

# **Ecology and Traditional Wetland Practice**

Lessons from Wastewater Utilisation  
in the **East Calcutta Wetlands**



Dhrubajyoti Ghosh

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**East Calcutta Wetlands**

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Worldview  
Kolkata

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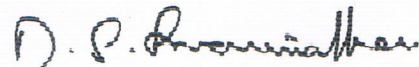
*Dedicated to my parents and those ordinary people  
who know how to live creatively with nature*

## Foreword

The recent Tsunami tragedy in Asia has highlighted the importance of conservation of mangrove wetlands which serve as bio-shield to reduce the fury of tidal waves and coastal storms. Unfortunately the importance of wetlands either in coastal or inland areas for sustainable human security is not being realised widely. This book based upon careful research by one of world's leading ecologists, Dr Dhrubajyoti Ghosh, is hence a very timely publication. As stressed by the author, no other ecosystem is as important as wetlands in ensuring sustainable water resource management. Taking the East Calcutta Wetlands as an example the author has shown how greed-based development will ultimately harm human populations. In the East Calcutta Wetlands, the local people have created the world's largest assembly of waste water fish ponds. This is an excellent demonstration of traditional ecological prudence which leads to converting waste into a valuable resource.

Dr Ghosh has brought out very clearly the multiple benefits of traditional wetlands practices. The benefits include the more efficient removal of coliforms thereby conferring health benefits. The author has given a design for community based management of urban wetlands. A community based approach brings scientists and local communities together into a symbiotic partnership. The book shows the way to use the wetlands in ecologically wise manner so that the concept of sustainable development can be converted from rhetoric to reality.

In my view Dr Ghosh is spearheading a movement for **welfare ecology**, just as Prof. Amartya Sen is leading the welfare economics movement. Welfare ecology helps us to reap the benefits of natural endowments without destroying them. I hope this book will be widely read and used for developing ecologically and socially beneficial methods of wetland management.



**Prof M S Swaminathan**  
UNESCO Chair in Ecotechnology  
Chairman, National Commission on Farmers and  
President, National Academy of Agricultural Sciences

## *Preface*

The present author has been visiting the East Calcutta Wetlands for more than twenty years, without interruption. Today, the traditional knowledge base of using wastewater is showing signs of erosion. The continued uncertainty in this area, which once had thriving resource recovery practices, has flattened the diverse crease of a cultural heritage that is now dying. And this exactly is the challenge of conserving the East Calcutta Wetlands.

In the recent years, scientific studies in the East Calcutta Wetlands have picked up some pace, which is likely to gain further as a result of this ecosystem being listed as a Wetland of International Importance by the Ramsar Convention. This is a satisfying feeling for the author who, in the early eighties, had the privilege of introducing the uniqueness of the area to the rest of the world by way of naming it and mapping its boundary, of unfolding for the first time some of its unknown features and of expounding the wealth of traditional wisdom that flourished here, and establishing how that continues to subsidise the city of Kolkata ecologically.

This wetland area is still in need of many more intelligent minds to carry out dedicated scientific investigation. At this point of time an introductory monograph on this ecosystem, which has a mind-boggling diversity of its own, was considered necessary. In this present case the different phenomena of the East Calcutta Wetlands have been observed as an outcome of an evolving traditional practice, which is interpreted here by using a subjective tool known as Ecology. In the process it has trodden a relatively unknown pasture of knowledge by unlocking the 'perceptual construct' of the traditional fishing community of this area. These people have been able to transact with nature in using wastewater in a much more meaningful way than the mainstream scientific and engineering community could ever do. *Living creatively*

*with nature*' is how the mindset of these local people has been defined and it can be verified in many other ecosystems where people with similar mindset have succeeded in establishing sustainable means and pace of exploiting natural resources.

This book stokes an incipient debate. '*Living creatively with nature*', it has argued, can be the founding postulate for environmental conservation and perhaps describes the genesis of traditional knowledge more profoundly. It has attempted to understand the intrinsic strength of the subaltern majority and possible routes to their well-being, differently.

### ***Acknowledgements***

I am grateful to the Government of West Bengal for allowing me to hang around an ecosystem for more than two decades.

I remember my mother whom I lost about two years ago. She had always been with me during my thought processes and stood by me at times of distress. Thereafter I would thank the farmers and the producers of the resource recovery practices who tolerated my presence and enquiries for all these years. I express my deep sense of gratitude to Mr. Premtosh Ghosh who has always been my best reference point for almost all kinds of information relating to the wetland area. Late Ganesh Biswas, who passed away about a decade back, had also been a good teacher. His demise was an irretrievable loss to the seekers of knowledge. Mr. Harekrishna Mondal seemed to know everything about the land tenure and mouza maps of this region. He was very kind to guide me through the entire wetland area during the initial years of my education and introduction. I must mention Mr. Sukumar Biswas, son of late Ganesh Biswas, for having taken over the reigns reasonably well and being always helpful. The list tends to become longer for my close association with so many of them through such a long period of time. Often I used to get surprised at their enviable grasp over managing natural resource systems which they handled with great ease and confidence. I have however restricted myself from naming all of them and mentioned only those who took me to the rest of them and opened in front of me the

gates of ecological learning. I would rather recognize my unwillingness to list them all as an inertia of my cultural roots where respecting a *chashi* (a farmer) comes as an act of greatness instead of a natural trait.

Dr.M.S Swaminathan had been telling me to complete this manuscript for many years and provided his inspiring comments whenever I made any part of the monograph available to him. Dr.K.K.Bagchi, for more than a decade, acclimatised me with the intricacies of governance and brought the best out of me in the matters of wetland conservation. Ms.Aditi RoyGhatak, Ms.Susmita Sen and Ms.Dhruba Dasgupta carefully read the text and improved it. Without their help this could not have been completed. Ms.Subhamita Chaudhuri did an excellent job of drawing figures and formatting the text. Ms. Sudeshna Ghosh has been very helpful in reading the whole text carefully. Dr. Subir Ghosh helped me in writing the portion on biodiversity. Mr. Arijit Majumdar and Mr. Swapan Maity provided me with some information about the area. Mr. Sujit Choudhuri created a decent map for this book. I am grateful to all of them. Ms.Srirupa Roy and Ms.Lopamudra Banerjee have been helpful in taking care of the issues relating to economic valuation of wetlands. I thank both of them. Dr. Sarmila Banerjee read the manuscript in part and has always been keen to see this monograph published. Mr. Biplab Chakraborty helped me in the finer areas of completing the manuscript and maintained a healthy pressure to complete the scripts on time. Tvishampati , my son, has always raised difficult questions, which helped me immensely to strengthen my arguments.

