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Session the Chair, Dr. P. Gupta at W.B.B.B. Sponsored Seminar

Participants and Dignitaries

Teacher-in-Charge, Managing Editor, Editor-in-Chief on the Dias

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WBBB Sponsored One Day Seminar on

"Challenges and Opportunities of Biodiversity in South-West Bengal'

(Department of Botany, Seva Bharati Mahavidyalaya, Kapgari, Jhargram, W.B)

Seminar Type: State Level

Sponsored by: West Bengal Biodiversity Board, Govt. of West Bengal, India

Date & Time of Seminar: 01/12/2017 (10:00 am. Onwards)

Spot registration Time: 01/12/2017 from 9: 45 am. Onwards

Types of Representation: Oral and Poster

Topic of Seminar: Challenges and Opportunities of Biodiversity in South-West Bengal'
Ref. of Letter of West Bengal Biodiversity Board: 1000/5K(Bio)-8/2017 dated 17.10.2017

EDITORIAL

Dr. Barin Kumar Pramanik, Managing Editor, IJIRD.

It is our immense pleasure that the Authority and the Seminar Organizing Committee of Seva Bharati Mahavidyalaya, Kapgari, Dist. Jhargram (W.B) has tagged our Journal (IJIRD) in the seminar entitled "Challenges and Opportunities of Biodiversity in South-West Bengal" sponsored by West Bengal Biodiversity Board. They have also given us the opportunity to publish their seminar papers as a Special volume/Additional volume (Dec, 2017) in our journal. I on behalf of the Society and Journal Committee, thanks to the authority, West Bengal Biodiversity Board who gave permission and financial support to do this kind of workshop. Again I, on beahalf of the Journal Comitte thanks to the Organizer, specially Smt. Pampi Ghosh, Head, Department of Botany of the College for their sincere effort to make it complete.

The topic regarding biodiversity is very relevant topic in today's scenario. The biodiversity has been threatened now a day due to economic growth and development. Human development has fundamentally changed the nature of the biotic environment in which we live. Industrialization and economic growth have increased habitat and resource use, changing the distribution and concentration of biological species, a disturbance that has had profound implications for human well-being in our developing world. The extent biodiversity loss is staggering, and that clearly indicates our crucial responsibility to work to protect the precarious condition of the millions of species with whom we share our globe.

I hope a large number of participants from scholars, teachers and students shall take part in the seminar and there will be a fruitful discussion on biodiversity. The society and especially the students will be benefited out of the discussion and paper presentation. Moreover, our journal will be enriched by publishing those valuable research papers in this volume. Once again I thank the Teacher-in-Charge of Seva Bharati Mahavidyalaya, Kapgari, Jhargram, West Bengal.

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BIODIVERSITY: CHALLENGES AND OPPORTUNITIES IN SOUTH WEST BENGAL

Dr. Binod Chowdhary
Teacher-in-Charge & Organizing President, WBBB Sponsored Seminar Committee
Seva Bharati Mahavidyalaya, Kapgari, Jhargram, W.B.

We are very happy to organize this first one day state level seminar, "Challenges and Opportunities of Biodiversity in Southwest Bengal" sponsored by The West Bengal Biodiversity Board, Department of Environment, Govt. of West Bengal. Our College is situated in a remote area and just on the edge of sal forest and surrounded by so many small islands like tribal villages. Students are from so many communities and income group. Mainly to aware our students about their environment and biodiversity we are arranging such type of seminar. I thank the officials of WBBB to give us this opportunity for organising such type of seminar, Coordinator of the seminar Mrs Pampi Ghosh, Head Dept. of Botany and total organising committee. Authority, International Journal of Integrated Research and Development (IJIRD) is highly acknowledged as they help to publish papers in the UGC listed journals which is very popular and famous in front of readers as it is multi-linguistic, mult-idisciplinary, peer reviewed (blind), indexed one circulated as hard copy to mostly all Institutes nearby including Vidyasagar Universty Library, Midnapore.

MANAGEMENT OF BIODIVERSITY: A BIG CHALLENGE FOR THE FORTHCOMING GENERATIONS

Pampi Ghosh
Head, Department of Botany
&
Organizing Secretary, WBBB Sponsored Seminar Committee
Seva Bharati Mahavidyalaya, Kapgari

Biodiversity is a diversity of Biological entities in nature though it is measured in an ecosystem basis. Small to smaller or from small to bigger level it is always run through the variations among the group based organisms indeed its nature and consequences are different. The variations and variability of all living organisms in an ecosystem is known as biodiversity. Say for example diverse plants, animals and microorganisms in an ecosystem represent its diversity. Similarly in marine or desert the biodiversity is always different from other areas which may have a significant role to make the environment meaningful. So, largely community and its development including spread of geographical strata depend upon the mode of conservation that sustains the ultimate fate of the biodiversity in a space and time bound area. Not only is that it always functional in its periphery where organisms play a vital role for its complete interactions but in contrary its predictive values are immense. The variability of species and its determinants actively participate to fulfil the goal of importance, in the said environment. The gene, species and ecosystem are therefore signifying the levels of biodiversity. Not only nature made ecosystem, other manmade ecosystem also persist in the same environment where we see many diverse but stressful organisms in nature. They have their own rigidity but they stand there with a particular ecosystem based level called trophic levels.

Man made environment dwindling day by day and significantly destroying the environment by various direct and indirect ways. So, now a day, we need to overcome the stress and need to protect the environment too. This means that pristine ecosystem from the degraded one is the big challenge to save us by saving species or ecosystem to protect us from the coming threat in the environment. Therefore, we should take proper way to make ecosystem meaningful. The final product of the environment must meet the advanced criteria that make the ecosystem clean, green and pollution free. So, global warming and green house effect in a globe must be dropped off. Our forthcoming generation should be very punctual, moral and sensitive to learn about the facts and factor of the environment. In this way they can face the burning problems in any time by any cost to protect the mother earth and can save us peacefully. West Bengal Biodiversity Board, Govt. of West Bengal, gave us permission to complete it in all respect, so authority of WBBB released finance in addition to the permission to conduct such diverse seminar. I, on behalf of the department thanks to the authority of the College and authority of WBBB for their support. Hope that all participants will take opportunity from this seminar in all respect to think about the biodiversity and conservation of species over the globe.

REPORT ON ONE DAY SEMINAR ON "CHALLENGES AND OPPORTUNITIES OF BIODIVERSITY IN SOUTH WEST BENGAL"

Phalguni Gupta
Department of Physics, Dinabandhu Andrews College, Garia, Kolkata-700084

A one day seminar was conducted by the Department of Botany, Seva Bharati Mahavidyalaya Kapgari, Jhargram on December 1st, 2017 on "CHALLENGES AND OPPORTUNITIES OF BIODIVERSITY IN SOUTH WEST BENGAL."

'Biological diversity' means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems.

The southern region of West Bengal is endowed with a large number of rivers, sea, forests, cultivable land and villages. Hence this region is teeming with a wide variety of wild life, marine life, domestic life, birds, insects and plants. Due to human encroachment their natural habitat is currently facing a perturbation. Consequently some of the species of living organisms have become extinct while a threat has been posed to some others. In this seminar the causes and effects of endangerment of biodiversity and its probable methods of prevention have been discussed.

The seminar was split in four sessions. After a brief inaugural session the second session was conducted by four speakers holding respectable positions in different colleges.

The maiden speaker was Dr. Biwajit Maiti, Associate professor of Physics, Govt General. Degree College Kharagpur –II. In his deliberation he analyzed how overpopulation and modernization is leading to a depletion of natural resources thus disturbing the ecosystem. Conversion of forests to cultivable land, felling of trees, killing of wild animals for tan and food, construction of mobile towers and uncontrolled use of fossil fuels, are throwing a threat to biodiversity both biotic and a-biotic. We are in dire requirement to look for a remedy from this very moment. Hence it is necessary to measure the depletion of natural resources both living and non living and proper arrangements are to be made to replenish them. This will restore the ecological balance and maintain the biodiversity thus making the world a better place to live in for a longer period.

The next speaker was Dr. Debabrata Das, Associate professor and HOD of Botany, Govt. General. Degree College, Lalgarh, Jhargram. In his lecture he discussed the significance of the term 'Biodiversity', and its wide spread right from unicellular organisms to large multi cellular animals and plants. South west Bengal is rich in natural resources like fallow land, rivers, coastal plains, estuary, wild life, forests and shrubberies. These natural resources are degrading fast due to consumption of resources at a rate faster than they are regenerated. Overpopulation, industrial and technology development, deforestation, over-fishing, mining and pollution all contribute to the problem as well. Also some undesirable species are depriving some indigenous species of their natural habitat. He has also mentioned about the researches going on about the causes, effects and remedial methods of biodiversty challenges. The West Bengal biodiversity board formulated the Biodiversity act-2002, which some environmental protection rules, whose implementation is based on a three tier level comprising Govt, administrators, forest officers and local people. This would lead us to extension and dissemination of knowledge about these facts on Global basis on common platform.

The third speaker was Dr. Sibsankar Pal, Associate Professor of Bengali, Govt. General Degree College, Tehatta Nadia. He has discussed the relevance of the seminar in a simple and attractive language. He has appealed to everyone to take the responsibility of maintaining this earth worthy of living for our future generations. This requires, the co-ordination of persons from all fields of knowledge to create awareness about the threats to biodiversity and make an universal attempt to counter it, preserve a stable situation and improve our environment. In this context he recited some portions from Bengali mythological literature to lay emphasis on intimate co-existance of human beings with nature.

The last lecture was delivered by Dr. Barin Kumar Pramanik, Officer in Charge and Associate Professor of Economics, Gorubathan Govt. College, Fagu, Kalimpong. He highlighted the relationship between growth of Economics and biodiversity loss. Growth of economics enhances agricultural and industrial productions resulting in environmental degradation and decrease of biodiversity. He has also adopted econometric models to quantify the measurement of biodiversity and predict its challenges and antidotes.

In the third session teachers and students from different subjects and professions in their brief deliberations threw light on the history of biodiversity, its relation with human society its imminent risks and how to combat them.

The final session was poster presentation competition by the students. The students gave their best to exhibit both local and universal biodiversity, their relation with rural and urban life, their threats and remedies. The posters were evaluated and the students were graded.

It was fascinating to find that in this seminar the four speakers were from four different subjects, both science and humanities. The posters were presented by students of all age groups right from Class IV to undergraduate standard. This points out that the responsibility of preservation of biodiversity is not the concern of only a few educated persons and those who are working on environmental improvement. If people from all subjects, all professions and from all corners of the society work in harmony to meet the challenge of biodiversity its proper maintenance is possible. Only then our future generation will be able to wonder at the marvels of nature and wander deep into its diverse biotic and a-biotic domain.

THE EFFECT OF TRADITIONAL KNOWLEDGE SYSTEM AND CUSTOMARY BELIEFS ON BIODIVERSITY: THE ADIVASI EXAMPLES

Rajat Kanti Das

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&

President, The Indian Anthropological Society, Kolkata, Email: *rajat_p_das@yahoo.com*

I

Biodiversity has a socio-cultural dimension among those societies which have a long experience of living in close proximity with nature. Their long and intimate relation with nature is responsible for producing an interaction pattern which takes the form of man-environment complex. Following an ecological approach may be helpful to understand the links between a group's natural surroundings and characteristics of members, displayed individually or collectively. Their association with the environment for generations has made them an inseparable component of the ecological system they are placed in. Today, the ecological system no longer functions as a 'self-regulating', 'self-persisting' system, but there is still scope for analyzing the importance of ecology in human society and culture. Showing his concern with ecological study and its influence, Daryll Forde, writing as early as 1934, considered the 'body of known and available resources and means of providing and utilizing materials goods of all kinds' as exogenous to the social structure. His main point of consideration was whether or not social systems were autonomous and closed. Even today, exploring the relations between environment, resources, techniques of resource exploitation and social organization is no less useful when seen in the context of data provided by demographers, agronomists and others. Environmentally conditioned societies functioning as ecological systems could provide us with the opportunity to examine the full range of human potential within the limits of environmental regulation. If it is conceded that physical conditions of environment could enter into the social and with it, cultural development and patterns of behavior of indigenous communities almost as a natural process, then the study of interacting relations between the social-cultural patterns and physical conditions in such a context may still be a meaningful exercise. Ethnographic sketches provided by anthropologists of small, compact and relatively undifferentiated societies are to a large extent ecologically-oriented. The total range of human relations, both internal and external to such a society, may constitute its social-cultural environment, the study of which may be one approach to a holistic understanding of socio-cultural phenomenon in its natural setting. Clearly, an 'indigenous perspective' is necessary for such an approach to be made effective, which lays stress on the integration of people with their environment. An indigenous perspective can best be provided by the so-called tribe in its indigenous or traditional form. When a society functions within a defined ecological setting in the form of a fixed environment like forest over a long period of time, it tends to develop a cultural orientation. This is reflected in social and cultural norms related to forest. The relationship with forest in such a case is one of interdependence rather than oppositional. The indigenous or traditional knowledge system is the outcome of such a long and mutually interacting relationship. Pursuing the local way of managing the natural environment like forest and putting plant-based resources to greater use of ever expanding population in a judicious way can be the priority. This could be achieved without mindlessly destructing the natural base, which also highlights the need to preserve such a knowledge system. Conservation and sustainable system of development programmes may be worked out by making profitable use of the local experience. This calls for adoption of an approach which would allow the local people with a long tradition of living with nature to cultivate their own knowledge system for the conservation of natural environmental resources. Of course, the process of internal differentiation that has entered into the tribal or adivasi society has weakened its compact and cohesive character to a great extent. When the state-centrists are at loggerheads with globalists over the control of natural resources, the community becomes the ultimate sufferer, which had an inalienable right over such resources. Turning our attention to the adivasi communities of South-West Bengal, it must be said in clear terms that no such community is now in a position to exercise full control over natural resources like forest. With the loss of traditional values and increasing exposure to modern way of life, the traditional knowledge system based on plants and their uses does not attract the attention it deserves. There is another side of it. Then real life situation dominated by practical considerations has got the better of symbiotic elements of their culture and religion, which were at the centre of their traditional way of life. A few examples of such a community may be discussed here.

II

For the Santals, who have been engaged in wet cultivation for a long time, not all ecological adjustments are community-centric because they now live mostly in a plural, heterogenous situation where they are no more than co-shares of a common environment. It becomes difficult for them to retain the basic tenets of a tribal society in the

face of growing complexities, individualism and state-centric control system establishing itself in no uncertain terms. This does not mean that they have already reached the stage when the basic premises of tribe stand in direct opposition to modernism. What actually transpires is that tribal traditions are now evaluated, scrutinized in terms of their acceptability in the modern situation marked by economic development and progress, technological leap forward and social differentiation combined with loss of cultural values. Still, the Santals continue to nurture a mythic tradition, which is strong enough to sustain their culture, may not be strictly in its traditional form but there is unmistakable presence of the traditional spirit. If myth can even now be understood as 'the relationship between a people, their part and their environment' (David Leeming and Jack Page, 1998), it applies no less to the Santals. They carry with them their mythic tradition in almost every sphere of life.

Though religion among them is mainly concerned with a belief system and a tradition of maintaining a large pantheon of about 150 spirit deities, generally called Bongas, there is also a practical side of it. The occurrence of a sacred grove (Jaher Than) which is the seating place for the Bongas, stand as an example of how human welfare and prosperity could be approached by symbolically combining man and spirit in a complex. The symbolical association can have a practical significance as well. The bongas associated with Jaher Than are generally benevolent, unlike the malevolent forest bongas, and therefore are readily acceptable. Centering around the sacred grove, a secular traditional body representing the village (ato) used to function meticulously. From the contemporary perspective, the sacred grove has a practical value and can take a sacred cover while spreading a message. The whole effort can take the form of a movement, which actually it does. It has now created a new awareness in the minds of the people, spreading the message of preservation of trees in different areas. Quite a number of people have been involved in the process, all of whom are not necessarily community members. Side by side, the social significance of the sacred grove has outweighed its religious attachment. From a different consideration, Santal religion in its traditional form is an integral part of socio-cultural life which permeates all aspects of Santal existence reflecting a true holistic tradition. Santal religion could attain uniqueness and a specific form on the basis of cultural and religious symbols, lifestyle rituals and their association. A strong social significance of religion among the tradition-minded Santals is more than apparent. Their attitude towards nature is marked by a sense of reverence which has a positive value in matters pertaining to conservation of trees and biodiversity maintenance.

The Santals are predominantly an agricultural tribe and they maintain an agricultural calendar in relation to seasonal changes and a display of symbiosis - a harmonious association between natural changes and human activities. Barring a few areas where agriculture is no longer pursued with regularity, in almost all other Santal-dominated areas an agricultural calendar is followed. Even otherwise, there has been a strong ceremonial attachment of rural based Santals to agricultural land. They try to maintain an agricultural cycle, which is also manifested in the agricultural rituals they perform. The major sequences of technology-initiated operations and consumption of agricultural products can thus be linked with magico-religious rites and rituals. More than displaying human power as exploiters of natural resources like land, the emphasis is on propitiating nature for her benevolence.

It needs to be acknowledged here that the traditional Santal society tried to project an environment with human and animal, organic and inorganic or super organic functioning in perfect harmony. Individuals could find themselves in symbiosis with human neighbours, with domestic and wild animals, with crops and vegetation, with soil and land, and with cosmic objects. But the orders created out of it had to be constantly worked upon and made meaningful to individual users. The Santals could construct a world of their own in a way which was valuable and meaningful to them. The situation earlier was different when individual world views were shaped by the society or were expressions of a common social world. The process seems to have been reversed now. Traditional cultural practices are found to be inadequate to deal with the present stressful situation which has been made more complex by the induction of modern practical variables and as result, they have to face situations marked by emotional solidarity conflict involving their basic identity. This identity cannot probably be dissociated from their age old link, real or symbolical, with nature.

III

When it comes to a small, anthropologically defined simple society naturally placed in a forest-clad setting, their attitude manifests a practical sense finding a symbolic connection between man and nature. Their belief system is dominated by the idea that all components of Nature-earth, air and water-are repositions of power, which, through various forms and media, interface with or exercise control over human lives. By identifying with such components, they used to maintain a type of balance with nature, which permeated their total life process. The forest-dwelling 'Birhor' represent such a society. The name Birhor actually stands for jungle people (Bir-jungle; hor-man). The Birhors may be broadly divided in to two sections :(1) The Uthlu or Bhulia, the migratory Birhors living in and around the forest, and (2) The Jaghi or Thaniza, the Birhors opting for permanent settlement.

There was a time when religion pervaded almost the total existence of Birhor, which was thought to have given them protection from evil spirits and ensured unending support of the benevolent spirits through appropriate performance of rites and scarifies, thereby making their survival free from dangers posed by all known and unknown sources of power and energy. This is still applicable to those who are placed in their natural setting defined by forest. In such a case, the whole Birhor life - economic, domestic, social and socio-political –is pervaded by religion. Hills believed to be the seat of spirits are personified to include them in the kinship world made up of all known and unknown objects. Among the spirits, there are specific Buru Bongas and Ora Bongas, who are the spirits of the different hills thought to have formed the original homes of Birhor clans. They are usually identified with the hills in different areas. The Jaghi or settled Birhors call them Buru (hills) Bongas, whereas the Uthlu (migratory) call them Ora (house) Bongas. The difference is obvious. In the traditional world view of the Birhors man, animals, inanimate objects and spirits are all bought within the same category, each interchanging position with the other, but locked in a relation of opposition and complementarity.

Jaghis, particularly those who have to depend on regular cultivation of land, follow an agricultural calendar and the festivals they perform are symbolically connected with agricultural production. To the Birhors, trees like *Ficus religiosa* or peepal, *Bassia latifo*lia or mohua, *Aegle marmelos* or bael, *Adina cordifolia* or karam are considered sacred. These trees along with bamboo are associated with the performance of festivals. They are also not supposed to cut the branches of trees like uli (*Mangifera indica*), matkom (*Basia latifolia*), sarjom (*Shorea robusta*), taraf (*Buchanania latifolia*), kadam (*Anthocephalus cadamba*) and some other flowering trees. Because of their close association with nature in the form of hills and forests, the Birhors maintain and intimate relation with natural environment –organic as well as inorganic. They have knowledge about the utility of many plants, trees and forest products and are keen observers of natural phenomena like rain, heat, fire, dry spell, cold and wind. Forest is one element which affects and controls the lives of Birhors in a big way. Their religion in the form of beliefs and practices is centered round hilly forest, whereas their settled life bears reflection of Hindu influence which has even affected their traditional belief system. The degradation of forest has not only uprooted the Birhors from their traditional sources of livelihood creating instability in their economic activities, it has made them poorer in the religious field. Their traditional knowledge system, built around intimate interaction with forest, has also suffered in the process. It has even changed their attitude towards forest. No longer is moral justification sought in extraction, which in some cases reaches the level of destruction, of forest products.

IV

Indigenous or traditional knowledge developed by the locally grounded tribal societies or adivasis is an informal knowledge system nurtured by such societies for generations. The holders of such knowledge could be regarded as the initial conservers of biodiversity in specific contexts. With the degradation and decrease of forest, marginalization of traditionally rooted tribes or adivasis is a known consequence. Their loss of status in terms of loss of control over natural resources like forest has also affected the knowledge system in no uncertain terms. No doubt, it has been fast loosing ground. That it could make positive contributions to the cause of biodiversity maintenance or conservation of valuable plants and trees is exemplified by the practice of sacred grove. It is time that such a knowledge system receives our due attention. Today, it may be difficult to maintain the undifferentiated character of a community, but community-centric collective consciousness may still be a meaningful proposition in matters relating to conservation or preservation of natural resources. Human uses of environmental goods and resources may vary from society to society, but when viewed from an ecological perspective, it may be possible to discern a uniformity of pattern. In a situation marked by increasing openness of the social system, the interaction pattern between the social system and environment also takes a new turn. The interacting variables have increased, many of which are man-made and not all of which are in the best interest of environment. From the context of biodiversity preservation, they have a negative influence.

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BIODIVERSITY LOSS AND ECONOMIC GROWTH: A GENERAL PREVIEW

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ABSTRACT

This paper highlights the relationship between biodiversity loss and economic growth in light of the current debate on the effects of economic growth on environmental quality. The basic premise of the paper is that biodiversity loss belongs to a special class of environmental degradation because it involves complex ecosystems the loss of which cannot be recovered by technological advances. The main finding is that while economic growth has an expected adverse effect on biodiversity, the composition of economic output can also be significant particularly in low-income countries. The study highlights the need to develop appropriate institutions and macroeconomic policies that allow biodiversity values to be internalized in decision-making processes.

Key words: Biodiversity, Growth, Sustainable Development.

I. INTRODUCTION

Biodiversity loss is among the most serious environmental problems the world is facing today. Natural habitats in the moist tropical regions, which harbour the majority of the world's flora and fauna, are being lost at an alarming rate. It is estimated that in tropical rain forests alone the rate of loss of entire species (not merely genetic varieties or subspecies) is now a minimum of about 27,000 per year, or three per hour, and the rate is increasing. This rate of decline is believed to be at least 1,000 times the 'ordinary' (i.e., background) rate of extinction (Wilson, 1992). There are many who believe that we are facing a biodiversity crisis and others have gone as far as to suggest that we are slipping into a rate of extinction that may well rival that which resulted in the demise of the dinosaurs some 65 million years ago. Within the last decade, there has been a resurgence of the debate about the effects of economic growth on environmental quality. This particular debate has been fuelled by studies

carried out in the early 1990s that showed that there is an inverted U-shaped relationship between certain indicators of environmental degradation and economic growth (e.g., see Grossman and Krueger, 1991, 1995; Antle and Heidebrink, 1995; Shafik and Bandyopadhyay, 1992; Selden and Song, 1994). This relationship is now widely known as the *Environmental Kuznets Curve (EKC)*. The EKC hypothesis suggests that environmental effects are initially low at low levels of economic growth. However, as development proceeds, the rate of pollution increases. At higher levels of economic development, countries are able through structural change to substitute towards industrial and agricultural technologies that are less harmful to the environment. A typical feature of the EKC is the inverted U shape, which suggests that the level of pollution reaches a maximum level with respect to income, after which it begins to decline.

The EKC debate is of considerable national and international importance. The existence of such a relationship would lend support to the view that as countries develop they will experience a cleaner environment (Beckerman, 1992; Bartlett, 1994). A corollary of this view is that pollution is a necessary evil for countries at an early stage of development and that economic growth is the key to solving environmental problems.

This paper considers the issue of biodiversity loss in the context of the current debate on economic growth and environmental quality. The EKC debate has given rise to a rapidly expanding literature, part of which is reviewed in the next section. However, the majority of these studies focus on aspects of environmental degradation such as air/water pollution and deforestation. The basic premise of this paper is that biodiversity belongs to a special class of environmental degradation because it involves complex ecosystems the loss of which cannot be recovered by technological advances. As such they differ from other types of environmental degradation such as pollution and deforestation for which improvements are possible to some extent. Furthermore, biodiversity levels are not related to energy use unlike pollutants commonly used in EKC studies. Thus, at the global level, there cannot be a turning point in the relationship as income increases. Rather than estimating an EKC relationship, here we endeavour to investigate the determinants of biodiversity loss and offer suggestions for policy. The main finding of the study is that while economic growth has an expected adverse effect on biodiversity, the composition of output can be important particularly in low-income countries. For some aspects of biodiversity such as mammal and bird species, the results indicate that there is some scope for using appropriate institutional and macroeconomic policies to reduce the rate of species decline.

The remainder of the paper is organized as follows. Section II briefly reviews the current literature on EKC relationships and biodiversity loss. Section III discusses the data and methodology, while Section IV reports the empirical results for four indicators of biodiversity. The final section evaluates the empirical findings and discusses the policy implications.

II. LITERATURE REVIEW

The term 'environmental Kuznets curve' was first used by Selden and Song (1994) when they suggested that the environment-income relationship might be similar to the one proposed by Kuznets (1955) for income inequality in relation to development, namely an 'inverted-U' shape. To date, the empirical evidence in support of the EKC has been mixed. Earlier studies (e.g., Shafik and Bandyopadhyay, 1992; Panayotou 1993, 1995; Grossman and Krueger, 1995) found an EKC relationship for sulphur dioxide (SO2), suspended particulate matter, and carbon dioxide at incomes below US$8,000 per capita. However, more recent research casts doubt on an EKC for SO2 (Stern and Common, 2001) and other air pollutants (Harbaugh et al., 2000). Even when the EKC appears to be valid, there are doubts about the stability and hence the reliability of the turning points. For example, in Cropper and Griffith (1994), the per capita income levels of most of the African and Latin American countries in the sample were below the EKC turning points.

In their study which used a much larger sample of countries over a longer period of time than previous sulfur EKC studies, Stern and Common (2001) found that the turning point estimates were sensitive to sample choice. For example, using a sample of 23 OECD countries and a random effects model, they obtained an inverted-U shape with a turning point of US$9,239 which was well within the sample. However, using a global sample, they obtained a very high turning point of US$101,166, implying that the EKC is effectively a monotonic function of income. This finding is consistent with that of List and Gallet (1999) who also found a very high turning point for sulphur for US states when they used a long time series (1929-1994) and a wide income range (US$1,162-US$22,462).

Harbaugh et al. (2000) re-examined the empirical evidence for the EKC for SO2, smoke, and total suspended particulates using data from World Bank (1992) and Grossman and Krueger (1995), with the benefit of an additional ten years of data. They also tested the sensitivity of the EKC relationship to different functional forms and econometric specifications, to the inclusion of additional covariates besides income and to the nations, cities and years sampled. They found that the location of the turning points, as well as their very existence, was sensitive to both slight variations in the data and to the econometric specification. For example, merely cleaning up or updating the original data caused the inverted-U shape to disappear. On the basis of these results, they concluded that there is little if any empirical support for the existence of an EKC for these pollutants.

