam state soil temperature measured maximum it may be due to Assam central receives maximum sunrays from the sun and varies in altitudes. Assam lies in low altitude than Shillong which is about 10 metres higher in altitude than Assam. Soil receives sunlight in day time and soil temperature increases when measure in day than in night.

Vegetation impacts soils in numerous ways. It can prevent erosion caused by excessive rain that might result from surface runoff. Plants shade soils, keeping them cooler and slow evaporation of soil moisture, or conversely, by way of transpiration, plants can cause soils to lose moisture. Plants can form new chemicals that can break down minerals and improve the soil structure. The type and amount of vegetation depends on climate, topography, soil characteristics, and biological factors. Soil factors such as density, depth, chemistry, pH, temperature and moisture greatly affect the type of plants that can grow in a given location. Dead plants and fallen leaves and stems begin their decomposition on the surface. There, organisms feed on them and mix the organic material with the upper soil layers; these added organic compounds become part of the soil formation process.

SURVEY OF FISH DIVERSITY OF UMSHAIT RIVER RI-BHOI DISTRICT, MEGHALAYA, INDIA

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Abstract

A total of 17 species of fishes belonging to 3 order, 8 families and 13 genera were recorded from different sampling stations. Family Cyprinidae is represented by 7 species, Channidae by 3 species Cobitidae 2 species and Family Nemacheilidae, Clariidae, Olyridae, Badidae and Cichlidae are represent by one species each. Danio rerio, Barilius bendelisis, Lepidocephalichthys guntea, Olyra longicaudata, Badis.sp are common and presence in all the sampling station. Morphometric measurements of the collected fish species is measured using standard methods. Attempts have been made for the first time to access the fish diversity of Umshait River.

INTRODUCTION

Fishes are unique life forms with many unique characteristic features that distinguish them from other vertebrates. They occupied different aquatic habitat with different feeding mechanisms. The study of fish diversity is called Ichthyodiversity. Ichthyodiversity refers to variety of fish species; depending on context and scale, it refers to alleles or genotypes within a fish community, and to species life form across aqua regimes (Burton et al., 1992).In this context, Northeast India harbours 422 fish species belonging to 133 genera and 38 families (Goswami et al., 2012).

Meghalaya is one of the Northeast states of India and biodiversity hotspots (Roach, 2005).The richness in biodiversity can be attributed to the variety of vegetation, diverse topography, differential climate and heavy rainfall of

the region. Similarly, due to its geomorphology, there is a variety of hill streams, rivers and lakes which favours the distribution of different types of fishes in the region. The richness and abundance of fishes in the region is evident from the accounts of Nath and Dey (1997), Sen (1982, 1995, 2000), Sen (1985), Goswami et al., (2007, 2012). However, over the years there is habitat lost and many of the fish species has become endangered. Human intervention, like habitat destruction and defragmentation (Cuizhang et al., 2003), pollution (Lima-Junior et al., 2006) and climate change (Mas-Marti et al., 2010) are the major causes for the disappearance of many fish species. In this context, the objective of the present study is to give a recent data regarding fish diversity of Umshait River.

Umshait River falls in the Western region of Ri-Bhoi District, Meghalaya, Northeast, India (Fig. 1).The river got its name "Umshait" (locally, um= water, shait = speed) because of its high speed running down the hill slopes from Old Jirang till it reaches Khri River. The river originates in Old Jirang Village (25°56'21N and 91°34'52E) at an elevation of 600m and joins Khri river(25°48'39.52"N and 91°34'24.40"E) at an elevation of 318m, travelling a total distance of 24.5 Km. The main tributaries of Umshait River are Umpohphlang, Umpalngem, Umphung, Umpyrtha, Umiap-khla and Umkynsier. The gradient of the river varied considerably that results in a series of rapids, runs, riffles and pools along the river coarse. This river has provided food for the local people from the fish present in it over the years. However, the diversity of the river is now under threat due to unending anthropogenic activities and therefore it is being felt that there is an urgent need for documentation of this diversity in order to develop a fresh water diversity information system (Islam et al, 2013) of this river.

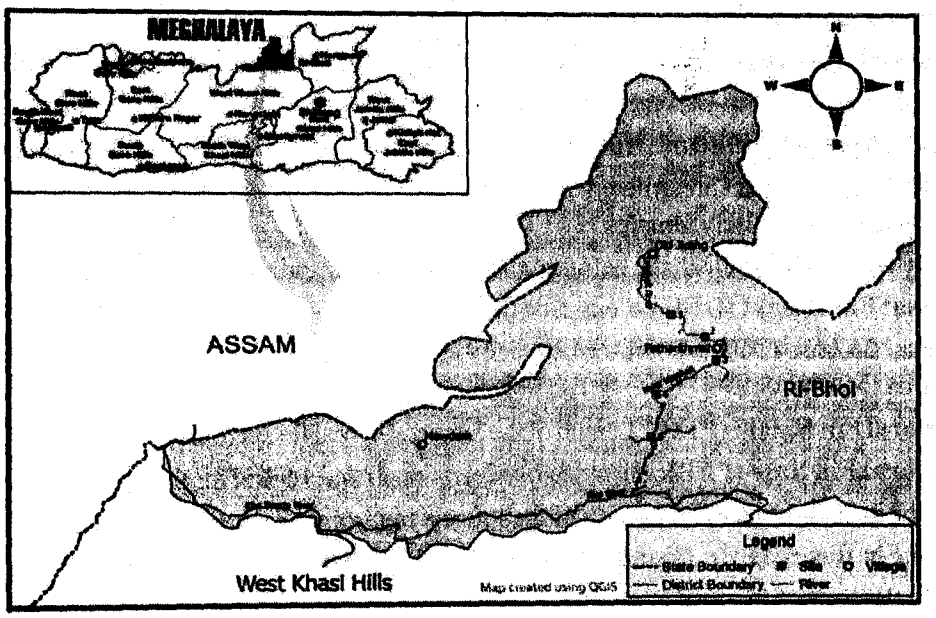


Fig 1: Map showing Umshait River in Western part of Ri-Bhoi District, Meghalaya, India.

MATERIALS AND METHODS

1. **Sampling stations:** Five sampling stations are chosen for sampling viz. (i) Jirang, (ii) Upstream of Patharkhmah, (iii) Downstream of Patharkhmah, (iv) Mawskei, (v) Umkynsier. About 2-3 kilometres of the river are covered for each sampling. Sites were chosen on the basis of accessibility and similarity in physical habitat.
2. **Sampling methods:** Sampling was done in all the sampling stations twice a week during the study period. Cast net, gill net and local techniques are used to collect the fishes during sampled period. Some of the fishes collected were released back into the river and only a few were kept for further identification.
3. **Identification:** Various morphological characters like shape, colours etc were recorded with the help of photographic documentation.The collected specimens are preserved in 8-10% formaldehyde solution and the samples were sent to Zoological Survey of India, Shillong for identification.Information on local name is obtained from fishermen.

4. **Morphometric measurement:** Morphometric measurement of the collected specimen was done following standard procedure as describe by Lowe-McConnell (1971) and Grant &Spain (1975). Measurements were taken with the help of Vernier callipers and the following measurements were taken during the study:
   i. **Total Length (TL):** Its represents the maximum elongation of the body from end to end. It is the distance in a straight line between the anterior most part of the body (snout or pre-maxilla, whichever is making the anterior most extremity of the body) to the tip of the tail.
   ii. **Fore Length (FL):** It is the distance from the anteriormost part of the body to the anterior limit of the median notch or the bifurcation of the caudal fin.
   iii. **Standard Length (SL):** It is measured from the anterior most part of the body to the base of the caudal fin (Hipural joint), where a groove forms usually when the tail bents from side to side.
   iv. **Head Length (HL):** Distance between the snout or pre-maxilla and the posterior most-edge of the operculum bone.
   v. **Pre-Dorsal Length (PDL):** Distance from the anterior most part of the body to the first dorsal fin ray.
   vi. **Pre-Orbital or snout length (PO):** Distance from the anterior most part of the body to the front margin of the eye orbit.
   vii. **Inter-Orbital Width (IOW):** Distance from the upper margin of the right orbit to the upper margin of the left orbit as measured from the dorsal surface. This measurement is also called as the least distance between the two orbitals.
   viii. **Post-Orbital Length (POL):** Distance from the post margin of the orbit to the end of the operculum bone.
   ix. **Eye diameter (ED):** Distance between the anterior and posterior of the eye in the longitudinal axis.
   x. **Anal length (AL):** Distance from the anterior most part of the body to the anterior limit of the anal aperture.
   xi. **Grid Length (GL):** Circumference of the body at its deepest point which sometimes indicates maturity of the species particularly females.
   xii. **Body Depth (BD):** Distance between the dorsal and ventral surface at the deepest point (or half of GL).
   xiii. **Dorsal Fin Height (DFH):** Length of the largest fin ray or spine of dorsal fin.
   xiv. **Dorsal fin base (DFB):** Distance between the anterior and posterior and of the dorsal fin taken along the base of the fin.
   xv. **Pectoral Fin Height (PFH):** Length of the largest pectoral fin spine taken from the base of the pectoral fin.
   xvi. **Pectoral Fin Base (PFB):** Distance between dorsal and ventral insertions of the pectoral fin.
   xvii. **Anal Fin Height (AFH):** Length of the longest ray from the anterior insertions of the anal fin.
   xviii. **Anal Fin Base (AFB):** Distance between anterior and posterior insertions of anal fin.
   xix. **Least Height of Caudal Peduncle (LHCP):** Also termed as least height of the body,it is the shortest height of the caudal peduncle between the end of the anal fin and the origin of the caudal fin. Infact, it is the width of the caudal peduncle at the hipural joint.
   xx. **Gap Width (GW):** Also termed as width of mouth. Distance between the angles ofthe closed mouth.

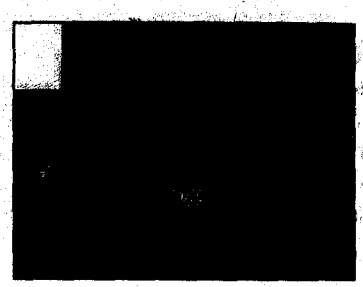
RESULTS

The fishes collected during the study period (Table 1) are listed below according to their systematic position with description of their morphology, habitat, food habits and uses. Morphometric measurement of the collected fish species is shown in Table. 2.

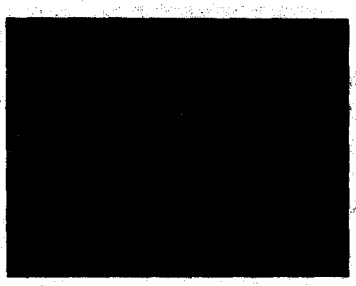
Danio rerio (Hamilton, 1822) (Fig. 2)

The species belong to the family Cyprinidae. It is locally known as "Dohmaitkja". It has blue and yellow- silvery horizontal stripes running both on its body and fin up to the end of caudal fin. Due to their beautiful stripes *Danio* Fig.2. *Ddfiio rerio* is mainly used as Ornamental fish but it the study area it is also used as food. They are found mainly in slow-moving to stagnant standing water part of the river and also occur in streams, canals, ditches and rice-fields. It is a carnivores feed on worms and small crustaceans, also on insect larvae. There is no threat of this fish in the study area

Devario equipinnatus (McClelland, 1839) (Fig. 3)
The species belong to the family Cyprinidae and is locally known as "Dohparthih" The collected specimen has silvery body with horizontal blue and yellow stripes. It is an Ornament fish and it is also used as food. It inhibits river and streams mainly in running water. It is a carnivores and pelagic feeds on detritus and insect. The species is found in less number during the study.