In course of my journey, which itself was so eventful, I have not been able to make everybody happy. I found myself in opposition to a section of the society, fairly predictably, on certain issues relating to conservation of the ecosystem. All this helped me in understanding the dialectics of power better and thereby in shaping the tools to preserve the ecosystem more appropriately. I thank them as well.

DG

Kolkata

27January, 2005





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### *Note:*

*1. Calcutta has recently been renamed as Kolkata. In this book both these names are interchangeably used. The Calcutta Metropolitan Water & Sanitation Authority (CMW&SA) has also been rechristened Kolkata Metropolitan Water & Sanitation Authority (KMW&SA) and both these names are used in the text. However, the name of the 'East Calcutta Wetlands' has not been changed.*

*2. The 'East Calcutta Wetlands' is a waste recycling region. It has also been termed as the 'East Calcutta Wetlands and Waste Recycling Region', covering 12,500 hectares. These two terms have been interchangeably used.*

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## CHAPTER 1

# Introduction

*Wisdom is the aggregate of knowledge and experience.*

**L**earned souls, only a few though, are recognizing better the wisdom of the ordinary men in designing conditions of living which are sustainable. In many cases, traditional livelihood practices stand the rigours of scientific enquiry. A few of these can also provide directions for future scientific research into areas of environmental conservation and the welfare of the masses. One such practice that has evolved into a management system is the East Calcutta Wetlands that provides a fascinating lesson on living creatively with nature. This ecosystem is displaying ingenuity of the local farmers in using the functions of nature for creating livelihoods that are ecologically balanced and economically remunerative.

The East Calcutta Wetlands are in fact a repository of many kinds of lessons. Here, an urban planner finds answer to the problems of waste management and design of a stable urban fringe. A sanitary engineer learns to redefine waste as a resource. A wetland expert learns how indigenous local knowledge prompts wise use of nature. An economist learns to value an ecosystem and recommend sustainable choice for municipal waste disposal alternatives. An environmental expert learns the basics of sustainable development and areas where precisely the people know better. Finally, an ecologist has at his disposal a vast tutorial ecosystem, which can easily be a centre of learning for the rest of the world.

In the course of his professional responsibilities, the author has regularly visited the East Calcutta Wetlands since the 80s and has come to the firm conclusion that this ecosystem has far from exhausted showing up its nearly endless facets. A close examination of this precious ecosystem reveals how these features are interwoven meticulously into a web of happenings that hold such a complex maze of transactions between nature and human interventions in balance. The area was earlier known as the Salt Lakes and it was renamed the 'East Calcutta Wetlands' by this author, who has been unravelling the mystery of these wetlands and trying to grasp its equally interesting ecological history. This is the history of wetland transformation, exemplifying the role of livelihood compulsions in creating outstanding designs of conservation and wise use.

The wetlands are too vast in their complexity and not all of it can be covered in the pages that follow. Some of the vital gleanings are being dealt with in

this monograph, keeping in mind contemporary environmental concerns and interest in this ecosystem, the need to facilitate studies in the wetlands, the observation of such traditional practices that the East Calcutta Wetlands demonstrate and how these wetlands can influence the choice of technology, especially wastewater treatment, in the poorer countries with ample sunshine. Decision-makers may also find this work of some use for bringing before them an unknown treaty in wise use. They may in fact adopt the framework of conventional knowledge in the field of wastewater treatment and wetland management in particular and sustainable development in general.

Development models are undergoing fundamental changes. These are perforce to accommodate the significance of nature to avoid the collapse of the entire living system, more pointedly human life. Care for nature, therefore, has become an establishment agenda encompassing every government, the United Nations, international banking agencies, monetary funds, conventions, trade agreements and even military treaties. Never before have ecology and economics come so close to each other in their planetary orbit. Yet there is very little literature to satisfy this investigator, that there exists sufficient intellectual togetherness in academic initiatives combining these two disciplines. Albeit the paucity of global thinking has affected even the present effort, one hopes that many such efforts may help in consolidating thoughts into theory. Implementable and appropriate guidelines will hopefully be available in future, incorporating environmental concern in development initiatives, particularly in the developing countries. Until then we shall keep trying.

This work will remain incomplete if this author fails to keep it on record that all these academic exercises are not much beyond 'translation' or more appropriately a mere deciphering of the oral tradition of a group of ordinary men who demonstrate with effortless ease where the knowledge lies, what one has to do with municipal waste, what are the basic conditions of sustainable development and most importantly how best to live creatively with nature.

The task of 'ecological interpretation' is going to emerge as an important scientific tool to help the transition towards sustainable development of the majority of the global population. Ecological interpretation attempts to bridge the gap between the traditional/ local wisdom relating to humankind's transactions with nature, and the mainstream planning and design process. The present effort in ecological interpretation of a traditional practice is one of the not-so-frequent documents which describes the travel of an unknown local knowledge to the national policy level.

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## CHAPTER 2

# Wetlands and their Wise Use

*Other than rivers in some way, in many parts of the world, no other ecosystem is as important as wetlands in ensuring sustainable water resource management.*

**M**ost of us have a reasonably fair idea of what wetlands are. Sadly, till today, a proper definition has evaded those who are searching for one. In simple terms, wetlands are the areas where land meets water. General configuration of the surface of the earth includes areas of depressions, level lands and mounds. These occur as both large-scale and small-scale features. For the most part the depressions are covered with water either temporarily or permanently. Wetlands are parts of the earth's surface between these terrestrial and aquatic systems. Thus shallow lakes, ponds, tanks, marshes, swamps, bogs, dead river beds, borrow pits are all wetlands irrespective of their extent, duration of water logging, climatic regions in which they exist, their water quality and degree of human intervention.