A major shortcoming of EKC studies is their focus on a range of air and water pollutants, ignoring important ecological aspects of the environment. Indicators such as protected areas expressed as a percentage of total land area and threatened species of mammals and birds as a percentage of all such species in a country have been identified by MacGillivray (1993) as two important indicators of biodiversity which should be included in any examination of environmental performance.

The *Global Biodiversity Strategy* defines biodiversity as the totality of genes, species and ecosystems in a region (WRI/WCU/UNEP, 1992). The ecosystem level is related to the spatial scale and pattern of species combination, while the genetic and species levels deal with the numbers of species and variations amongst them. In addition to the standard definition above, it has been suggested that landscape diversity should also be considered when defining biodiversity (Noss and Cooperrider, 1994). Biodiversity benefits humans in a variety of ways. First, there are direct uses such as the discovery of wild relatives of agricultural crops such as corn and potato that have disease-resistant properties. Secondly, there are other benefits including discoveries for the advancement of medicine and understanding of the life sciences, as well as provision of services such as stabilization of hydrological cycles on larger landscape scales. In this regard, biodiversity has insurance and information value.

Whereas some progress has been made in recent years towards collecting information to aid environmental management, scientists still have only a limited understanding of the earth's biodiversity resources. This is due to gaps in knowledge about species and the complex nature of ecosystem interactions. For example, of the 13 to 14 million species on earth, only 1.75 million (13 percent) have been scientifically described. The status of the 1.75 million described species have never been fully assessed (UNEP, 1995). There is also uncertainty about the rates of species extinction. It is estimated that about 500 animal species have become extinct since 1600 (Smith et. al, 1993). The majority of these extinctions have occurred among vertebrates, which constitute only a small fraction of the world's species. Therefore, it is possible that many more extinctions among small-bodied organisms such as insects have escaped our attention.

Although environmental factors such as climate contribute to biodiversity decline, by far the major causes are conversion and degradation of natural habitats. Habitat loss affects all three of the principal levels of biodiversity (i.e., genetic, species and ecosystem biodiversity). 'Conversion' refers to the transformation of a natural form of a resource into another form suitable for human use. This can occur in various ways. For example, conversion occurs when an excessive amount of the main constituents of an ecosystem is withdrawn (e.g., clear felling of a forest). Another instance is when too much of an introduced element (artificial or natural) is added to the ecosystem. Conversion occurs mainly to supply the needs of a growing human population. One of the consequences of conversion is that the available habitat becomes fragmented. Over time, the isolated fragments are unable to support the remnants, resulting in species loss.

Given that biodiversity is a public good whose benefits cannot be appropriated by individuals, the rate of conversion and thus the rate of biodiversity decline is higher than is socially desirable (Krautkraemer, 1995). The decline of biodiversity resources is also due to the fact that the value of these resources is underestimated or ignored in decision-making processes. Another unique feature of biodiversity compared to other public goods is that whereas the costs are borne locally, the benefits accrue globally. Therefore, the incentive to supply (or conserve) biodiversity may be lesser than for other public goods. Although government policies are supposed to correct the market failure associated with biodiversity, there are numerous cases in which government policies have actually promoted biodiversity decline. Examples include the pricing of logs in tropical forests, and subsidization of land clearing and export commodities.

In the following section the framework for modeling biodiversity decline is discussed together with the econometric specification of the relationship between biodiversity and various socioeconomic variables.

III. METHODOLOGY

A. Measuring Biodiversity

Biodiversity is a complex variable that is difficult to capture with a single indicator. A naïve model of biodiversity is based on the ecological theory of island biogeography (MacArthur and Wilson, 1967) which represents the number of species (S) as a function of area (A) as follows:

(1) $S = CAz$

where C and z are positive parameters, with z ranging from 0.10 to 0.35 (Wilson, 1992). If, say, $z = 0.25$, then at the margin, a 1 percent increase in area results in a 0.25 percent increase in the number of species. Thus, it can be seen that equation (1) is non-linear in both the parameters and variables. The following model was therefore specified:

(2) $\ln S = \ln C(X) + z \ln(A)$

where X is the vector of variables whose impact on biodiversity we wish to investigate. Due to lack of data indicators of species diversity were used as proxies for biodiversity. These were as follows: (1) number of known mammal species/10,000 sq km (*MAMMALS*); (2) number of known bird species/10,000 sq km (*BIRDS*); (3) number of known higher plant species/10,000 sq km (*PLANTS*); (4) percentage of bird and mammal species threatened with extinction (*PBMT*); and (5) average annual percentage change in the number of known mammal species for the period 1989/1999 (*PCMAM*). The last indicator was only obtained for mammals due to insufficient data for the other species. The above indicators are problematic because many countries have already lost significant numbers of species in the past. Thus, information on past species decline may not be a good reflection of current actions taken by humans. Notwithstanding the problems, we are compelled to use these indicators for lack of better alternatives.

B. Factors Affecting Biodiversity Loss

Building on the above model, it is hypothesized that biodiversity is directly affected by the size of habitat, population pressure, climate, the level of income and composition of output of a country, as well as by institutional factors such as the level of economic freedom and the macroeconomic policy environment. Each of these factors is briefly discussed below.

Habitat size:

As indicated above, habitat loss is a crucial factor affecting biodiversity decline. Most forms of economic activity require more physical space, implying loss of species habitat and therefore loss of biodiversity. The main cause of habitat destruction is the clearing of vegetation for agricultural and other purposes. It has been suggested that one of the devastating effects on biodiversity is the fragmentation of habitat into 'islands' separated by artificial vegetation (e.g., see Robbins, 1980). In this study, the percentage of land developed for agriculture and other uses (*PDLAND*) and the percentage of protected land area (*PPLAND*) were used as proxies for habitat size. It is expected that the percentage of protected land area will be positively related to biodiversity levels, while the percentage of land developed for agriculture and other uses will be negatively related to biodiversity levels.

Population pressure:

Population growth increases the demand for food, shelter and other services that require increased conversion of habitat. It has been shown that high population densities can lead to excessive deforestation and hence loss of biodiversity (e.g., see Cropper and Griffiths, 1994). While the rate of habitat conversion may not necessarily be proportional to population size, it is quite clear that unchecked population growth will have adverse effects on biodiversity levels unless resource use per capita declines. Available statistics indicate that much of the growth in population is from the high rate of urbanization. According to the World Bank, developing country cities as a group will grow by 160 percent by 2030, whereas rural populations will grow by only 10 percent (World Bank, 1992). Population density (*POPDENS*) and urban population growth (*UPOPGRO*) were used as measures of population pressure. It is expected that both measures will be negatively related to biodiversity levels. Population density was used for Indicators 1 through 3 (i.e., number of species per 10,000 sq km), while population growth was deemed to be more appropriate for Indicators 4 and 5.

Climate:

It is a well-known fact that species diversity increases as one moves from the polar areas towards the equator. Studies suggest that phenomena such as ozone depletion and CO2 emissions that contribute to global warming may indirectly increase biodiversity loss. For example, Holm- Hansen et al. (1993) found that ozone depletion reduced productivity in the Antarctic ocean by less than 5 percent, while Termura et al. (1990) found that ultra-violet radiation reduces the rate of CO2 assimilation by land plants. Dummy variables for climate were used to account for climatic effects on biodiversity. For this purpose, the countries in the sample were divided into three climatic groups: (1) cold and cold temperate countries; (2) sub-tropical and dry countries; and (3) wet tropical countries. It is expected that the coefficient on climate will be positively related to biodiversity levels.

Income:

Income (represented by GDP per capita) is expected to affect the level of biodiversity because it is related to the level of economic output. The higher the level of economic output, the higher is the rate of habitat conversion in order to produce material goods and services, resulting in a higher level of biodiversity decline. In addition, it is hypothesized that biodiversity decline is not only affected by the level of economic activity but also by the composition of economic output. Countries with agriculture forming a high proportion of their total output will experience faster biodiversity decline due to more rapid conversion of habitat for agricultural purposes. Thus, agricultural value added as a percentage of GDP (*AGRICPC*) is included as a regressor in the model.

Level of institutional development:

It is hypothesized that the development of a country will be accompanied by the development of economic, social and political institutions that help to internalize the value of biodiversity into decision-making processes of the state and individuals. For example, a fully developed market system offers opportunities to use market mechanisms and fiscal policies (e.g., pollution taxes and taxes on land conversions) to achieve certain environmental objectives. Furthermore, the market system provides scope for the creation of markets for environmental goods (e.g., markets in rights for environmental use). The institutional proxy used in this study is the level of economic freedom in a country. It is hypothesized that increased economic freedom is associated with improvement in the functioning of the market system, which enables economic agents to better take into account the environmental costs of economic growth. Also, it may be argued that greater economic (and political) freedom allows individuals and groups to lobby the government for provision of a cleaner environment.

The particular version of the index of economic freedom used in this study is published by the Fraser Institute (Gwartney and Lawson, 1997). It was chosen over other indices of economic freedoms (e.g., Messick, 1996; Holmes et al., 1997) because it is focused principally on economic freedoms as distinct from broader social freedoms such as freedom of speech, freedom to assemble, freedom from torture and so on. The index (*FREE*) ranges from 0 (most free) to 20 (least free). It is expected that a negative relationship will exist between the degree of economic freedom and biodiversity level.

Macroeconomic policy of environment:

It is expected that macroeconomic policies will affect the level of environmental degradation, which in turn will affect biodiversity resources. In this study, the black market premium on foreign exchange is used as a proxy for exchange rate and trade policies, which in turn reflect the overall macroeconomic environment. For example, a high black market exchange rate indicates a 11 restrictive trade policy stance and overvaluation of the domestic currency. The net effect of exchange rate and trade policies on biodiversity decline cannot be determined *a priori*. It is possible, for example, that currency overvaluation could negatively affect private rents from timber exports. However, on the other hand it could also discourage development of non-timber forest product industries. The measure of the black market premium on exchange rates used here (*FOREX*) is based on a scale of 0 to10, with 0 representing a black market exchange rate premium of 210 percent or more and 10 representing a premium of 0 percent.

C. Econometric Model and Data

For Indicators 1 through 3 the following econometric model was estimated:

(3) lnEij = α0 + α1lnGDPi + α2lnAGRICPC + α3lnFREEi + α4lnFOREXi + α5lnPOPDENSi + α6lnPDLANDi + α7lnPPLAND + α8lnCLIMATEi + εi

For indicators 4 and 5 the following econometric model was estimated:

(4) Eij = α0 + α1lnGDPi + α2lnAGRICPC + α3lnFREEi + α4lnFOREXi + α5lnUPOPGRO + α6lnPDLANDi + α7lnPPLAND + α8lnCLIMATEi + εi

where *Eij* is an indicator of biodiversity level, j = 1 (mammals), 2 = (birds), 3 = (plants), 4 = (pbmt) and 5 (pcmam); εi is a random error term; and all the other variables are as previously defined.

Cross sectional data on the above variables were obtained for 50 countries, including 20 low-income, 15 middle-income and 15 high-income countries. The use of panel data was restricted with many indicators only being reported for the 1990's. GDP per capita (in PPP terms, 1995 International S) was used as a proxy for income. Data on GDP per capita, the Index of Economic Freedom, and the black market exchange rate premium were obtained from Gwartney and Lawson (1997), while data on population density and the percentage of agricultural value

added in GDP were taken from World Bank (1999). Data on the remaining variables were obtained from *World Resources* (WRI, 1990, 1999).

III. EMPERICAL RESULTS

A. Regression Results

To quantify these relationships more precisely and examine the impact of economic growth on biodiversity, equations (3) and (4) were estimated using ordinary least squares (OLS). As pointed out by Stern et al. (1996), data used in EKC studies are subject to the problem of heteroskedasticity and therefore OLS estimation would yield unbiased but inefficient parameter estimates. Initial diagnostic tests on the models revealed the presence of significant

heteroscedasticity and therefore White's heteroskedasticity consistent covariance matrix estimator was used (White, 1980). Table 2 reports the results for known species of mammals, birds, and higher plants per 10,000 sq km and the average annual percentage change in species numbers for mammals. The equation for the percentage of birds and mammals threatened with extinction is not reported due to the poor fit.

TABLE 1

Breakdown of Means of Biodiversity Indicators by Income Categories[a]

Variable	Low Income (<US$5000)	Middle Income (US$5000-14500)	High Income (>US$14,500)	Full Sample
Number of mammals/10,000 sq km	61.4 (27.8)	51.4 (34.6)	31.3 (29.2)	51.8 (32.1)
Number of birds/10,000 sq km	164.2 (84.4)	147.3 (106.8)	85.6 (53.10)	142.5 (90.5)
Number of higher plants/10,000 sq km	1754.6 (1148.2)	2564.8 (2472.1)	1120 (1027.6)	1847.8 (1658.4)
Percentage of birds and mammals threatened	3.7 (4.8)	3.9 (4.8)	6.7 (8.4)	5.3 (6.3)
Average percentage change in mammals	0.9 (2.9)	1.1 (6.1)	-1.8 (-35.1)	0.4 (4.0)

[a] Standard deviations are in parentheses.

The figures for mammals decrease from 61.4 per 10,000 sq km for low-income countries to 31.3 per 10,000 sq km for high-income countries. A similar pattern is observed for birds, with numbers declining from 164.2 per 10,000 sq km for low-income countries to 85.6 per 10,000 sq km for high-income countries. These results support the trends observed in the graphical analysis. However, in the case of higher plants, the mean number of plants per 10,000 sq km increases from 1755 for low-income countries to 2565 for middle-income countries, before declining to 1120 for high-income countries (Table-1).

TABLE 2

Regression Estimates for Determinants of Biodiversity

Variable	No. of mammals /10,000 sq kma		No. of birds /10,000 sq kma		No. of higher plants/10,000 sq kma		Average % change in No. of mammals 89-99b	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Intercept	6.00•••	2.98	4.02•••	3.22	3.51•	1.45	22.88••	2.14
*ln*GDP	-0.28••	-2.26	-0.04•	-1.37	0.11	0.56	-1.40•	-1.51
*ln*AGRICPC	-0.08	-0.60	0.09	0.94	-0.11	-0.63	-2.70•••	-2.65
*ln*FREE	-0.10	-0.41	0.08	0.43	0.27	0.70	-1.91•	-1.30
*ln*FOREX	0.01•	1.87	0.02	0.84	0.30•••	6.01	-0.06	-0.20
*ln*POPDENS	-0.10••	-1.99	-0.11•••	-2.85	-0.20•••	-2.61	-	-
*ln*UPOPGRO	-	-	-	-	-	-	-0.02	-0.05
*ln*PPLAND	0.11•••	2.31	0.12•••	2.91	0.10•	1.35	-0.12	-0.39
*ln*PDLAND	0.02	0.30	0.03	0.49	0.19	1.22	-1.04••	-2.04
*ln*CLIMATE	0.54•••	2.64	0.48•••	3.25	1.39•••	4.88	5.85•••	3.64
R^2	0.34		0.35		0.44		0.28	
Adjusted R^2	0.29		0.29		0.39		0.18	
Std error	0.64		0.53		1.02		3.63	
F-statistic	5.95•••		5.89•••		8.63•••		2.91•••	
N	99		98		98		71	

[a] The dependent variable is the logarithm of number/10,000 sq km.

[b] The dependent variable is the logarithm of the average annual percentage change in the number of known mammal species.

•••, ••, and, • indicate statistical significance at the 1%, 5% and 10% level, respectively, for a one-tailed test.

We begin the discussion with the effects of the economic output variables (*GDP* and *AGRICPC*) on biodiversity. The level of economic activity represented by income has a significant negative effect on species density for mammals and birds but not for higher plants. It also appears to have an adverse effect on the average annual percentage change in the number of known mammal species. The proxy for the composition of economic output (*AGRICPC*) is highly significant for the average annual percentage change in the number of known mammal species. This result provides some justification for the view that it is not only the level of economic output *per se* which is injurious to biodiversity, but also the composition of that output. This confirms the fact that conversion of habitat for agricultural and other purposes is one of the major threats to biodiversity conservation (Table-2).

The coefficient on economic freedom (*FREE*) is negative and statistically significant for the average annual percentage change in the number of known mammal species. This result indicates that to some extent, there are better prospects for developing institutional responses for dealing with biodiversity concerns the greater is the level of economic freedom in a country. In general this is consistent with earlier findings that: (i) insecure property rights and government instability are associated with increased deforestation (Deacon, 1994), and (ii) increase in civil and political freedoms improves environmental quality (Torras and Boyce, 1998; Barrett and Graddy, 1998). The black market exchange rate premium (*FOREX*) is positive and statistically significant for mammals and higher plants, with the effect being relatively stronger for the latter. This particular variable is an indicator of distortions in the economy and the implication here is that removal of such distortions could lead to an improvement in not only the economy but also aspects of the environment.

Turning now to the indicators of population pressure, it can be seen that, as expected,

population density has a highly significant negative effect on biodiversity loss in general. Urban population growth has a negative effect on the average annual percentage change in the number of known mammal species, although this is not statistically significant. Of the habitat size variables, the percentage of protected land area (*PPLAND*) is significant for all the three indicators of species density, while the percentage of land developed for agriculture and other uses (*PDLAND*) is significant for the average annual percentage change in the number of known mammal species. These results lend empirical support for the view that space is a limiting factor to biodiversity protection and provide a justification for the policy of setting aside nature conservation areas. According to Peter Vitousek of Stanford University, 40 percent of the earth's land surface has already been transformed for direct human use and over half of all accessible surface freshwater is in use. Finally, the results in the last row of Table 2 indicate that climatic differences significantly explain biodiversity loss.

The next stage of the analysis was to estimate models that allow interaction of low and high income dummy variables with the other right-hand side variables. Such models allow for the possibility that the impact of these variables may be different in low-income and high-income countries. Torras and Boyce (1998) tested this type of hypothesis for various pollutants. Following Torras and Boyce (1998), we use US$5,000 per capita income as the cut-off between high and low-income countries. Approximately half of the sample fell into the low-income category after this division. The results (Table 3) indicate that the negative effects of agricultural expansion on mammal and bird species densities are significant for low-income countries but not for high-income countries.

TABLE 3

Regression Estimates for Determinants of Biodiversity – Low and High Income Countries

Variable	No. of mammals /10,000 sq km.		No. of birds /10,000 sq km.		No. of higher plants/10,000 sq km.		Average % change in No. of mammals 89-99.	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Intercept	5.00**	2.42	4.24***	2.44	3.10	1.06	24.50**	1.67
*Ln*GDP	-0.19*	-1.31	-0.06	-0.39	-0.14	-0.57	-0.97	-0.76
*ln*AGRICPC-LOW	-0.10**	-1.75	-0.12*	-1.33	-0.02	-0.12	-3.47***	-2.92
*ln*AGRICPC-HIGH	-0.01	-0.04	0.001	0.01	-0.17	-0.49	-2.28**	-1.32
*ln*FREE-LOW	-0.12	-0.39	0.09	0.35	0.10	0.23	-3.47*	-1.49
*ln*FREE-HIGH	0.02	0.07	0.08	0.33	0.72	1.75	-2.36	-1.64
*ln*FOREX-LOW	0.001	0.01	0.02	0.69	0.47***	7.74	-0.67	-0.45
*ln*FOREX-HIGH	0.01	0.25	0.02	0.50	0.06	0.85	-0.07	-0.25
*ln*POPDENS-LOW	-0.09*	-1.45	-0.12**	-2.09	-0.14*	-1.48	-	-
*ln*POPDENS-HIGH	-0.10*	-1.35	-0.11*	-1.77	-0.23**	-2.13	-	-
*ln*UPOPGRO-LOW	-	-	-	-	-	-	-0.39	-0.65
*ln*UPOPGRO- HIGH	-	-	-	-	-	-	-0.03	-0.05
*ln*PPLAND-LOW	0.16***	2.36	0.16***	2.74	0.15*	1.55	-0.55	-1.17
*ln*PPLAND-HIGH	0.04	0.48	0.05	0.84	-0.03	-0.25	0.55	0.85
*ln*PDLAND-LOW	0.02	0.16	-0.02	-0.17	0.14	0.83	-0.92	-1.14
*ln*PDLAND-HIGH	0.001	-0.03	0.12	1.17	0.24	0.37	-1.38	-1.23
*ln*CLIMATE-LOW	0.64***	2.85	0.49***	2.54	1.61***	5.00	6.81***	3.40
*ln*CLIMATE-HIGH	0.47*	1.42	0.52**	2.02	1.07***	2.43	0.93	0.23
R^2	0.36		0.37		0.57		0.33	
Adjusted R^2	0.25		0.25		0.49		0.14	
Std error	0.66		0.55		0.93		3.71	
F-statistic	3.17***		3.14***		7.26***		1.87*	
N	99		98		98		71	

a The dependent variable is the logarithm of number/10,000 sq km.

b The dependent variable is the logarithm of the average annual percentage change in the number of known mammal species.

***, **, and, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for a one-tailed test.

The effect on the average annual percentage change in the number of known mammal species is significant for both income groups, but is more pronounced in low-income countries. These results can be explained in two ways. First, agriculture tends to form a higher component of economic output in low-income countries compared to high-income countries. Secondly, harmful agricultural practices such as slash-and-burn cultivation and uncontrolled use of insecticides and pesticides are more prevalent in low-income countries. For example, slash-and-burn agriculture has been identified as the main source of deforestation in countries such as Columbia, Ecuador, Peru, Bolivia, Ivory Coast, Nigeria, Zaire, India, Sri Lanka, Thailand, Indonesia and the Philippines (Myers, 1992; FAO, 1992, Grainger, 1993). It is also a contributory factor in Mexico, Brazil, Myanmar and Vietnam (Table-3).

The variable for economic freedoms is significant for low-income countries but not for high income countries in the case of the average annual percentage change in mammal species numbers. Likewise, the variable representing the macroeconomic environment (*FOREX*) is significant for low-income countries but not for high-income countries in the case of higher plants. The effect of population density on mammalian species density is approximately similar for both low and high-income countries, although the effects on bird and higher plant species densities are slightly higher for high-income countries.

Although not statistically significant, the rate of urban population growth (*UPOPGRO*) appears to have a relatively greater effect on the average annual percentage change in mammal species numbers in low-income countries than in high-income countries. A similar differential impact can be observed in the case of percentage of protected land area (*PPLAND*) where the effects are significant in low-income countries for mammals, birds and higher plants but not in high-income countries. Finally, for all four indicators of biodiversity loss, climatic effects are relatively more significant in low-income countries. This particular result could partly be explained by the fact that countries in the colder regions, which tend to be the richer countries, have already lost a large amount of biodiversity and are now experiencing a slower decline. Another possibility is that species in these countries have become more resistant or better adapted and therefore decline at a lower rate.

IV. CONCLUSION AND POLICY IMPLICATIONS

Biodiversity loss ranks among the major global environmental problems confronting the world. It is a form of environmental degradation that has not been well highlighted in the current debate on the effects of economic growth on the environment. Biodiversity loss belongs to a special category of environmental degradation because it

involves the irreversible loss of valuable ecosystems. Thus, in this case policy implications associated with EKC-type studies are inappropriate. In this paper an attempt has been made to empirically examine the relationship between biodiversity and economic growth using indicators of species diversity and income per capita as proxies for biodiversity and economic growth, respectively. The main finding is that while economic growth has an adverse effect on biodiversity, the type or composition of this growth can also be significant for biodiversity loss. In particular, it was shown that countries with a higher component of agricultural output in total output, which tend to be the low-income countries, experience relatively greater biodiversity decline. Although farmers in these countries tend to use low-level agrotechnology which is environmentally benign, inappropriate farming practices such as slash-and-burn cultivation is a major cause of deforestation and hence biodiversity loss. There is therefore the need to address the underlying causes of biodiversity loss in these countries which include poverty, lack of property rights and tenure regimes, lack of inadequate rural infrastructure, health and education services, and lack of employment opportunities.

The institutional proxy used in the study was an indicator of economic freedoms that is more narrowly defined than those used in previous studies. This indicator is based mainly on economic freedoms while the others have been based on broad social freedoms. The study results indicate that while improvement in economic freedoms can be associated with improvement in mammal and bird species numbers, the effect on biodiversity is much stronger in low-income countries compared to high-income countries. The main implication here is that there is a need to develop appropriate institutional and macroeconomic policies that allow biodiversity values to be internalized in decision-making processes at the individual and national levels. However, a major obstacle to achieving this objective is that biodiversity is a global public good, and as such individuals and countries have no incentive to invest in the stocks of such resources. Thus, there is the need for more international initiatives such as the Global Environmental Facility that aim to promote the management of biodiversity resources.

In conclusion, a number of caveats are in order. Given that the measurement of biodiversity loss is imprecise and there are omitted variables in the model, the magnitudes of the estimated coefficients are also uncertain. Nevertheless, the negative effects of economic growth on biodiversity appear to be quite robust. There is the need for more studies of this kind to enhance our understanding of the relationship between biodiversity loss and economic growth. In particular, there is the need for country specific studies. Unfortunately, the availability of good quality time series environmental data remains a major obstacle to this type of analysis. In many countries, time series data on environmental indicators prior to 1989 is unavailable or so poorly reported that its use would be detrimental to any study. Finally, there is a need to investigate the role of additional socioeconomic and institutional factors in the income-biodiversity relationship.

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ABBREVIATIONS USED

CO2: Carbon Dioxide
EKC: Environmental Kuznets Curve
FAO: Food and Agriculture Organization
GDP: Gross Domestic Product
OECD: Organization for Economic Cooperation and Development
OLS: Ordinary Least Squares
SO2: Sulfur Dioxide
UN: United Nations
UNEP: United Nations Environment Program
WCU: World Conservation Union
WRI: World Resources Institute

SUSTAINABLE DEVELOPMENT: A REVIEW

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Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
· The concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given and
· The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.
— *World Commission on Environment and Development, Our Common Future (1987), Brundtland report*

Introduction

Mother earth has evolved with her special atmosphere to support life to flourish in it. Variety of life forms from single cell bacteria and microbes to big plants and animals all have grown with their individual features in varied ecosystems specially designed for water, land and air. This huge biodiversity is very much essential to maintain proper food chain, to provide natural pest control mechanism, to preserve fertility of land and to retain quality of air and water for the sustenance of life in it. But, we, the human being, in course of civilization, have been exploiting the natural resources ever more and in turn, creating environmental pollution, thereby destroying biodiversity and the ecological balance is being disturbed. This causes extinction of thousands of species of plants and animals in every moment. Unless we initiate immediate measures to restore biodiversity, new and harmful bacteria and microbes and gene modified pests will grow with threats to other life forms and the consequence is a huge natural disaster. Therefore, methods of sustainable development are required to be formulated with no waste of time. Some discussion is presented here with rules and measures taken up or to be taken up for establishment of new industries, power plants, roads and urban centers. Special emphasis is given to pollution control measures and public awareness schemes.

What is sustainable development?

The phrase sustainable development means a strategy that should provide a method to restore natural resources and to maintain equilibrium of human ecosystem (homeostasis) keeping the social and economic growth of the present state of civilization. That is there must be a fine balance between the use of natural resources and its replenishment. Along with this there must have some measures for environmental protection. So to say, sustainability science is the study of sustainable development and environmental science twined together. The goal of this is to maintain, regenerate and improve natural resources for future generations with clean and green environment to live in.