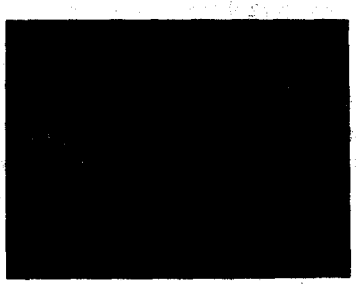


Esomus danricus (Hamilton, 1822) (Fig. 4)
It is known as the Indian Flying Barb owing to their extremely long barbels belongs to the family Cyprinidae. It is locally known as "Dohmare". It is a benthopelagic species, usually found in river, stream, ponds, ditches and canals. **Fig.4:-** *Esomus danricus* They are ornament fish. They are omnivores that swim and feed on insects close to the surface. The collected specimen has golden silvery colour with horizontal blue band punctuated with black colour anteriorly.



Barilius bendelisis (Hamilton, 1807) (Fig. 5)
It is locally known as "Dohthymmai" belongs to the family Cyprinidae. The species has silvery body with dark spot on posterior of the scales. It also has vertical stripe seen when live but not clearly. The ventral caudal fin has big dark spot in colour. The fish is used as food and ornament. They are found to inhabit streams and rivers with pebbly and sandy bottom. They are omnivores, benthopelagic in nature and are common during the catch.

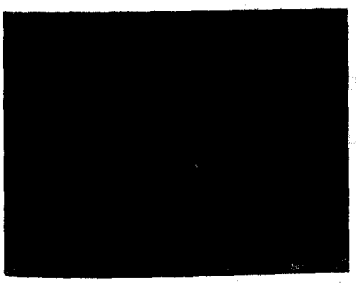
Fig 5:- ***Barilius bendelisis***



Barilius barna (Hamilton, 1822) (Fig. 6)
It is locally known as "Dohthymmai" belongs to the family Cyprinidae. The collected specimen has silvery body with dark blue vertical stripe running from the dorsal part of the body to the mid ventral part. It is a benthopelagic bottom feeder. The species is found in very low number during the catch in which all are released back to their only one is taken as sample. There is an urgent need to conserve the member of this fish in Umshait River. This fish is used as ornament and also as food.

Garra lamta (Hamilton, 1822) (Fig. 7)
The species belong to the family Cyprinidae. It is locally known as "Dohthang". The body is elongated and cylindrical with a round snout and mouth is inferior and crescent-shaped. It has a golden brown to golden orange in colour. The species is used as ornament and food. The species is benthopelagic herbivores found feeding on the algae and other plants presence in the stone. It is mainly found in running water with gravels and stones.

Fig 7:- ***Garra lamta***



Puntius sophore (Hamilton, 1822) (Fig. 8)
It is locally known as "Dohkaputhi". The collected specimen colour is silvery. It has a large dark spot presence in the caudle base and dorsal fin. The operculum also has a golden spot. It is found to inhabit rivers, streams and submontane regions where the water flows slowly. The fish is found in large number during the study with different size. It is a plentiful shoaling fish. It is an omnivores and used as ornament and food.

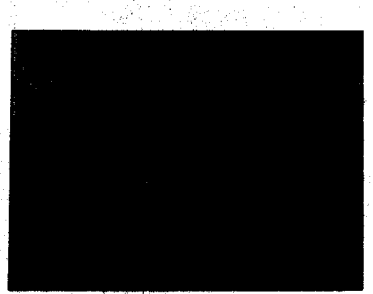
Fig 8:- ***Puntius sophore***

Lepidocephalichthys berdmorei (Blyth, 1861) (Fig. 9)
It is locally known as "Dohshyip" (Shyip=Sand) since it is mainly found in the sand. The body of the collected specimen is yellowish to brown with varying from finely speckled to coarsely spotted but always with a mid-lateral **Fig. 9:-** *Lepidocephalichthys berdmorei* series of large, irregular blotches. It has a large black spot on the upper half of caudal base. It is a carnivores and used as ornamental fish. Found in clear, swift streams and river with sandy bottom.

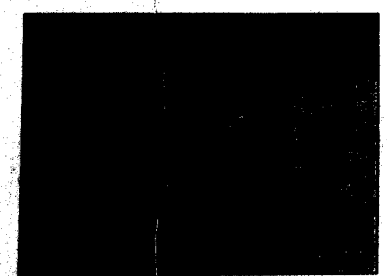
Lepidocephalichthys guntea (Hamilton, 1822) (Fig. 10)
It is locally known as "Dohshyip" (Shyip=Sand) since it is mainly found in the sand. The body of the collected specimen is yellowish with varying from finely speckled to **Fig.10:-** *Lepidocephalichthys* coarsely spotted but always with a midlateral series of large, *guntea* irregular spots. The body depth is almost equal from head to tail. It is a carnivore inhabits rivers and stream. The species is demersal where their floor is mainly sand. It is used as ornamental fish and food.

Schistura reticulofasciata (Singh & Banarescu, 1981)(Fig. 11)
It is locally known as "Dohsyngkai- uri". The collected specimen has golden brown colour with vertical dark stripe. The body is elongated and cylindrical body. The species native place is Meghalaya inhabits stream and river **Fig.**II:- *Schistura reticulofasciata* found in the area where there are gravels and pebbles. It is used as ornamental fish and food.

Clarias magur (Hamilton, 1822) (Fig. 12)
It is known as catfish, locally known as "Dohmagur".The body of the specimen is grey to black. The head is crescent shape and bear special accessory respiratory organ for air breathing. They have high commercial food value and demand in the market. They are carnivores found in river and muddy areas.



Olyra longicaudata (McClelland, 1842) (Fig. 13)
It is a species of long tail catfish. It is locally known as "Dohtara". It has purple body with dark horizontal stripe. It is a carnivores inhabits river and stream and used as ornament.

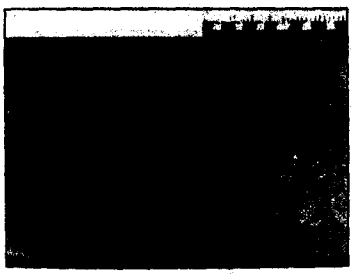


Badis sp. (Fig. 14)
It is locally known as "Dohparthih-eitning". The live species colour is black and golden yellow. It also has a red stripe at the base of dorsal fin and the body near to it. Badis species are carnivores feeds on insect larvae and other microorganism. They are found in river and stream with pebbles and gravel.

Oreochromis mossambicus (Peter, 1852) (Fig. 15)
It is locally known as "Dohkha-kwoi". The body is black silvery with yellowish ventral operculum. It also has red stripe at the tip of dorsal fin and caudal fin. This is exotic fish introduced to river from pond during flood. It feeds on algae, especially diatoms, and detritus, large individuals also take insects and other invertebrates.

Channa gachua (Hamilton, 1822) (Fig. 16)
It is locally known as "Dohthli-pathar" (Dohthli indicates Chnna sp, pathar = ricefield). It is also known as dwarf snake head because its head resemblance to that of the snake. The collected specimen colour is yellowish black. It
Fig. 16:- *Channa gachua* can tolerate large changes in temperature and acidity. It inhabits mainly wetlands, canal, ditches, stream and river. It is carnivore's fish feeds on insect and small fish. It is used mainly as food.

Channa punctata (Bloch, 1793) (Fig. 17)
It is also known as spotted snake head. It is locally known as "Dohthli-gore". It has a golden white body with dark spot. It is a carnivores feeds on small inset and fish. It has food value and commercial use. It inhabits in streams.
Fig. 17:- *Channa punctata* canal and ponds.



Channa stewartii (Play fair, 1867) (Fig. 18)
It is locally known as "Dohthli-kroh" (Dohthli indicates Channa sp, kroh = cave). The collected specimen colour is dark with black spot on the body. The ventral portion of the head is bluish in colour. It is found in river and stream mainly in **(Fig. 18)** *Channa stewartii* between stones. It is a carnivores and it is used as food.

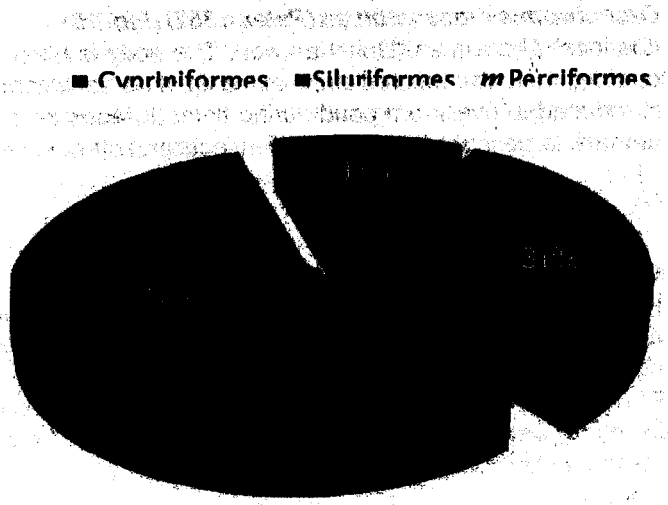


Fig. 19: Percentage of species at Order level.

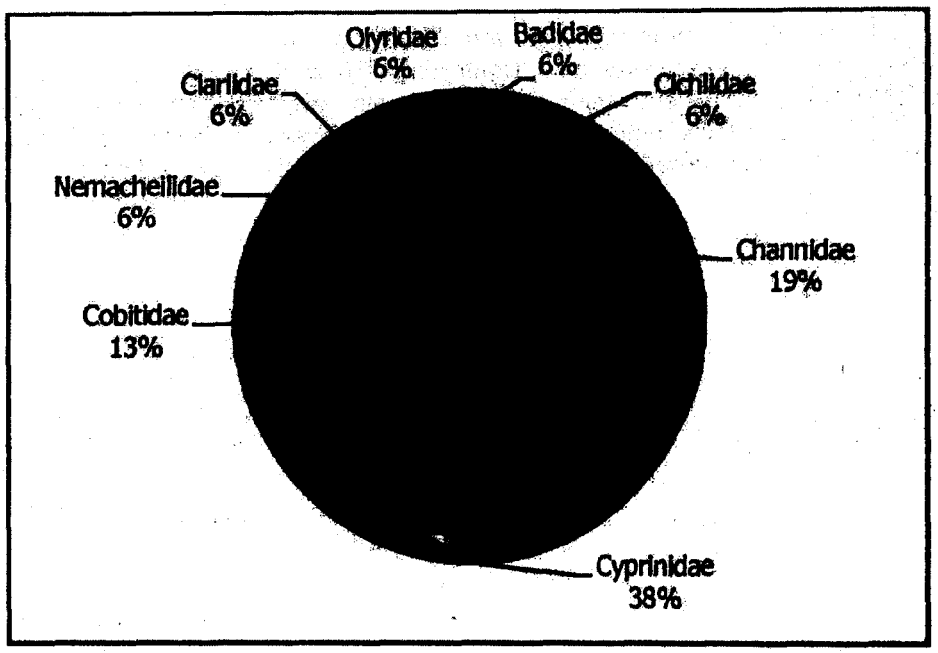


Fig. 20: Percentage of species at Family level.