One unique characteristic of wetlands is the presence of water and water-saturated soil. This may again either be a permanent or seasonal feature. During the period of water logging, wetlands should support hydrophytes. This ecosystem is a transitional zone between the dry terrestrial and wet aquatic systems, having characteristics of both the systems, as well as some of its own, which are unique. Diversity of character, size, type, and mode of occurrence of wetlands have given rise to different indices of describing them. It should be noted that wetlands have been defined from time to time to suit a particular location and such definitions could be extended and applied to other regions also. A universal definition of wetlands has not yet been established. According to Mitsch & Gosselink, wetlands often include three main components. These are presence of water, unique soils differing from those of uplands and presence of vegetation adapted to wet conditions. Some of the initial definitions are mentioned hereunder (Mitsch & Gosselink, 1986).

**Circular 39 Definition-** This is one of the earliest definitions of wetlands given by US Fish and Wildlife Service in 1956. It states that-

*The term 'wetlands' refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds, usually with emergent vegetation*

*as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs, and deep lakes are not included. Neither are water areas that are so temporary as to have little or no effect on the development of moist-soil vegetation.*

**Canadian Wetland Definition (1979)**- This is used in the Canadian Wetland Registry, which is the data bank and inventory of Canadian Wetlands. It states that-

*Wetland is defined as land having the water table at, near or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soil, hydrophilic vegetation and various kinds of biological activity which are adapted to the wet environment.*

**Fish and Wildlife Service Definition (1979)**- This definition is so far the most comprehensive one and states that-

*Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non-soil and is saturated with water or covered by shallow water at sometime during the growing season of each year.*

This is the most widely accepted definition of wetlands in the United States today.

**Legal Definition given by the US Army Corps of Engineers** for implementation of dredge and fill permit system required by Section 404 of the 1977 Clean Water Act Amendments. The definition given was:

*The term 'wetlands' means those areas inundated or saturated by surface of groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.*

The definition that is most universally accepted has been given by the **Ramsar Convention**, which states that,

***The wetlands are the areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres.***

With the amount of scientific thinking and research that are now being fed into the study of this ecosystem and its management it is no wonder that we may see more appropriate definitions coming in future. Common people in

this country easily understand a marsh or swamp, lakes and mud flats (Fig.1). There is a vast multitude of people who in fact draw their sustenance from wetland resources and have considerable understanding of wetlands.

In recent times, the United States has been particularly active in matters of wetland conservation. To bring together the initiatives of the various departments and agencies, it was thought useful to maintain a reference definition of wetlands that will stand outside the context of any particular agency, policy or regulation. This was considered to place a broad framework around regulatory practice and put into perspective regulatory definitions and the selection of criteria and indicators for regulatory purposes. Accordingly, a reference definition has been framed and reads as follows:

*A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physico-chemical, biotic, or anthropogenic factors have removed them or prevented their development.*

Going by this definition, three major factors characterise a wetland: water, substrate (physico-chemical features) and biota. Referring to these factors as "parameters" is incorrect. Though wetlands depend for their existence on all three of them, it is often scientifically defensible, in the absence of alterations or ambivalent indications, to infer information about one factor from another. The states of these characteristic factors are the criteria for identification of wetlands: recurrent, sustained saturation (the hydrologic criterion), physical and chemical conditions in the substrate that reflect recurrent, sustained saturation (the substrate criterion), and the presence of organisms that are specifically adapted to recurrent and sustained saturation of the substrate (the biological criterion).

Out of these three factors, water has special status because neither the characteristic substrates nor the characteristic biota of wetlands can develop in the absence of specific hydrologic conditions. Disturbance of the biota or substrate can produce a wetland in which the characteristic substrates or organisms are absent, at least temporarily. In contrast, elimination of the characteristic hydrology of a wetland eliminates the wetland, though the characteristic substrate and organisms can persist for some time after the hydrologic change. So when hydrology has been altered, the presence of organisms and substrates that are characteristic of wetlands does not necessarily indicate the presence of a wetland.