Animals including human being had their birth in forest, but over the years in course of development human destroyed forest to build their settlements, villages and cities and to grow croplands and agricultural fields. Following 18th century industrial revolution in Europe, deforestation had been taken to new heights with setting of industries, power plants, mines, big cities, markets and business centers, ports and rail and road connectivity. These used up huge amount of wood and mine products as fuel and in turn, emitted green house gasses and other pollutants to environment. Some wise people raised slogan against deforestation and tried to make others aware with their writings. Sustainable Forest Management strategy was developed in late 18th century. This movement took scientific shape in the hands of Alexander Von Humboldt, Georg Ludwig Hartig, Gifford Pinchot and Aldo Leopold in the development of environmental movement and forest management. One of the first uses in true sense of the term sustainability was by the *Club of Rome*, a forum of a group of scientists from MIT, in their classic report *Limits to Growth* of 1972 where they affirmed that "We are searching for a model output that represents a world system that is sustainable without sudden and uncontrolled collapse and capable of satisfying the basic material requirements of all of its people". In 1980 the *International Union for the Conservation of Nature* published a world conservation strategy that introduced the term "sustainable development" as global priority. Two years later in 1982 the *United Nations World Charter for Nature* forwarded five principles of conservation to judge and guide human activities on nature. In 1987 the *United Nations World Commission on Environment and Development* released the report *Our Common Future*, commonly called the Brundtland Report which is recognized as the definition of sustainable development.

From the intergenerational framework on the goal of "socially inclusive and environmentally sustainable economic growth" of Brundtland Report, in 1992, the *UN Conference on Environment and Development (Earth summit 1992)* published the *Earth Charter*, which gave emphasis on the building of a just, sustainable and peaceful global society

of the 21st century. The action plan was *Agenda 21* which emphasized on broad public participation in decision making as fundamental prerequisite for sustainable development. It has four sections

- *Section I: Social and Economic Dimensions* is directed toward combating poverty, especially in developing countries, changing consumption patterns, promoting health, achieving a more sustainable population, and sustainable settlement in decision making.
- *Section II: Conservation and Management of Resources for Development* includes atmospheric protection, combating deforestation, protecting fragile environments, conservation of biological diversity (biodiversity), control of pollution and the management of biotechnology, and radioactive wastes.
- *Section III: Strengthening the Role of Major Groups* includes the roles of children and youth, women, NGOs, local authorities, business and industry, and workers; and strengthening the role of indigenous peoples, their communities, and farmers.
- *Section IV: Means of Implementation* includes science, technology transfer, education, international institutions and financial mechanisms.

Therefore the key strategy is information, integration and participation where everyone is a user and information provider. In 1997 the *UN General Assembly* held a special session and found an uneven progress and identified general trends of increasing globalization, widening inequalities in income and continued deterioration of the global environment. As plan of implementation, *World Summit on Sustainable Development (Earth Summit 2002)*, affirmed UN commitment to "full implementation" of Agenda 21 alongside the achievement of *Millennium Development goals* and identified principles and treaties on sustainable development including economic development, social development and environmental protection.

United Nations Conference on Sustainable Development of 2012 was attended by leaders from 180 countries, they affirmed their commitment on *Agenda 21* and the outcome is a document "The Future we want". In 2015, the *United Nations General Assembly* formally adopted the "universal, integrated and transformative" *2030 Agenda for Sustainable Development*. It is a set of 17 *Sustainable Development Goals* (SDGs) those are to be implemented and achieved in every country within 2030.

Sustainable development is configured as the integrated development of four interconnected domains: ecology, economics, politics and culture. Therefore, the Human Development Index not only depends on the increase of human settlements on this earth, rather it means human habitat with all the modern amenities in a healthy environment.

Measures of sustainable development and Ecological stability

It comes from sustainable interrelation between human and nature: A healthy human settlement requires availability of quality air, water and land to build home, to grow crops, to develop industries and to lay roads. For these since resources are extracted from environment, unless proper measures are taken the quality of air, water or land should degrade. Furthermore, the waste generated by this process will degrade the atmosphere to larger extent. Technical report on the usage of land and water and specifically on climate change by individual survey or by sensors or satellite imaging and scientific processing of data will provide us the information of the condition of local environment and its global impact. Accordingly, from this assessment report on the socio economic condition of the region and its industrially strategic location, government with the help of social scientists, economists and environmentalist will frame out a rule or law on the usage of natural resources and its means of replenishment. Also, some option should be designed for the mitigation of climate change. For example, water management by reuse of water and rain water harvesting, use of renewable energy and low power devices, use of biodegradable products instead of plastics, use of technologically advanced waste management devices in industries, adopting environment friendly methods for farming and cultivation (such as agroforestry, mixed farming, multiple cropping, crop rotation etc.) and obviously aforestation for preservation of biomass and biodiversity are the basic measures those must be taken care of. So that in the long run we have an adaptive human ecosystem which will meet human needs as well as preserve the environment.

Earlier it was the thought that economic development means growth of Gross Domestic Product (GDP). Competition between the developed countries for more GDP has lead to overexploitation of natural resources along with excess release of pollutants in the environment. If it will continue, soon nature will lose its ability to replenish and come to a tipping point of failure and extinction of life on earth; huge loss of biodiversity hints towards that. Economists today speak of sustainable economics, that means countries around the world will continue to advance economically but, not in the expense of environment. In present day economics, environmental quality is considered as a scarce resource and a deciding factor. So, every economic policy must include proper cost-benefit analysis such that not much strain will fall on environment. As very complex and diverse relation holds between nature and human activities, for example those at rural and urban sectors or at developed and underdeveloped countries the economic policies should accommodative one to incorporate these variations. However, some common policies or measures must be adopted, those are

i) use of renewable energy sources (solar, hydroelectric, wind, tidal energy) instead of fossil fuel or nuclear source.

ii) use of advanced low emission or emission free technology.
iii) use of low power consumption devices.
iv) use of fuel efficient transports.
v) behavioural changes of extensive use of public transport and use of cycling and walking.
vi) adoption of modern architecture and planned urbanization.
vii) any corporate or business house or government organization must be aware of their social responsibility and should contribute to the socioeconomic development of the locality.
viii) awareness of social solidarity or catholic social teaching to alleviate poverty of the weaker section of society through financial, environmental and social help.
ix) preservation of cultural diversity. In the 3rd World Congress of United Cities and Local Governments (UCLG) it was regarded as the fourth pillar of sustainable development in framing the policies at different regions of the world.
x) political and social empowerment pertaining to organisation, authorisation, legitimation and regulation of social life held in common; in accordance with this way of governance or political changes are necessary.
xi) environmental studies and sustainable development should be introduced as a compulsory subject in every course of higher education to percolate the message to future generations and to initiate further research and development.

The International Institute for Sustainable Development has developed a political policy framework linked to a sustainability index and its measure. The framework emphasises on six core areas, international trade and investment, economic policy, climate change and energy, measurement and assessment, natural resource management and the role of communication technologies in sustainable development. Each of these sectors should be monitored very closely and ethically for public policy making and governance.

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SOME POTENTIALLY IMPORTANT MEDICINAL PLANTS OF COASTAL PURBA MEDINIPUR WITH SPECIAL REFERENCE TO ECONOMIC DEVELOPMENT

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ABSTRACT

Coastal Medinipur, famous site now falls under East Midnapore District in West Bengal has its varied biological diversity. This belt harbors many wild medicinal and economically important plants that are available in late winter and summer. But a few of them are available round the year with immense importance as they have large demand among local people. Here some potentially important medicinal but economic plant species have been represented. The market demand and use values of these plants were also represented here. The direct benefits of biodiversity in terms of money exchange from those plants have been discussed. So, these may be used in cultural garden after artificial manipulation which may be a source of economy of rural people. This will draw more attention to manage the resources in a sustainable basis to protect phyto-diversity in natural habits. Hope that more efforts would be drawn in near future to manage the resources to evaluate the market economy with a fruitful way.

Key words: Purba Medinipur, Some medicinal plants, Biodiversity value, market demand and conservation.

INTRODUCTION

Coastal belt of Purba Medinipur District is a famous site in West Bengal from the ancient age. Purba Medinipur is one of the 23 administrative districts of West Bengal with the head quarters at Tamluk which was previously called 'Tamralipta'(Bandyopadhyay, 2009). It was formed on 1st January 2002 after partition of Medinipur into Purba Medinipur and Paschim Medinipur though the later on is divided now as Jhargram and Paschim Medinipur district since 2017. The state of Odisha is at the south west border; the Bay of Bengal lies in the south; the Hoogly river and South 24 Paraganas district to the east; and Howrah district to the north east. The district has four sub-divisions namely Tamluk, Contai, Egra and Haldia (Wikipedia, 2017). Total area of the district is 430140 lakh hac. The Purba Medinipur district is geographically located between 21° 36′ 35″N to 22°57′ 10″ N latitude and 86° 33′ E to 88° 12′ 40″ E longitude (Das and Das, 2014). Topographically the district can be divided into two parts i.e. a) almost entirely plane lands on the East, west and north and b) the coastal plain land on the south. The coastal belt of Purba Medinipur district is 27% of West Bengal. This district has a long coastal tract of 65.5 km extending from West Bank of Hooghly estuary from New Digha and then Junput, Dadanpatrabar, Khejuri and Haldia on the east to the further north east up to the Tamluk or bank of Rupnarayan (Mondal *et al.* 2013). It has five Coastal Community Development Blocks, namely Khejuri II, Contai II (Desapran), Contai I, Ramnagar I and II. The elevation of the district is about 10 meters above mean sea level. This belt is often occasionally affected by the cascades of cyclones and tornadoes.

The environment is characterized by strong winds, erosion, high evaporation, salinity and scarcity of nutrients in the soil. The soil of coastal belt is mainly alluvial, sandy and saline. Alluvial soil is found in inland which is very fertile and different types of crops and vegetable are grown. Sandy soil is found in sand dunes and generally least of or devoid of organic matter. Saline soil is found in coastal tidal area and in salt pan (Das, 2014). Major rivers of Purba Medinipur are Haldi, Rupnarayan, Rasulpur, Bagui and Keleghai. River water is an important source of irrigation. Majority of plant species available are wild natural kind but a few of them are agricultural type. Some plants are introduced type used time to time for various purposes. Coastal areas and tidal areas are covered with halophytes and halophytic associates. There are some exotic species like *Eupatorium, Lantana, Parthenium* etc. Local people cultivate land with different economic plant species like Rice, Khesari (*Lathyrus* sp.) etc. They sell those items in different places along with local wild and cultivated economic plants in local market. But, all plants species are influence in their habitat and extensively used by local people for different purposes. Man made influence posed as a threat on those plants. These are mainly anthropogenic activities which are fishery, tourism, setting of industries which cause a great loss of vegetation as well as natural ecosystem fragile. People destroy flora knowingly or unknowingly here and there.

Generally coastal areas are fragile in nature and very much important due to its various types of flora and fauna. But now days the area is filled with number of people including fishermen. They occupy the belt for their occupation. Thus a category of people destroy natural vegetation too. Natural causes like strong wind, cyclone,

high tide etc. cause serious damage on ecosystem and vegetation simultaneously. The halophytic association and sand binders available near the coast are also being damaged equally. In this regard, a general overview of land pattern changes time to time and make vulnerable habitats that ruins composite diversity of ecosystem. This change may affects on the economic condition of local people as the natural resources are facing threat. Remembering these it is very important to study and monitor the vegetation, to make strategy to restore ecosystem. It is urged that coastal zone management authority, state government, Central Government and local people would take possible measures to make it pristine. By and large from our corner it is important to study natural resource for strategy development. Not only that the whole we can make an action plan to study and research on natural and planted medicinal and economically important plants that have potential valued. Vegetation of such belt may be protected in coastal belt areas to save the natural ecosystem as the situation create a challenge to the plants and people as well as humanity to make a safeguard for near future. The present study deals with the study of vegetation, their role on economic development. It reflects the use value and their sustainable use along with their status in coastal areas of Purba Medinipur. It will help to create to revive the habitual from degradation as well as to re-vegetate the land with economic and important plants for economic development of local people.

MATERILS AND METHODS

Several ecological surveys were done in the coastal areas of Purba Medinipur during last 4 years. In this year some surveys of market field have been conducted. Survey was conducted in four ways. Field study was done at village boundary, coastal roads, canal boundary, road sides, and rice field boundary, edges near wet lands, wastelands, and open field and in the public garden of the coastal Medinipur. Study was made with quadrat method seasonally. Special studies were done in coastal line for Casuarina, Cashew, Acacia, Prosopis plantation including halophytes and sand binder like *Spinifex* and *Ipomoea* sp. Market study was done for potentially important products of wild and cultivated plants. Knowledge was taken from resource persons regarding their experience for conservation of halophytes, medicinal or other economic and ecologically important plant species. Vegetation study was done on the basis of data collection required for frequency, density and abundance of the species in different sites of the coastal belt area. Specimens were collected in different seasons and collected specimens were studied at laboratory for identification and specimens were preserved for further research and study. Indigenous knowledge study is essential for each research. So, from field knowledge was gathered with the help of old aged persons. Literature study was done using libraries. Suggestions were taken for field workers and villagers to develop further strategies on research and extension. Photographs and soils were collected from field time to time for analysis of situations. All the materials preserved as herbarium specimen and museum specimens. Generally 4% formaldehyde solution and 4-5% copper sulphate solution were used as preservatives. Field notes and photographs were recorded for further study. Dry parts of fruits, seeds, barks, roots etc were preserved with naphthalene balls. Plant identification was done with the help of standard literature (Duthie, 1960; Hooker 1892-1897, Haines, 1921-1925; Prain, 1963; Das 2007, Anonymous, 1997, 2005, 2010, 2012, 2017) The names of plants were crossed checked following Bennet, 1987. Publications consulted for last few years were Chakraborty *et al.* 2012; Das and Das, 2014; Das, 2013; Das, 2015. Wetland plant species were indentified with the help of fresh water vegetation of Rimer, 1984. The species of salty marsh were indentified with the help of museum of specimen and herbarium specimens of CAL. Herbarium specimens were prepared as per the methodology of Jain and Rao, 1977. To study use pattern of medicinal plants, different books of Government sections have been used. But for general consideration the common book used was Kirtikar and Basu, 1918. Herbarium specimens were collected as per the manual published by Rao and Sharma, 1990. Halophytic species have been identified with the help of manual on mangroves in India (Banerjee *et al.* 1986). Other literature used were Blasco (1975), Banerjee (1987), Dwivedi *et al* (1974), Mukherjee (1978), Naskar *et al.* (1978), Rao *et al.* (1972), Sanyal *et al.* (1984), Sidhu (1960), Thothatri (1981), Wahead Khan (1959), Walson (1928), Gul and Khan (1995), Subhanian *et al.* (2010), Jha *et al.* (2011) and Ahmed *et al.* (2011).

RESULT AND DISCUSSION

Result shows that 83 plant specimen are found there as common occurrence in coastal belt (Table 1). Among them, *Acacia auriculoformis, Anthocephalus cadamba, Borassus flabellifer, Casuarina equisetifolia, Delonix regia, Diospyros malabarica, Samania saman, Spondias pinnata, Syzygium cumini, Tamariandus indicus, Terminalia arjuna are woody arboreal as commercial plants for fuel wood purpose.* Commercial fruit yielding plants are *Borassus flabellifer, Carica papaya, Cocos nucifera, Mangifera indica, Pithecellobilum dulce, Psidium guajava, Moringa oleifera, Citrus maxima,* and *Zizyphus jujube.* Medicinal plants widely used are *Achyranthes aspra, Adhatoda vasica, Abroma augusta, Enhydra fluctuans, Glycosmis pentaphylla, Ichnocarpus frutescens, Vitex negando, Pedalium murex* and *Urena lobata.*Economically cultivated species are *Anthocephalus cadamba, Bombax ceiba, Bougainvellia spectabilis* etc. Medicinal plants are *Alocasia indica, Amaranthus spinosus, Amaranthus viridis, Centella asiatica, Chenopodium album, Colocasia esculenta, Dioscorea alata, Enhydra fluctuans, Glinus oppositefolius, Ipomoea aqatica, Ipomoea batatas, Marselia quadrifolia, Moringa oleifera* etc. Commercially important plants are *Musa paradiasiaca, Polygonum plebeium, Portulaca oleracea, Spondias pinnata, Tamarindus indica* and *Typhonium trilobatum.* Demand of local wild plants in local market is very high.

Market values of some wild products are as follows- *Amorphophallus campanulatus* (corm) Rs. 40/Kg.,*Centella asiatica* (leaf) Rs.80/Kg., *Chenopodium album* (whole plant) Rs.20/Kg. ,*Dillenia indica* (Fruit) Rs.10/piece, *Dioscorea alata* (tuber) Rs.40/Kg.,*Enhydra fluctuans* (twig) Rs.10/bunch,*Glinus oppositifolius* (twig) Rs.25/Kg., *Ipomoea aqatica* (twig) Rs.5/bunch,*Marselia quadrifolia (leaves)* Rs.50/Kg.,*Moringa oleifera* (leaves, flowers and fruits) Rs.10,70,120 respectively/Kg., *Musa paradisiaca* (fruits) Rs.7/piece, *Polygonum plebium* (twig) Rs.30/Kg.,*Spondias pinnata* (fruit) 20/Kg. Some halophytes and halophytic associates are *Acanthus ilicifolius*, *Aleuropus lagopoides*, *Avicennia marina*, *Avicennia officinalis*, *Balbostylis barbata*, *Exoccaria agallocha*, *Giseki pharnaccoides*, *Hydrophylax maritime*, *Ipomoca pes-caprae*, *Launaea sarmentosa*,*Opuntia monocantha*, *Porteresia coarctata*, *Salicornia herbacea*, *Salsola kalitenenifolia*, *Sonneretia apetala*, *Suaeda monoica*, *Suaeda maritime* and *Tecticornia indica* etc. Other species found here are *Barringtonia racemosa*, *Canavalia rosea*, *Caesalpinia bonduc*, *Clerodendrum inerme*, *Ipomoca violacea*, *Meropa angulata*, *Pandanus odoratissimus*, *Stenochlaena palustris*, *Thespesia populnea*, and *Tylophora tenuis*. Important medicinal plants are *Adhatoda vasica* (leaves), *Aloe vera* (leaves), *Abroma augusta* (seeds), *Andrographis paniculata* (leaves and whole plant), *Azadirachta indica*, *Catharanthus roseus*,*Centella asiatica* (leaves),*Cissus quadrangularis*, *Costus speciosus*, *Emblica officinalis*, *Enhydra fluctuans*, *Euphorbia neriifolia*, *Gloriosa superba*, *Ichocarpus frutescens*, *Jatropha gossipifolia*, *Marselia quadrifolia*, *Ocimum sanctum*, *Plumbago zeylanica*, *Smilax ovalifolia*, *Swietenia mahogany*, *Tylophora tenuis*, *Vitex negundo* and *Wedelia calendulacea*.

The study revealed that coastal belt need immediate protection for some endangered species. *In-situ* conservation is needed urgently. Habitat conservation is needed to protect these plant species as they help local people to develop their economy and to stay alive in changing situation

Table 1.

Plant species of common occurrence though some are used in different purpose

Sl. No.	Name	Family	Plantation /technique	Use	Conservation
1	*Acacia catechu* (L.) Willd. Oliv.	Mimosaceae	Propagated by plantation with seeds	Unripe crushed seeds are used to treat Syphilis	Measures needed
2	*Acacia auriculiformis* A. Cunn. Ex. Benth.	Mimosaceae	Seed germination rate is high	Ornamental, fuel wood is obtained	Measures needed
3	*Acacia nilotica(L.) willd. Ex. Del. ssp indica* (Benth.) Brenan	Mimosaceae	Plantation type and grow naturally	To treat diarrhea, tonsillitis, keep teeth and gum healthy	Need protection
4	*Achras sapoda* L.	Sapotaceae	Economic plant	To treat fever hemorrhage, wound, ulcer and gall bladder stone	Grafting should be adopted to conserve
5	*Achyranthes aspera* L.	Amaranthaceae	Wild	Root Part is used in *ali* (a paste with turmeric and *Costus* rhizome which is anthelmintic), used in gynecology and to sease the symptom of malaria	Need conservation
6	*Adhatoda zeylanica* Medic.	Acanthaceae	Propagation through cutting.	Leaf is used in bronchodilator action, cough and cold.	Need conservation
7	*Albizia lebbeck* (L.) Willd.	Mimossceae	Commercial tree	Used to treat boil, cough, abdominal tumors & inflammation	Need conservation

8	*Alstonia scholaris*(L.) R.Br.	Apocynaceae	Propagation through cutting	Bark is used to treat Malaria, epilepsy and asthma.	Need conservation & protection
9	*Anthocephalus cadamba (Roxb.) Miq.*	Rubiaceae	Avenue tree ,Need more plantation	Used in anemia and arthritis	Need protection
10	*Argemone Mexicana*(Roth.) Schum	Papaveraceae	Seed is very dangerous if mixed with rapeseed	Used to treat kidney pain and malaria	Need to conserve
11	*Andrographis paniculata*(Bur m. F.) Wall. ex Nees	Acanthaceae	Wild	Used to treat common cold, upper respiratory tract infection, jaundice and cancer.	Need protection of waste land
12	*Anona squamosa* L.	Annonaceae	Economic planted by seed	Leaf decoction is used to treat dysentery , urinary tract infection and wound	Need plantation for conservation
13	*Areca catchu* L.	Arecaceae	Economic, sand binder ,planted with seed	Used economically	Need protection & more plantation
14	*Azadirachta indica* A. Juss.	Meliceae	Medicinal, economic, propagated through seed	Leaf and bark balance blood sugar levels, improves liver infection and skin disease	
15	*Bambusa bamboos* (L.) voss	Poaceae	Economic	Leaf used in digestive problem, respiratory and menstrual problem	Need more plantation
16	*Bambusa tulda* Roxb.	Poaceae	Economically usable	Used in paper making	Need more plantation
17	*Barringtonia seutangula*(L.) Gaertn.	Lecythidaceae	Wild propagated by seed	Used to treat anti microbial disease and diarrhea	Need conservation
18	*Bombax ceiba* L.	Malvaceae	Silky flosses are important	Ornamental, bark is used in urinary problem	Need suitable use
`19	*Borassus flabellifer* L.	Arecaceae	Good sand binder	All parts economic	Need more plantation in coastal areas
20	*Bougainvellio spectabilis* Willd.	Nyctaginaceae	Ornamental, propagating by cutting	It has anti diabetic and anti inflammatory action	Need more propagation
21	*Caesaleinia bonduc* (L.) Roxb.	Caesalpiniaceae	Nuts are economic	Seeds are antipyretic and used in liver disorder.	Needs protection from illegal cutting and burning.
22	*Calotropis gygantea* R. Br.	Asclepiadaceae	Economic, cotton is obtained.	Used in skin disease.	Need protection.
23	*Calotropis procera* (Ait.) Ait.f.	Asclepiadaceae	Cotton is obtained	Flosses are used for its filling purpose	Protection is needed
24	*Cassia alata* L.	Caesalpiniaceae	Fruits are economic	Ornamental ,used as vermicide ,	Conservation is not needed

				astringent ,purgative and to treat skin disease	
25	*Cassia fistula L.*	Fabaceae	Ornamental ,propagated by seeds	Used to treat cancer, constipation, diabetes and pimples	Protection needed
26	*Casuarina equisetifolia J.R.&G.Forst.*	Casuarinaceae	Economic plantation stand	Windbreak of sea sore	Illegal felling should be prevented and need protection
27	*Cissus quadrangularis* L.	Vitaceae	Economic	Steam used for bone fracture, peptic ulcer, osteoporosis scurvy and cancer	Need protection
28	*Centella asiatica* L.(Urban.)	Apiaceae	Vegetative propagated, economic	Leaf used for anxiety, improving memory and intelligence	Need protection from illegal collection
29	*Citrullus colocynthis* (L.) Schrad.	Cucurbitaceae	Vegetative, propagated by Seed, Sed germination is low.	It has antimicrobial activity	Need protection for conservation of phyto-diversity.
30	*Citrus maxima* (Burm.f.) Merr.	Rutaceae	Economic, vegetatively propagated	Fruit and leaves are used to treat liver disorder	Need more plantation
31	*Clerodendrum inerme* (L.) Gaertn.	Verbenaceae	Conserve soil	Soil protector in canal sore, used to treat fever ,skin disease, rheumatism and asthma	Need conservation
32	*Clerodendrum infortunatum* L.	Verbenaceae	Grow margin of seasore bandh,propaga ted by seed	Leaves are used in liver disorder, malaria and diabetes	Need protection
33	*Coccinia grandis* (L.)Voigt.	Cucurbitaceae	Propagated by seeds	Fruits are used to treat fever, leprosy, asthma , bronchitis and jaundice.	No need for conservation
34	*Cocos nucifera* L.	Arecaceae	Economic, soil protector	Nutritious, roots are used as mouthwash ,used in dysentery	Need protection and plantation
35	*Crotalaria pallid* Ait.	Fabaceae	Not known		Preservation needed for phyto-diversity conservation
36	*Croton bonplandianum* Baill.	Euphorbiaceae	Anti-bleeding agent	Used as fuel and detergent, leaf paste is applied for skin disease	Need protection
37	*Cuscuta reflexa* Roxb.	Cuscutaceae	Epiphytic	Febrifuge and used in viral disease, useful for the treatment of headache, labor pain and bone fracture	Need more study
38	*Cynodon dactylon*(L.) Pers.	Poaceae	Fodder plant,vegetativ e	Juice is good in normalizing sugar level, it enhance	Need habitat coservation

			propagation,sacred plantof Hindu	immunity	
39	*Cyperus rotundus* L.	Cyperaceae	Fodder plant	Used as stomachic, bulb is used to treat fever and digestive system disorder	Need protection
40	*Datura metel* L.	Solanaceae	Propagated by seed	Used in asthma	Need conservation
41	*Delonix regia* (Boj.)Raf.	Caesalpiniaceae	Ornamental	Leaf steam and bark is used to treat diarrhea, constipation and diabetes	Need protection and plantation
42	*Dillenia indica* L.	Dilleniaceae	Economic	Fruit is used to treat abdominal disorder, bark and leaves are astringent, used as mouth wash	Need protection and plantation
43	*Diospyros malabarica*(Desr.)Kostel.	Ebenaceae	Fruits economic	Used to treat diarrhea, dysentery, gonorrhea, leprosy and tumors.	Needs protection
44	*Dolichandrone spathacea*(L.f.) K. Schum.	Bignoniaceae	Canal side plant low in frequency	Mangrove trumpet tree	Need attention and special study
45	*Eucalyptus globules* Labill.	Myrtaceae	Plantation stand	Oil is used to treat bronchitis, influenza and diabetes	Need protection for first few years.
46	*Ficus benghalensis* L.	Moraceae	Common, religious plant	Used in ulcers, vomiting, fever, inflammation and leprosy.	Need protection
47	*Ficus religiosa* L.	Moraceae	Common, religious plant	Bark checks blood loss, diarrhea, gout and lowers serum uric acid level.	Need protection
48	*Ficus hispida* L.f.	Moraceae	Common canal side plant	Used to treat fever, jaundice, piles and diabetic ulcers	Need protection from cutting as firewood
49	*Gardenia jasminoides* J.Ellis.	Rubiaceae	Ornamental,propagation by cutting	Low in frequency	Need more plantation
50	*Glycosmis pentaphylla* (Retz.)D.C.	Rutaceae	Common ,helps to study community	Medicinal, treat liver disorder	Need more work
51	*Gloriosa superb* L.	Colchicaceae	Rare	Treat infertility, ulcer kidney problem, cancer, small pox; applied in child birth	Need habitat conservation and more attention
52	*Ichnocarpus frutescens*(L.)R. Br.	Apocynaceae	Low in frequency	Used to treat rheumatism, asthma and cholera	Need special protection
53	*Ipomoea fistulosa* Forsk.	Convolvulaceae	Grow in fencing side	Used as fuel wood	Need protection from cutting