Order	Family	Sl. no	Scientific name	Local name	S-I	S-II	S-III	S-IV	S-V
Cypriniformes	Cyprinidae	1.	[illegible]	Dohmaiti [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		2.	*Devario equipinnatus*	Dohparthih	–	+	+	–	+
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		4.	*Barilius bendelisis*	Dohthymmai	+	+	+	+	+
		5.	*Barilius* [illegible]	Dohthymmai	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		6.	*Garra lamta*	Dohthang	+	+	–	–	+
		7.	*Puntius sophore*	Dohkha-puthi	–	+	+	+	+
	Cobitidae	8.	*Lepidocephalichthys berdmorei*	Dohshyip	–	+	+	–	–
		9.	*Lepidocephalichthys guntea*	Dohshyip	+	+	+	+	+
	Nemacheilidae	10.	*Schistura reticulofasciata*	Dohtara	+	+	–	–	–
Siluriformes	Clariidae	11.	*Clarias magur*	Dohmagur	–	–	+	–	–
	Olyridae	12.	*Olyra longicaudata*	Dohsyngkai-muri	+	+	+	+	+
Perciformes	Badidae	13.	*Badis sp.*	Dohparthih-[illegible]	+	[illegible]	+	[illegible]	[illegible]
	Cichlidae	14.	*Oreochromis mossambicus*	Dohkha-kwoi	–	–	+	–	–
	Channidae	15.	*Channa gachua*	Dohthli-[illegible]	+	–	+	[illegible]	[illegible]
		16.	*Channa punctata*	Dohthli-gore	–	+	+	–	–
		17.	*Channa stewartii*	[illegible]	[illegible]	+	[illegible]	[illegible]	[illegible]

Table 1:- Fish recorded at different stations.

Danio rerio	3.9	3.7	3.1	0.7	1.9	0.2	0.2	0.4	0.2	0.9	0.9	0.45	0.7	0.3	0.6	0.1	0.6	0.3	0.7	0.1
Devario equipinnatus	6.9	6.3	5.5	1.4	3.2	0.4	0.5	0.7	0.4	3.3	2	1	1.1	1.1	1	0.2	0.9		0.8	0.1
Esomus danricus	4.6	3.9	3.6	1	2.3	0.3	0.2	0.4	0.2	2.6	1	0.5	0.8	0.3	1	0.3	0.7	0.3	0.7	0.1
Barilius bendelisis	12.3	11.5	10.5	2.8	5.8	0.9	1.4	1.6	0.5	7.6	3.9	1.85	1.8	1.6	1.7	0.65	1.2	1.5	1.4	0.4
Barilius barna	9.8	9.1	8.1	2.4	4.4	0.6	1.1	1.1	0.6	5.5	3.2	1.6	1.2	1.3	1.5	0.3	1.1	1.9	1.2	0.5
Garra lamta	11	12	9.1	2.1	4.3	1	1	0.6	0.4	6.3	1.7	0.85	2	1.4	1.6	1.6	1.6	1.8	1.3	0.1
Puntius sophore	8.4	7.6	6.6	2	3.6	0.5	0.8	0.8	0.5	4.8	2.5	1.25	1.4	1.2	1.2	0.3	0.9	0.8	0.8	0.2
Lepidocephalichthys berdmorei	6.9	–	5.9	1.2	3.1	0.2	0.2	0.6	0.5	4.4	1.3	0.65	1	0.8	1.2	0.2	1.8	0.4	0.8	0.1
Lepidocephalichthys guntea	8.3	–	6.8	1.3	3.8	0.3	0.2	0.7	0.6	5.1	1.6	0.8	0.9	0.7	0.9	0.2	0.9	0.4	0.8	0.2
Schistura reticulofasciata	4.8	4.5	4.1	0.8	2.1	0.4	0.2	0.4	0.1	2.8	1	0.5	0.7	0.6	0.8	0.3	0.7	0.2	0.5	0.2
Clarias magur	12.3	–	10.6	2.8	3.3	0.9	1.5	1.9	0.2	5.3	2.8	1.4	1.5	6.8	1.4	1.5	1.5	5.5	0.7	0.3
Olyra longicaudata	10.3	8.8	7.9	1.9	4.8	0.4	0.5	0.8	0.1	3.4	1.5	0.75	1	0.7	1.6	0.3	0.7	2.4	0.8	0.2
Badis.sp	3.7	–	3	1	1.3	0.3	0.3	0.5	0.2	0.9	1	0.5	0.6	0.6	0.7	0.2	0.6	0.5	0.6	0.1
Oreochromis mossambicus	14.5	12.3	11	4.6	4.5	1.2	1.8	1.9	0.9	7.6	10	5	2	5.7	3.7	0.7	3.3	2.2	1.5	0.7
Channa gachua	8	–	6.6	2.2	2.4	0.4	0.7	1.4	0.4	3.4	1.7	1.85	0.6	4	1.4	0.4	0.7	2.5	0.6	0.2
Channa punctata	14.1	–	11.5	4.2	4.7	0.9	1	3.1	0.6	6.4	3	1.5	1.2	6.4	2.2	1.7	1.3	4.3	0.8	0.2
Channa stewartii	15.5	–	12.3	3.9	4.4	0.9	1.3	2.4	0.6	6.2	3.2	1.6	1.8	7	2.6	0.8	1.4	4.3	0.9	0.4

Table 2:- Morphometric measurement (Mean) of the collected fish species.

DISCUSSION

A total of 17 species of fishes belonging to 3 order, 8 families and 13 genera were recorded from different sampling stations during the study period. Maximum diversity is observed in the Order Cypriniformes with 56% follow by Perciformes 31% and Siluriformes 13% (Fig.18). Family Cyprinidae is represented by 7 species (Danio rerio, Devario equipinnatus, Esomus danricus, Barilius bendelisis, Barilius barna, Garra lamta and Puntius sophore), Channidae by 3 species (Channa gachua, C. punctata and C. stewartii), Cobitidae 2 species (Lepidocephalichthys berdmorei and L. guntea) and 1 species each are represented for family Nemacheilidae (Schistura reticulofasciata), Clariidae (Clarias magur), Olyridae (Olyra longicaudata), Badidae (Badis.sp) and Cichlidae (Oreochromis mossambicus). It was found that the most common fish species collected from all the stations are Danio rerio, Barilius bendelisis, Lepidocephalichthys guntea, Olyra longicaudata, Badis.sp while most of them showed restricted distribution and are collected from one or two stations. Exotic species like Oreochromis mossambicus were also encountered to be present in Station-III. Sarkar et al., (2010) reported that the presence of exotic fish indicate threat to local species due to their establishment in the river and thus affect the natural germplasm (Goswami et al., 2012).

Local fishermen also reported other fish species locally known as Dohsna, Dohkhushi but none was recorded during the field survey. This may be due habitat lost and environmental degradation. The stone quarrying are common in Umpalngem tributaries and almost all part of it had been affected. Exploit of sand and other resources such as stones (Mawlein) from the river had destroyed the habitat of the fish in the river. Due to human interventions many river ecosystem have been lost and populations of riverine species have become highly fragmented (Bunn and Arthington, 2002). Use of plant poison and lime by the local fishermen to catch the fish may be one of the reasons for the disappearance of most of the fishes from the river. A similar logic was also put forward by Goswami et al., (2007).

Similarly, less flow of water during dry season has led to decrease in the number of adult fish since they got caught easily by local people for food. Therefore, use of indigenous fishing gears should be encouraged instead of modern gears (Shinde et al., 2009) for conservation purpose. However, since there is no previous information on the fish diversity from this river it is difficult to access the decline in its diversity but it is hope that the present study will provide much information needed for future research.

CONCLUSION

All the fishes that are recorded during the study period are being exploited and used as food. Lack of knowledge by the villager about the biodiversity has been another cause for overexploitation of fish and habitat destruction. For this purpose general awareness programme should be given to the people and student in order to conserve the fish diversity of the Umshait River. Unity of all the villages and people of the area to conserve the diversity along with the help of the government departments like Fishery Department, Forest and Environment Department is the need of the hour.

STUDY OF PLANT DIVERSITY OF SHILLONG COLLEGE EXTENDED CAMPUS AT UMROH, MAWKASIANG

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INTRODUCTION

Plants form the basis of all food webs, and underpin the functioning of all ecosystems. They support and maintain human life on this planet. Ironically, in the past few centuries the changes in human society and the increasing pace of development resulted in increased habitat loss and degradation, invasive aliens, over-exploitation of resources, and even climate change, threatening and rapidly depleting the existence of these valuable natural resources. A recent report features that more than 20% of the world's plants are threatened with extinction (Anon, 2010). A large part of the remnant biodiversity precariously survives in a few pockets of ecologically sensitive landscapes of the earth's surface.

To understand and assess richness of the biodiversity, a taxonomic study of the flora and forests is essential. Knowledge of vegetation and flora of any region is important for the study of biodiversity and its environment. It is also

important for resource management and planning activities at the local, regional and global levels. There is a need for systematic detailed surveys of plant resources, both exotic and indigenous and preparation of the flora of smaller areas like districts, protected areas, unexplored areas, etc. as this is a requisite for understanding the ecosystem's function and its conservation and for the development of rural as well as urban economy of a region.

Many educational institutions like university and colleges have vast areas and these can provide highly valuable resources for biodiversity. Especially in ecologically devastated urban landscapes, these sprawling campuses of educational institutions serve as refuge to many plants and animals (Rajendra et. al 2014, Dey et al. 2013, Jain et. al 2005, Harshad, 2008). In developed countries, many institutions are now taking steps to improve their environmental performance on issues such as waste, energy and transport, but few consider biodiversity to be a priority in their environmental management strategy. In reality many institutional campuses already contain important habitats and there are always opportunities to increase biodiversity through sensitive grounds management. These institutions can also effectively involve themselves in conserving and regenerating the biodiversity of the regions in which they are located. Till date, biodiversity studies in educational campuses in India are few in number and yet to received enough attention. In the state of Meghalaya in particular such studies are lacking. Keeping in view, the importance of plants and the lack of biodiversity studies in educational campuses of the state, the present study is undertaken with the aim to provide the basic information of the plant diversity in a college campus and to identify a range of activities to benefit biodiversity on campus. In addition, the present study aims to create awareness to student communities about the importance of plant diversity and the need for their conservation. It can also be use constructively in the sustainable planning of environmental activities for the benefit of both man and natural environment.