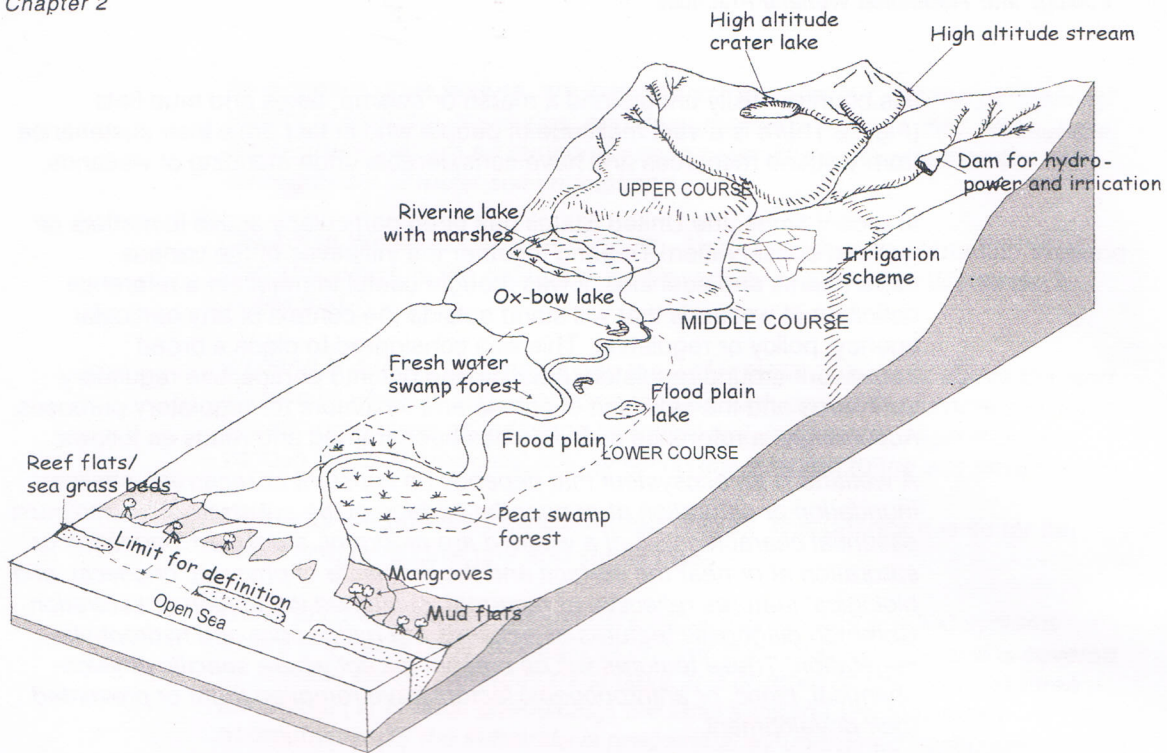


Fig. 1: Types of wetlands included in the Ramsar definition

### What is the Ramsar Convention?

It is now important to know about the Ramsar convention in some detail. The Ramsar Convention is an inter-governmental treaty adopted on 2 February 1971 in the city of Ramsar in Iran. Interestingly, Ramsar is the first of the present day global inter-governmental treaties on conservation and wise use of natural resources and has come even before the Stockholm Conference of 1972 which is held as the beginning of whatever is happening in environmental conservation at the global level.

The official name of the treaty was 'The Convention on Wetlands of International Importance especially as Waterfowl Habitat'. The name itself reflects the weakness of the convention. It is ecologically inappropriate to retain such a strong species bias in any convention on ecosystem conservation. Wetland is an ecosystem and the conservation objectives are completely defeated if one single species happen to rule the business. Happily, over the years, observes a Ramsar information document, "the Convention has broadened its scope to cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely useful for biodiversity conservation in general and for the well-being of human communities. For this reason, the increasingly common use

of the short form of the treaty's title, the *Convention on Wetlands* is entirely appropriate". In fact, even the logo of the Ramsar Convention has been changed. The 'birds' have given place to an impression of wetlands. Today the Convention provides remarkable assistance in wetland conservation activities throughout the world and has become much more effective in working towards its objectives.

When a country becomes a signatory to the Ramsar Convention it agrees *prima facie* to a set of commitments. The Convention, for example,

- entails an endorsement of the principles that the Convention represents, facilitating the development at national level of policies and actions, including legislation that helps nations to make the best possible use of their quest for sustainable development;
- presents an opportunity for a country to make its voice heard in the principal intergovernmental forum on the conservation and wise use of wetlands;
- brings increased publicity and prestige for the wetlands designated for the List of Wetlands of International Importance, and hence increased possibility of support for conservation and wise use measures;
- brings access to the latest information and advice on application of the Convention's internationally accepted standards, such as criteria for identifying wetlands of international importance, guidelines on application of the wise use concept, and guidelines on management planning in wetlands;
- brings access to expert advice on national and site-related problems of wetland conservation and management through contacts with Ramsar Bureau personnel and consultants through application of the Ramsar Advisory Mission mechanism when appropriate; and
- encourages international cooperation on wetland issues and brings the possibility of support for wetland projects, either through the Convention's own Small Grants Fund or through the Convention's contacts with multilateral and bilateral external support agencies.

India is signatory to the Ramsar Convention since 1981. It has so far been able to list 19 sites as wetlands of international importance. These sites are shown below.

Name of Wetland	Date of declaration	State	Area
1. Ashtamudi Wetland	19.08.02	Kerala	61,400 ha
2. Bhitarkanika Mangrove	19.08.02	Orissa	65,000 ha
3. Bhoj Wetland	19.08.02	Madhya Pradesh	3,201 ha
4. Chilika Lake	01.10.81	Orissa	116,500 ha
5. Deeper Beel	19.08.02	Assam	4,000 ha
6. East Calcutta Wetlands	19.08.02	West Bengal	12,500 ha
7. Harike Lake	23.03.90	Punjab	4,100 ha
8. Kanjli	22.01.02	Punjab	183 ha
9. Keoladeo National Park	0.10.81	Rajasthan	2,873 ha
10. Kolleru Lake	19.08.02	Andhra Pradesh	90,100 ha
11. Loktak Lake	23.03.90	Manipur	26,600 ha
12. Point Calimere Wildlife and Bird Sanctuary	19.08.02	Tamil Nadu	38,500 ha
13. Pong Dam Lake	19.08.02	Himachal Pradesh	15,662 ha
14. Ropar	22.01.02	Punjab	1,365 ha
15. Sambhar Lake	23.03.90	Rajasthan	24,000 ha
16. Sasthamkotta Lake	19.08.02	Kerala	373 ha
17. Tsomoriri	19.08.02	Jammu & Kashmir	12,000 ha
18. Vembanad-Kol Wetland	19.08.02	Kerala	151,250 ha
19. Wular Lake	23.03.90	Jammu & Kashmir	18,900 ha

Table 1: List of wetlands of International Importance in India under Ramsar Convention

Source: Ministry of Environments and Forests, Government of India

The details of all these sites and most other information relating to the Ramsar Convention is available in the Ramsar website ([www.ramsar.org](http://www.ramsar.org)). Criteria for selecting Ramsar sites can be seen in Annexure 1. It may be interesting to note that none of these criteria hold livelihood issues of any consequence for rating a wetland. A sizeable section of the poorer countries rely upon wetlands for their sustenance and in fact work as wetland managers. In West Bengal alone about 1 to 3 % of the total population

depends on wetlands for their subsistence living. These are the areas of improvement, which are expected to come in the future versions of selection criteria of the Ramsar Convention.