54	*Ipomoea aquatic* Forssk.	Convolvulaceae	Economic, protect soil,propagated by seed and vegetatively	Remove constipation	Need protection
55	*Jatropha gossypifolia* L.	Euphorbiaceae	Seeds are economic, oil is obtained from seeds	Twigs are used as tooth brush; used to treat eczema, dysentery and urinary disease	Need protection and care
56	*Kyllinga trieeps* Rottb.	Cyperaceae	Economic		Need habitat conservation
57	*Limonia acidissima* L.	Rutaceae	Economic, propagated by seed	Used to treat belly pain, gum bleeding and prevent low blood pressure.	Need protection of habitat
58	*Mangifera indica* L.	Anacardiaceae	Economic	Seeds are used in asthma and fruits are used in heat stroke	Need more plantation
59	*Mikania cordata* (Burm.f.) B.L. Roxb.	Asteraceae	Medicinal	Prevent external bleeding; it is antiseptic	Need habitat conservation
60	*Milletia pinnata* (L.) Panigrahi	Fabaceae	Economic	Wind breaker, prevent soil erosion; it has antiseptic properties	Need habitat conservation and more protection
61	*Moringa oleifera* Lam.	Moringaceae	Highly economic	Prevent pox ,check blood pressure	Need large scale plantation
62	*Oldenlandia corymbosa* L.	Rubiaceae	Low in population	Used to treat stomach disorder ,jaundice	Need protection
63	*Opuntia stricta* (Haw.)Haw.	Opuntiaceae	Population insufficient	Stabilizes sand dunes	Need protection from burning
64	*Opuntia monocantha* Haw.	Opuntiaceae	Population insufficient	Sand binder	Need population protection
65	*Pandanus fascicularis* Lam.	Pandanaceae	Low in frequency	Used to treat colic and rheumatism	Need protection of habitat and protection from burning and cutting
66	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Low in population	Juice is used as beverage, used to treat gonorrhea, heart and abdominal complain	Need increase in population
67	*Phyla nodiflora* (L.) Greene	Verbenaceae	Fodder and soil binder plant	Used to treat diarrhea, fever and wound	High in frequency, no need for conservation
68	*Pithecellobium dulce* (Roxb.)Benth.	Mimosaceae	Economic	Seed is used in constipation	Need protection
69	*Prosopis juliflora* (Sw.)D.C.	Mimosaceae	Fuel wood species		Frequency is low, need more plantation
70	*Psidium guajava* L.	Myrtaceae	Economic, propagated by cutting and grafting	Used in tooth ache, vomiting and diarrhea	Need more plantation

71	*Ricinus communis* L.	Euphorbiaceae	Economic medicinal	Castor oil is obtained; used to treat skin disease	Need more plantation
72	*Samania saman* F.Muell.	Mimosaceae	Wood of commerce	Treat diarrhea and stomach ache	Need more plantation and protection
73	*Spondias pinnata* (L.f.) Kurtz.	Anacardiaceae	Commercial,economic	Used to treat diarrhea, irregular menstruation, indigestion and nausea	Need large scale plantation
74	*Syzygium cumini* (L.)Skeels.	Myrtaceae	Economic, medicinal	Fruit is used to treat diabetes, it is a good blood purifier	Wild, need more plantation
75	*Terminalia arjuna*(Roxb.)Wight &Arn.	Combretaceae	Medicinal	Treat gonorrhea and cardiac problem	Need conservation
76	*Tamarindus indica* L.	Fabaceae	Economic, medicinal	Treat abdominal pain , diarrhea and dysentery	Need more plantation
77	*Thespesia populnea* (L.) Soland.	Malvaceae	Road side plant, economic	Treat ulcerative colitis	More plantation is needed
78	*Thevetia peruviana* (Pers.) Schum.	Apocynaceae	Ornamental plant	Oil has antifungal and anti termite property	Need more plantation
79	*Tiliacora acuminate* Colebr.	Menispermaceae	Woody climber	Used to treat leucoderma	Need protection
80	*Tinospora cordifolia* (Thunb.)Miers.	Menispermaceae	Wild climber with photosynthetic root, frequency is low	Used to treat skin infection and gonorrhea	Need species protection
81	*Trewia nudiflora* L.	Euphorbiaceae	Wood of commerce	Used to treat rheumatism	Need more protection and plantation
82	*Urena lobata* L.	Malvaceae	Medicinal	Used to treat bone fracture	Need habitat conservation
83	*Vitex negundo* L.	Lamiaceae	Medicinal	Treat in rheumatism, insect and catfish bite , gum pain	Need habitat conservation

CONCLUSION

Ecosystem damage and soil erosion is going under threat due to anthropogenic and natural cause. As a result, species are destroying from habitats. In some places new halophytic plantations are uprooted and destroying by grazing. Renovation of canal system has created damage to associated flora. Coastal bank has been broken by tidal flow day by day. Government should take steps to protect land; otherwise all the natural vegetation will be vanished in near future. Local people should be aware about importance of vegetation. Ministry of Forest and Environment and climate Change must put attention through state bodies to check the fragile ecosystem. Local authority should have to form a committee of local people to create new plantation and protection of habitat and species for our sustenance.

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EFFECT OF BIODIVERSITY ON HUMAN HEALTH IN WEST BENGAL

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ABSTRACT

It is already established that there were great biodiversity in the south West Bengal. But there was no systematic review was found on only effects of biodiversity on human health of the south West Bengal. The aim of this study was to determine the effects of biodiversity on human health of south West Bengal in a systematic manner. Pilipenko N *et al.* (2018) revealed that sesamin was able to inhibit formation of a major metabolite of warfarin, 7-hydroxywarfarin. *Saha p et. al. (2016)* was determined the genetic diversity and multiplicity of infection of P. falciparum population in Kolkata, West Bengal, India. The majority of genotypes occurred at a frequency below 10%. The mean multiplicities of infection for msp1 and msp2 gene were 2.05 and 3.72, respectively. The P. falciparum population of Kolkata was genetically diverse. As the frequencies of most of the msp1 and msp2 alleles were low, the probability of new infection with genotype identical to that in pre treatment infection was very rare. *Banik A et. al. (2016)* indicated that the diverse polyvalent phytonic PGP bacteria, which may be exploited as bio-inoculants to improve rice production *Shasmal M et. al. (2012)* postulate that the prominent helical structure related to the 23S rRNA actively participates in the mechanisms of translation in mycobacteria. *Saha DC and Padhy PK (2011)* stated that the effect of air and noise pollution on abundance and variability of birds in this forest have been compared to an almost non-polluted forest of the same bio-geographic zone. Both species diversity and population density of birds were found to decrease in the polluted forest, especially in the areas adjacent to crushers. Significant medical and pharmacological discoveries are made through greater understanding of the earth's biodiversity. Loss in biodiversity may limit discovery of potential treatments for many diseases and health problems.

Keywords: Biodiversity- South -West Bengal

INTRODUCTION

Biodiversity underpins life on earth, and refers to the variety found in biota from genetic makeup of plants an animal to cultural diversity. The term biodiversity, now enshrined in the literature, refers to the biological diversity to describe the variety of life forms at all levels, from micro-organisms to wild flora and fauna, besides the human species. However, the variety of living beings should not be viewed individually, but as a structural and functional whole, from the ecological standpoint of the natural system.

People depend on biodiversity in their daily lives, in ways that are not always apparent or appreciated. Human health ultimately depends upon ecosystem products and services (such as availability of fresh water, food and fuel sources) which are requisite for good human health and productive livelihoods. Biodiversity loss can have significant direct human health impacts if ecosystem services are no longer adequate to meet social needs. Indirectly, changes in ecosystem services affect livelihoods, income, *and local* migration and, on occasion, may even cause political conflict.

The main aim of the study was to review whether there is any effect of biodiversity on human health and determine the root cause of it and also find the remedial measures of it.

Pilipenko N et. al. (2018) were established that the rate of 7-hydroxylation of warfarin was significantly decreased in the presence of sesamin in the range of concentrations from 5 to 500 nM, and was not affected by episesamin, caffeic acid and ferulic acid in the same range of concentrations. The kinetic analysis indicated non-competitive type of inhibition by sesamin with Ki = 202 ± 18 nM. They revealed that sesamin was able to inhibit formation of a major metabolite of warfarin, 7-hydroxywarfarin. Saha p et al. (2016) was determined the genetic diversity and multiplicity of infection (MOI) of P. falciparum population in Kolkata, West Bengal, India. A total of 80day-zero blood samples from Kolkata were collected during a therapeutic efficacy study in 2008-2009. DNA was extracted; allelic frequency and diversity were investigated by PCR-genotyping method for msp1 and msp2 gene and fragment sizing was done by Bio-Rad Gel-Doc system using Image Lab (version 4.1) software. P. falciparum msp1 and msp2 markers were highly polymorphic with low allele frequencies. In Kolkata, 27 msp1 different genotypes (including 11of K1, 6 of MAD20 and 10 of Ro33 allelic families) and 30 different msp2 genotypes (of which 17 and 13 belonged to the FC27 and 3D7 allelic families, respectively) were recorded. The majority of these genotypes occurred at a frequency below 10%. The mean MOI for msp1 and msp2 gene were 2.05 and 3.72, respectively. The P. falciparum population of Kolkata was genetically diverse. As the frequencies of most of the msp1 and msp2 alleles were low, the probability of new infection with genotype identical to that in pretreatment infection was very rare. Banik A et al. (2016) stated that the diversity of endophytic and epiphytic diazotrophs in different parts of rice plants has specificity to the niche (i.e. leaf, stem and root) of different

genotypes and nutrient availability of the organ. Inoculation of the indigenous, polyvalent diazotrophs can facilitate and sustain production of non-leguminous crops like rice. Therefore, N2-fixing plant growth promoting bacteria (PGPB) were isolated from different parts of three Indian cultivated [Oryza sativa L. var. Sabita (semi deep/deep water)/Swarna (rain fed shallow lowland)/Swarna-Sub1(submergence tolerant)] and a wild (O. eichingeri) rice genotypes which respond differentially to nitrogenous fertilizers. Thirty-five isolates from four rice genotypes were categorized based on acetylene reduction assay on nitrogenase activity, biochemical tests, BIOLOG and 16S rRNA gene sequencing. The bacteria produced 9.36-155.83 nmole C2H4 mg(-1) dry bacteria h(-1) and among them nitrogenase activity of 11 potent isolates was complemented by nifH-sequence analysis. Phylogenetic analysis based on 16S rDNA sequencing divided them into five groups (shared 95-100 % sequence homology with type strains) belonging to five classes-alpha (Ancylobacter, Azorhizobium, Azospirillum, Rhizobium, Bradyrhizobium, Sinorhizobium, Novosphingobium, spp.), beta (Burkholderia sp.), gamma (Acinetobacter, Aeromonas, Azotobacter, Enterobacter, Klebsiella, Pantoea, Pseudomonas, Stenotrophomonas spp.) Proteobacteria, Bacilli (Bacillus, Paenibacillus spp.) and Actinobacteria (Microbacterium sp.). Besides, all bacterial strains possessed the intrinsic PGP traits of like indole (0.44-7.4 µg ml(-1)), ammonia (0.18-6 mmol ml(-1)), nitrite (0.01-3.4 mol ml(-1)), and siderophore (from 0.16-0.57 µmol ml(-1)) production. Inoculation of rice (cv. Swarna) seedlings with selected isolates had a positive impact on plant growth parameters like shoot and root elongation which was correlated with in vitro PGP attributes. They indicated that the diverse polyvalent phytonic PGP bacteria, which may be exploited as bio-inoculants to improve rice production. Shasmal M et. al. (2012) analysed a 3D cryo-EM map of the 70S ribosome from Mycobacterium smegmatis, a saprophytic cousin of the etiological agent of tuberculosis in humans, Mycobacterium tuberculosis. In comparison with the 3D structures of other prokaryotic ribosomes, the density map of the M. smegmatis 70S ribosome reveals unique structural features and their relative orientations in the ribosome. Dramatic changes in the periphery due to additional rRNA segments and extra domains of some of the peripheral ribosomal proteins like S3, S5, S16, L17, L25, are evident. One of the most notable features appears in the large subunit near L1 stalk as a long helical structure next to helix 54 of the 23S rRNA. The sharp upper end of this structure is located in the vicinity of the mRNA exit channel. Although the M. smegmatis 70S ribosome possesses conserved core structure of bacterial ribosome, the new structural features, unveiled in this study, demonstrates diversity in the 3D architecture of bacterial ribosomes. They postulate that the prominent helical structure related to the 23S rRNA actively participates in the mechanisms of translation in mycobacteria. Saha DC and Padhy PK (2011) stated that The Rajmahal-type quality stones for building purposes are found abundantly in Birbhum district, West Bengal, India, where stone mining and crushing have become the main industrial activity. Although crusher dust is injurious to health, demand for crushed stone is ever-increasing as a result of rapid infrastructural growth in the country. Most of the crusher units at Rampurhat are situated along the roadways adjacent to forest under Tumboni Beat of Rampurhat Range of Birbhum Forest Division. Excessive load of air pollution in this area has led to degradation of this forest. The status of the ambient air and noise level was evaluated. The effect of air and noise pollution on abundance and variability of birds in this forest have been compared to an almost non-polluted forest of the same bio-geographic zone. Both species diversity and population density of birds were found to decrease in the polluted forest, especially in the areas adjacent to crushers. For comparing the pollution status of two different forest sites and for establishing whether the density of birds have any correlation between the sites, the Student's t-test and the chi-square test were applied respectively. Most of the results proved to be significant.

There is growing concern about the health consequences of biodiversity loss and change. Biodiversity changes affect ecosystem functioning and significant disruptions of ecosystems can result in life sustaining ecosystem goods and services. Biodiversity loss also means that we are losing, before discovery, many of nature's chemicals and genes, of the kind that have already provided humankind with enormous health benefits. Biodiversity plays a crucial role in human nutrition through its influence on world food production, as it ensures the sustainable productivity of soils and provides the genetic resources for all crops, livestock, and marine species harvested for food. Access to a sufficiency of a nutritious variety of food is a fundamental determinant of health. Nutrition and biodiversity are linked at many levels: the ecosystem, with food production as an ecosystem service; the species in the ecosystem and the genetic diversity within species. Nutritional composition between foods and among varieties/cultivars/breeds of the same food can differ dramatically, affecting micronutrient availability in the diet. Healthy local diets with adequate average levels of nutrients intake, necessitates maintenance of high biodiversity levels. Intensified and enhanced food production through irrigation, use of fertilizer, plant protection (pesticides) or the introduction of crop varieties and cropping patterns affect biodiversity, and thus impact global nutritional status and human health. Habitat simplification, species loss and species succession often enhance communities vulnerabilities as a function of environmental receptivity to ill health. Importance of biodiversity for health research and traditional medicine: Traditional medicine continues to play an essential role in health care, especially in primary health care. Traditional medicines are estimated to be used by 60% of the world's population and in some countries are extensively incorporated into the public health system. Medicinal plant use is the most common

medication tool in traditional medicine and complementary medicine worldwide. Medicinal plants are supplied through collection from wild populations and cultivation. Many communities rely on natural products collected from ecosystems for medicinal and cultural purposes, in addition to food. Although synthetic medicines are available for many purposes, the global need and demand for natural products persists for use as medicinal products and biomedical research that relies on plants, animals and microbes to understand human physiology and to understand and treat human diseases. Infectious diseases: Human activities are disturbing both the structure and functions of ecosystems and altering native biodiversity. Such disturbances reduce the abundance of some organisms, cause population growth in others, modify the interactions among organisms, and alter the interactions between organisms and their physical and chemical environments. Patterns of infectious diseases are sensitive to these disturbances. Major processes affecting infectious disease reservoirs and transmission include, deforestation; land-use change; water management e.g. through dam construction, irrigation, uncontrolled urbanization or urban sprawl; resistance to pesticide chemicals used to control certain disease vectors; climate variability and change; migration and international travel and trade; and the accidental or intentional human introduction of pathogens. Biodiversity provides numerous ecosystem services that are crucial to human well-being at present and in the future. Climate is an integral part of ecosystem functioning and human health is impacted directly and indirectly by results of climatic conditions upon terrestrial and marine ecosystems. Marine biodiversity is affected by ocean acidification related to levels of carbon in the atmosphere. Terrestrial biodiversity is influenced by climate variability, such as extreme weather events (ie drought, flooding) that directly influence ecosystem health and the productivity and availability of ecosystem goods and services for human use. Longer term changes in climate affect the viability and health of ecosystems, influencing shifts in the distribution of plants, pathogens, animals, and even human settlements.

Control the causes of significant injury to biodiversity, and adopt measures to avoid or minimize adverse impacts on biodiversity. Establish a system of protected areas and take measures to promote environmentally sound development in areas adjacent to protected areas. Both within and outside of protected areas, manage biological resources to ensure conservation and sustainable use; promote the protection of ecosystems, natural habitats and maintenance of viable species populations in natural surroundings; develop laws to protect threatened species or populations. Rehabilitate and restore ecosystems and promote recovery of threatened species. Control the risks of the use and release of genetically modified organisms likely to have adverse impacts on biodiversity. Create incentives for the conservation and sustainable use of components of biological diversity. Promote and encourage public understanding of biodiversity conservation. Protect, preserve, and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant to the conservation and sustainable use of biological diversity. Promote their wider applications with the approval and involvement of their holders, and encourage equitable sharing of the benefits of using this knowledge. Take measures for ex situ conservation (i.e., conservation outside the natural environment) of biodiversity components as an essential complement to the primary conservation measures of habitat protection and restoration. This includes establishment and maintenance of gene and seed banks

CONCLUSION

It may be concluded that biophysical diversity of microorganisms, flora and fauna provides extensive knowledge which carry important benefits for biological, health, and pharmacological sciences. Significant medical and pharmacological discoveries are made through greater understanding of the earth's biodiversity. Loss in biodiversity may limit discovery of potential treatments for many diseases and health problems.

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ONE NEW VARIETY OF *MELIOLA ACALYPHIDIS* TORO FROM SOUTHERN WEST BENGAL

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ABSTRACT

During mycological survey in 2005-2006, one new variety of *Meliola acalyphidis* Toro causing leaf spots on one medicinal plant *Acalypha indica* L. (Euphorbiaceae) was collected from district East-Midnapur, West Bengal, India. It is described and illustrated in this paper. The critical survey of literature revealed that no variety of *M. acalyphidis* Toro has been recorded on host *Acalypha indica* L. (Family-Euphorbiaceae) hitherto. Hence this is reported for the first time from West Bengal of India. The main object of this study is to identify the known and unknown pathogens which cause diseases on the economically important plants. Secondly, this study would be helpful to a fungal taxonomist to arrange the fungi in different groups under biodiversity study. The holotype is deposited in Mycological Herbarium, Post Graduate Department of Botany, Presidency College, presently Presidency University, Kolkata, West Bengal, India (PCC 5730).

Key words: Meliolaceae, *Meliola acalyphi* var. *indica* var. nov., fungal taxonomy , new variety, West Bengal, India.

INTRODUCTION

Leaf inhabiting fungi are the most fascinating ones, which attracted attention of many workers all over the world since a long time. They cover a wide range of fungi. During mycological survey in 2005-2006, several interesting foliicolous meliolaceous fungi were collected from district East-Midnapur of West Bengal, India. This paper deals with description of one new variety of *Meliola acalyphidis* Toro. A large no. of researchers have done their work on meliolaceous fungi viz. Bilgrami *et al.* (1979, 1981, 1991); Crane and Jones (2001); Hansford (1961); Hosagoudar (1996, 2004, 2008, 2010, 2013); Hosagoudar *et al.* (1998, 2000, 2010, 2011); Jamaluddin *et al.* (2004); Jana *et.al.* (2005, 2006, 2007, 2008, 2009), Kar and Maity (1970), Patil and Thite (1997). Patil and Mahamulkar (1999), Sarbhoy *et al.* (1996).

MATERIALS AND METHODS

Infected plant parts were noticed carefully in the field, field notes made regarding their pathogenicity, nature of infection, locality, altitude etc. In the field each infected plant parts were collected separately in the polythene bags. These infected plant parts were pressed neatly and dried in-between blotting papers. For microscopic study, scrapes were taken directly from the infected leaves of hosts and mounted in 10% KOH solution. After 30 minutes, KOH was replaced by Lacto-phenol, prepared according to Rangaswami, 1975. After the study of each collection, the holotypes were deposited in Mycological Herbarium, Post Graduate Department of Botany, Presidency College, presently, Presidency University, Kolkata, West Bengal, India (PCC 5730).

RESULT AND DISCUSSION

Coloniae amphigenae, maxime epiphyllae, nigrae, densae, velutinae, subdensae vel densae ad 3 mm diam., dispersae, raro conluentes. Hyphae subrectae, undulatae vel anfractuae,, bruneae, septatae, plerumque alternatae acuteque ramosae, dense reticulatae, cellulae plerumque 18-34 x 6-9 µm. Appressoria alternata, ad 10% opposita, recta vel curvula, antrorsa vel patentia, bicellula, atrobrunnea, 17-27 µm longa; cellula basali cylindracea vel cuneata, 3.5-10 x 3.5-8 µm; cellula apicali ovata, globosa, integra, sublobata vel stellatus lobata, 12-19 x 10-15 µm. Phialides producentes in ramus separates myceliales, alternatae, raro oppositae, ampulliformes, 15-27 x 6 -10 µm. Setae myceliales numerosae, dispersae vel juxta perithecia aggregatae, rectae, nigrae, 400-800 x 7.5-10 µm, irregularis bifurcatae vel trifarcatae ad apicem, 15-20 µm longae. Perthecia dispersa, globosa, nigra, verrucosa, 140-200 µm diam. Asci ovales vel elliptici, 2-4 sporae. Ascosporae ellipsoidae vel obovoideae, 4-septatae, rectae vel leniter curvulae, utrique rotundatae, fortifier septis constrictae, medio cellula largus, 35-45 x 14-18 µm.

Colonies amphigenous, mostly epiphyllous, black, velvety, subdense to dense, up to 3 mm in diameter, scattered, rarely confluent. Hyphae substraight, undulate to crooked, brown, septate, branching mostly alternate at acute angles, closely reticulate, cells mostly 18-34 x 6-9 µm. Appressoria alternate, about 10% opposite, straight or bent, antrorse to spreading, straight to curved, 2-celled, dark brown, 17-29 µm long; stalk cells small, cylindrical to cuneate , 3.5-10 x 3.5-8 µm ; head cells ovate, globose, entire, sublobate to stellately lobate, 12-19 x 10-15 µm. Phialides borne on a separate mycelia branch, alternate, rarely opposite, unicellular, pale brown, ampulliform, 15-27 x 6 -10 µm. Mycelial setae numerous, scattered to grouped around perithecia, straight, black, 400-760 x 7.5-10 µm, irregularly bifurcate to trifurcate at the apex, 15 to 25 µm long. Perithecia scattered, black, round with verrucose wall, seated in the centre of the mycelial colony, 140-200 µm in diam. Asci few, oval to elliptical, 2-4-spored. Ascospores ellipsoid to obovoid, broad, 4-septate, straight to slightly curved, rounded at ends, deeply constricted at the septa, middle cell larger, dark brown, 35-45 x 14-20 µm.

Specimen studied: On leaves of *Acalypha indica* L. (Family-Euphorbiaceae), Heria, East-Midnapur, West Bengal, India, Coll. T. K. Jana, 05.12, 2005, PCC 5730 (Holotype).

Etymology: From the name of the species.

Table 1. Comparative account of *Meliola acalyphidis* Toro and *M. acalyphidis* var. *indica* var. nov.

Name of fungi	Colonies	Appressoria	Mycelial setae	Ascospores
Meliola acalyphidis	Epiphyllus	Alternate; Head cells entire or irregularly angulose to lobate, 13-18 x10-14 µm.	650 x 8-10 µm, apex variously and irregularly dentate or bifurcate to 20 µm, with branches dentate.	Oblong, constricted, 38-44 x 16-18 µm.
Meliola acalyphidis var. *indica* var. nov.	Amphigenous, mostly epiphyllus	alternate, about 10% opposite; head cells ovate, globose, entire, sublobate to stellately lobate, 12-19 x 10-15 µm.	400-760 x 7.5-10 µm, irregularly bifurcate to trifurcate at the apex, 15 to 25 µm long.	ellipsoid to obovoid, broad, straight to slightly curved, deeply constricted at the septa, middle cell larger, 35-45 x 14-20 µm.

Meliola acalyphidis was reported by Toro (1934) on host *Acalypha* sp. (Family-Euphorbiaceae) from Venezuela (Hansford, 1961). The proposed new variety viz. *M. acalyphidis* var. *indica* var. nov. from India is close to *M. acalyphidis* Toro but differs from it in having ovate, globose, sublobate to stellately lobate head cells of appressoria (head cells of appressoria ovate, entire or irregularly angulose to lobate in *M. acalyphidis* Toro), irregularly bifurcate to trifurcate mycelia setae and up to 760 µm long (mycelia setae variously and irregularly dentate or bifurcate with branches dentate and upto 650 µm long in *M. acalyphidis* Toro), ellipsoid to obovoid ascospores with larger middle cell (Oblong ascospores in *M. acalyphidis* Toro). The critical survey of literature revealed that no variety of *M. acalyphidis* Toro has been recorded on host *Acalypha indica* L. (Family-Euphorbiaceae) hitherto. It is therefore suggested as a new variety of *M. acalyphidis* Toro and reported for the first time West Bengal of India (Table-1).

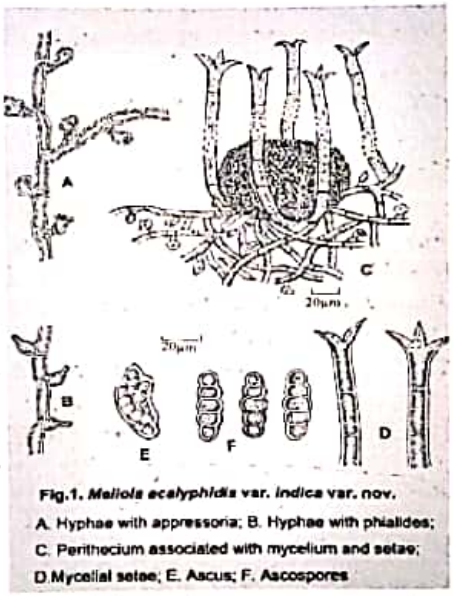

Fig.1. *Meliola acalyphidis* var. *indica* var. nov.
A. Hyphae with appressoria; B. Hyphae with phialides;
C. Perithecium associated with mycelium and setae;
D.Mycelial setae; E. Ascus; F. Ascospores

Fig. 1 *Meliola acalyphidis* Toro var. *indica* T. K. Jana *et.* A. K. Das var. nov.

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BIRDS ARE GOOD BIODIVERSITY INDICATORS

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ABSTRACT

Scientists have invented many instruments to measure the health of ecosystem. But, in research, it comes out that health of ecosystem can be predicted by the living being, the bird and its behaviour. Such living organism that is used in such a manner is called an indicator species. Birds can be a good indicator of any place's biodiversity. As example, woodpecker species diversity would serve as a proxy for avian diversity of that area. Species richness in birds is correlated with woody plants and aquatic herpetofauna. Birds also indicate the pollution level and disease outbreak. In my present study, in Medinipur District, I have found one woodpecker species, but around 63 species of different birds which indicate diversity of avifauna also indicates phyto-diversity but needs more research to predict the health of Biodiversity of Southwest Bengal.

Key words: Biodiversity, Birds, indicator species, associatal species, habitat conservation.

INTRODUCTION

Birds are the most important component of environment as well as biodiversity. They inhabit on the trees and in aquatic bodies mainly. To fetch food they move as wader in marshy places and also on soil. They make their nest on trees that are another important component of environment. Birds prove themselves as biodiversity, pollution and disease indicator. As example, diversity of woodpecker species indicates the presence of diverse type of birds and also diversity of plants. Diversity of bird species and species richness correlate with the woody plants and aquatic herpetofauna. I am studying on birds of southwest Bengal. So far I have been found 63 bird species; most of them are common birds. Some of the birds are winter migrant or partial migrant. One bird is near threatened. The bird is black headed ibis which is recorded by me from Kuldiha area of Paschim Medinipur. So, this place is good habitat for so many birds those migrate from far of places to find their friendly environment. Some birds are extinct, some are endangered, some are threatened and some are vulnerable. Some examples of extinct birds are dodo, giant moa, great auk and passenger pigeon. They are extinct because of human intervention. Use of chemical as pesticides and bovine medicine affect the health of birds, *e.g*, some Bengal Vultures. Now a day, they are critically endangered. They are ***Critically Endangered*** because of using Diclofenac, Draxin and Micotil which are drugs used for cattle to cure respiratory disease, foot rot and pain. Now they are critically endangered, so they need conservation. Vultures are effective biological scavengers. Birds also indicate disease outbreak, *e.g.*, early crow death during 2000 in North America during the outbreak of west Nile viruses.