OBJECTIVES

The main objectives of the study are:-

1. To inventorise plant species within the college campus.
2. To study the floristic composition and phyto-sociological characteristics of the vegetation in the college campus.?

REVIEW OF LITERATURE

For more than a century, a number of studies on floral diversity focusing on different aspects have been carried out world over. Some of these studies focused on species richness in different types of forests like those of Zent and Zent, 2004 who studied the floristic composition, structure, and diversity of rain forest of Sierra Maigualida, Venezuelan Guayana. Tang and Ohsawa, 2009 studied the ecology of subtropical evergreen broad-leaved forests of Yunnan, southwestern China, Upadhaya et al, 2003 analysed the tree diversity in subtropical broadleaved forest of the Jaintia hills in Meghalaya, northeast India; Sahu et al. 2007 inventorised species diversity in tropical dry deciduous forest of Boudh district, Eastern Ghats of Orissa, India.and Tripathi and Tripathi, 2010 carried out a comparative study on the Community composition and structure of subtropical vegetation of forests in Meghalaya State, northeast India. Others like Pandey and Shukla 1999, Kadavul and Parthasarathy 1999, Bhuyan et al. 2003, Muthuramkumar et al. 2006 studied species composition and population structure in forest stands with varying level of disturbance. The study of species diversity is helpful to understanding community composition, structure, change and development (Li et al., 2002). They also provide useful information essential in understanding ecosystem function and conservation.

Studies on species richness and distribution by earlier workers such as de Candolle (1874) and Copeland (1939), focused mainly on large-scale, cross continental patterns. This has changed and now modern interest has focused largely on distribution of organism along the latitudinal and altitudinal gradients (Rohde 1992, Bachman et al. 2004, Bharali 2012), environmental gradient (Gentry 1988, Givnish 1999, Currie and Francis 2004, Tripathi and Tripathi 2010) together with the processes that control these patterns.

Academic institutions could play a very significant role in conserving biodiversity with minimal effort which might support other institutions concerned with conservation and management of biodiversity. Several studies have been conducted to analyze the biodiversity richness in institutional campuses. El-Juhany and Al-Harby, 2013 carried out a study on the Status and Diversity of Ornamental Plants in King Saud University Campus at Riyadh, Saudi Arabia. Rajendra et al. 2014 studied the floristic diversity of the Bharathiar university campus, India and found 335 vascular plant species growing within the campus. A rapid assessment of biodiversity on the Campus of Indian

Institute of Technology - Madras reported the presence of 298 non-cultivated plants (Care Earth, 2006). Nautiyal, 2011 studied plant diversity in the ISEC campus, Bangalore and identified as many as 320 plant species belonging to 90 different families.

STUDY AREA

The study was conducted in Shillong College extended campus. The main campus of Shillong College is located in Boyce Road, Laitumkhrah, however, with the coming up of many new departments, the college required more space hence an extended campus was set up. The extended campus is geographically located at 25° 36' 55" N and latitude and 91° 58' 55" E longitude, in the outskirt of Umroh village, at the distance of about 12 kilometers from the main city Shillong (Figure 1 (a)). The campus is situated at the foot hills, at an elevation of 1200 m altitude above mean sea level (MSL). It is surrounded by hillocks on the eastern, western and northern side and bounded by a river on the southern side. Two rivulets, one each on the eastern and western side emerged from the forests on the hill top and join the main river downhill. The campus area has a remarkable physiographic characteristic which is a combination of hilly terrain and flat land. With just an area of 8 acres, the campus is unique in that it has a fairly diverse ecological setting which is comprised of montane forest, flat plains and riparian ecosystems. The montane forests are of broad-leaved type and provide a suitable habitat for a variety of bird species and small forests animals like squirrels and rodents. The campus site is an ecotone between pine forests and the agricultural land.

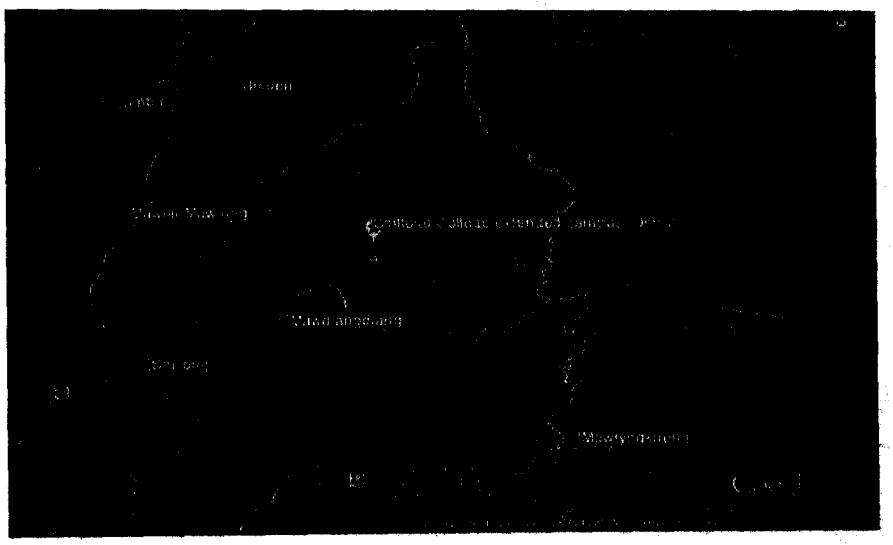

Figure 1 (a). Location Map of the study area

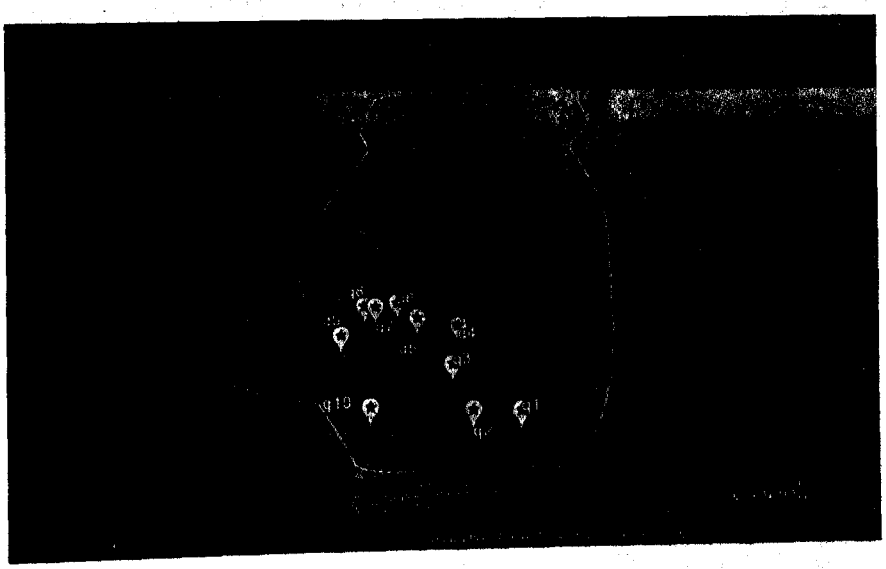

Figure 1 (b). Sampled vegetation plots

METHODS

Field work to study plant diversity in the campus was conducted during the month of October 2014 - March 2015. Vegetation sampling

The vegetation sampling was done by quadrat method. The trees (GBH > 10 cm at 1.37 m above the ground) were identified, measured and recorded by randomly sampling with ten quadrats of 10 m x 10 m size [Figure 1 (b)]. Trees with multiple stems and connected near the ground were counted as single individual (Ayyappan and Parthasarathy 1999). Plants without bole and having many perennial branches from the base were distinguished as shrubs and these along with climbers and lianas were identified and recorded by placing 5x5 m quadrat within each 10 m x 10 m quadrat. Similarly, individuals without any woody tissues i.e., herbs were identified and recorded by placing 1 m x 1 m quadrat within each 10 m x 10 quadrats (Figure 2). Saplings and seedlings were not considered for the study.

Plant identification

Specimens of all plant species were collected and herbarium was prepared following Jain and Rao (1977) and species identification was done with the help of Forest Flora of Meghalaya (Haridasan and Rao 1985-1987) and Flora of Assam (Kanjilal et al. 1934-1940). Further, their identification was confirmed by matching with specimen in the Shillong herbarium, Botanical Survey of India, Shillong. The voucher specimens were deposited at the Herbarium of Shillong College for further reference. Digital photographs of live plant species were also taken.

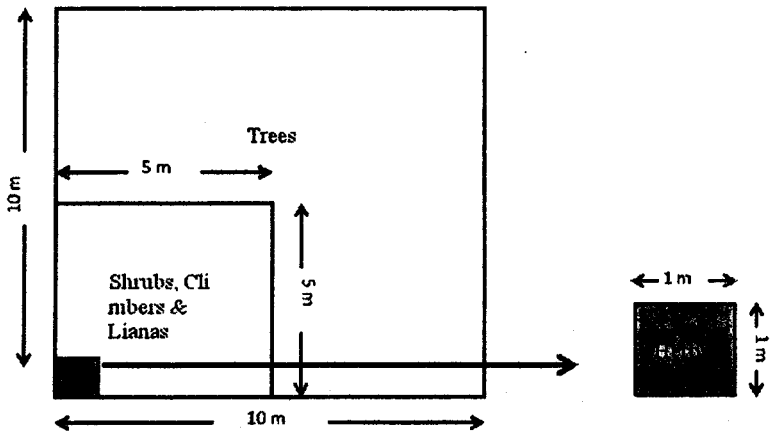

Figure 2 A schematic field layout for vegetation studies

Data analysis

Important community parameters such as frequency, density, abundance and basal area (in case of tree) of all species were computed following Misra (1968) and Muller-Dombois and Ellenberg (1974). The IVI for tree species were calculated by summing up the relative values of frequency, density and basal area while, the IVI for shrubs and herbs were obtained by summing the relative values of frequency and density. Importance value was used to rank each species and the plant species with the highest importance value in the stand was considered the dominant species.

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Number of quadrats studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrats studied}}$$

$$\text{Abundance} = \frac{\text{Number of individuals of a species}}{\text{Number of quadrats of occurance of the species}}$$

$$\text{Basal Area } (m^2) = \pi r^2, \text{ where } r = \frac{\text{Average diameter}}{2}$$

Dominance = Basal Area x Density

IVI = Relative frequency + Relative density + Relative basal area/dominance (for trees)

IVI = Relative frequency + Relative density (for shrubs, climbers & lianas and herbs)

To determine species diversity and evenness the Shannon's diversity index (*H'*), Simpson's dominance index (D), Pielou's evenness index were calculated (Magurran 1988) as given below.

Shannon-Wiener diversity Index $(H') = -\Box p_i \times \log p_i$

Where, H' = Shannon -Weiner diversity index; p_i is the proportion of individuals in the ith species i.e., (n_i/N); n_i = importance value index of the species and N = importance value index of all the species.

Simpson's dominance Index $(D) = \Sigma(n_i)/N \times (n_i)/N$

Where, n_i = importance value of the ith species; N = sum of importance value of all species

Pielou's evenness index (e) = $H'/\log_e S$

Where, H' = Shannon -Weiner diversity index; S = number of species

The horizontal distribution pattern of species in a community was computed following Whitford's index (Whitford 1949)

Whitford's index = Abundance / Frequency

Where, the value <0.025 indicates regular distribution, 0.025 – 0.050 indicates random distribution and > 0.050 indicates clumped distribution.