### **Wetland classification**

Classification and inventorying of wetlands are the two important tasks for wetland management. Different classifications have been made from time to time, each differing from the other in basis and objectives. In the US and Canada, some of the earliest wetland classifications were made on the basis of how they could be drained for human use. Later the objective was to compare different wetlands for their value to waterfowl. Subsequently, the classifications were centred on multiple ecological values of wetlands (Mitsch & Gosselink, 1986). The recent classification and inventory of wetlands are made with protection of their multiple ecological value in mind. The classifications reflect varied structural and functional characteristics of wetlands over the world and the need for identifying the boundaries of these ecosystems for the purpose of inventory, evaluation and management. Objectives of wetland classification can be broadly identified as:

- grouping wetlands on the basis of similar hydraulic regimes;
- grouping wetlands with similar vegetation type, plant or animal species, mode of formation etc. analogous to taxonomic classification done by the life scientists;
- grouping functionally or resource-wise valuable wetlands;
- grouping wetlands on the basis of conservation needs;
- grouping them into units for inventory and mapping.

The Ramsar Conference has described a classification system which was approved by the 1990 Conference of the Contracting Parties. The categories listed in the classification were not intended to be scientifically exhaustive. This classification only provided a broad framework for the rapid identification of the main wetland habitat types represented at each site, with the 'dominant wetland type' clearly mentioned. Forty-two wetland types are identified in the classification system, grouped into the categories 'coastal/marine', 'inland', and 'human-made' ([http://www.ramsar.org/lib\\_manual.2004e.htm](http://www.ramsar.org/lib_manual.2004e.htm), Ramsar Convention Manual).

In 1989 IUCN, The World Conservation Union, published the Asian Wetland Directory where the wetlands of India were broadly divided into eight basic categories:

1. the tanks and reservoirs of the Deccan Plateau together with the lagoons and other remaining wetlands of the west coast of the peninsula;
2. the vast saline expanses of Rajasthan, Gujarat and the Gulf of Kutch;

3. the freshwater lakes and reservoirs from Gujarat eastwards through Rajasthan and Madhya Pradesh;
4. the deltaic wetlands and lagoons of India's east coast;
5. the marshes, jheels, terai swamps and chaur lands of the Gangetic Plain;
6. the flood plain of the Brahmaputra and the marshes and swamps in the hills of northeast India and the Himalayan foothills;
7. the lakes and rivers of the montane (primarily Palearctic) region of Kashmir and Ladakh;
8. the wetlands (primarily mangrove associations) of India's island arcs.

#### **Wetland uses**

The wetlands are always evaluated from an anthropocentric approach. Therefore, opportunities provided by the wetlands to the human beings are measures for their evaluation. These opportunities may be both direct and indirect. The usefulness of a wetland can be determined from the point of view of flora and fauna it sustains, its ecosystem values, and contribution of wetlands for maintaining global air and water cycles (Mitsch & Gosselink, 1986). The populations, which are benefited from or thrive on wetlands range from man, waterfowl, fish, plant, to a host of other micro-organisms. Wetlands are useful in many ways. One can cite a long list of uses which man gets from wetlands both directly and indirectly. Wetland animals and birds provide food, fur, skin, and other items. Plants provide food, shelter, timber, medicine, and a host of other non-edible uses. Wetlands are habitat for endangered and rare species of birds and animals. Wetland ecosystem is especially important for migratory birds and waders. They are habitats for different endemic, relict, regional varieties of sub-species of plants, insects, and other invertebrates and wildlife even in otherwise congested industrial regions (Mitsch & Gosselink, 1986).

When considered as an ecosystem, the wetlands are useful for nutrient recovery and cycling, releasing excess nitrogen, inactivation of phosphates, removing toxins, chemicals and heavy metals through absorption by plants, and also in treating wastewater. Removal of suspended solids from flowing water by reducing the flow also facilitates the retention of water for sometime whereby biological, physical and chemical changes are made possible (Mitsch & Gosselink, 1986). Retention of sediments by wetlands reduces siltation in the rivers. In addition, wetlands also help in mitigating floods, recharging aquifers, and reducing surface runoff and consequent erosion (Fig.2).