So, Birds are very effective biological tool who can predict any environmental or pathogenic changes before humans can. Like house sparrow, those are decreasing due to electronic waves from cell phone towers because it affects their health. So, we can say that, it will obviously affect human in near future. Therefore, it should be re-modified. In my study area I also counted the less abundance of sparrows except in mud houses and cow sheds. So it is a big challenge to collect the data of diverse bird species from my study area and to save them at present and future. The opportunity is, there are so many sanctuaries but very few research works on those areas are done till date in details, therefore we should go for more detail study again and again.

STUDY AREA

Selected study area includes entire Midnapore Town and its surround forest areas including Kansai belt. Agricultural croplands also visited frequently. Degraded land habitat beside the University campus was taken for study.

RESULT AND DISCUSSION

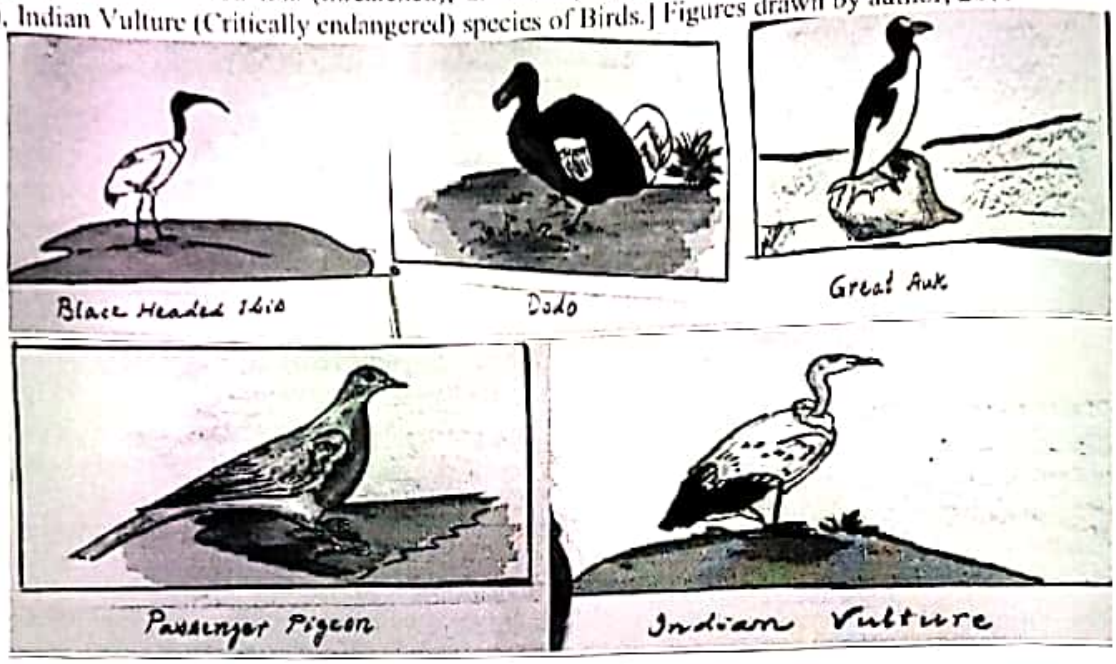
In the present study area at Midnapore Town and its surrounidings, I have been recorded many bird species round the year. These ate red vented bulbul, red whiskered bulbul, black winged kite, black kite, jungle myna, bank myna, common myna, Asian koel, brainfever bird, brown shrike, Indian roller, common kingfisher, white breasted waterhen, scaly breasted munia, black throated munia, black drongo, house crow, northern raven, spotted owlet, barn owl, coppersmith barbet, blue throated barbet, fulvous breasted woodpecker, lesser goldenback, Indian pond heron, black crowned night heron, black hooded oriole, black naped oriole, Asian paradise flycatcher, Common sandpiper, intermediate egret, black headed ibis, yellow footed green piegeon, white breasted kingfisher, stork billed kingfisher, oriental magpie robin, jungle babbler, asian pied starling, chestnut tailed starling, hoopoe, great cormorant, little cormorant, rufous treepie, cheastnut tailed starling, oriental darter, purple sunbird, house sparrow, Eurasian collared dove, spotted dove, laughing dove, rock pigeon, paddyfield pipit, ashy headed sparrow lark, common chiff chaff, greater coucal and green bee eater. Some birds listed here are nocturnal like barn owl and

spotted owlet. The spotted owlet is nocturnal but is also seen during day time. Only these two nocturnal birds are observed by me in my study area. May be more are there, so need regular observation. Other birds are diurnal but sometimes the greater coucal is seen in night times. The bee eaters also stay till 7: 30p.m. This is the highest time the bee eaters stay. Black drongo catches insects during night in presence of street light because insects are attracted towards the light. So the drongos seat near the light on the electric poles and on electric wires. In the early morning we saw spotted owlets on banyan tree but they fly freely from one big tree to another mango tree. Crows follow the spotted owlests in that time. Barbets of various kind have been observed by me but lineated barbet and brown headed barbets are found here occossaniolly.

CONCLUSION

So, birds are litmus of the environment, "if birds die we also die" (anonymous, 2017). Wood pecker species indicate the diversity of species. So, it needs more research in our study area. Though flora and fauna study in Southwest Bengal reported that this area is not so far polluted avifauna study put some question mark of those observations.

Plates: 1-5 [1. Black-headed ibis (threatened), 2. Dodo (Extinct), 3. Great Auk (Extinct), 4. Passenger Pigeon (Extinct), Indian Vulture (Critically endangered) species of Birds.] Figures drawn by author, 2017



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DIVERSE USE OF SOME EATABLE MEDICINAL PLANTS, FRUITS AND FLOWERS OF SOUTHWEST BENGAL WITH SPECIAL REFERENCE TO MARKET DEMAND

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ABSTRACT

Lower tract of Chotanagpur in India has a great range of vegetation but in contrary the Rarah of Southwest Bengal boosts luxuriant growth of varied natural resources that might be a source of different indigenous food and feed that harbour large scale economy to the Rarah people. Southwest Bengal part of the West Bengal, is homogenous to its natural beauty, consequently its apex has a large number of tribal people which have the opportunity to use diverse type of food, fodder, medicinal plants, beverages, flower and different indigenous plant products. But fact is that the proximal line for eco-development is eco-culture and eco-heritage. So, context and contrast in both the lower and upper part exhibit a parallel line for the sustainable use of resource and mobilization of resource as the people is under same level. So, attributes of culture, society and environment, intake of food and fodder and flow line of variability make the land homogenous though there is much heterogeneity in North Bengal of West Bengal. The present article reflects diversity of eatable medicinal plants, fruits, some flowers and fruits which need to withstand the ecosystem pristine rather than degraded. Hope that all the indigenous Rarah people along with migratory people would take initiative to restore the ecosystem healthy wealthy and scenic day by day which needs more meaningful management in near future.

Key words: Southwest Bengal, eatables, market, management, conservation.

INTRODUCTION

Medicinal plants are plants of special kind which are used in various purposes to cure the ailments of man and animals. It is very important because unknowingly we are applying those that have in general had a traditional value based importance. Say for example, *Momordica charantia*, *Luffa acutangula* and *Sechium edule*. The prior two are antidiabetic and the last one is multifunctional and applicable everywhere in hill of West Bengal including neighbouring states of India. People use leaf, twigs, fruits and tuberous roots for various ways like vegetables and preparation of pickles even to reduce the indigestion. In our area other medicinal plants like *Moringa* and *Enhydra* are leafy vegetables used widely to cure the skin disease even for the precaution to small pox disease. Some plants used by people round the year to recover the constipation. West Bengal Rarh part is a treasure of medicinal plants. Revealed literature suggested that a large of plants used by various parts of South Bengal as medicinal (Anonymous [1-6]) which have been published by Govt. of West Bengal, Forest Directorate to popularize plants as medicinal plants. Not only from the above mentioned source, but from our childhood we see that leafy vegetables are tasty even used to procure the fish and meat. In coastal area, people use *Carissa spinarum* twigs to procure the spoiled fish, event they use the liquor of tea to tasty the rotten fish and meat. The antioxidant properties of some green vegetables and fruits recover the scavenging parts and event the damaged cells of the body. Minerals, vitamins and different fibres improve the body and make it suitable for disease resistance. In this Rarh area we see common plants that are found and marketed time to time. People use the plants, fruits, flowers and the associated parts for their home meal preparation. The list of all eatables is given below:

Medicinal Plants: *Paederia foetida, Moringa pterigosperma, Momordica charantia, Lagenaria cicarera, Benincara indica, Musa sapiens, Mentha piperata, Enhydra fluctuens, Asteracanthus longifolius, Centella asiatica, Ocimum sanctum, Andrographis paniculata, Adhatoda vasica, Nyctanthes arbour-tristis, Dioscorea bulbifera, Bauhinia variegate, Aloe vera, Allium sativum, Allium cepa, Zingiber officinale, Capsicum annum, Solanum viarum, Solanum torvum, Solanum anguivii.*

Fruits: *Terminalia bellerica, Terminalia chebula, Phyllanthus emblica, Aegle marmelos, Borassus flabellifer, Phoenix sylvestris, Flacourtia indica, Feronia elephantum, Ficus glomerata, Cucurbita pepo, Lagenaria cicerera, Mangifera indica, Dillenia indica, Artocarpus integrifolia, Artocarpus lakoocha, Averhhoea carambola, Tamarindus indica, Ziziphus jujuba, Spondias dulce, Citrus decumena, Cocinia cordifolia, Tricosanthes dioica.*

Flowers: *Sesbania sesban, Moringa pterigosperma, Bauhinia racemosa, Musa paradisiaca, Tamarindus indica, Cucurbita pepo, Cordia myxa, Nyctanthes arbour-tristis.* In the Rarh region maximum plants and their produces are highly eatables. So, study and research is essential to qualify the fate of these plants and their products. Remembering these present studies was undertaken.

AREA UNDER STUDY

Study area includes four lateritic districts of West Bengal namely Jhargram, PaschimMedinipur, Bankura, and Purulia. The villages and remote villages including hill and plain forest areas have been recorded to observe the plants used by people along with market demand after study at daily markets and weekly markets. In some cases market study was conducted with local people after identified the markets like Nayagram, Lalgarh, Panchkhuri, Balarampur, Purulia, Jhargram, Murardi, Saltora, Joypore, Ramkanali and Bishnupur.

MATERIALS AND METHODS

Questionnaire was made and asked questions to resource persons at different places to know the status of produces including the status of plants, their market value and demand among people. Seasonal study at field in different forest and home premises of tribal community have been done to analyze the potential use of these Non-timber forest produces (NTFPs). Their fate and possible conservation measures have been pointed as per the ideas and methods taken from the people. Data was developed and specimens were collected and analyzed to know the biomass of the species produced. Species identified using local flora and books on medicinal plants were consulted published by Forest Directorate, Govt. of West Bengal, Research wing, time to time. Specimens were housed in personal custody to make herbarium specimens later. Books and published literature used time to time to identify the Rarh based medicinal plants in our area [7-14] including other plants from community based protected area [15].

RESULT AND DISCUSSION

In the present study, ten (10) common plants were recorded which have huge value and used by local people of the said region (Table 1). Similarly six (6) species were used as flowers by tribal people during starvation (drought and flood) as the region has various tribal people (table 2). In the same study twelve (12) medicinal plants have been recorded from Rarh areas which have been used by local people for direct use as well as for market sale (Table 3). Seven (7) plants were used as fodder plants (Table 4) as the site has a large number of domesticated animals. The market value of some commodities available in the said region is high. These are transported from local market to big markets even from filed to weekly market. The resource has a high potential as the demand is moderately high. Indigenous people collected the materials from field and procure them for long term preservation. Good example is lac (from *Laccifera lacca* insects), tassar and mahua (*Madhuca indica*) flowers at Balarampur market in Purulia. The people are flexible to collect these items from field. These are forest, country yards and from gardens of local people. Demand and fate vary from season to season though mushrroms and resins are highly valuable. It is observed that only the monsoon and post monsoon seasons are better for study and analyze the data in field.

Table 1. Usable plants of common use in Rarh Region

Sl. No.	Common Name	Scientific Name	Habitat
1.	Amlaki	*Emblica officinalis*	Planted as well as Forest plant
2.	Bahera	*Terminalia bellerica*	Forest plant
3.	Haritaki	*Terminalia bellerica*	Forest and degraded land
4.	Kalo Jam	*Syzygium cumini*	Every where
5.	Aam	*Mangifera indica*	In all the land forms
6.	Bel	*Aegle marmelos*	Here and there
7.	Kotbel	*Feronia acidissima*	In premises of open Country yards
8.	Kend	*Diospyros melanoxylon*	Forest and degraded stand
9.	Boichi	*Flacourtia indica*	Margin of forest and in degraded land
10.	Kul	*Ziziphus jujube*	Wasteland, forest, degraded land and aside the pond, river and jheel

Table 2. Flowers used instantly for various purposes

Sl. No.	Common Name	Scientific Name	Habitat
1.	Sajne	*Moringa oleifera*	In the garden of local people
2.	Kural	*Bauhinia racemosa*	In forest area
3.	Bokful	*Sesbania sesban*	Country yard
4.	Kumra	*Cucurbita pepo*	Farmers garden
5.	Lau	*Lageneria cicerera*	Farmers garden
6.	Mahul	*Madhuca indica*	Forest and open field

Table 3. Medicinal Plants of local importance

Sl. No.	Common Name	Scientific Name	Habitat
1.	Bisalangali	*Gloriosa superb*	Forest, bushy patch, wasteland in shrubbery
2.	Anantamool	*Hemidesmus indica*	Forest and Waste land
3.	Satmuli	*Asparagus racemosus*	Forest and garden
4.	Iswarmul	*Aristolochia indica*	Forest and road side jungle
5.	Kumarika	*Smilax ovalifolia*	Forest
6.	Apang	*Achyranthes aspera*	Road side
7.	Talamuli	*Curculigo orchioides*	Forest and degraded stand
8.	Amlaki	*Emblica officinalis*	Plantation stand and forest
9.	Haritaki	*Terminalia chebula*	Forest and degraded land
10.	Bahera	*Terminalia bellerica*	Forest
11.	Tulsi	*Ocimum indicum*	Degraded land with human habitation
12.	Basak	*Justicia adhatoda*	Road side and in garden

Table 4. Plants used as Fodder

Sl. No.	Common Name	Scientific Name	Habitat
1.	Sabai	*Eulaliopsis binnata*	Degraded land
2.	Durba	*Cynodon dactylon*	Every where
3.	Kharang	*Aristida adscenccconoides*	Degraded land
4.	Kash	*Saccharum spontaneum*	Riverian belt
5.	Kodo	*Paspalum notatum*	Degraded forest
6.	Mutha	*Cyperus rotundud*	Waste land
7.	Jaldurba	*Oplismenus indica*	Forest patch and river belt

CONCLUSION

Rarh is a vast tract in West Bengal which has different types of geographical habitats and varied types of people with different food habits. Not only that, the area nurtures many types of quadrupeds usually grazed and browsed type in a large tract of geographical space. The animals and plants interact in the said ecosystem with a great deal of interaction along with various types of people and their lifestyle persists side by side in a sequential manner. Therefore, there is a scope of study in Rarh region to analyze eatables with the demand of the produces available in the region time to time. High demand reflects high risk of vulnerability with the aid of low frequency of availability of plant species. That indicates the threat locally of a great extent along with geographical territory which need present day research to conserve species for our sustenance. Hope that people will talk about the botanical identity with geographical amplitude to set up a managerial line for sustenance of species in near future.

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APPLICATION OF VAM FUNGAL BIOFERTILIZER: A CHALLENGE

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ABSTRACT
Our environment is complex one which consists of a large and diverse number of flora, fauna and abiotic factors. All components are influenced by each other. Alteration of abiotic components of our natural environment, obviously affect the health of flora and fauna of the said ecosystem. The negative effects caused by alteration of environmental abiotic factors make deleterious effect and the result is varied pollutions. Using various chemical fertilizers we unknowingly or knowingly decreasing the soil fertility and at the same time losing the rhizosphere organisms. These organisms help to make an eco-friendly healthy soil. Soil microorganisms such as bacteria, fungi, algae, symbiotically abode at the roots of the plants and helps in many ways. Some bacteria and algae help to increase soil nitrogen and at the same time supply the nutrients to the plant. Some fungi like vesicular arbuscular mycorrhizae (VAM) symbiotically penetrate in to the host plants feeder root cortex and a bridge with soil. The VAMF absorb various nutrients like N, P, K, Ca, Fe, Mn, Cu, Zn etc. from the soil and transfer these to its hosts. Not only that these fungi improve soil structure, suppress plant diseases and improve plant tolerance to water stress, salinity, soil acidity and heavy metal toxicity. Large scale applications of VAM fungi on selected plants show better yield as bio-fertilizer that increases chlorophyll content of leaves, carbohydrate and Protein contents. Hope that isolates from locally available VAM fungi would be a boon to restore the ecosystem pristine.
Key words: VA-mycorrhiza, Bio-fertilizer, applications.

INTRODUCTION

Fertilizer is that substance which helps to grow and produce more within less time. Its nature is living microorganisms that act directly in environment and interact with whole sphere that has no side effects. Now a day, it becomes a problem to use chemical fertilizer further as the huge use of chemical fertilizers alter the environment and reduce the micro flora of the said sphere even render the growth and development of other living components. So, the concept of using bio-fertilizer comes to scientist's mind. A vast research and widespread of applications of bio-fertilizers is going on globally to produce better yield on agricultural, horticultural and floricultural crops. The beneficial use of AM inoculums in agriculture and raising nurseries has been reported by many workers (Smith and Read, 1997). Inorganic fertilizers release nutrients faster but they increase soil acidity and induce cytological defects in crops (Tabur and Oney, 2009). Chemical fertilizers are also costly and effect on crop production. In recent years various researches went on VAM fungi and it has been shown that in addition to enhancement of phosphate uptake they showed several benefits to the host plants such as root disease control by biological means (Allay and Chakraborty, 2010), disease resistant (Pozo and Azcon-Aguilar, 2007), nodulation and improve absorption of nitrogen (Johansen et al. 1983), drought resistance (Powell and Bagyaraj, 1984, Auge et al. 2015), soil aggregation (Rilling and Mummy, 2006) and increase uptake of several micro and macro elements. So, VA-mycorrhizae have been used widely in agriculture, horticulture and afforestation programme in forestry and even reclamation of deserts (Sullia, 1991). Mycorrhizae help its host plants to get rid of from different types of stresses and increase uptake several micro and macro nutrients from soil which are needed for the host pants interactions and ultimately the growth. Mycorrhizal fungi have synergistic interactions with other beneficial organisms such as nitrogen fixers and phosphorus solubilizers (Sreenivasa and Bagyaraj, 1989). Therefore, the present study is important to popularize bio-fertilizers among all.

STUDY AREA

Present research includes forest soil, degraded soil and plantation stand soils of four districts of lateritic Southwest Bengal. These districts are Jhargram, Paschim Medinipuir, Bankura and Purulia. Floricultural plants as well as medicinal plants have been used by present author that are collected from Gopegarh forest area of Midnapore town and from Nayagarm degraded land of Jhargram District. *Kalanchoe pinnata* and *Catharanthus roseus* were used in experimental study including agricultural plant like *Curcuma amada* was taken for study of yield during the entire phase of study.

MATERIALS AND METHODS

Spores of different VA-mycorrhizal fungi were purchased from CNBRCD, Bangaluru for mass production of Bio-fertilizer. Forest soils, agricultural and degraded land soils were collected to extract local VAM fungi for inoculation of experimental plant by bio-fertilizers. Experiments were done for 6 months in net house under special

treatment. Results available from experiment was analysed with other positive data available from different research fields on VAM-fungal inoculums that are applied on selected plants as bio-fertilizers.

RESULT AND DISCUSSION

Sl. No.	Experimental Plants	Experiment with worker
1.	Cowpea and Black gram	Ofili et al. (2014) experimented with *Glomus mosseae* inoculum which was used on *Vigna unguiculata* to show the result of potential bio-fertilizer application. Arumugam et al. 2010 showed increase of chlorophyll content in Cowpea by using VAM and *Rhizobium* inoculum. Rao and Rao (1996) experimentally showed that VAM fungi increase nitrogen and phosphorus concentration in black gram.
2.	Sunflower	Chinnamuthu and Venkata Krishna (2001) worked on oil seeds. Inorganic fertilizer with vermicompost and VAM was used as integrated fertilizer and observed better productivity. Chandrasekhar et al. (1995) showed positive result with *Glomus fasciculatum* as substitute of phosphorus fertilizer.
3.	Green gram	Bhat et al. (2010) used *Rhizobium* and VAM dually to show the effect under temperate condition.
4.	Pomegranate	Aseri et al. (208) used VAM as bio-fertilizer which improved plant growth, fruit yield in Indian Thar desert.
5.	Chilli	Gour et al. (1998) used indigenous mixed culture, *Glomus intraradices* used on Chili and observed better fruit yield.
6.	Papays and Pineapple	Rodrigue-Romero et al. (2011) showed reduction on necessity of phosphorous fertilizer by using VAM fungi during nursery stage under experimental condition.
7.	Brinjals	Konde and Sonar (1990) have worked on Dorli, Pragati etc. varieties of Brinjal responsive to VAM fungi.
8.	Life Plant and Periwinkle	Ghosh (2017) studied on experimental plants like *Kalanchoe pinnata* and *Catharanthus roseus* which showed better result as yield (chlorophyll, protein and total carbohydrate content of plants) with *Glomus mosseae, Acaulospora laevis* and *Gigaspora margarita.*
9.	Long piper	Seema and Garampalli (2015) showed biomass enhancement by using AM fungi on *Piper longum* L. (Piperaceae) plant.

CONCLUSION

Natural soils offer consortium of indigenous mycorrhizal fungi and can be used as a source of potent inocula. To improve the growth and better yield, locally isolated VAM fungi is suitable which is cost effective even easy to handle by experts as well as by local people. It is proved experimentally by so many research workers that indigenous VAMF widely applicable for many crop plants for betterment of yield, but field application itself is a challenge to prove it. Therefore, vast research on this field is recommended for future improvement even wide spread use of bio-fertilizers on crops over the globe.

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DIRECT VALUE OF BIODIVERSITY: A CASE STUDY ON BINODE SMRITI AGRI-HORTICULTURAL FARM, RAJSAHAR, PANSKURA, PURBA MEDINIPUR

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ABSTRACT

A few years I have planted Song of India and Victoria plants in my farm house previously which was filled with roses and gladioli including various ornamentals. These plants name could be many more in varied geographical areas but all people are familiar with Dracaena globally. Varieties of the plants grow a variety of places but the theme is that they grow under stress prone condition. Plants of those types have great economic value based on the production of leaves and twigs which have great demand. So, I think these plants may be planted and culture under controlled condition (Net house) which could be a source of income generation in rural India, nay everywhere globally in which labour and scientific manipulation is neglected. Cost and benefit analysis is a great challenge to make greater opportunity in near future for more income generation from the plant products in a garden or farm. The present article reflects insight for income generation through plantation of Victoria and Song of India in garden or a farm house.

Key words: Direct Value of Biodiversity, Victoria-Song of India, Indirect value, income generation.

INTRODUCTION

The General information of the cultivation method is given below:

Expenditure for cultivation of a Decimal land:

A decimal land required the following head wise expenditure incurred during cultivation:

(A) Plantlets and manure Cost-

Sl. No.	Items	Cost in Indian Rs.	Total (Rs.)
	Plantlet 100 Nos.	Rs. 25/- per plantlet	2500.00
	Organic manure:		
	a. Mustard Oil Cake 3kg	Rs. 25/- per Kg.	75.00
	b. Bone Dust 3 Kg.	Rs. 25/- per Kg.	75.00
	Inorganic manure		
	a. NPK 2 Kg.	Rs. 25/- per Kg.	50.00
	TOTAL (A)		2700.00

N.B.: Ratio of Organic to inorganic= 6:2 i.e. 3:1

(B) Ploughing and taking intermediate Care in field:

Sl. No.	Items	Cost in Indian Rs.	Total (Rs.)
1	Ploughing 2 times	Rs. 50/- per time	Rs. 100.00
2	Intermediate caring (Weeding and spraying of insecticide including fungicide)	Rs. 100/-	Rs. 100.00
3	Harvesting and others	Rs. 100/-	Rs. 100.00
	TOTAL (B)		Rs. 300.00

Gross expenditure is : C= A + B =Rs. 2700.00 plus Rs. 300.00 i.e. Rs. 3000/- per decimal land

Production and Income Generation:

Victoria plants get yield i.e. leaves obtained from a plant in field after 3 months. Annually a plant releases 50 leaves and the Song of India gets 100 twigs from a decimal land if condition fulfilled from every corner. Each leave of Victoria sale @ Rs. 1/-. Details information is given below:

(D) Income in terms of Money for Victoria plant cultivation in a decimal land

Sl. No.	Information item wise	Sale Price (Rs.)
1	Victoria plant releases 50 leaves/annum	
	So, 100 plants release 100 x 50 leaves/annum	Rs. 5000.00
2	Song of India releases 1 twig per plant	
	So, 100 plants release 100 twigs/annum	Rs. 5000.00

N.B.: A land capacity is only for a type of plant not the both type

Net Income:

Net income for Victoria is calculated on the basis 1 decimal land is: D-C= Rs. 5000.00 minus Rs. 3000.00= Rs. 2000.00. Therefore, 1 acre land may get Rs. 2000.00 x 100 = Rs. 2, 000, 00.00 per acre per year (Here, 100 decimal is equivalent to 1 acre land).

For Song of India, cultivation practice is same but the harvesting period is different. Here, 2 years or more time is required to get final crop. The old plants get more and more branches therefore too much old plant means more profit. A twig is used as an ultimate product whereas in case of Victoria plant, leaf is used as main product or crop. Sale price for a twig of Song of India is amounting Rs. 5/- (five only).

Fig. 1 Dracaena plantation, Mature plant in garden, plants in nursey under nethouse condition

In addition to these mentioned above we can get more profit from cuttings i.e. made by air layering. During soil preparation, shallow ploughing is essential though the soil after ploughing need activation by using organic manure and get sun drying for at least 20 days. In general air layering process done in net house (Fig. 1) of Rajsahar Garden, Panskura. Intermediate care includes cleaning of weeds, different dead parts of leaves etc. Glycil is used as herbicide. To remove fungal infection Bordeaux mixture is used. Watering done directly to the base of the plant without spraying from top, attachment of leaves to the ground should be discarded to protect infection made by pathogenic fungi and bacteria. Infected leaves should be discarded and placed in a place and after drying make them ash using fire to remove pathogen from inoculums. Micronutrients used time to time. Available micronutrients are agromin (2g/Lwater), phytonol (1 ml/3L water), trasco 5 (1ml/L). Surface water is used without deep water to avoid heavy metal toxicity. Cao and Cupper sulphate used 1% for soil and 0.5% for plant treatment. Cuttings need application of Cupper sulphate to check entry of pathogens. In market metalaxyla and mancozeb is available which may be used 2g/L to check fungal infection. Insecticides like hamla or metacid may be used. To check devastating fungal infection mencozeb and carbondazem is used widely, the mixture is so called saf. To check the soft rotting of leaves aso for stem netifo is used.