Circumferences at breast height (cbh) of trees in a forest were divided into various size classes and size structure of tree species in each forest was determined.

RESULTS

Floristic diversity

On the basis of the field survey conducted in the campus area, 89 species belonging to 72 genera (1 unidentified) and 54 (1 unidentified) families were recorded excluding the lichens, bryophytes and mycoflora which was not possible during the present study. Out of these, 31 were tree species belonging to 27 genera and 21 families with Fagaceae as the dominant families. The number of shrub species was 24 belonging to 20 genera and 18 families, with Moraceae as the dominant families (Table 1). Climbers and lianas were represented by 15 species belonging to 13 genera (1 unidentified) and 12 families (1 unidentified) while herbs were represented by 19 species under 18 genera and 13 families. The dominant family among herbs was Asteraceae. The families, genera and species of plants recorded in the campus are given in Table 3.

Family	No. of genera	No. of species
Anacardiaceae	1	2
Apocyanaceae	1	1
Araliaceae	1	2
Arecaceae	1	1
Asparagaceae	1	1
Aspleniaceae	1	1

Asteraceae	6	7
Begoniaceae	1	1
Betulaceae	1	1
Blechnaceae	1	1
Caprifoliaceae	1	2
Chloranthaceae	1	1
Commelinaceae	1	1
Convolvulaceae	1	1
Cyatheaceae	1	1
Cyperaceae	1	1
Dioscoreaceae	1	1
Dipsacaceae	1	1
Ericaceae	2	2
Euphorbiaceae	1	1
Fabaceae	3	4
Fagaceae	3	4
Hypoxidaceae	1	1
Iteaceae	1	1
Lamiaceae	2	2
Lauraceae	2	2

Density

Density of trees, shrubs, climbers & lianas and herbs of forests within the campus is given in Table 2. Tree density was recorded to be 2520 individuals ha-1. Tree species like Itea macrophylla, Lyonia ovalifolia, Lindera caudata contribute maximum density. As compare to trees and climbers & lianas, an exceptionally high density was recorded for shrub species which was 7840 individuals ha-1. Maximum density was contributed by Eurya japonica and Viburnum foetidum. Density of climbers & lianas was found to be 4480 individuals ha-1. Smilax oxyphylla recorded the highest density (1440 individuals ha-1) amongst climbers and lianas. In case of herbs, the density was recorded to be in 92000 individuals ha-1.

Basal Area

The basal area is calculated for tree species only and was found to be 40.12 m2ha-1. (Table 2 and Table3). Maximum basal area was exhibited by tree species Albizia sp. with 7.12 m2ha-1 and minimum by tree species Schefflera hypoleuca with basal area of 0.16 m2ha-1.

Table 2 Various phyto-sociological characteristics of tree, shrub, climber & liana and herb of the forest within the campus

Attributes	Tree	Shrub	Climber & Liana	Herb
Species richness	31	24	15	19
No. of genera	27	20	13	18
No. of family	21	18	12	13
Density (individuals ha^{-1})	2520	7840	4480	92000
Basal cover (m^2 ha^{-1})	40.16	-	-	-
Shannon diversity index	2.62	2.58	1.95	2.51
Simpson's dominance index	0.11	0.11	0.21	0.11
Pielou eveness index	0.76	0.81	0.72	0.85

Table 3 Structure and composition of trees, shrubs and herbs in the study area (Density in ha-1 and basal area in m2 ha-1).

Name of Species	Family	Density	Basal Area	IVI
TREES				
Albizia sp.	Mimosaceae	10	7.12	4.04
Beilschmiedia sp.	Lauraceae	10	0.19	1.7
Betula alnoides Buch.-Ham. Ex D. Don	Betulaceae	20	3.51	5.64
Castanopsis purpurella (Miq.) Balak.	Fagaceae	80	2.89	15.96
Castanopsis sp.	Fagaceae	110	2.8	17.27
Cyathea sp.	Cyatheaceae	10	2.85	2.6
Eurya acuminata DC.	Theaceae	160	0.33	16.79
Ficus fistulosa Reinwdt.	Moraceae	10	0.26	1.72
Ficus sp. 1	Moraceae	50	0.31	4.99
Ficus sp. 2	Moraceae	10	0.29	1.73
Helicia robusta Wall. ex. Benn.	Proteaceae	10	0.71	1.87
Itea macrophylla Wall.	Iteaceae	430	0.62	34.73
Lindera caudata Benth.	Lauraceae	380	1.04	40.8
Lithocarpus dealbatus (Hk.f. et. Th.ex Miq) Rehder	Fagaceae	50	1.88	8.87
Lyonia ovalifolia (Wall.) Drude	Ericaceae	420	0.6	35.14
Manglietia sp.	Magnoliaceae	10	1.1	2
Michelia sp.	Magnoliaceae	10	0.5	1.8

Micromelum integerrimum (Roxb.) Wight & Arn	Rutaceae	10	0.46	1.79
Myrica esculenta Buch.-Ham. ex D.Don.	Myricaceae	80	2.27	13.03
Pinus kesiya Royle ex Gordon	Pinaceae	120	3.03	19.53
Quercus semiserrata Roxb.	Fagaceae	10	1.03	1.98
Rhododendron arboreum Sm.	Ericaceae	50	0.68	4.37
Rhus acuminata DC	Anacardiaceae	10	0.71	1.87
Rhus javanica Linn.	Anacardiaceae	30	0.22	5.12
Sauraria sp.	Saurauiaceae	20	0.41	2.31
Schefflera hypoleuca (Kurz) Harms	Araliaceae	10	0.11	1.67
Schima wallichii (DC.) Korth.	Theaceae	300	1.45	35.29
Styrax serrulatum Roxb.	Styracaceae	40	1.13	5.59
Syzygium sp.	Myrtaceae	10	0.16	1.69
Viburnum coriaceum Bl.	Caprifoliaceae	10	0.77	1.89
Wendlandia glabrata DC.	Rubiaceae	40	0.7	6.24

		-	Density	IVI
SHRUBS				
Blechnum orientale Linn.	Blechnaceae	-	360	8.04
Breynia retusa (Dennst.) Alst.	Euphorbiaceae	-	560	15.76
Butea minor Buch.-Ham. ex Bakr	Fabaceae	-	40	2.23
Callicarpa rubella Lindl.	Verbanaceae	-	40	2.23
Desmodium microphyllum (Thunb.) DC.	Fabaceae	-	200	6.00
Eurya japonica Thumb.	Theaceae	-	1960	35.34
Ficus fulva Reinwdt.	Moraceae	-	480	16.47
Ficus hirta Vahl.	Moraceae	-	80	2.74
Ficus heterophylla Linn.	Moraceae	-	40	2.23
Inula cappa (Buch.-Ham. ex D. Don) DC	Asteraceae	-	120	4.98
Lantana camara Linn.	Verbanaceae	-	640	13.34
Mentha longifolia (L) Huds.	Lamiaceae	-	120	3.25
Musseanda macrophylla Wall.	Rubiaceae	-	40	2.23
Osbeckia nepalensis Hk. f.	Melastomataceae	-	40	2.23
Osbeckia stellata Buch.-Ham. ex D.Don	Melastomataceae	-	440	10.78
Pandanus sp.	Pandanaceae	-	160	3.76
Phoenix acaulis Buch.- Ham. ex Roxb.	Arecaceae	-	40	2.23

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Polygonum molle D. Don	Polygonaceae	-	280	8.74
Rubus ellipticus Sm.	Rosaceae	-	200	4.28
Rubus rugosus Sm.	Rosaceae	-	440	14.23
Schefflera venulosa (W. & A.) Harms	Araliaceae	-	40	2.23
Symplocus pyrifolia Wall. ex G. Don	Symplocaceae	-	40	2.23
Urena lobata Linn.	Malvaceae	-	400	12.00
Viburnum foetidum Wall.	Caprifoliaceae	-	1080	22.40
		-	Density	IVI
CLIMBERS & LIANAS				
Alyxia sp.	Apocyanaceae	-	80	4.91
Asparagus racemosus Willd.	Asparagaceae	-	40	4.02
Desmodium sp.	Fabaceae	-	80	4.91
Dioscorea bulbifera Linn.	Dioscoreaceae	-	40	4.02
Ficus sp. 4	Moraceae	-	40	4.02
Kadsura heteroclita (Roxb.) Craib.	Schisandraceae	-	160	6.70
Lygodium flexuosum (Linn) Sw.	Schizaeaceae	-	1240	46.43
Piper griffithii C. DC.	Piperaceae	-	280	15.63
Piper sp.	Piperaceae	-	240	11.61
Porana racemosa Roxb.	Convolvulaceae	-	40	4.02
Pueraria lobata (Willd.) Ohwi	Fabaceae	-	40	4.02
Smilax oxyphylla Wall.	Smilacaceae	-	1440	50.89
Stephania sp.	Menispermaceae	-	160	9.82
Tetrastigma serrulatum (Roxb.) Planch	Vitaceae	-	560	25.00
Unidentified sp 4		-	40	4.02
		-	Density	IVI
HERBS				
Asplenium sp.	Aspleniaceae	-	15000	22.55
Begonia roxburghii A. DC	Begoniaceae	-	3000	12.64
Carex baccans Nees.	Cyperaceae	-	1000	4.21
Cautleya spicata (Royle) Baker	Zingiberaceae	-	4000	10.60
Crassocephalum crepidioides (Benth.) Moore	Asteraceae	-	1000	4.21
Curculigo orchioides Gaetrn.	Hypoxidaceae	-	2000	8.42
Cyanotis sp.	Commelinaceae	-	6000	12.77
Dipsacus asper DC.	Dipsacaceae	-	2000	5.30
Emila sonchifolia (Linn.) DC	Asteraceae	-	2000	5.30

Eupatorium adenoforum Spreng.	Asteraceae	-	2000	5.30
Eupatorium riparium Regel	Asteraceae	-	20000	27.99
Globba sp.	Zingiberaceae	-	2000	8.42
Gnaphalium affine D. Don	Asteraceae	-	3000	9.51
Hedyotis uncinella Hk. & Arn.	Rubiaceae	-	1000	4.21
Oplismenus compositus (L.) P. Beauv	Poaceae	-	6000	12.77
Sacandra glabra (Thunb.) Nakai	Chloranthaceae	-	8000	21.20
Scutellaria discolor Colebr.	Lamiaceae	-	3000	6.39
Selaginella sp.	Selaginellaceae	-	8000	11.82
Siegesbeckia orientalis Linn.	Asteraceae	-	3000	6.39

Dispersion pattern

For all life forms i.e., trees, shrubs, climbers & lianas and herbs, a uniform trend was observed i.e., majority of the species were found to occur in Raunkier's frequency class A, few species representing Class B and C, still fewer or almost absent in D and E. Only in case of trees, species were present in class D and E (Figure 3).