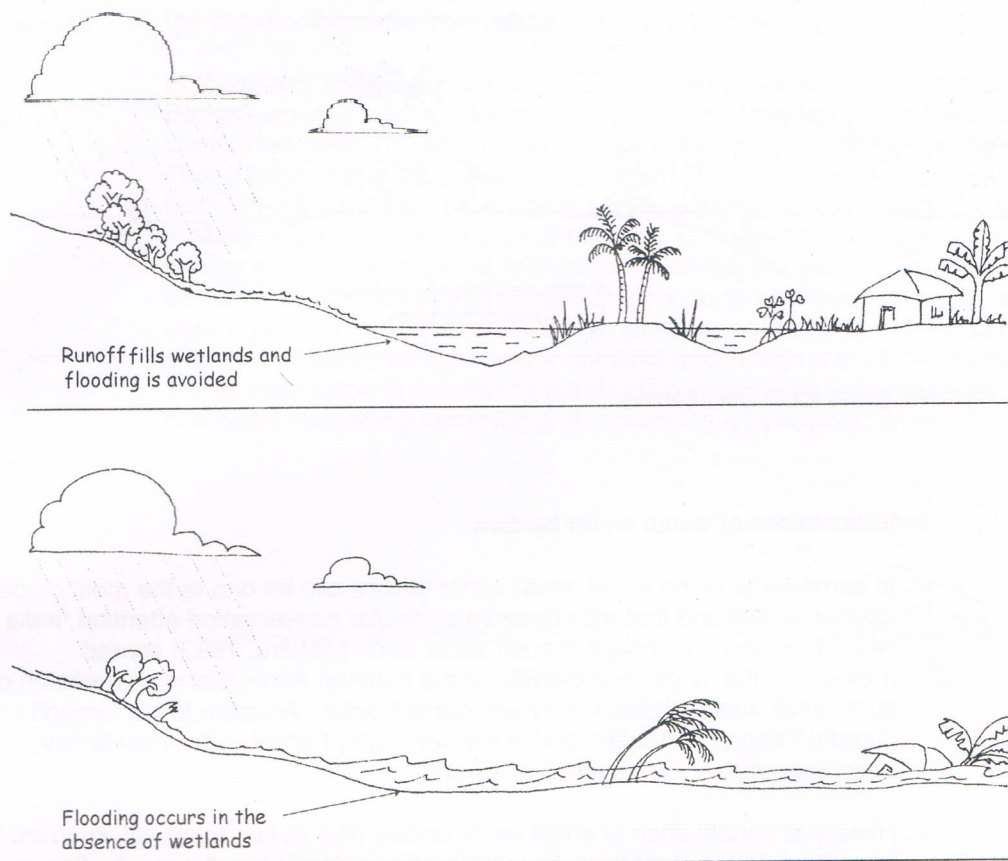


Fig.2: Wetlands regulate flow and control flood

Mangrove wetlands in India and Bangladesh act as buffers against devastating storms of the Bay of Bengal (Fig.3). Wetlands also influence microclimate of a locality. Besides these, they are also valued for their aesthetic qualities and recreational opportunities. A freshwater wetland checks saltwater intrusion from the adjacent brackish water environment through interface pressure.

On a global scale, the wetlands function significantly in maintaining air and water quality including nitrogen, sulphur, methane, and carbon dioxide cycles.

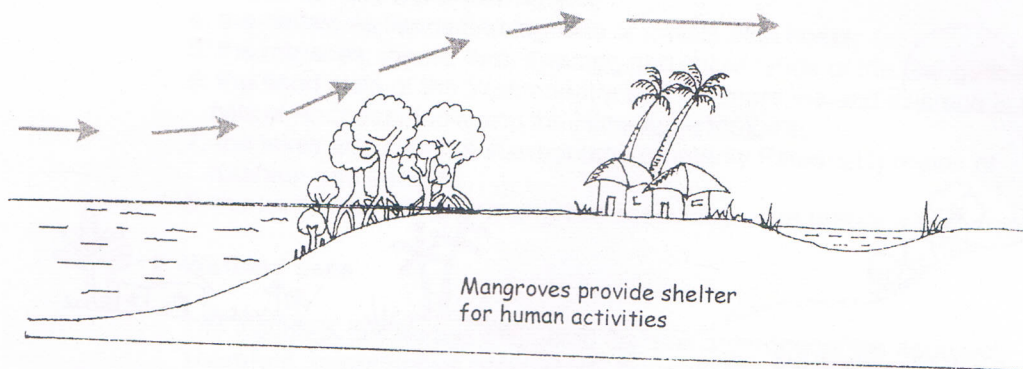


Fig.3: Mangroves act as storm barriers

### Importance of small water bodies

In some parts of the world, small water bodies can be one of the most crucial classes of wetland that may deserve particular conservation attention. India has more than one million of such water bodies (Misra, 1993) spread throughout the length and breadth of the country. An outstanding research on such small water bodies have been carried out by Anupam Misra through Gandhi Peace Foundation and our knowledge of small water bodies has been considerably enriched by his work.

History of construction of small water bodies (like *pukur, talab, tal, kund* etc.) goes back to a distant past. Numerous references to small water bodies are found in our epics. Systematic construction of ponds has been recorded for about a thousand years between 5<sup>th</sup> to 15<sup>th</sup> centuries AD (Misra 1993). There has been a gradual and thereafter a sharp decline in the construction of ponds in the subsequent years. Yet, ponds or small water bodies still have enormous significance in wetland management in India. Restoration and construction of ponds can be the most important components for their unified role in surface water management and groundwater recharge. With the exit of big dams as solution to irrigating our agricultural fields, and with the increasing problem of freshwater storage everywhere, small water bodies deserve most serious conservation attention.

From the definitions of wetlands, it is not sufficiently clear whether the entire lake, reservoir or a pond or only the edges of such water bodies can be termed as wetlands. It is also true that water bodies, specially the small ones are intrinsically linked with the life and livelihood of many Indian villagers, especially those who are poor. To avoid definitional dilemma, it may be better to take up the case of 'wetlands' and 'water bodies' together and national policy/strategy for conservation can be drawn jointly. This coalition of ecosystems, which are very close and have overlapping nature and

functions, characteristics and attributes, can be a pragmatic step to enhance the conservation and wise use of both the systems.

In the recent times an interesting trend has set in some districts of West Bengal, which deserve mention. In Hugli district, for example, in the course of the last ten years more than one thousand ponds have been excavated. These ponds have depths varying between 3-5 meters and sizes ranging from 0.3 to 1 hectare. These ponds are excavated to provide earth for brick-making (Fig.4). For the owners of the land, selling out the earth brings more money than selling the land. Moreover, by selling the earth he retains the ownership of the land and gets an excellent pond where he grows fish and uses it partially for irrigation. This is a relatively recent phenomenon and scientific research on this trend is not available. It will be useful to observe this sudden surge in excavating ponds. The importance of these water bodies for harvesting rainwater and recharging groundwater is well known.