Harvesting:

Leaf Cutting of Victoria is done during evening. A bundle of leaves of Victoria contains 20 to 25 leaves depending upon the size and volume of the leaves. It also depends upon the instructions of salesmen who are buying these from the garden.

Information and Knowledge Gathered:

Dr. Vivekananda Mahanti, Assistant Director of Agriculture, Panskura, Purba Medinipur; Sufal Mandal, District Horticultural Officer, Purba Medinipur; Dr. Debabrata Das, Associate Professor & Head, Department of Botany, Lalgarh Govt. College, Jhargram; Smt. Pampi Ghosh, Asst. Prof. and Head, Department of Botany, Seva Bharati Mahavidyalaya, Kapgari, Jhargram etc.

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DEVIL UMBRELLAS: THEIR BIO-DIVERSITY AND IMPORTANCE

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ABSTRACT

The structure that we call a mushroom is only the fruiting body of the fungus. Although mushrooms are considered to be delicious in various parts of the world, but not all varieties are edible. Consuming poisonous mushrooms can cause adverse effects on the body, ranging from gastrointestinal irritation to kidney failure. The reason behind this is that certain mushrooms contain toxic substances that are often misidentified as edible mushrooms. There are over thousand types of mushroom identified in the world, out of which around 32 varieties are considered to be fatal and about 53 varieties to be relatively less toxic. Every mushroom consumer should be familiar with the five dangerous groups of fungi. These are:-1.Amanitas, 2.The false morels, 3.Little brown mushrooms, 4.Jack-o'lantern, 5.Green-Spored Lepiota. Out of which about 13 varieties are found in South West Bengal which belong to the groups of amanita, false morels and little brown mushrooms. Mushrooms in the first three groups cause virtually all the fatal mushroom poisonings in the world, accounting for 90 percent of mushroom-related deaths and disease by their toxins like amatoxin, gyromitrin, muscarine, Ibotenic acid etc. There are also hundreds of other mushrooms belonging to the last two groups may cause mild stomach-ache, vomiting, diarrhoea, cramps and loss of coordination. Though some mushrooms prove fatal but they must be conserved as they enrich the biodiversity and also most importantly, their role as the sole decomposers can never be overlooked.

Key Words: Biodiversity, Mushroom, Amanitas, Morels, Jack-o'lantern, Conservation.

INTRODUCTION

Mushroom is a saprophytic fungus that grows on dead and decaying organic matter. Although mushrooms are considered to be delicacies in various parts of the world, not all varieties are edible. Wild mushroom consumption leads to mushroom poisoning, commonly known as mycetism, which has become a common concern today. The reason behind this is that certain mushrooms contain toxic substances that are often misidentified as edible mushrooms. So, it is essential to know the basic concept of mushrooms to use widely among poor people even those who are always flexible to use mushrooms in their dining table.

DESCRIPTION OF SOME TAXONS

Every mushroom consumer should be familiar with the five dangerous groups of fungi. These are the:-1.Amanitas, 2. the false morels, 3. little brown mushrooms (lbms), 4. Jack-o'lantern and 5. Green-spored lepiota.

1. AMANITAS (*Amanita* spp.)

An amanita starts as an egg-shaped button, which breaks open as the mushroom grows. Fully developed amanitas are gilled mushrooms with parasol-shaped caps that may be white, yellow, red or brown (Table 1).

2. FALSE MORELS (*Helvella* and *Gyromitra* spp.)

False morels have wrinkled, irregular caps that are brain-like or saddle-shaped. They may be black, gray, white, brown or reddish. Size - 2 to 8 inches tall.

3. LITTLE BROWN MUSHROOMS (LBMs)

Little Brown Mushrooms (LBMs) includes all small to medium-sized, brownish mushroom with spores of all colours.

4. JACK-O'-LANTERN (*Omphalotus olearius*)

Fresh specimens sometimes give off a faint greenish glow at night or in a darkened room. Jack-o'-lanterns have a pleasant, fruity fragrance. Size- 3 to 10 inches tall, cap 3 to 8 inches in diameter. These mushrooms are found in summer and rainy season, in large clusters at the base of trees, on stumps or on buried wood.

5. GREEN-SPORED LEPIOTA

These large, common mushrooms often appear in fairy rings on suburban lawns. They cause violent gastro-intestinal upset. It is the only mushroom with a greenish spore. Size- 4 to 12 inches tall, 2 to 12 inches in diameter. This mushroom is found in summer and rainy season, on the ground in lawns, and meadows.

Table 1. Some Toxins and their effects

MYCO TOXINS	FOUND IN GROUPS	SECRETING SPECIES	BIOLOGICAL EFFECTS
1. AMATOXIN	Amanitas, Little brown Mushroom	*Amanita exitialis* *Amanita verna* *Amanita alboflocccosa (Indian)* *Galerina autumnalis*	1. Causing liver and kidney failure. 2. violent vomiting, bloody diarrhea, and severe cramps occurs. 3. Ultimately causing death.
2. GYROMITRIN	False morels	*Gyromitra fastigiata* *Gyromitra gigas* *Verpa bohemica* *Helvella sp.*	1.Causing diarrhoea, vomiting, gastro-intestinal distress and Head-aches. 2. Sometime kidneys, liver and red blood cells are damaged which may result in death.
3.GASTROINTESTINAL IRRITANTS	Jack o'-lantern mushroom, Green spore lepiota.	*Agaricus hondensis,* *Boletus pulcherrimus,* *Boletus erythropus,* *Russula emetica.*	It cause nausea, cramps, diarrhoea and vomiting.
4. MUSCARINE	Little brown mushrooms, Jack- o'-lantern	*Boletus luridus.* *Omphalotus olivascens.* *Clitocybe dealbata.* *Inocybe fastigiata.* *Inocybe lanuginose.* *Chantharellus*	1. It causes excessive salivation, perspiration, tears, severe vomiting and diarrhoea. 2. Also cause visual disturbances, difficulty breathing, a drop in blood pressure.
5. COPRINE	Little brown mushrooms	*Coprinus atramentarius* *Coprinus variegates*	It causes rapid heartbeat, light headedness, reddening of nose and eyes, Nausea and occasional vomiting occurs.
6. IBOTENIC ACID	Amanitas	*Amanita muscaria* *Amanita pantherina* *Amanita gemmata* *Amanita caesarae*	1. It causes confusion, mild euphoria, loss of muscular coordination, profuse sweating. 2. A feeling of increased strength, delusions, convulsions and hallucinations occurs.
7. PSILOCYBIN & PSILOCIN	Little brown mushrooms	*Psilocybe cyanescens* *Psilocybe cubensis*	Cause problem in colour perception, visual distortions, nausea, vomiting and anxiety occurs.

CONCLUSION

Many mushrooms have their toxins. So, the poisoning by those mushrooms on human and others have a bad effect in general scense but some have made serious effects on biological system. The so called effect is very much critical. Most mushroom poisonings are allergies, over-indulgence or food poisoning. Discomfort such as an upset of stomach or nausea might even occur from eating certain known edible species when they are improperly prepared. Consult is necessary with a mycologist for the identification of the ingested species.

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HUMAN ACTIVITIES ASSOCIATED WITH ROADSIDE TREES OF KOLKATA

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ABSTRACT

Plants provide many benefits to human being. Keeping the said point in mind, a study was done on some main and arterial roads or streets of south Kolkata and the objects were to study the type of trees planted, conservation strategies undertaken to protect those plants and the important role which these trees played in the life of human being. The present study highlights the roles of road-side trees in shaping socio-cultural and economic activities of urban dwellers of Kolkata. It records for the four different kinds of human activities like-public activities, religious activities, political activities and economic activities associated with twenty-two species of trees. Among them, the predominant tree species are *Ficus benghalensis* (Bat), *Ficus religiosa* (Asathwa), *Anthocephalus kadamba* (Kadam), *Delonix regia* (Krishnachura). Majorities of the *Ficus benghalensis* and *Ficus religiosa* trees are mature than the others and were planted in the past which are conserved by the local people. As avenue trees in cities have been viewed largely from the beautification and aesthetic point of view, so in general the trees have been planted for ornamentation. The study also discusses the ecological importance of such knowledge in urban afforestation programme and a way to conserve the biodiversity richness through some local conservation strategies.

Key words: Afforestation, Socio-cultural, aesthetic, biodiversity, conservation.

INTRODUCTION

From time immemorial forests and plants played an important role in maintaining our life support system. The importance of forest and forestry practice now a day's getting more attention, because academicians, politicians, planners and even general people are also more concern about forests and the rate of concern is continuously increasing. This is due to direct interactions in the ecosystem which face a multidirectional role in the environment in any time. Though people became more concern about forests but it is highly noteworthy that practically no attention has been paid regarding the cover in urban areas. A systematic study in the urban areas of the country in terms of types of trees planted, role of trees in the lives of citizens is very necessary for understanding the aspects and reaching to a conclusion for formulating a policy on trees in urban centre.

STUDY AREA

Some particular areas of south Kolkata were undertaken for the present study. A complete study of all tree plants separately for each side of the road was done. The study site covers the following route i.e. from Garia to Rabindra Sadan through Anwar Shah, Rashbihari, Hazra; from Garia to Gariahat through Jadavpur, Dhakuria and from Gariahat to Rashbihari More. The chosen area demarks a triangular shape and it includes many main roads of South Kolkata which gives an outline idea about the planted trees in the avenues of South Kolkata.

METHODOLOGY

A complete study of all the planted trees, separately, on each side of the road was done and for each tree the associated human activities were recorded. The survey was conducted between 10 a.m. to 3 p.m. in the month of April, 2017. A large number of photographs representing various human activities associated with avenue trees were taken. During this survey type of plant species were recorded. Their conservation strategies were also studied well.

HUMAN ACTIVITIES: It is noted that the trees were associated with some kind of human activities. Such activities were associated more with the mature trees than with young one. At the same time, it was observed that many trees were associated with more than one activity. Among the all trees the maximum number of activities associated with plant species like *Ficus benghalensis, Anthocephalous cadamba* and *Ficus religiosa*. According to our field record, and counting each activity separately we divided human activities under 4 categories i.e. (i) Public activities, (ii) Religious activities, (iii) Political activities and (iv) Economic activities Table 1). (ii) PUBLIC ACTIVITY: It is observed that various kinds of public activities are associated with avenue trees. There are many cycle rickshaw stand, taxi stands under the trees. A tree also provides shade from the Sun and also gives protection from rain. In the absence of a bus stand, trees are also used as a bus stop. Refuges that live in the footpath also use trees in their daily life, like; they use the branches of trees for drying clothes etc. (ii) ECONOMIC ACTIVITY: A wide range of economic activities were observed associated with the road side trees. Main activities are selling vegetables, fruits in market. There are also present a number of tea stall, cigarettes stall, pan shop, tobacco shop etc.

Cobblers, cycle, motor cycle repairing shop are also found. Road side trees also provide space for poor people who cannot afford to pay rent for shops and thus sell their products under the trees. So, there are found many barber, cobbler beneath the road sided trees. (iii) RELIGIOUS ACTIVITY: Among the all trees, most trees are found to be associated with religious activities in the form of places of worship like temples, - open or covered structure. There are trees namely– *Ficus benghalensis, Ficus religiosa* associated with religious activities. Some others are also found in some places, to be associated with religious activities. (iv) POLITICAL ACTIVITY: Road side trees are also associated with political activities Rickshaw and Van Driver Union office situated beneath the trees, paper of a political party attached to bole of trees, political banner in the trees etc.

RESULTS AND DISCUSSION

The present study reveals that, a total of 22 tree species are used by human beings in Kolkata for four different purposes. In the study it is noted that, a number of species have been planted along the road of South Kolkata. Among them, the predominant species found there are Bat, Asathwa, Kadam, Krishnachura. Bat and Asathwa trees are the most mature than kadam, krishnachura. Thus it is obvious that, Bat and Asathwa were planted in the past. As avenue trees in cities have been viewed largely from the beautification and aesthetic point of view, so in general the trees have been planted for ornamental purpose.

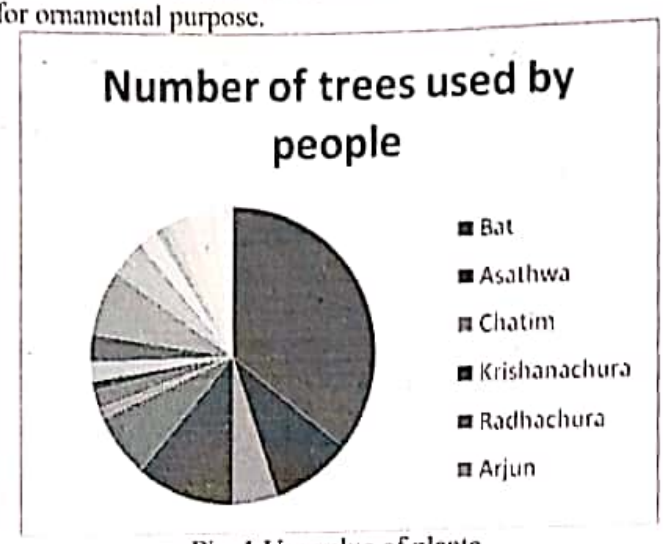

Fig. 1 Use value of plants

We all know that trees help in regulating temperature, moisture and wind speed. Trees also prevent soil erosion and increase ground water level. Trees also help in reducing sound and dust pollution level and avenue trees provide place for various birds and insects. The main data of study proves that avenue trees play a vital role in the lives of city dwellers in general and in the life of poor people. Trees help poor people by providing them place for their many daily activities. Trees are also associated with religious function. From the above discussion, we can say that, our choice of species should be such that the function like socio-economic, religious, ecological are maximised. Again a careful study revealed an interesting fact; it was observed that where there were some shops or other establishment the trees developed very well, while in their absence the development was not to the mark. So from this observation it is clear that, if the trees along the roadside have to survive, involvement of people is absolutely necessary. It was also noticed that if people worshipped a tree as a sacred tree then the chances of survival of that tree is 100%. The association of people with the road-side trees, particularly those used for religious purpose is so strong that they ensure the plant's protection. Thus the local people indirectly help to conserve avenue trees in an otherwise highly changing urban environment. From an ecological point of view, such type of study (knowledge) is relevant in urban afforestation programme. In choice of trees, local climatic condition is also a great factor. In Kolkata, before and during monsoon, people experienced with several high speed storms. So, the trees should be able to withstand these storms otherwise every year many mature trees may be lost.

So, keeping the above point in mind we can say that the species to be planted along the roadside of South Kolkata should be evergreen, fast growing. Because evergreen trees provide shade throughout the year and the trees should be fast growing to withstand high storm, and also should have high probability of survival.

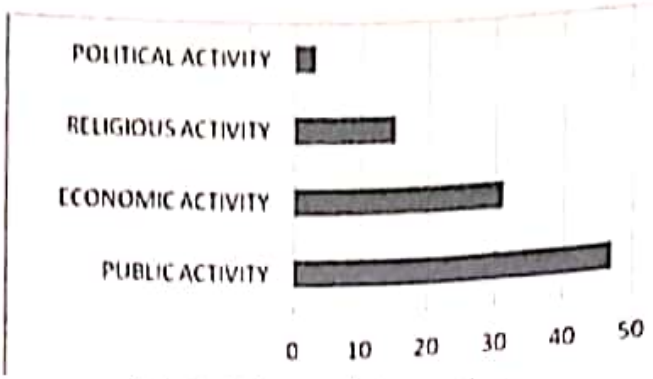

Fig. 2 Different activities of plants

The tree species which has all the above characteristics is Bat (*Ficus benghalensis*). But according to the view of some ecologists, mixed species plantation may serve ecological function better than mono species plantation. Therefore, a mixed plantation of Bat, Asathwa and Kadam would be the most ideal as Bat and Asathwa are worshipped by the Hindus (Fig. 1). The nature and extent of association between the avenue trees and city dwellers, particularly poor section is in fact an excellent indicator of the prevailing socio-economic condition of a city or country. After the study, there also arise another question that should we allow the self employed poor people to use the roadside place under trees. The construction of permanent structures hampers the smooth running of the traffic. But any one self employed by them using the place without making any permanent structure should be allowed to pursue their livelihood (Fig. 2).

Table 1. Tree species observed in Study sites

Sl. No.	Name of the plants		Family
	Scientific name	Local name	
1	*Ficus religiosa*	Aswathwa	Moraceae
2	*Ficus benghalensis*	Bat	Moraceae
3	*Delonix regia*	Krishnachura	Fabaceae
4	*Peltophorum pterocarpum*	Radhachura	Fabaceae
5	*Polyalthia longifolia*	Debdaru	Annonaceae
6	*Terminalia arjuna*	Arjun	Combretaceae
7	*Anthocephalus kadamba*	Kadam	Rubiaceae
8	*Caesalpinia pulcherima*	Krishnachura	Caesalpiniaceae
9	*Azadirachta indica*	Neem	Meliaceae
10	*Thevetia purpurea*	Kolke	Apocynaceae
11	*Zizyphus* sp	Kul	Ramnaceae
12	*Tamarindus indicus*	Tetul	Fabaceae
13	*Beautea monosperma*	Palash	Fabaceae
14	*Acaccia auriculiformis*	Akashmoni	Mimusaceae
15	*Mangifera indica*	Mango	Anacardiaceae
16	*Alstonia scholaris*	Chatim	Apocynaceae
17	*Mimusop elangi*	Bakul	Sapotaceae
18	*Saraca indica*	Ashoke	Fabaceae
19	*Swieteria macrophylla*	Mehagoni	Meliaceae
20	*Taabernaemontana divaricata*	Kath Tagar	Apocynaceae
21	*Roystonea regia*	Royal palm	Arecaceae
22	*Areca triandra*	Areca palm	Arecaceae

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IMPACT OF JOINT FOREST MANAGEMENT (JFM) ON BIOMASS PRODUCTIVITY OF PLANTS: A CASE STUDY

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ABSTRACT

The study deals with different ecological indicators as the important pointer for the success of any JFM programme. The biomass productivity of plants is an indicator for such type of study. The study was carried out in a coppice sal (*Shorea robusta*) forest of Bhagabatichawk under Midnapore East Forest Division at Paschim-Midnapore District of West Bengal. There is a Forest Protection Committee (FPC) to protect this coppice sal forest. The productivity of different plant species (except sal) in fenced, unfenced and degraded areas were measured. Here productivity is taken as production of above ground biomass of different plant species per unit time and unit area.Besides this the degree of human exploitation of fuelwood and different non-timber forest products (NTFPs) were assessed in a participatory method. It was seen that the annual productivity of some plantspecies was higher in fenced plot than the unfenced condition. Though in unfenced plots extraction of selected species is done, then total biomass production is more than the fenced ones. Generally some plant species are not collected by the village people or not grazed by herbivores. As a whole this study reflect that an enhanced productivity was obtained in the unfenced area as compared to the fenced area under the management of FPC and degraded area.This indicate that there is a positive impact of JFM on biomass productivity of plants.

Key Words: JFM, productivity, extraction, FPC, NTFPs.

INTRODUCTION

Joint Forest Management (JFM) can be used as an effective tool for the conservation of forests and economic upliftment of local village communities. Successful forest resource management throughcommunity involvement not only improves growth of the forest but also improves its other dimensions.Collective Forest Management variously known as Joint Forest Management, Participatory Forest Management, Community Forest Management etc. is a process to ensure continuity in resource generation, stability in physical and social environment and sustainability in production of goods and services. Conservation and enhancement of a natural resource like forest is not possible without the active and purposeful involvement of local people in its management. Community participation in forest protection as well as management has remarkably reversed the process of forest degradation in some parts of India. According to Brower and Zar (1977) the involvement of local people in a plant community is directly related to its biomass. The present study is an endeavour to quantify productivity and extraction pattern of fuelwood and other NTFPs in a community managed forest.Villagers have their access to destructive extraction of biomass from some selected plant species. According to Mishra et. al.(2001) the productivity of certain fuelwood producing species show that the perfect protection leads to dominance of a particular species on the one hand and decreases level of total production on the other.

STUDY SITE

The study was carried out during the year 2013 in Bhagabatichawk forest of Midnapore East Forest Division at Paschim-Midnapore District of West Bengal, India. The study area lies within the geographical limits of 21° 36′ to 22° 57′ N latitude and 86° 33′ to 88° 11′ E longitude of Midnapore East Forest Division. The general altitude of this region is 15 – 16m above MSL. Bhagabatichawk is a village near Midnapore town of Paschim-Midnapore District, where Forest Protection Committee (FPC) has existed last 25 years. In this village all the 53 families are either landless or marginal farmers but all they are member of FPC. They protect 61hectares of coppice sal (Shorea robusta) forest named as Bhagabatichawk forest under Midnapore East Forest Division.

CLIMATE

The study area is basically hot and humid with a short period of winter. It is evident that the higher temperature is attained during the months of April to June. The lower temperature is met within the months of December and January. Generally maximum average temperature(37°c – 39°c) is recorded in the month of May and minimum average temperature (16°c – 18°c) is recorded in the month of January. The South-West monsoon is the main source of rainfall in this region. The North-Western wind starts blowing from the month of May with high velocity, carries very little moisture. The rainy season continue from July to September.

Vegetation Type: According to Champion and Seth (1968) the Coppice Sal Forest of a wide range in this region (South West Bengal) fall in between the "Dry Deciduous Sal" and "Moist Peninsular Sal" vegetation types. Puri et. al. (1989) has been classified the vegetation of this region under series 16 entitled as " *Shorea - Cleistanthus - Croton*" series.

AIMS AND OBJECTIVES

To find out the impacts community management on biomass extraction of different plant species other than *Shorea robusta* (Sal) in a forest under management of FPC. It will also focus through upon such type of extraction under unmanaged condition.

METHODOLOGY

The study was conducted to compare three type of plots such as fenced plot and unfenced plot which are managed by FPC and the third one was the adjacent degraded forest plot where no management practice is followed.The methodology has been designed following Hall andBawa (1993), as below-

a) The method involved setting up nine randomly selected sample plots, such asfenced, unfenced and degraded plots. These nine plots include three in fenced condition, three in unfenced condition and the rest three in adjacent degraded forest under unfenced condition. Size of the plots weredetermined by "species areacurve" (Oosting-1958). The area of each plot was (30m x 30m), within each plot the size of the quadrat was (30m x 30m) for tree species, (5m x 5m) forshrubs and (1m x 1m) for herbs.In fenced plot fencing was done for temporary protection at a stretch of land measuring 1m was maintained as the margin to avoid any edge effect.Fencing was done to assure no biomass extraction by the villagers. The unfenced and degraded plots were defined with outline only.

b) Quarterly biomasswas taken by destructive sampling of the different plants (except Sal) in all the study plots, 1st quarter from January to March, 2nd quarter from April to June, 3rd quarter from July to September and 4th quarter from October to December.

c) Calculation of the productivity in terms of above ground biomasswas done in the laboratory from the samples collected after oven drying.

d) Degree of human exploitation (except green or dry sal leaf) was calculated by frequenthouse hold survey in this village with the help of FPC members by weighing the collected dry materials. Besides this the weight was taken to the head loads, cycle loads which were collected from this forest.The extracted biomass thus assessed was converted to per unit area.

RESULT AND DISCUSSION

Table 1. MEAN ANNUAL PRODUCTIVITY OF FUELWOOD PRODUCING SPECIES

Name of the Species	Biomass (kg/ha)		
	Fenced plot	Unfenced plot	Degraded plot
Antidesma acidum Retz.	82.00	197.60	12.64
Combretum roxburghii Spreng.	5346.37	2933.77	438.19
Ehretia laevis Roxb.	94.08	23.76	X
Helicsteris isora Linn.	19.99	335.04	X
Holarrhena antidysenterica Wall.	182.50	431.72	18.23
Lantana camara L.	98.00	102.54	27.91
TOTAL	**5822.94**	**4024.43**	**496.97**

Table 2. MEAN ANNUAL PRODUCTIVITY OF SOME MEDICINAL PLANTS

Name of the Species	Biomass (kg/ha)		
	Fenced plot	Unfenced plot	Degraded plot
Andrographis paniculata Nees.	8.28	3.70	1.27
Curculigo orchioides Gaertn.	15.39	44.23	X
Dioscoria alata L.	0.97	4.99	X
Hemidesmus indicus R.Br.	8.96	8.20	X
Holarrhena antidysenterica Wall.	182.50	431.72	18.23
Ichnocarpus frutescens R.Br.	15.66	14.50	X
Madhuca longifolia (Koenig) MacBride.	226.30	140.40	7.29
Smilax ovalifolia Roxb.	9.36	11.61	0.84
TOTAL	**467.42**	**659.34**	**37.63**

Table 3. MEAN ANNUAL PRODUCTIVITY OF DIFFERENT NTFPs

Name of the Species	Biomass (kg/ha)		
	Fenced plot	Unfenced plot	Degraded plot
Catunaregam spinosa (Thunb.) Tiruv.	25.61	36.17	1.28
Coccinia indica Naud.	X	1.26	X
Dioscoria alata L.	0.97	4.99	X
Diospyros exculpta Buch-Ham.	10.23	51.07	X
Flacourtia indica (Burm.f.) Merr.	98.34	6.88	2.46
Madhuca longifolia (Koenig) Mac Bride.	226.30	140.40	7.29
Zizyphus oenoplia Mill.	4.63	3.15	2.23
TOTAL	**366.08**	**243.92**	**13.26**

Direct measurement of productivity has a set of difficulties such as it is always influenced by interaction with the tree layer (canopycover, etc) and effect of extraction. Lele (1993) pointed out that these effects would typically require conducting controlled experiments that simulate the manner and magnitude of extraction while allowing for the measurement of extracted material. The sustainable extraction of non-timber forest products (NTFPs) may provide an alternative to deforestation and ensure conservation of biological diversity in tropical forests is becoming popular (Plotkin and Famolare – 1992, Salick et.al. -1995). The study reveals some important facts regarding the impacts of forest management by local community on the productivity of the forest. The important management decisions of the FPC are as below -

a) Allowing only the six shrubs species to be collected as fuelwood, such as*Antidesmaacidum* Retz,*Combretum roxburghii* Spreng,*Ehretia laevis* Roxb,*Helicsteris isora* Linn,*Holarrhena antidysenterica* Wall and*Lantana camara* L.
b) FPC allowed dry leaves to be collected only during the dry season for fuel without any interruption because decomposition of dry leaves more or less does not takes place during dry season. Besides this if it is totally restricted then the problem will be create about the crises of fuel material.
c) Restriction of dry leaves collection during post-monsoon period as decomposition takes place on that time.
d) The committee also has set up some rules for equitable distribution of fire wood during pruning.

Table 4. ANNUAL & MONTHLY EXTRACTION OF FUELWOOD AND DIFFERENT NTFPs (Kg/ha)

MONTH	FUELWOOD	COCCINIA FRUIT	KENDU LEAF	THORNY BUSHES	MUSHROOM (*Lycoperdon* sp.)
Jan	110.65				
Feb	608.60				
Mar	714.28				
April	314.28		2.89		
May	680.94		6.74		
June	226.18	2.12			
July	214.28	2.38			
Aug	192.85	1.31			8.92
Sept	218.09				6.55
Oct	190.47				
Nov	491.07			71.42	
Dec	206.18			58.76	
Total (Annual)	**4167.87**	**5.81**	**9.63**	**130.18**	**15.47**

From the above result it is seen that the total annual productivity of fuelwood in fenced area is 5822.94 kg/ha and 4024.43 kg/ha (Table -1) in unfenced area, where extraction of biomass occurred within the guidelines of FPC. From the survey it is seen that the annual extraction of fuelwood is4167.87 kg/ha (Table- 4). So the annual productivity of fuelwood in unfenced condition is (4024.43 +4167.87) = 8192.30 kg/ha, which is higher than the productivity of fenced area. The total annual productivity of fuelwood in degraded forest is 496.97kg/ha (Table-1), which is too much less than the FPC managed forest either fenced or unfenced condition. In degraded forest no management practices are there, so such type of forest are gradually degraded or denuded. There is no restriction about the collection of some NTFPs like, Coccinia sp. fruit, mushroom, thorny bushes, because the production of such NTFPs are negligible (Table- 4) and these are available only in

two or three months in a year.Besides this no money will be gain either to the Government or to the FPC from that NTFPs.