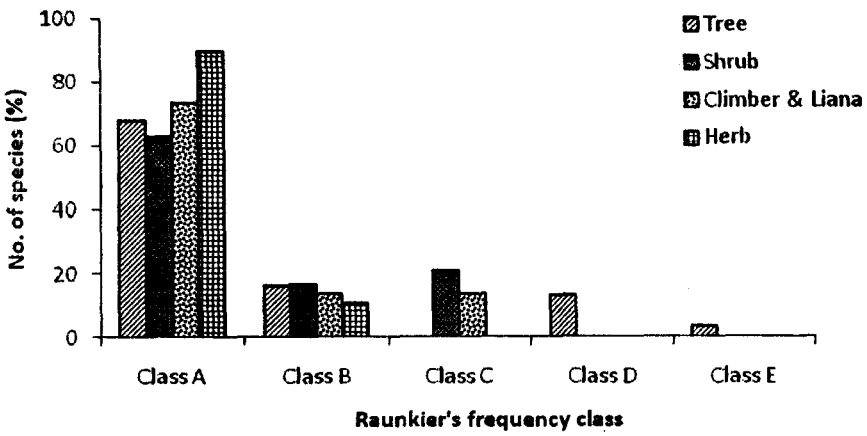


Figure 3 Percentage of trees, shrubs, climbers & lianas and herbs in different Raunkier's frequency classes

Horizontal Distribution Pattern

The horizontal distribution pattern calculated using Whitford index is presented in Figure 4. Almost all the species exhibit clump distribution with very few species exhibiting random pattern and none for regular pattern.

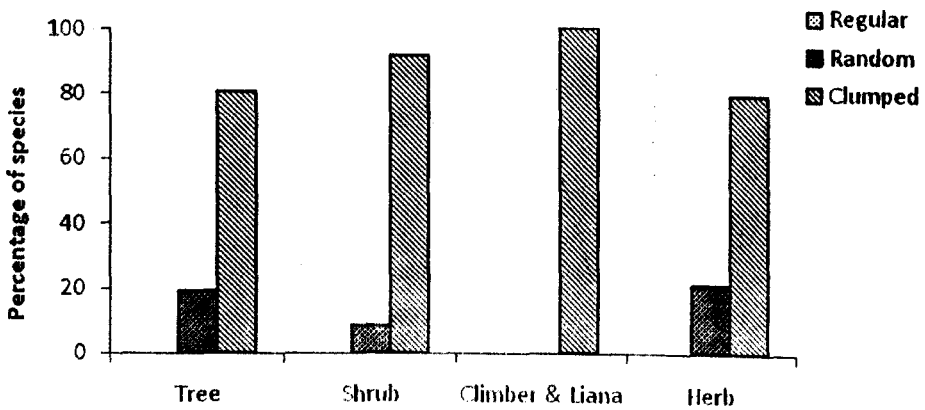


Figure 4 Percentage of species exhibiting different horizontal distribution pattern in the study area

Dominance Distribution Pattern

Dominance of species was determined based on the IVI values. The tree layer was found to be dominated mainly by Lindera caudate, Schima wallichii, Lyonia ovalifolia and Itea macrophylla (Table.3). Amongst shrub, species with highest IVI was Eurya japonica (IVI=35.35). For climber & liana, Smilax prolifera and Lygodium flexuosum recorded comparatively high IVI value than the rest, whereas for herbs, the highest IVI value was represented by Eupatorium riparium (Table 3). The dominance-diversity curve for tree, shrub, climber & liana and herb followed a log normal distribution curve as shown in Figure 5

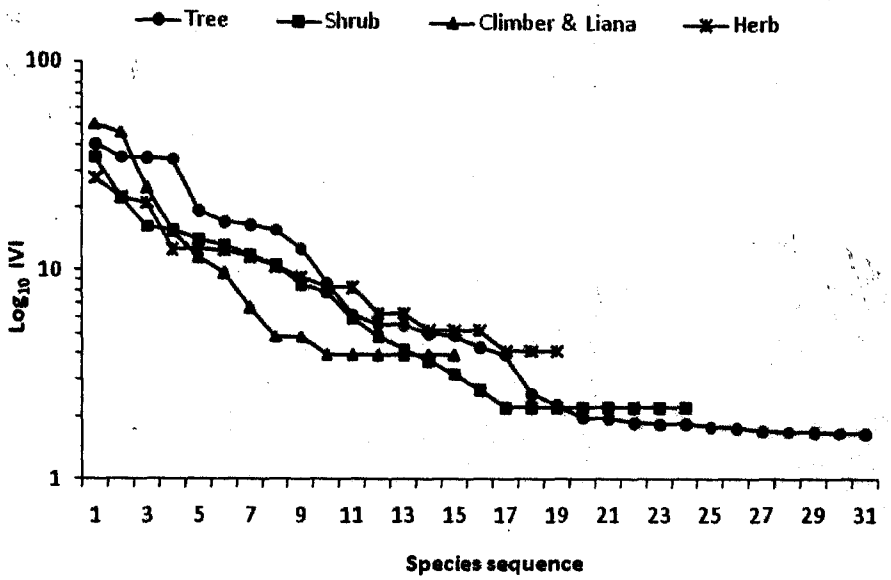
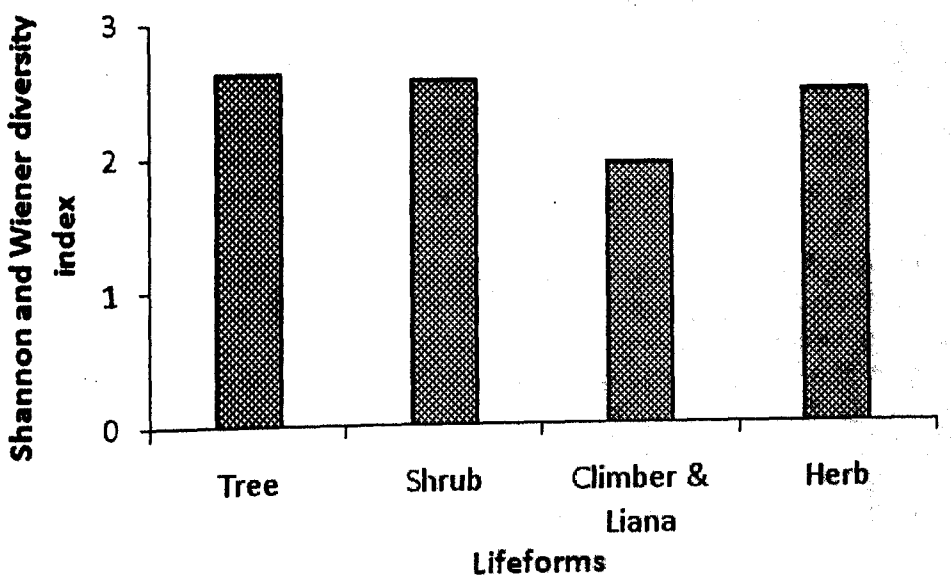


Figure 5 Dominance-diversity curves for tree, shrub, climber & liana and herb species in the study area

Species diversity, dominance and evenness indices

The Shannon species diversity index was found to vary between different lifeform. It was maximum for tree, followed by shrub and herb and minimum for climber & liana. (Table 2 & Figure 6). Simpson dominance index was equal for tree, shrub and herbs. It was slightly lower for, climber & liana. Pielou evenness index was highest in herb, followed by tree, shrub and least for climber & liana. (Table 2 & Figure 6).



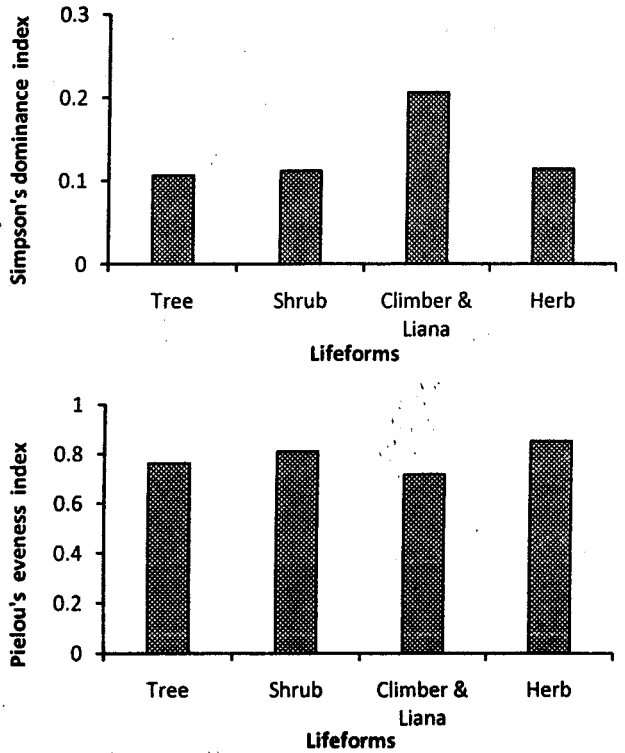


Figure 6 Species diversity, dominance and evenness indices of tree, shrub, climber & liana and herb species
Figure 7 Density, species richness and basal area of tree species in different girth classes (cm)

DISCUSSION

Altogether, 89 species belonging to 72 genera (1 unidentified) and 54 (1 unidentified) families were recorded from the campus area. The floristic richness recorded in the present study is much lower than those recorded in similar studies by Rajendra et al. 2014 and Nautiyal 2011, which is most likely due to the small size of the campus area. The ?oristic composition of the study area is similar to the subtropical semi-evergreen and broadleaf forests of Meghalaya and elsewhere in India, and the forests of southern China, as is evident by the prevalence of Fagaceae, Moraceae, Rubiaceae, Lauraceae and Theaceae members (Balakrishnan 1981-1983, Mishra et al. 2004, Tripathi et al. 2010, Chittibabu and Parthasarathy 2000, Box 1995, Tang and Ohsawa 2009). This similarity in floral composition may be attributed to a number of factors such as similarities in geographical characteristics and climatic conditions and because of their moderately close proximity.

For the time being, a segment of the campus still have natural forests as it is expose to minimal human disturbances. While the campus still has semi-evergreen and broadleaf elements growing, the areas adjoining the campus are devoid of these but dominated by pine trees. Continuous human intervention in these broadleaf forests has paved the way for development of pine forests, which represent the edaphic and biotic climax community on disturbed sites, which are seasonally dry and nutrient poor (Tripathi and Tripathi 2010).

In the present study, the tree density obtained was much higher, while the basal cover is comparable with the results of Tripathi and Khongjee (2010) and Tripathi and Tripathi (2010) obtained in different human impacted forests of Meghalaya. High shrub and herb density in the area was mainly due to sparse canopy of the tree layers and availability of ample sunlight greatly favors growth of light demanding herbaceous plants (Bhatnagar 1966).