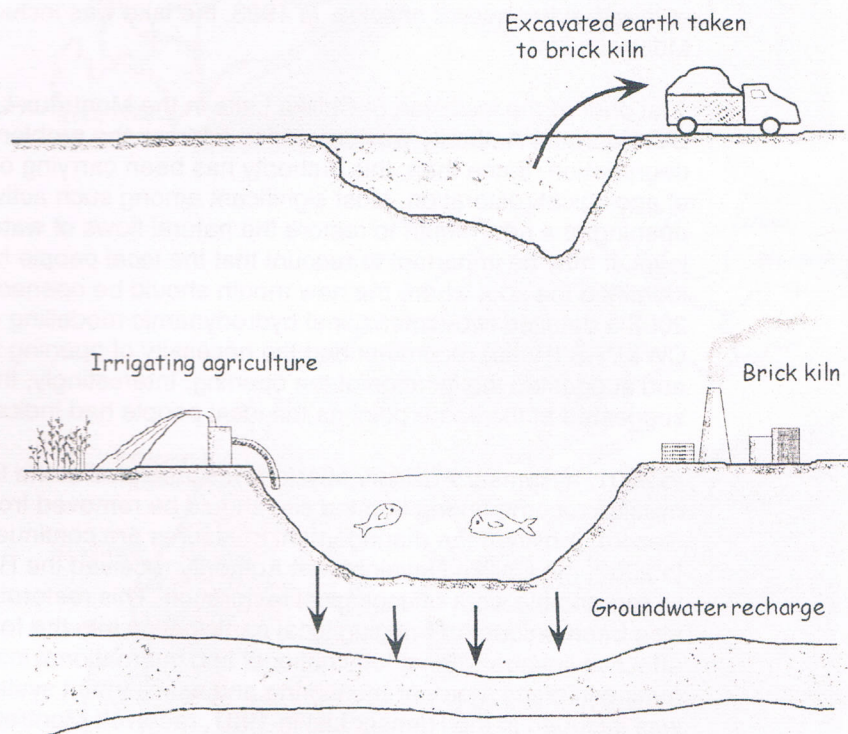


Fig.4: Ponds are created for making bricks

### The Montreux List and the Chilika Lake example

The responsibility of properly maintaining the ecological character of the Ramsar sites lies with the respective countries. In cases where undesirable

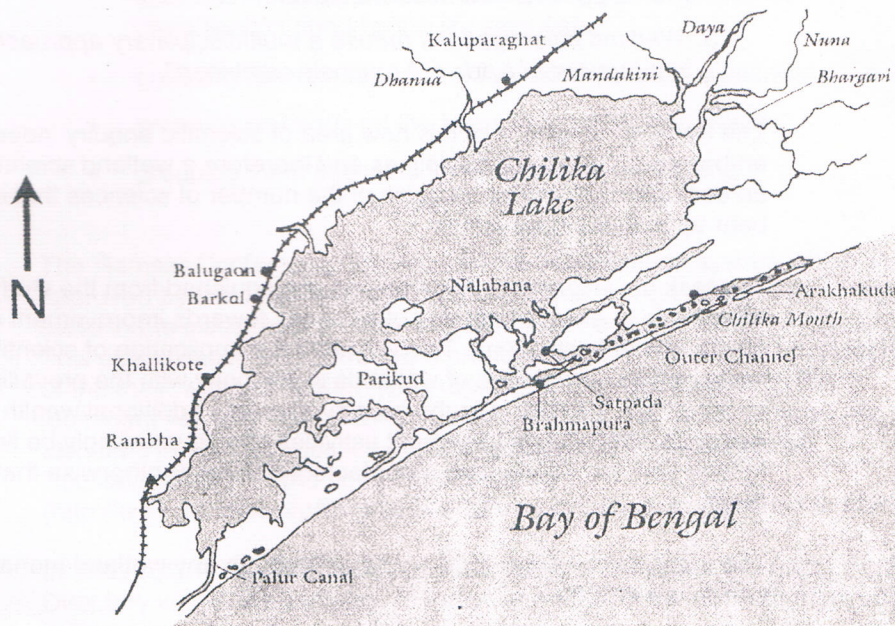
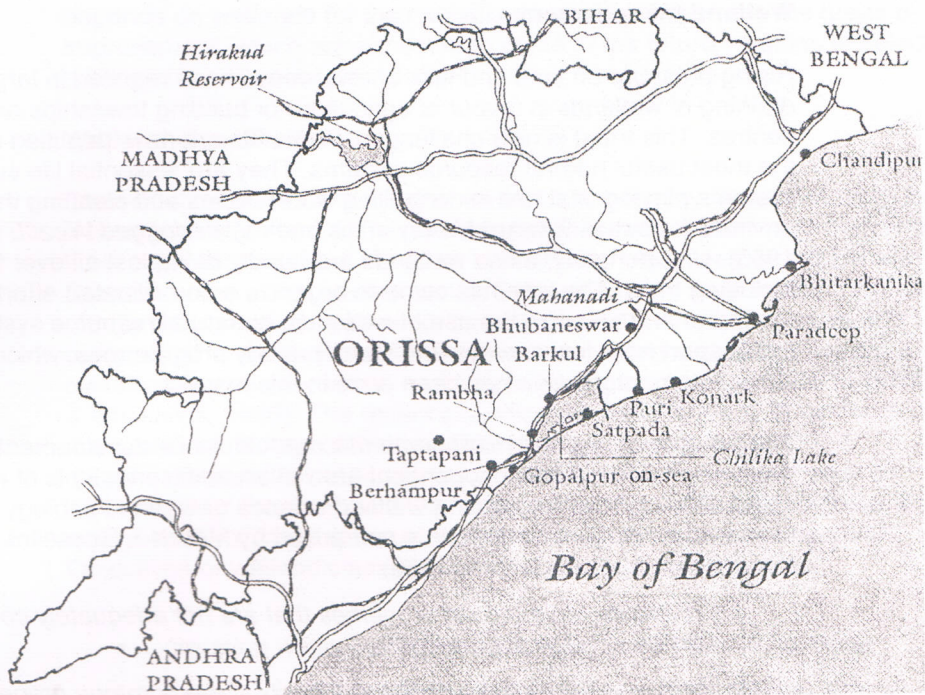


activities have inflicted perceptible change in the ecological character of the Ramsar site, it may get highlighted in the Montreux Record. The Montreux Record is the principal tool of the Ramsar Convention to discipline any breach of action leading to adverse changes that have occurred, are occurring or are likely to occur in the ecological character of the candidate wetland, deeming prioritized conservation attention.