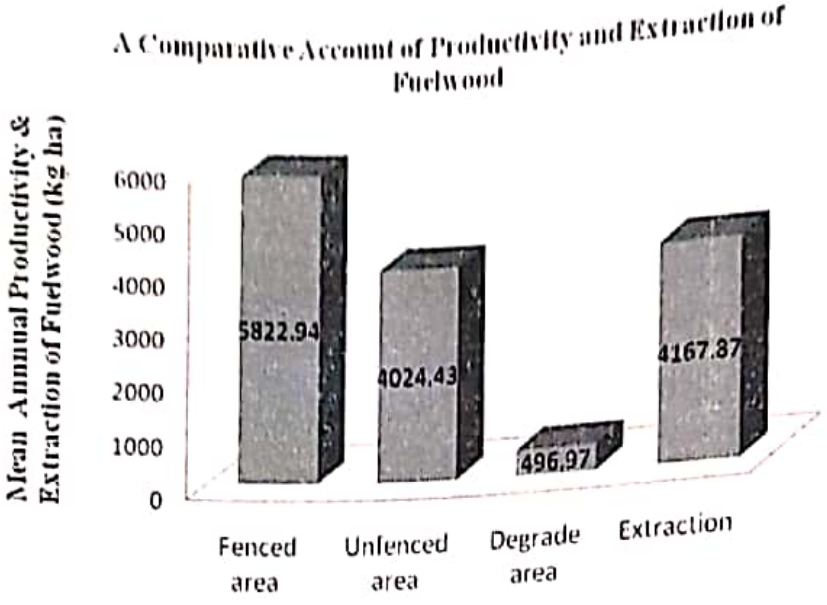

Fig. – 1

A Comparative Account of Actual Productivity of Fuel Wood at Fenced, Unfenced & Degraded Area

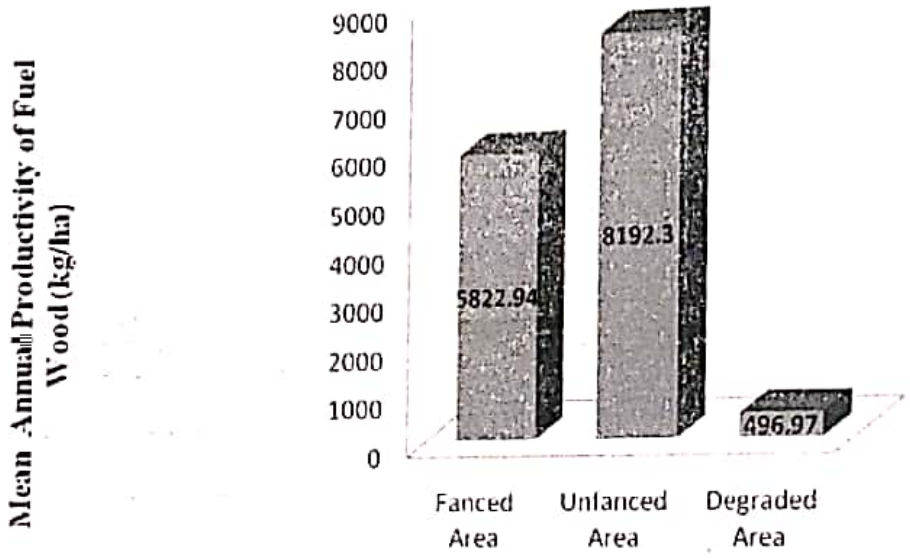

Fig.--B

The total annual productivity of some medicinal plants in fenced condition is 467.42 kg/ha (Table-2) and in unfenced condition it is 659.34 kg/ha (Table-2), which is higher than the fenced condition, because here no ojha or traditional practitioner that collect the medicinal plants. In degraded forest this is 37.63 kg/ha (Table-2), becausein this plot among the eight medicinal plant species only four species are available in very poor condition.

The total annual NTFPs production (except salleaf)in terms of above ground biomass was366.08 kg/ha (Table-3) in fenced areaand 243.92 kg/ha in unfenced area(Table-3).The total annual extraction was 161.09 kg/ha (Table-4). So the actual annual productivity of NTFPs in unfenced condition was (243.92 +161.09) = 405.01 kg/ha which was more than the fenced condition. Whereas, this result was only13.26 kg/ha (Table-3) in degraded forests. This result also indicates that the effect of JFM on productivity of plants is positive. In this study it was recorded that the annual productivity of some species were higher in unfenced plot than the fenced ones, because those species which are never extracted by the people e.g. –*Curculigo orchioides* Gaertn, *Dioscoria alata* L.(only rhizome is collected after drying of the above ground parts) , are added to the total biomass of unfenced plots. Besides this the FPC mainly follow the concept of "Kath and Kukath". The village people never extract the Kath species i.e. woody tree species like- *Antidesma acidum* Retz., *Helicsteris isora* Linn., *Holarrhena antidysenterica* Wall., *Diospyros exculpta* Buch-Ham. etc. In the unfenced condition the Kath species are not extracted by the villagers. Those species which are never grazed by the herbivorous, like *Catunaregam spinosa* (Thunb.) Tiruv. had higher productivity in unfenced plots. In fenced condition the productivity becomes low due to completion in between the species where the dominant ones negatively influence the productivity of other species. This can be better understood by observing species wise biomass productivity in fenced, unfenced and degraded ones. Biomass studies are interested to the forest managers to judge the performance of species in terms of the total biological production and to assess the nutrient drain by the way of harvesting the species. Over harvesting or continued extraction may alter population size, growth rates and reproductive capacity of harvested species, leading to a reduction in the quantities of NTFPs (Hall and Bawa 1993).Toledo et.al. (1992) calculated the quantum and number of useful products used by indigenous people and commented that the uses derived from the non-woody parts of plants counters the notion that tropical forests are primarily important as source of timber. It is interesting to note that the annual productivity of different plant species is higher in fenced plot than the unfenced or degraded plot. But a close watching reveals that, if we consider the extraction of fuel wood and different NTFPs then the actual productivity in unfenced plot becomes higher (i.e. calculated biomass + extracted biomass) than the productivity in fenced plot. In degraded forest no management, no protection, no rules and regulation are there.

CONCLUSION

In thisstudy it has been interestingly noted that Joint Forest Management (JFM) system managed by FPCs provide a better option for biomass productivity. The biomass yield of plant species was more in exposed condition i.e. in unfenced plot than in a physically fenced condition. This shows that physical fencing can never be a better option in comparison to social fencing where villagers take care of the biomass resources under controlled level of extraction.

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STUDY OF MYCORRHIZAL BIODIVERSITY IN ACID LATERITIC SOIL OF WEST BENGAL AND MYCORRHIZAL EFFECT ON THE GROWTH OF TWO VEGETABLE CROPS

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ABSTRACT

Mycorrhiza has wide range of occurrence in acid lateritic soil of West Bengal. The isolated VAM species, identified and selected for experiments included *G.fasciculatum, G.mosseae* and *A. dilatata* used for *growth of Capsicum. annuum* and *Solanum. melongena* (family: Solanaceae). Three indigenous VAM fungi and mixed inoculum showed their efficacy in enhancing the growth of Solanaceous fruit vegetables. The VAM fungi showed variations in their effects on vegetables, but overall growth enhancement was always more than non mycorrhizal plants. VAM inoculated seedlings positively affected the productivity. The effect of single VAM inoculations on growth and biomass were not consistent but the plants treated with Mixed inoculum induced synergistic response resulting into significant rise in the growth parameters recorded.

Key words: *Capsicum, Brinjal with VAM inocula, yield thraugh inocula*

INTRODUCTION

The red lateritic soil of South West Bengal, India has low pH and low water holding capacity (Ghosh and Verma, 2004). It is deficient in available phosphate and other nutrients and to a certain extent in nitrogen and organic carbon as well (Ghosh and Verma, 2004, 2004).This soil is developed from granite silt and formed due to oxidation and free water flow. The acidity factor, low moisture level tends to immobilize the phosphorus as bound iron and aluminium phosphates and thus reduces its availability. For sustainable agriculture, high productivity with minimum damage to ecological and socioeconomic condition and to reduce the quantity of agrochemicals, biofertilizer seems to be a viable alternative (Sharma et al. 1986) with the biofertilizers, not only the input of fertilizer can be lowered but also the loss of fertilizer can be reduced. Mycorrhizae reaches its extensive hyphal system beyond the depletion zone of plant roots and as an obligate symbiont help in absorption and translocation of phosphate and other nutrients (Jakobsen et al., 1992; 1994; Smith and Read, 1997). Besides nutrients they also provide cross protection from disease and enhance the moisture content through hyphal system in rhizospheric soils. Vesicular arbuscular mycorrhizae (VAM) act as a bridge between the host and the soil (Read, 1991) and benefit the plant by procuring P and other nutrients from beyond nutrient depletion zone. VAM are of special significance in low fertility soil (Hatch, 1937), where it increases nutrient absorption. Plant grown under phosphorus deficient soil such as acid lateritic soil, have greater dependence on mycorrhizae (Ghosh and Verma, 2006, 2011 and Ghosh et al. 2016, Ghosh and Verma, 2015). There is an adequate possibility of utilization of VAM fungi in commercial agriculture. Present study was undertaken to ascertain the best strain of VAM for quantity and quality fruit yield and better plant growth in acid lateritic soil condition of West Bengal, India.

MATERIALS AND METHODS

A general survey was made on Vesicular Arbuscular Mycorrhizal (VAM) status in common vegetations, crop fields of Midnapore, lateritic zone of South West Bengal state, India. Field experiments were conducted at the experimental cum botanical garden of Botany Department, Sabang Sajnaikanta Mahavidyalaya, since 2015 to 2017. Two vegetable crops, *Capsicum annuum* L. and *Solanum melongena* L. were grown during December to March to study the VAM activity. Rhizospheric soil samples were collected from three depths after scraping 1cm top soil i.e. 1 -10cm. 11-20cm and 21-30cm. Composite samples were collected in four replicates for each depth. Soil for pot experiment was collected from 0 to 25cm depth from area without vegetation.VAM fungal spores were extracted from the soil by the method of Gerdemann and Nicolson, 1963. Pure culture of *A. dilatata, G. fasciculatum* and *G.mosseae* were identified following the manual of Schenck and Perez (1990), Trappe (1982) and INVAM (www.invam.com) voucher specimens and descriptions.

RESULT AND DISCUSSIONS

Result showed effect of VAM inocula on the growth, yield of fruit of *C. annuum* in field condition. Plant growth improved with all VAM inoculation compared to control. Mixed inoculum induced significantly higher plant height among all the treatments, where increase in plant height was about 38% and 40% more than control in 2015-16 and 2016-17 respectively. Single inoculation with *A. dilatata, G. fasciculatum* and *G. mosseae could* increase the height 25, 11, 21 and 19, 20, 15% respectively in consecutive two years. *A. dilatata* and mixed inoculation produced significantly more number of leaves compared to *G. mosseae, G. fasciculatum* and control in 2015-16. Although no

significant variation of leaf number was observed among *A. dilatata*, mixed inoculation and *G. fasciculatum* treatments but they were significantly higher compared to *G.mosseae* and control in 2016-17. Significantly higher leaf area index (LAI) was recorded with mixed inoculum among the treatments in 2015-16. However, no significant variation in LAI was observed among VAM treatments except *G. fasciculatum* where LAI was observed significantly lower than *G. mosseae* only. Overall, mixed VAM inoculation produced more LAI as well as plant height on an average basis taking both the years of growth. VAM inoculations produced significantly higher plant dry weight not only from control but also among the treatments. Maximum affect was seen in case of *A. dilatata* in 2016-17 although every treatment increased the biomass significantly over control but the trend was not observed in between the treatments. In general, NPK content of plants significantly improved in all the VAM treatments in both the years of experiment. Nitrogen uptake was observed significantly higher in mixed inoculation followed by *A. dilatata* and *G. mosseae* and *G. fasciculatum* in 2015-16. In 2016-17, Nitrogen content significantly improved in all VAM inoculations except *G. fasciculatum*. VAM inoculations boosted up shoot available 'P' content 2.5 to 3.75 times over control in 2015-16. *G. mosseae* proved most efficient as it produced significantly higher 'P' content among all the treatments followed by *A. dilatata*, mixed inoculation and *G. fasciculatum*. The 'P' enhancements by VAM treatments were also effective in 2016-17, but slightly lower than 2015-16. All VAM treatments produced significantly higher total K content in plant tissues over control. Total K content of the plant was recorded maximum with *G. mosseae* followed by inoculations with *G. fasciculatum*, *A. dilatata* and Mixed inoculum in general.

Fruit yield per plant improved significantly with all VAM inoculations compared to control one. Mixed inoculums produced significantly higher yield among all the treatments. In between other treatments, *A. dilatata* produced significantly higher yield compared to *G. mosseae* and *G. fasciculatum*. Fruit fresh weight and dry weight per plant followed similar trend in both the years. Mixed inoculum again appeared most efficient in producing the highest mean fruit weight among the treatments followed by *G. mosseae*, *A. dilatata* and *G. fasciculatum*.

Acid phosphatase activity was always recorded 4 to 5 times more than alkaline phosphatase throughout the experiments. *A. dilatata* induced both types of phosphatase activity in both the year. *G.mosseae* and mixed inoculum appeared to be the second and third in enhancing the phosphatase activities. However, in general all the inoculums treatments significantly enhanced the phosphatase activities over control. VAM infection percentage was higher in both the years and it ranged between 65 to 87%. Effect of VAM on the growth, yield of fruit of brinjal (*S. melongena*) in field condition was tested. Plant growth improved with all VAM inoculations compared to control. Mixed inoculum induced higher plant height among all the treatments on an average basis of the two years, where increase in plant height was about 33% and 20.5% more than control in 2015-15 and 2016-17 respectively. Result in all cases except *G. fasciculatum* condition produced significantly higher plants and single inoculation with *A. dilatata* and *G. mosseae* could significantly increase the height 18.6%, 20.5% and 23%, 19.5% in two years respectively. *A. dilatata* inoculation induced significantly more number of leaves among the treatments in both the years. Although no significant variation of leaf number was observed among *G. fasciculatum* , *G.mosseae* and Mixed inoculation but they were significantly higher compared to control in 2016-17. *A. dilatata* and Mixed inoculation produced significantly higher leaf area index (LAI) compared to *G. fasciculatum*, *G.mosseae* and control in 2015-16. In 2016-17, *A. dilatata* induced significant higher LAI compared to all VAM treatments. Overall, *A. dilatata* inoculation produced more LAI as well as leaf number on an average basis taking both the years of growth.

CONCLUSION

Two vegetable crops were more dependent on *A. dilatata* followed by mixed inoculum. The variation in dependency level of different crops on different VAM fungi has also been observed by Plenchette et al. (1983) which is similar in my research trend. The variation and dependency of plants clearly indicated that some degree of preference do exist in host VAM interaction (Van der Heijden et al., 1998). Here the result shows similar pattern. However, high colonization could not be correlated to high mycorrhizal efficacy in this experimental result.

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IDENTIFICATION OF TEMPORAL CHANGING ASPECT ON BIODIVERCITY BY GEOSPATIAL TECHNOLOGY. A CASE STUDY AT LOTHIAN AND PRENTICE ISLAND, SUNDARBAN, W.B.

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ABSTRACT

Geospatial Technology of vegetation can be an attractive and alternative to the scientific methods of field scouting due to the capability of covering large areas rapidly and repeatedly, providing spatial and temporal information necessary for eco-sustainable management. The potential of RS and GIS application in vegetation is very intensive method, as it is able to infer about vegetation growth and its nature in a non-destructive mean. Numerous Spectral Perpendicular Vegetation Index has been developed to characterize vegetation canopy. Plant canopy reflectance factors and derived multispectral Vegetation Index are receiving increased attention in floristic research as robust surrogates in traditional biophysical parameters. Spectral reflectance and thermal emittence properties of soil and vegetation have been used extensively to predict ecological variables such as percentage of vegetation cover, plant biomass, green leaf area index and other important biophysical characteristics. Vegetation Index is strongly modulated by interaction of solar radiation with photo synthetically active plant tissues and thus is indicative of dynamic biophysical properties related to productivity and surface energy balance. The basic objective of this study is to convey the potentiality of vegetation indices in the quantification of bio physical principles of floristic habitat of deltaic environment and to review the application of geospatial technology in botanical research.

Key Words: *Temporal changing aspect on Biodiversity, Complexity Index, Different Canopy, Correlation and Regression analysis.*

INTRODUCTION

Imagery from satellite and airborne remote sensing systems has the ability to provide spatially comprehensive information of remote and inaccessible locations, making this a valuable tool for scientific research on biodiversity and ecosystems. It is noted that the majority of work has focused on classifying and mapping canopy communities and that only recently attention has been drawn to the quantification of biophysical properties of canopy using spectral vegetation indices of several types of spectral vegetation indices available; ratio indices have been most frequently applied to satellite data for canopy. For example, Green et al. (1997, 1998b) used imagery from the SPOTHRV (System Pour l' Observation de la Terre—Haute Resolution Visible) satellite sensor and the CASI, (Compact Airborne Spectrographic Imagery) airborne instrument, to derive the widely used Normalized Difference Vegetation Index (NDVI) and correlated this with in situ measurements of canopy leaf area index (LAI).They argued that the LAI of mangroves with relatively open canopies might be underestimated if they were growing over white sand, or overestimated if dark organic detritus covered the sediment (Green et al. 1997).The region like the deltaic parts of Sundarban having a huge biodiversity is being hunted by number of environmentalists as well as ecologists. Its inaccessibility because of creek dynamics and ever changing sand coverage because of the very dynamical behavior of tide, limits the study of biodiversity. So, in the perspective of remote sensing or the space application and statistical formulation using band algebra will help the scientific study to a great extent.

OBJECTIVES OF THE STUDY AREA

Land use & Land cover Classification to delineate the study area of Lothian & Prentice Island, Leaf Area Index (LAI) measurement to find out canopy area zonation, Perpendicular Vegetation Index (PVI) to assess vegetation cover, To assess correlation between Perpendicular Vegetation Index (PVI) and Greenness index (GI), Damages of Canopy Cover density and its impact, Temporal change on Biodiversity in Lothian & Prentice Island and to find out the major aspect of eco-sustainability on the study area.

STUDY AREA

The present study is undertaken at Lothian and Prentice Island of western Sundarbans, India from 88°18'10"e to 88°21'30"e longitude and 21°32'50"n to 21°42'30"n latitude. The image data are acquired over the area covered by three different types of mangroves or canopy in Lothian and Prentice Island. The island is regularly inundated by diurnal tide up to a certain distance from the northern coast.

METHODOLOGY

As the first step of analysis, the image has been digitally classified to draw a decision boundary for the values of pixel digital number, indicating different types of vegetation bunches using Fuzzy k-means algorithm. Here, an initial mean vectors are arbitrarily specified for each of k^{th} clusters. Each pixel of the training set is then assigned to the class whose mean vector is closest to the pixel vector, thus forming a set of decision boundaries. A new set of cluster mean vectors is then calculated from this classification and pixels are reassigned accordingly.

Fig: Digital Classification using FUZZY K-Mean

In each iteration the k-means will tend to gravitate towards concentrations of data within there currently assigned region of the feature space. These iterations are continued until there are no significant changes in pixel ssignments from one iteration to the next. Specifically, this is the magnitude change of the mean vectors from (i-l) to the iteration i, summed over all k-clusters.

$$\Delta\mu = \sum_{k=1}^{K} |\mu_k(i) - \mu_k(i-1)|$$

For the betterment of accuracy, iteration has been incremented. That is following all the rules of fuzzy k-means algorithm the three vegetation zones have been segmented but proper specification cannot be drawn. So, for reaching to actual conclusion the following band algebra are used.

RESULT AND DISCUSSION

It has been said a prior that no clear succession pattern is seen in the Sunderban regions. The tidal behavior, creek dynamics, mangrove and salt marsh interactions, the differential colonization of the halophytic species etc hinders to identify the zonation of the floristic environment. So a micro level zonation would be a wise approach.

LAI (Leaf Area Index)

The spectral characteristics of canopy are influenced by Leaf Area Index and percentage of vegetative cover, growth stage, stress condition etc. Besides background soil, moisture content of the soil has significant influence on the vegetation reflection or absorption during the early stages of the growth. Since every floristic species has its own unique leaf arrangements and unique leaf structure, it is an important biological parameter that defines the pattern of solar radiations and its seasonal variation in the area. Remote sensing may provide much information about this.

PVI (Perpendicular Vegetation Index)

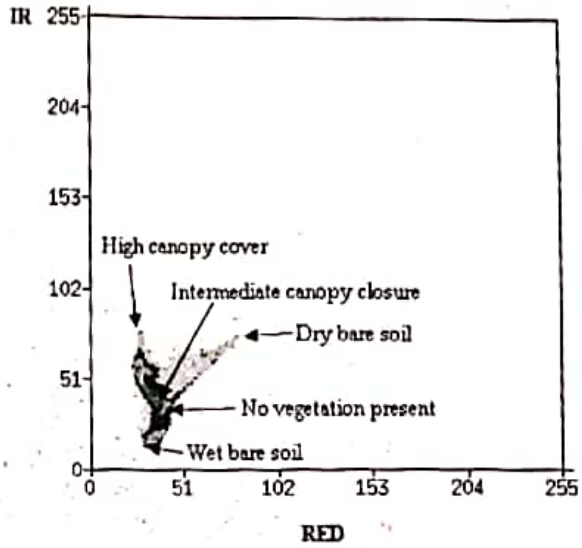
This is an index that uses the soil base line co-efficient (slope and intercept) which provides a relation between the reflectance in the red and infrared regions for the range of the soil types without vegetation cover. PVI for TM band is –

$$[(0.355 * \text{Band } 4 - 0.149 * \text{Band } 3)^2 + (0.355 * \text{Band } 3 - 0.852 * \text{Band4})^2]$$

PVI	Vegetal Coverage	Remarks
1 to 14	No cover / Wet soil	No vegetation
15 to 29	Low cover	Algal mat / salt marsh sp. (mainly grass)
30 to 44	Partial cover	Salt marsh / Mangrove associates
45 to 60	Full cover	Mangroves (mainly tree group)

Table-PVI (Perpendicular vegetation Index)

Usually the PVI values range between 1 and 60. This whole range is classified here as the presence of wet soil and low, partial or full vegetation canopy cover. In this case, if theoretically a straight line is drawn at the angle of 48^0 from the origin of the axis and is considered as the soil line, the DNs having the index range 1 to 15 lie over the line and the range 45 to 60 are at the distant position (nearer to the Y axis) from that line. On the other hand, the clusters having positive index relationship with PVI is increasing with the GI and if a domain function is drawn for GI (like 1>GI>-1); for GI towards 1 denotes the presence of medium to tall trees and vice versa. Now, if an intersection operation (Boolean AND operator) is followed over the LAI, PVI and GI, we can clearly identify the succession pattern as well as the nature of the canopy coverage. The outcome of this operation is tabulated later.



Red DNs	IR DNs	Canopy Closure	Remarks
30 - 36	15 – 22	No	Tidal mud flat (wet soil), Algal mat is dominant
42 - 45	32 – 36	No	No vegetation / Tidal mud flat
76 - 79	69 – 72	No	Dry soil / Sand dunes
25 - 29	41 – 61	Intermediate canopy	Medium trees / mangrove associates
19 - 24	70 – 76	High canopy	Tall trees/ mangrove proper

Table: Correlation between Infrared Band(Y) and Red Band(X)

It is seen that within this estuarine area basically three vegetation zones are prominent, where after comparing with PVI and LAI, the zone 2 will show the dense nature of vegetation, having the tree groups of mangroves. On the other hand, zone 1 and 3 according to the PVI and LAI denotes the presence of moderately dense cover having basically mangrove aconite and salt marsh, to low dense cover having marsh grasses. It is distinctly revealed from GI that at the river and creek bank margin the growth of vegetation is high – the habit of mangrove proper and the trees are of medium height. Apart from these digital indices vegetation zones can clearly be clustered from the scatter plots of pixel of Red and NIR feature space. The pixel value wise vegetation zonation is tabulated below:

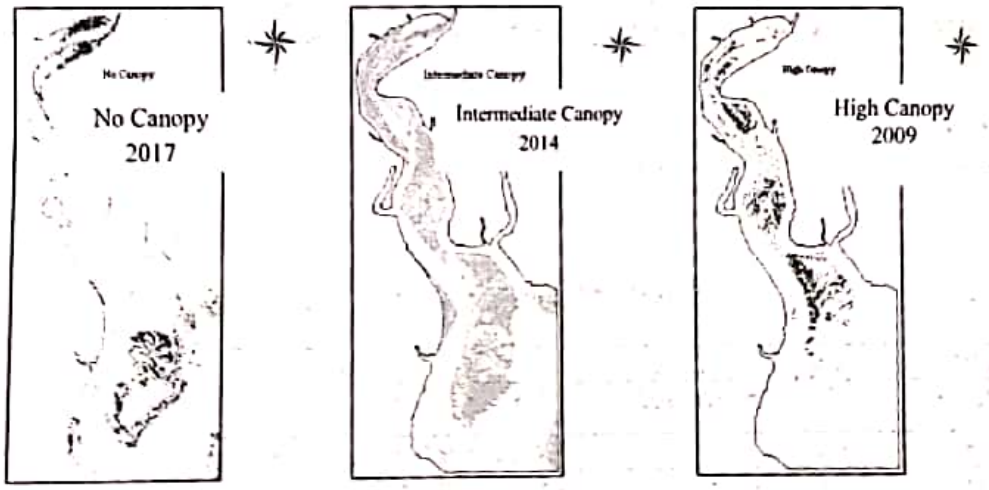


Fig: Result of Canopy Closure change and Temporal Changing Aspect on Biodiversity

Red DNs	IR DNs	Canopy Closure	Remarks	Probable Species Name
30 - 36	15 – 22	No	Mudflat(wet soil), Algalmat is dominant	N.A.
42 - 45	32 – 36	No	No vegetation / Tidal mud flat	Salicornia brachiata, Crinum difixum,
76 - 79	69 – 72	No	Dry soil / Sand dunes	Ipomoea biloba,Ipomoea pescaprae
25 -29	41 – 61	Inter mediate canopy	Medium trees / mangrove weeds / associates	Porterasia coarctata, Cryptocryne ciliate
19 - 24	70 – 76	High canopy	Tall trees/ mangrove proper	Xylocarpus granatum, Xylocarpus mekongensis,

Table: Result of Mangrove Species and Canopy Closure Changing Aspect on Biodiversity

CONCLUSION

The relationship between several spectral vegetation indices and plant canopy LAI and nature of canopy cover through Perpendicular Vegetation Index have been assessed. The effects of variations in background types, typical of those found beneath mangrove canopies, on these spectral indices have also been examined. The results presented here indicate that the estimation of LAI and percentage of canopy cover using the difference-based and derivative-based indices. The influence of the background is not only dependent on the overall brightness but also the shape of background reflectance spectra, which can vary substantially for the range of substrate types found in floristic environments. In the present study a strong relationship is seen between the GI and LAI but from this relationship the segmentation of the canopy nature may be erroneous due to differential leaf geometry and alignments. It is seen that at some optimum point or extent this linear relation may break and in that situation a polynomial regression line should be fitted between the variable indices. Besides, in some cases having higher GI, according to PVI it should be indicated as having intermediate to high canopy cover. From this succession interpretation can not be done. So, it is better to identify the vegetation pattern and nature from the scatter plots of Red and NIR feature space.