Majority of the species exhibit clump distribution and frequency class A was dominant, therefore, the forest may be termed as highly heterogeneous and patchy in terms of species distribution. This clumping pattern of dispersion of trees, shrubs, climber & liana and herbs obtained in the study area is in conformity with the findings of similar studies elsewhere (Ashton 1969, Parthasarathy and Karthikeyan 1997). Moreover, Odum (1971) has emphasized that contagious distribution is the commonest pattern in nature, which is due to small but significant variations in the environment such as topography and soil factors (Currie and Paquin 1987). Random distribution is found only in very uniform

environmental conditions whereas, the regular distribution occurs where severe competition between the individuals exists (Panchal and Pandey 2004).

The dominance-distribution curve showed a log-normal distribution which represents equitability and stability of the community that signifies abundance of species having intermediate dominance values in the community (Magurran 1988).

The Shannon Weiner diversity index for tree, shrub, climber & liana and herb is much less than that reported by Tynsong (2010) from primary forests of south Meghalaya and Upadhaya et al. (2003) and Mishra et al. (2005) from sacred groves in Jaintia Hills and West Khasi Hills, respectively. The low Shannon Wiener diversity value of the forest stands indicated that the ecological structure is less complex (Odum 1971). Small sampling size and disturbance impact may also be an important factor responsible for lower diversity index (Tripathi and Khongjee 2010). The Simpson's dominance index of tree, shrub, climber & liana and herb species in the study area was higher than reported by Tripathi and Khongjee (2010) and Tripathi and Tripathi (2011) in Meghalaya. In general, species diversity and dominance index showed inverse relationship (Singh and Mishra 1969, Murthy and Pathak 1972, Joshi and Behera 1991) and Simpson's index is heavily weighed towards the most abundant species in the sample and it is less sensitive to species having only a few individuals (Magurran 1988). High value of the evenness index re?ects that much of the value of diversity is attributed to the species that are relatively rare (Pandey and Shukla 2003) which was not seen in the present study.

Highest species richness and density is represented by the girth class 10 - 20 cm. The decrease in species richness and density with increasing girth class in the present study is in conformity with the findings of Hara et al. (1997) in evergreen broad-leaved forests in Japan, Kadavul and Parthasarathy (1999) in semi-evergreen forests of Eastern Ghats, India and Bhuyan et al. (2003) from dipterocarpus forests of Arunachal Pradesh. This distribution resulted in a reverse J shaped curve in all forests revealing that adult individuals were very few. Very few trees with GBH >70 cm were recorded, signifying that the forest might have been subjected to clear felling in the past years. Abundance of young individuals is also a characteristic feature of vegetation on moist and infertile soil. The distribution of basal area in the girth classes did not corroborate the distribution of stems. It was concentrated in the 30-40 cm girth class suggesting that the stems in these classes dominate.

CONCLUSION

The biodiversity of the campus is important as it is vital that native species of flora are conserved. Due to limited resource and time constraint, many plant species present within the campus cannot be recorded in the present study. There are many more life-forms that need to be identified upto species level. Precautions should be taken that habitat of plant species in the campus should not be threatened due to unplanned activities being carried out in favour of human development. Proper planning need to be done before any activity is carried out and efforts should be made to retain the natural environment in the campus. With this study we hope to encourage similar works in other institutional campuses which may lead to the enlistment of endangered or endemic species or even the discovery of plant species which are new to science . Studies like the one that has been conducted can help to create or expand the data base on floral richness of any area under study and may aid those who are in need of such infromation in the near future.

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ACCURATE DETERMINATION OF ACCELERATION DUE TO GRAVITY, g IN SHILLONG USING ELECTRONIC TIMER

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INTRODUCTION

The acceleration due to gravity is the most fundamental parameter in Physics. The motion of object on the earth's surface, atmosphere, etc. is governed by the earth's gravity. Earth's gravity is the force with which the earth attracts the object towards its centre. If the object is free to move under the effect of this force, it continues to move with certain value of acceleration, called the acceleration due to gravity and symbolized by the letter 'g'. In recent years, people developed very precise instruments like gravimeters with resolution of 1 in 106 for accurate determination of local gravity [Cook A.H]. The underlying principle on all these sophisticated instruments is either the principle of pendulum or time of fall of an object. But all parameters are measured precisely. The main objective is to minimize all the errors that are usually encounter in all scientific experiment. Another way of minimizing errors, is to repeat the number of observations to suitable till a pattern of stability of data distribution and then draw conclusion from these data by using standard laws of statistics. Precise and greater resolutions instruments cannot be easily set up in all Undergraduate Physics Laboratory because of the financial constraints of the institutions. Therefore, the feasible approach towards accurate measurement of any quantity is to repeat the experiment many times under optimum condition and tediously analyze the data mechanically. The process of analyzing the data are no more time taking nowadays because the computer software or programme are always there for whatever purpose so desired. Since the value of acceleration due to gravity in our place is not found in any standard literature and for all purpose its theoretical is only the one calculated by using the international formula, we feel that accurate measurement of this physical constant g that we come across in our day to day Physics classes should be undertaken now and if there is any other scholar who want to improve or re-investigate its value they should not feel surprise that such work is already done. Moreover the detail analysis of the experimental data in Microsoft Excel 2007 should be appreciated by all students of physics at undergraduate degree level of Indian Universities especially in the Northeastern Parts of India where rigorous analysis of data in undergraduate level is never carried out to estimate the uncertainty level or accuracy level. In all experiments, estimation of errors is important; otherwise the whole work of reporting the result is incomplete [Taylor JA].

This experiment that we designed is not to be compared with those of high level of research at university level; rather it is our humble step of improving the laboratory work, but with an aim to determine the accurate value of the constant we use so often in our topical deliberations. The experiment also introduced the application of statistical methods in analyzing the experimental data.

In principle, g can be determined by measuring the time t for an object to fall through a known vertical distance y by applying simple formula

$$y = ut + \frac{1}{2}gt^2 \quad (1)$$

where u is the velocity of the object at the time which we start the clock. If we start the clock exactly at the time the ball just falls from its stationary position, then . Then the equation (1) becomes,

$$y = \frac{1}{2}gt^2 \quad (2)$$

The greatest challenge in all free fall experiment is the accurate measurement of time of flight and the validity of equation (1) is questionable [Garg M et. al]There is no means of measuring "start time" with sufficient accuracy by using stop clock at one hand and eyes focused on the falling object (Wick K and Ruddick K). Again there is a problem if the stop time is exactly at the instant when the object falls through a height h. Thus a scale and clock method is not an accurate way of doing the experiment. To be precise in the measurement of time, we rely on electronic device which can switch the timer at the correct time and stop the same at the correct time. We employed an electronic timer in our experiment. But even then, any instrument has its own limitation. It is because of this, we need ways of minimizing the error that arises from the limitation of the instrument we used. The limitation of the electronic timer in our experiment is considered and care has been taken to minimize the error that arises from its limitations. Since the start time and the stop time play a crucial role in the determination of g, we have to take care of it. In this experiment we determine the error in the time due to off start and off stop of the electronic timer. More-over the formula (1) or (2) is strictly true when the object falls in the presence of gravity alone. But it is not possible to remove atmospheric air in the laboratory we perform the experiment, so we have to take care of the buoyancy and viscous drag of atmospheric air (Lindemuth J).

MATERIAL AND METHOD

Description of Apparatus

The photographs of our experimental set up are shown in fig. 1 & 2.

Fig. 1. Expertmental Set-up

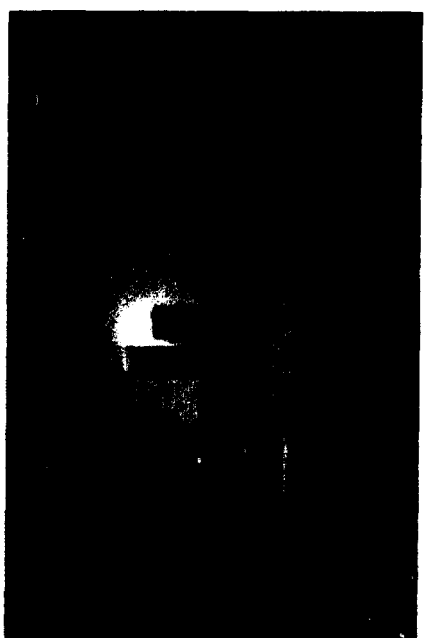

Fig.2 Experimental set-up with modified telescope for scale reading

The main component of the apparatus consists of the electronic timer. Since the least count of the timer is only 0.01 s, we feel that a scale of least count 0.001 m is sufficient to measure a vertical height through which the steel ball falls. The ball release mechanism consists of an electromagnet and a switch. When the switch is on the catch position, the timer is set to zero. The ball is held in its position by the action of electromagnet. The ball fall immediately when the circuit is broken, or the electromagnet lose its magnetism. The timer start immediately once the "catch" switch is turn to the "release" switch. As long as the circuit of the gate is not broken the timer reading continues to record the time. When the ball hits the Flap below, which complete the gate circuit, the circuit is broken and the timer stop. The time of flight is thus the duration of time from the time of release of the ball by the electromagnet to the time the gate circuit is broken. But it is advisable to investigate that the timer record the exact time when the ball falls and the flap detach from the gate circuit. But it is an inherent property of the timer to start ahead or later of the time when the ball is actually released, or stop earlier or later of the time the ball actually hits the flap placed at scale reading 0.0 cm. To eliminate these offset times of the timer; we plot a graph of height (y) versus the square of time (t2). The graph is extrapolated to find the offset time, here of course, we find the Square of the offset time. Vertical alignment of the apparatus is also taken care of by using plumb line. The distance of the lowermost portion of the spherical steel ball from the flap is measured by seeing the alignment through a low power telescope attached to the carriage which we modified on the travelling microscope. The parallax is taken care of while measuring the distance.

In order to prevent the steel ball from hitting the hard floor, we use a saw dust filled tray to catch the ball.

Theory

The equation of motion of an object falling through a fluid is

$$m\frac{d^2y}{dt^2}=\left(m-\frac{4}{3}\pi r^3\rho_{air}\right)g-k\left(\frac{dy}{dt}\right)^2$$

where

m = mass of falling object

r = radius of the sphere

k = propotionality constant for viscous drag .

In our experiment, the effect of buoyancy may be neglected since we are using a dense spherical ball, the mass of air displace is negligible compared to mass m of the ball. Thus the equation (3) becomes

$$m\frac{d^2y}{dt^2}=mg-k\left(\frac{dy}{dt}\right)^2 \qquad (4)$$

The quantity k is given by

$$k=\frac{1}{2}C_d\rho_{air}A$$

Where

C_d = drag coefficient

A = Cross-sectional area of the fallingball = πr^2

The drag coefficient depends on shape, nature of surface and Reynolds's number, R_e (Landau L and Litshift E)

The value of C_d in our experiment is calculated to be $C_d \approx 0.5$ [Landau L and Litshift E]. Therefore for the radius of ball (Table I) used in our experiment,

$$k \approx \frac{1}{2} \times 0.5 \times 1.225 \times \frac{22}{7} \times \left(\frac{0.7156}{100} \right)^2$$

$$k \approx 4.929 \times 10^{-5} Ns^2 m^{-2}$$

The solution of Eq. (4) is

$$y(t) = \frac{V_T^2}{g} \ln \left(\cosh \left(\frac{gt}{V_T} \right) \right) \tag{5}$$

where

V_T = terminal velocity of the ball,

$$V_T = \sqrt{\frac{mg}{k}} \tag{6}$$

Expanding Eq. (5)

$$y(t) = \frac{V_T^2}{g} \ln \left(1 + \frac{1}{2!} \left(\frac{gt}{V_T} \right)^2 + \frac{1}{4!} \left(\frac{gt}{V_T} \right)^4 + ... \right) \tag{7}$$

We estimate the maximum possible value of the term $\frac{1}{4!}\left(\frac{gt}{V_T} \right)^4$ and found it to be insignificant as compare to the term $\frac{1}{2!}\left(\frac{gt}{V_T} \right)^2$ keeping in consideration of the degree of precision of our experimental set up. Thus we neglect the term, $\frac{1}{4!}\left(\frac{gt}{V_T} \right)^4$.

Hence Eq. (7) reduces to

$$y(t) = \frac{V_T^2}{g} \ln \left(1 + \frac{1}{2!} \left(\frac{gt}{V_T} \right)^2 \right). \tag{8}$$

Substituting the value of V_T from Eq.(6), we rewrite Eq. (8),

$$y(t) = \frac{\frac{mg}{k}}{g} \ln \left(1 + \frac{1}{2!} \left(\frac{gt}{\sqrt{\frac{mg}{k}}} \right)^2 \right)$$

$$y(t) = \frac{m}{k} \ln \left(1 + \frac{1}{2!} \left(\sqrt{\frac{gk}{m}} t \right)^2 \right).$$

$$y(t) = \frac{m}{k} \ln \left(1 + \frac{1}{2} \frac{gk}{m} t^2 \right). \tag{9}$$

This gives the height that the object, starting from rest would fall in time, t.

Eq. (9) may be further simplified,

This gives the height that the object, starting from rest would fall in time, t.
Eq. (9) may be further simplified,

$$y = \frac{m}{k}\left[\frac{1}{2}\frac{k}{m}gt^2 - \frac{1}{2}\left(\frac{1}{2}\frac{k}{m}gt^2\right)^2 + \ldots\right]$$

$$y = \frac{1}{2}gt^2 - \frac{1}{4}\frac{k}{m}g^2t^4$$

The value of $\frac{1}{4}\frac{k}{m} \approx 1.04\times10^{-3}$, this term is insignificant as compared to the first term, if the vertical distance is less than 1m.

Data Collection and Analysis

The diameter of the sphere is measured by using a screw gauge of least count $0.001\ cm$ and the mass of the ball measured using a digital balance of least count $0.1\ g$. The values are recorded in Table I

$$r = 0.7156 \pm 0.000418\ cm$$
$$m = 11.9g$$

The experimental set up is aligned properly, the ball is allowed to fall through height starting from a height of 10.0 cm till 90.0 cm increasing by a step of 10.0 cm. For each height, y, 20 observations of time of fall are taken. The observations are directly recoded in the Microsoft Excel spread sheet. The mean of 20 observations gives the observed time of fall, t' for a given height is calculated and its standard deviation is taken, Table II. The graph is plotted with vertical height in vertical axis and square of time t' in vertical axis, Fig.3.

Then the graph is extrapolated to meet the time axis at . The time is the error in time due to inaccuracy in start and stop time of the timer. This quantity is to be subtracted from the square of the average time, t'2 of various heights. Then another column is inserted for true value of square of average time of fall for a given height. Using the square of the true time, a graph of is plotted and using the curve fitting method in Excel, the graph is fitted linearly and the coefficients are determined from these curve fittings. The values of the coefficients are indicated in the graph 2. (Fig.3.). The value of g is obtained from the graph.

Using LINEST function [Morrison F A] the standard deviation of the slope of the linear trend line is found to be [13]

The value of g is compared with the one obtained from the theoretical calculation based on the international gravity formula [11],

$$g = 9.780327\left[1 + 0.0053024\sin^2 L - 0.000058\sin^2 2L\right] - 3.8\times10^{-5}H\ \ ms^{-2}$$

where the latitude of Shillong College in radians is 25 26 28.2 radian and H= altitude of the place from Sea-level, H=1475 m(GPSMAP 78 Series, GARMIN Make)

RESULTS AND DISCUSSION

The value of g is obtained as .
The theoretical value of g obtained from this formula is 9.78528
Our value is slightly less than the theoretical value.

The value of g thus obtained from experiment is in good agreement with the one obtained from the theoretical calculation. There is a scope for improving the experimental result with instruments of greater resolution and larger degree of precision. The vertical scale that we used may be replaced by a 100 cm long Vernier scale. The electronic timer of resolution 0.01 s may be replaced by another timer of least count 0.1 ms. The accuracy of the results may be easily reproduced at any other laboratory. T

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Table I

						mean (cm)	stdev (cm)
Diameter, D'	1.421	1.422	1.422	1.423	1.423	1.4222	
Corrected D	1.430	1.431	1.431	1.432	1.432	1.4312	0.000837
radius, r	0.715	0.7155	0.7155	0.716	0.716	0.7156	0.000418
mass	11.9	11.9	11.9	11.9	11.9	11.9	0

Table II

y (m)	observed time (t'), (s)	t'^2 (s^2)	(t^2), (s^2)	standard deviation in t', (s)	Standard Deviation in t^2, (s^2)
0.1	0.142	0.02	0.017	0.007	0.01
0.2	0.217	0.047	0.044	0.014	0.03
0.3	0.257	0.066	0.063	0.009	0.02
0.4	0.289	0.084	0.081	0.012	0.02
0.5	0.321	0.103	0.103	0.013	0.03
0.6	0.36	0.13	0.127	0.008	0.02
0.7	0.381	0.145	0.142	0.010	0.02
0.8	0.409	0.167	0.164	0.009	0.02
0.9	0.43	0.184	0.181	0.006	0.01

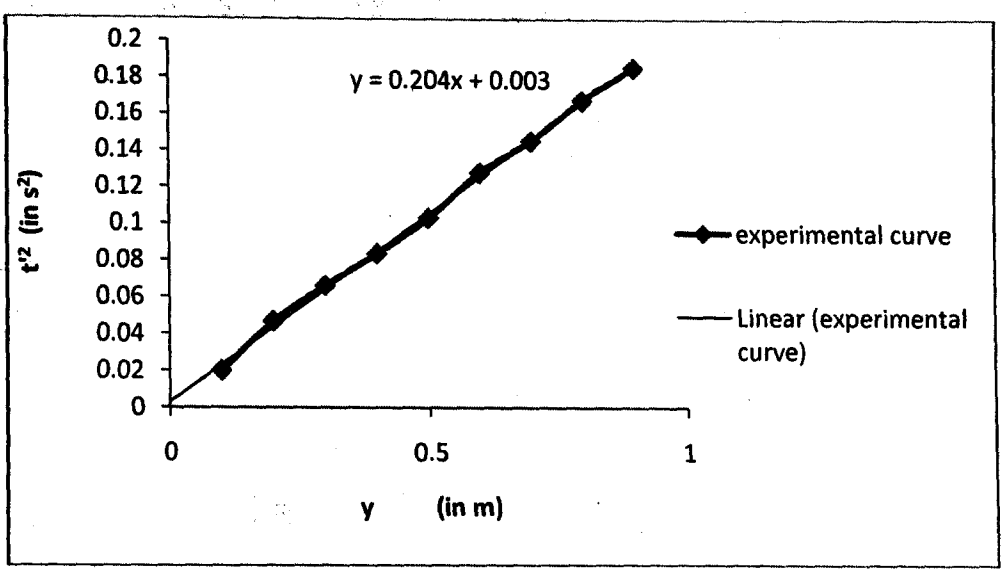

Fig3. Graph 1. *A plot of t'^2 versus vertical height, y. From the graph, the error time, t_0^2 is determined.*

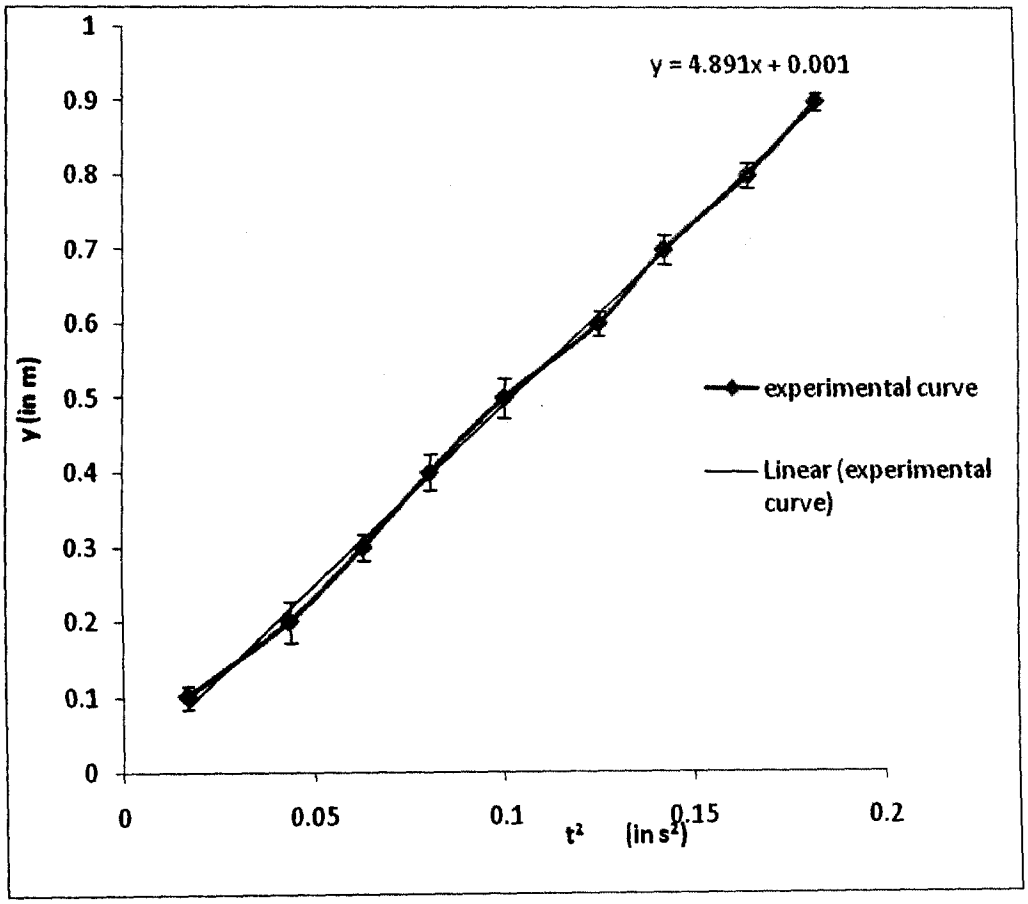

Fig.4. Graph.2 A plot of corrected square of time t2 versus vertical height, y.

From the graph, value of g is determined. $9.782ms^{-2} \pm 0.072ms^{-2}$.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Principal, Shillong College and the Research Committee of the college for financing this Project.

Printed at Shandora Press