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THE THYMIC RESEARCH OF CHANA PUNCTATUS (BLOCH, 1793) IN SOUTHWEST BENGAL

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A Note

Chana punctatus (Bloch, 1793) is a freshwater snakehead fish. This fish belongs to the order Chaniformes and Family-Chanidae. *C. punctatus* found in freshwater ponds and paddy fields. Their natural populations are distributed among the Southeast Asia. The IUCN status of the species is "Least Concern". Thymic research of *C. punctatus* is hardly characterised on anatomical point of view. This gland may create several functional activities to protect against pathogen from the different aquatic ecosystems. We will address thymic organ as a valuable research material in modern scientific approach. The present study addresses towards the diversity of various call types which may have efficient role in association with thymus gland showing wide range of tolerance in relation to thier specific aquatic ecological habitats.

Key Words: *Chana punctatus*, Thymus, Cell diversity.

'QUEEN OF JUNGLE', JHARGRAM BIO-DIVERSITY CANVAS: IDEAL PLACE OF ECO-TOURISM IN WEST BENGAL

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ABSTRACT

Ecotourism is entirely a new approach in tourism and also green development. Ecotourism is a preserving travel to natural areas to appreciate the folk-cultural and natural-history of the environment, taking care not to disturb the integrity of the ecosystem, while creating economic opportunities that make conservation and protection of natural resources advantageous to the people. The 'Eco-tourism' means sustainable, equitable, community based management for improving living of standard of indigenous host and ancient past communities in a biodiversity based area. WTO defines 'Eco-tourism' as "tourism that involves travelling to relatively undisturbed natural areas with the specified objectives of studying, admiring and enjoying the sceneries and its wild plants and animals, as well as in existing cultural aspects found in this areas. The ecotourism can be categorized as tourism that is "Nature based, ecologically sustainable, where education and interpretation is a major constituent and where local people are benefited." Today, the entire world is facing a deep crisis and is in the danger of being doomed. The rich forest areas and biological diversity have been degraded due to anti environmental development. The continuous denuding of forest reserves has led to global warming and greenhouse effects. Fortunately, this has led to some realization, and now the world has awakened for new beginnings about human responsibility towards nature. The 'queen of Jungle in Jhargram' area is an abundant source of flora and fauna. Jhargram biodiversity canvas has numerous rare and endangered species in its surroundings. The forest area has covered by dense forest, lateritic red soil, many undulated hillocks, and hills, sacred groves, rapid and cascade river system and pleasure-peace-hospitable environment and folk cultural activities of ancient past and host people have created to eco-tourism campus in South Bengal. So, it is a natural and biodiversity canvas of West Bengal. Stretching from head of Dulung River to Subarnarekha basin, nayagram, rameswar, topoban, hatibari, kanak aranya, chilkigarh, laljal, belpahari, amlachati, kechanda are of the popular eco-tourism destinations in the Jhargram area of South Bengal.

Key Words: Ecotourism, sustainable development, economic opportunities.

ITRODUCTION

The term "Biodiversity" was coined by Rosen in 1986. The variability among living organisms from all sources including *inter-alia*, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystem". The 'queen *of Jungle Jhargramty'* area is an abundant source of flora & fauna. Forest and river system and pleasure-peace-hospitable environment and folk cultural activities of communities make the area and created to eco-tourism campus in South Bengal. So, it is a natural and biodiversity canvas of Bengal.

LOCATION OF THE AREA

The Jhargram District lies between 20°32' and 22°48' North latitudes and 86°34' and 87°20' East longitude approximately. On the North it is bordered with the civil districts of Purulia and Bankura and on the East it is bordered by the river Kangsabati (from the western border of Paschim Midnapore District) and partly by the river Subarnarekha from the western border of Kharagpur Division. Presently the Jhargram District consist of community development blocks like Binpur-I, Binpur-II, Jhargram, Jamboni, Gopiballavpur-I, Gopiballavpur-II, Sankrail, and Nayagram. It is having common borders with the State of Odisha on the South and on the West with the Jharkhand State.

OBJECTIVES OF STUDY

To discuss about Eco-tourism, to identify and observe Bio-diversity heritage and eco-tourism spots, to find out the significance and value of Bio-diversity, to analysis the relationship of people and environment, to point out for the management of local biodiversity and evironmental conservation.

MATERIALS AND METHODS

The research methodology of this work have been categorized into three parts, these are pre-field, field work and post field work. Prior to visiting the field area, total Jhargram district geographical area, existing literatures, published and unpublished report of the government and non-government organization, various cartographic materials, satellite data etc. have been collected and recorded. Several bio-diversity heritage and tourist spots have been observed in the forest area of Jhargram, sacred groves in connection with nature and local communities.

RESULTS AND DISCUSSION

Forest and wildlife are essential for ecological balance of an area. Forests are important components of our environment and economy. Besides economy forests check air pollution and soil erosion; they save the hill-slopes from landslides and in deserts trees reduce wind erosion by checking wind velocity. Forests attract rainfall too. Forests are important renewable natural resources. Forests ecosystem is dominated by trees, their species-content varying different part of the world. Forests contribute substantially to the economic development of our country by providing goods and services to the people and industry. They also play an important role in enhancing the quality of environment by influencing the life supporting system. Forests are also linked with our culture and cultivation. The chief product that forests supply is wood, which is used as fuel, raw materials for various industries as pulp, paper, news-print, board, timber, for furniture items, other uses as in packing articles for fruit, tea etc. matches, sports goods, etc. Indian forest also supply minor forest products like canes, gums, resins, dyes, tannins, lac, fibers, flosses, medicines, catha etc. For tribal people forests also provide food as tuber, roots, leaves, fruits, meat, from birds and other animals and medicine. Plants is the most valuable resorce of the forest area of Jhargram forest. This forest area classify in to three catagories, i.e a) natural forest. b) plantation forest. C) agro-forest. Natural Forest: This forest is under the dry deciduous forest. Sal and other trees along with grasses are found here. All tress and grasses is very significant asset of the forest area for the host people. Plantation forest: about 20% of the forest area is under the plantation forest area. The fallow land of the district has used for plantation. Species like Acacia, Eucalyptus, Anthocephalus and Tectona are planted here. The trees are used for wood and furniture purpose. Agro-Forest: Agro-forest is the most valuable planting programme of the host area. A large number of people engaged to agro-forestry in this area. Mango, Guava, Cashew, kul , tamarind, etc. are planted to grow for food items. Wildlife is most valuable resorce of this forest area of Jhargram forest. This forest cover are open and admixed type. Indian elephant (*Elephas maximus indicus*) and recently golden Jackal is reported from forest area. Some common birds including Black headed ibis and jungle quail are found here. Significant plant species of commercial kind are available here. These are bel, kanthal, bat, sal, mahul, kusum, harjora, kuchi jam and kendu. Flowers are important and make environment beauty during spring. These are semul, palas, gulmohor, bel, nim, bakul, chalta, radhachura, mahua, gamar, babul and tentul. The common interaction on forest area in Jhargram and its sarrounding environment are occupaied by fresh air, shadow and seasonal rain by the natural sal, simul, palash, mohua, kadam etc. Whereas fresh air means pollution free O_2 from sarrunding environment. Jhargram geographical forest cover (40%) belt is the most special place for fresh air cover zone. Another way tall and large size dense forest has created shadow environment. The area are chilkigarh, topobon and hatibari. These sites are the attraction sites for tourisum development in the district. Among the festival of Santhals in West Bengal, "Baha Parab" is observed in March i.e. in the spring. It is a traditional cultural activity directly connected to indigenous way of nature conservation measures. This is a prominent festival of tribal community of Bengal. This is a traditional, indigenous and religious festival of Santals, usually observed just after 'Dol Purnima' or 'Holi'. This is a spring festival bringing new hope and new life in nature connecting with human sustenance. It is a whole day and night festival with numerous religious and cultural rituals followed by trribal dance, music, procession, food and many more.

'Baha' means flower, 'Parab' means festival; so, this is actually a flower festival in spring. This is concerned with the worship of Sarjam or Sal (*Shorea robusta*) and Matkom or Mohul (*Madhuca indica*), the two important tree species of dry deciduous forests of Southwest Bengal. The main ingredients of this festival are the flower of sal and mohul. By traditional rule, they do not tear flowers or pluck new leaves of sal before observing this festival. *Chilkigarh Kanak Aranya'* Biodiversity area is located at left bank of Dulung river in Jamboni Block. The geographical area cover with Toposheet no - 73J/14 & 73J/15, Scale- 1:50,000. This geographical area covers 4 sq. km areas and stretches in between north- south 2 km and east- west is about 2 km. This site is a popular for its sacred groves, temple, serene beauty, primitive tribes and flowing river. Jhargram is a special characteristics geographical area of West Bengal. The town is famous for the city of nature and also healthy place of Bengal also India from 1922. This town has established for municipality area in 1982. Recent, this town is district head quarter of Jhargram district. The raj palace is the famous land mark of this town has brought heritage site of the South Bengal from 19th century. The city has a zoological park, which is known as Deer park. Amlachati is famous and popular site for largest Herbal and Medicinal plant garden in south Bengal. The area has created a pleasure land in Jhargram which is about 7 km from town. Tapoban is known as birth place of 'lab kush' by Indian mythology from ancient time. It is situated right bank of sita nala, which is flowing from high land of lateritic hard head in Nayagram block. The area is a sacred grove in the forest area, which characterized by ecological and rich biodiversity tourist spot. Rameswar is located on right bank of Subarnarekha River in Nayagram block, which is 75 km away from Jhargram. It is famous for lord Shiva from Ancient time. Shivaratri and makar sankranti are main festival of this area. Hatibari area is characterized by dense forest aside the river Subarnarekha. Pakhiralay, Satma and Jilly canal mouth are another eco-tourism spot of this area that are 60 km from town. Belpahari area has sal forests. Kechanda pond, sonajhuri piknik spot, boita, jungle Kanya, goyamara rahini and Gopivallabpur are places for eco-tourism.

CONCLUSION

The tribal and host people tradition has always taught that, humankind is a part of nature and one should look upon all creation with the eyes of a love and respect. It is tragic that since last few decades, the mad quest for the material end and economical progress in Jhargram District and abroad has become identical with the exploitation of nature in all its appearances. Today, the entire district is facing a deep crisis and is in the danger of being doomed. The rich forest areas and biological diversities have been relentlessly divested to erect concrete walls. Due to change in environment some abnormalities recorded in the ecosystem. So, it is right time to think to conserve the nature and environment to protect the ecosystem of Jhargram district for ideal place of eco-tourism centre of South Bengal. Therefore proper environmental management and strategies should be developed to establish socio-economic sustainable development of Jhargram.

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সংস্কৃত সাহিত্যে জীববৈচিত্র্য ও প্রকৃতি ভাবনা

অমিতাভ পাহাড়ী
অতিথি শিক্ষক, সংস্কৃত বিভাগ, সেবা ভারতী মহাবিদ্যালয়
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সারাংশ

প্রাচীন সংস্কৃত সাহিত্যে জীব ও প্রকৃতির মধুর মিলনের দৃষ্টান্ত পাওয়া যায়। সংস্কৃত সাহিত্যে কবিকুলশিরোমনি মহাকবি কালিদাস তাঁর প্রায় সমস্ত রচনাতে প্রকৃতির সাথে মানব জীবনের আন্তরিক সম্পর্কের কথা তুলে ধরেছেন। এছাড়াও চরক, সুশ্রুত সংহিতায় উদ্ভিদ ও প্রাণী কর্তৃক মানব জীবনের উপকারিতার নমুনা বারংবার লিপিবদ্ধ হয়েছে। বর্তমান নিবন্ধে দক্ষিন পশ্চিমবঙ্গে বসবাসকারী বিভিন্ন সম্প্রদায়ভুক্ত মানুষের মধ্যে সংস্কৃত সাহিত্যের জীববৈচিত্র্য ও প্রকৃতি ভাবনার প্রভাব তুলে ধরার চেষ্টা করেছি।

মূল শব্দঃ- সংস্কৃত সাহিত্য, কালিদাস, চরকসংহিতা, সুশ্রুত সংহিতা, জীববৈচিত্র্য।

মানুষের জীবন প্রকৃতি নির্ভর। প্রকৃতিক বাদ দিয়ে জড় কিংবা জীব কোন জগতেরই অস্তিত্ব কল্পনা করা যায় না। জীববৈচিত্র্যকে টিকিয়ে রাখতে প্রকৃতির করুনা অপার। সংস্কৃত সাহিত্য জগতে রাজাধিরাজ মহাকবি কালিদাসের প্রাচীন কাব্য, নাটকে প্রকৃতির অপরূপ রূপবৈচিত্র্য আমরা দেখতে পাই। কালিদাস প্রণীত প্রখ্যাত নাটক 'অভিজ্ঞান -শকুন্তলম্' নাটকে কন্বমুনির তপোবন এক প্রকৃতির লীলাক্ষেত্র। নাটকের প্রস্তবনাতেই গ্রীষ্ম সময়ের পাটল সংসর্গে সুরভি বনবায়ু, ভ্রমরের দ্বারা ঈষদীষৎ চুম্বিত শিরীষ কুসুম বিলাসিনী নারীর কর্ণভূষন হওয়ার বর্ণনা পাওয়া যায়।

সুভগসলিলাবগাহাঃ পাটলসংসর্গসুরভিবনবাতাঃ।
প্রচ্ছায়সুলভানিদ্রা দিবসাঃ পরিনামরনীয়াঃ।।" (অভিজ্ঞান শকুন্তলম্ ১/৩)

এই নাটকে আমরা মালিনী নদীর বর্ণনা পাই। এই নদীর তীরে কণ্বের আশ্রম যেখানে পাখিদের ফেলে যাওয়া যায় নীবার ধানের কনা দেখা যায়। এর থেকে আমরা বুঝতে পারি নির্মল প্রকৃতির জন্য, শুদ্ধ মনন ও চিন্তনের জন্য তপোবন আশ্রম পরিবেশ কতটা জরুরি। এই রচনায় আশ্রমস্থিত সুন্দর সুন্দর বৃক্ষের বর্ণনা পাওয়া যায়, কেসর বৃক্ষ, বনজ্যোৎস্নলতায় পরিবেষ্টিত সহকার বৃক্ষ যেগুলি শকুন্তলার পরম আত্মীয় ছিল। বর্তমানে আমরা সবাই শকুন্তলার শৈশব জীবনকে আদর্শ হিসেবে ধরি, কারন মানুষ, গাছ, পশু-পাখি কেউই শকুন্তলার শত্রু ছিল না এরা সকলে শকুন্তলার পরম বন্ধু ছিল।

এই নাটকের দ্বিতীয় অঙ্কে দেখা যায় শিকারে রত সসৈন্য রাজার অরণ্য জীবনের চিত্র। যেখানে পরিস্ফুট হয়েছে মৃগয়া বা শিকারের উপকারিতার কথা। মৃগয়ায় মেদ দূর হয়, শরীর ঝরঝরে থাকে, শরীরে উদাম আনবার জন্য মৃগয়া যে কতটা উপকারী তা আমরা জানতে পরি এই নাটকের মাধ্যমে।বর্তমানে সবাইকে বাঁচিয়ে রাখা জীববৈচিত্র্যের মূল লক্ষ্য নয়। বিভিন জীবের মধ্যে সামঞ্জস্য বিধানই জীববৈচিত্র্যের মূল উদ্দেশ্য। দক্ষিন পশ্চিমবঙ্গের উপজাতি সম্প্রদায়ের মধ্যে এই ধরনা আছে, তারা বন্য সমস্ত প্রণীকে শিকার করে না নিদিষ্ট কিছু প্রানীকে শিকার করে।

এই নাটকে মহিষগুলি জলাশয়ে স্নান, হরিণের রোমন্থন, শুকরের মত্ততা প্রভৃতির পরিচয় পাই। এই নাটকের তৃতীয় অঙ্কে আমরা দেখি মালিনী নদীর তীরে বেতস কুঞ্জের বর্ণনা। শরীরের তাপ শান্তির জন্য পদ্মপাতার আবরন শকুন্তলার বক্ষে দেওয়া হয়েছিল। দুষ্যন্তের প্রতি শকুন্তলার প্রেমপত্র রচিত হয়েছিল শুকপাখির পেটের মতো কোমল পদ্মপাতায় নখের আঁচড়ের দ্বারা।

"এতস্মিন্ শুকোদর সুকুমার নলিনীপত্রে নখৈঃ নিক্ষিপ্তবনংকুরু।

(অভিজ্ঞান শকুন্তলম্, তয় অঙ্ক, প্রিয়ংবদার উক্তি)

এর দ্বারা আমরা বৃক্ষ, লতাপাতা ও পঙ্কে প্রস্ফুটিত পদ্মপাতার গুনাগুন বুঝতে পারি। চতুর্থ অঙ্কে শকুন্তলার পতিগৃহ যাত্রাকালে আমরা দেখি বনরাজি শকুন্তলাকে বন্য অলংকার, বল্কল বস্ত্র উপহার দিয়েছে। একজন মানুষের সাথে বৃক্ষ তথা বিভিন্ন প্রাণীর সম্পর্ক যে কতটা মধুর তা শকুন্তলার পতিগৃহ গমন কালে বৃক্ষের পত্রত্যাগের মাধ্যমে বুঝতে পারি।তাইতো কন্বমুনি আশ্রমের গাছেদের, প্রানীদের কাছে শকুন্তলা বিদায়ের অনুমতি চাইলেন-

"ভোঃ ভোঃ সন্নিহিতা স্তপোবনতরবঃ-

পাতুং ন প্রথমং ব্যবস্যতি জলং যুষ্মাস্বপীতেষু যা
নাদত্তে প্রিয়মন্ডনাপি ভবতাং স্নেহেন যা পল্লবম্।
আদ্যে বঃ কুসুম প্রসূতিসময় যস্যা ভবত্যুৎসবঃ
সেয়ং যাতি শকুন্তলা প্রতিগৃহং সর্বৈরনুজ্ঞায়তাম।।" (অভিজ্ঞান শকুন্তলম্ ৪/৯)

মহর্ষি কন্বের প্রার্থনা শুনে বসন্তের দূত কোকিলের ডাকের দ্বারা শকুন্তলা পতিগৃহ যাওয়ার সম্মতির কথাও আমরা বুঝতে পারি ।এর দ্বারা প্রকৃতির কোলে লালিত বিভিন্ন জীবের সাথে মানুষের সম্পর্ক যে কতটা মধুর তা প্রাচীন কাল থেকে আজ অবধি বোঝা যায়।

বর্তমান সময়ে দেখা যায় দক্ষিন পশ্চিমবঙ্গে উপজাতি সম্প্রদায়ের মানুষজন বৃক্ষ জাত বহু দ্রব্য অলংকার হিসেবে ব্যবহার করেন। এছাড়াও কালিদাস প্রণীত 'রঘুবংশ ' মহাকাব্যে আমরা জীববৈচিত্র্যও প্রকৃতির ছোঁয়া পাই।এই কাব্যের প্রথম সর্গে আমরা দেখি মহারাজা দিলীপ ও সুদক্ষিনার অনপত্যতা দোষ নিবারনের জন্য গুরু বশিষ্ঠের আশ্রমে গমন। এই গমনকালে দেখা যায় চলমান সৌন্দর্যের চিত্রকল্প। শালগাছে নির্যাসের গন্ধে প্রকৃতি মুখরিত, পুষ্পারেনু শোভিত বায়ু যেন রাজদম্পতীর সেবায় নিয়োজিত

"সেবামানৌ সুখস্পর্শৈঃ শালনির্যাস গন্ধিভিঃ।
পুষ্পরেনুৎকিরৈর্বাতৈরা ধূতবনরাজিভিঃ।।"(রঘুবংশ, ১ম সর্গ, শ্লোক-৩৮)

শুধু তাই নয় রথের মধুর ধ্বনিতে মেঘ গর্জন অনুমান করে ময়ূর ময়ূরীদের নৃত্য, কেকাধ্বনি মুখরিত করেছে আকাশ বাতাস।

'ষড়জসংবাদিনীঃ কেকা দ্বিধা ভিন্নাঃ শিখন্ডিভি ঃ" (রঘুবংশ, ১ম সর্গ ,শ্লোক-৩৯)

বর্তমানে আমরা দেখি দক্ষিন পশ্চিমবঙ্গের বনাঞ্চল এলাকার অধিবাসীরা শালগাছের আঠা থেকে ধুনা তৈরি করে জীবন জীবিকা চালায়। কালিদাসের অপর কাব্য ঋতুসংহারে আমরা দেখি ছয়টি ঋতুর ক্রমান্বয়ে পরিবর্তনের সাথে সাথে মানবজীবনের নানা পরিবর্তন সূচনা। এছাড়াও জীববৈচিত্র্যের পরিবর্তন লক্ষ্য করা যায়। বর্তমানে আমরা দেখি প্রকৃতির কোলে টিকে থাকতে না পেরে আজ অনেক প্রাণী ও উদ্ভিদ অবলুপ্তির পথে । ফলে জীববৈচিত্র্য নষ্ট হচ্ছে। প্রকৃতি বর্ননের তথা জীব বৈচিত্র্যের ধারনা পাই কালিদাসের 'কুমার সম্ভবম্' মহাকাব্যে। এই কাব্যে প্রকৃতি যেন সচেতন হয়ে প্রতিভাত হয়েছে। প্রকৃতির মধ্যে বড় হয়ে ওঠা বিভিন্ন জীব, পশু পক্ষির মধ্যে পারস্পরিক সম্পর্কের চিত্র পাওয়া যায় এই কাব্যে। তাই কবির ভাষায় -

"অনন্তরঞ্চপ্রভবস্য যস্য, হিমং ন সৌভাগ্যবিলোপি জাতম্।
একো হি দোষো গুণসন্নিপাতে, নিমজ্জতীন্দোঃ কিরণেষ্বিবাঙ্কঃ।।"

বর্তমানে আমরা দেখি প্রকৃতির কোলে টিকে থাকতে না পেরে আজ অনেক প্রাণী ও উদ্ভিদ অবলুপ্তির পথে ।

"শরীর ং ব্যাধি মন্দিরম্ " -মানুষের শরীর মাত্রেই ব্যাধির মন্দির।মানুষের শরীর নানা করনে ব্যাধির দ্বারা আক্রান্ত হয়। ফলে স্বাস্থ্য হানি ঘটে। প্রচীন মুনি ঋষিগন সেই শরীরের রোগ ব্যাধি নিবারনের জন্য সর্বদা চেষ্টা করেছেন। ধারনা দিয়েছেন আয়ুর্বেদ শাস্ত্রের।প্রাচীন ঋষিদের প্রার্থনা ছিল শতবর্ষ আয়ু। এই আয়ু বৃদ্ধির জন্যই আয়ুর্বেদের ধারনা আসে।

বর্তমানেও এটি প্রচলিত আছে। এই আয়ুর্বেদ শাস্ত্রে আছে শরীরবিদ্যা, ভ্রুনবিদ্যা, স্বাস্থ্যবিজ্ঞানের নানা বিষয়। আনুমানিক খ্রীঃ ১ম শতকে মহর্ষি চরক রচিত ' 'চরক সংহিতা ' আয়ুর্বেদ শস্ত্রের প্রচীনতম গ্রন্থ। গ্রন্থটিতে ১২০টি অধ্যায় ও ৮টি স্থান আছে। এই শাস্ত্রে বর্নিত আছে- আয়ুর্বেদ কি ? বিভিন্ন ব্যাধির লক্ষন, কারন, প্রতিকারের উপায়। পিত্ত, কফ, গ্যাস যে রোগগুলি মানুষের নিত্য সঙ্গি তারও মুক্তির উপায় বর্ণিত আছে এই আয়ুর্বেদ শাস্ত্রে।এছাড়া সুশ্রুত সংহিতায় মস্তিস্কের, স্নায়ুর, বিভিন্ন অস্থির চিকিৎসা, অস্ত্রোপচার প্রভৃতি তত্ত্ব আছে। ভেল রচিত ভেল সংহিতা, চক্রপাণিদত্ত রচিত 'চিকিৎসারসংগ্রহ', গ্রন্থেও আয়ুর্বেদ এবং গাছ গাছড়ার দ্বারা বহু দুরারোগ্য মারণ রোগের চিকিৎসা কথা আলোচিত হয়েছে।

সহস্র বছর পূর্বে রচিত প্রাচীন গ্রন্থ সমূহে যে তত্ত্ব বর্ণিত ছিল তা আমরা সহস্র বছর পরেও উপলব্ধি করছি । আমরা আধুনিক সভ্যতার পাশ্চাত্য সমস্ত কিছুকে আকর্ষন করে অতীতকে ভুলে যাচ্ছি। কিন্তু মানুষও আজও নানা প্রয়োজনে অতিতের তত্ত্ব ও তথ্য সমূহকে খুঁজে বেড়াচ্ছে। মানুষ বর্তমানে অ্যালো প্যাথিক অধুনিক চিকিৎসায় দুরারোগ্য ব্যাধি সারাতে ব্যর্থ হয়ে প্রাচীন ঋষিদের দেখানো আয়ুর্বেদ চিকিৎসায় ফিরে যাচ্ছে। তথ্য অনুযায়ী দেখা যায় দক্ষিন পশ্চিমবঙ্গের অধিবাসীরা অনেক ভেষজ উদ্ভিদ রোগ নিরাময়ে ব্যবহার করেন। আমরা কখনোই প্রকৃতির দান বৃক্ষ সমুহকে ও বিভিন্ন জীবের অবদানকে অস্বীকার করতে পারব না। আমাদের নীরোগ শরীর, সুস্বাস্থ্য, প্রকৃতির ভারসাম্য রক্ষা, ও জীববৈচিত্র্য রক্ষার জন্য প্রাচীন মুনি-ঋষিদের দেখানো পথে অগ্রসর হয়ে নিজেদের জীবন সংগ্রামে টিকিয়ে রাখাই আমাদের একমাত্র কর্তব্য।।

তাই চরক সংহিতায় বলা হয়েছে-

"ধর্মার্থকামমোক্ষানামারোগ্যং মূলমুত্তমম্।
রোগাস্তস্যাপহর্তারং শ্রেয়সো জীবিতস্য চ।।" (চরকসংহিতা, সূত্রস্থান ১/১৫)

তথ্যসূত্র

অভিজ্ঞান শকুন্তলম্ -ড. চক্রবর্তী সত্যনারায়ণ, সংস্কৃত পুস্তক ভান্ডার, প্রথম সংস্করণ, ১৯৮৮
সংস্কৃত সাহিত্যের ইতিহাস-বন্দ্যোপাধ্যায় ধীরেন্দ্রনাথ, পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষৎ-প্রথম সংস্করণ, জুলাই ১৯৮৮/এ।
সংস্কৃত সাহিত্যের ইতিহাস-ড. দাস দেবকুমার, সদেশ, প্রথম সংস্করণ-১৪০৪।
রঘুবংশম্ (১ম সর্গ) - ভট্টাচার্য জনেশ, বি.এন. পাবলিকেশণ, প্রথম সংস্করণ বুদ্ধপূর্নিমা, ১৪২২।
অভিজ্ঞান শকুন্তলম্ -ড. রায় রায় পাপড়ি, সংস্কৃত বুক ডিপো, প্রথম সংস্করণ জুলাই -২০০২।
অভিজ্ঞান শকুন্তলম্ - ড. বসু অনিল চন্দ্র, সংস্কৃত বুক ডিপো, প্রথম সংস্করণ, সেপ্টেম্বর, ১৯৯৯
কুমারসম্ভবম্ -পাহাড়ী শুভময় ও সিনহা রাজীব, ডাভ্ পাবলিকেশন, প্রথম সংস্করণ, ভ্রাতৃদ্বিতীয়া -২০১৪

Group Photograph at the end of the Seminar

Dr. Biswajit Maity, representing introductory talk on Bio-diversity and presence scenario

Dr. P. Gupta receiving flower bouquet from the students of Seva Bharati Mahavidyalaya, Kapgari

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