The effectiveness of this disciplinary tool is best exemplified in the case of what has happened in the Chilika Lake in Orissa (Fig.5). A short detail on the Chilika episode may illustrate better how the Ramsar convention performs in restoring situations, which threaten to go beyond repair. In 1981, the Chilika Lake, the largest coastal wetland in the eastern coast of India was included in the Ramsar List of Wetlands of International Importance. The total area of the wetland is 116,500 hectares and it is separated from the Bay of Bengal by a long sandy ridge. Siltation and choking of the seawater inlet led to serious degradation in the ecological condition of the wetland, mainly resulting in the decline of fish productivity and diversity, and the proliferation of invasive freshwater species. In 1993, the lake was included in the Montreux List.

Just prior to the inclusion of Chilika Lake in the Montreux List, the Chilika Development Authority was created to address the problem of lake degradation. Since then, this authority has been carrying out excellent work of ecological restoration. Most significant among such activities has been the opening of a new mouth to restore the natural flows of water and salinity level. It may be important to recount that the local people had repeatedly identified the spot where the new mouth should be opened. During 2002-2003 a detailed two-dimensional hydrodynamic modelling of the lake by CW&PRS (Pune) recommended the necessity of opening the Lake mouth and suggested the location of the opening. Interestingly, the opening was suggested at the same point as the local people had indicated.

In 2001, a Ramsar Advisory Mission was instituted at the lake site. The mission recommended that the site should be removed from the Montreux Record, provided the management measures are continued and monitored. In 2002, the Chilika Development Authority received the Ramsar Award for its remarkable work of ecological restoration. This restoration process has also been unique for bringing local participation into the fold, ensuring effective linkage with various national and international institutions and putting in place a proper monitoring and assessment system. A lake, which was included in the Ramsar List in 1981, received Montreux notice on 1992, has now become a remarkable example of arresting the decline and thereafter restoring the ecosystem.



Modified from: *Chilika Lake, guidelines for ecotourism development* (1998), Wetlands International

Fig.5: Chilika Lake in Orissa, a Ramsar Site

### Wetland management

Rising pressure on land and lack of awareness have resulted in large-scale draining of wetlands in favour of agriculture or building townships or industrial centres. This trend is now challenged. Wetlands are now identified as one of the most useful natural resource systems. They are 'essential life support systems playing vital role in controlling water cycles and cleaning the environment' says Edward Maltby in his book *Waterlogged Wealth* (Maltby, 1986). Unfortunately, these wetlands are rapidly being lost all over the world including India. The time has come to organize a co-ordinated effort to meet the threat and optimize the use of wetlands as natural resource systems. In India, apart from few surveys and specific study programmes, which are again fragmentary, little has been done in this respect.

The practice of wetland management is age-old, while development of 'wetland science' as an independent area of scientific enquiry is of recent origin. The reasons for treating wetland science or wetland ecology as an independent subject have been summarized by Mitsch & Gosselink as follows: (Mitsch & Gosselink, 1986)

1. "Wetlands have unique properties that are not adequately covered by present ecological paradigms.
2. Wetland studies have begun to identify some common properties of seemingly disparate wetland types.
3. Wetland investigations require a multidisciplinary approach or training in a number of fields not routinely combined".

The frame of reference of this new area of scientific enquiry indeed embraces a number of disciplines and therefore a wetland scientist 'must be an ecological generalist because of the number of sciences that come to bear upon these ecosystems.'

The task of wetland management, as distinguished from the study of wetland science, is to ensure best use of wetlands towards improvement of environmental conditions. This will need the application of scientific and technological knowledge of wetlands in harmony with the prevailing conditions of the region or the country to create additional wealth from the wetlands. Wetland management activities should unfailingly be linked directly to land use, the people and other factors natural or otherwise that go with them.

The technical services to be rendered through any wetland management centre will include:

- i. Co-ordination of existing activities and information on wetlands,
- ii. Resource development planning,
- iii. System standardisation, design and upgrading,

- iv. Implementation, monitoring and impact assessment, and
- v. Management training.

In India, wetland specialists can scarcely find a pristine wetland to deal with. In most cases they exhibit presence of human interference. Significant knowledge now exists amongst various wetland communities for obtaining renewable resources. For example, the East Calcutta Wetlands, which sustain the world's largest practice of using city sewage in fisheries, simultaneously improve wastewater quality through the system. A wealth of creative know-how is retained here in oral tradition from which we have yet a lot to learn.

On the other hand in the State sector, flood control and irrigation projects have since long been modifying or altering wetlands and also not infrequently creating new ones – deliberately or inadvertently. Resource recovery as such does not come within the fold of these projects. In the agricultural and fisheries sectors also, the wetlands are often modified and altered. It is in developing fisheries and cultivating crops like paddy, jute or other commercial reeds that the wetlands are retained very near to their natural state. From the point of view of output, there are three kinds of wetland practices existing today. These are mis-utilisation, under utilisation and fair utilisation. These isolated or insular functions should be brought under a co-ordinated management to establish a comprehensive natural resource system to create multiplied wealth for the nation.

Since wetlands combine a number of different but vital functions of our life support systems, very little of conventional management design will fit, if at all, in the requisites of wetland management. Interestingly, in India fisheries function as a common link between a number of wetland functions and attributes – from improving wastewater quality to making estuarine mud-flats resource-efficient. Indeed in India, fishing is to be recognized as the dominant economic activity in course of the present phase of wetland resource development processes.

The objective of wetland management in any country depends upon the wetlands the country has, their functions, the types of uses people know of such wetlands and the basic need of the people. Accordingly, in our country we can have two sets of objectives - primary and secondary.

Primary objectives will include:

1. Flood control, reduction of damages caused by storm, rainwater harvesting and groundwater recharge.
2. Production of food (like paddy and fish) and fibre (like jute).
3. Enhancement of livelihood security.
4. Improvement of wastewater quality.
5. Wildlife conservation including habitat for fish spawning.

6. Reduction of atmospheric pollution and temperature moderation.
7. Conducting scientific enquiry and desirable land use studies.

Secondary objectives will include:

1. Production of commercial reeds and other crops.
2. Using wetlands as buffer between industrial and urban segments or saline and non-saline segments.
3. Fire fighting.
4. Reduction of soil erosion.
5. Providing recreational and aesthetic benefits.

Sometimes wetland management can be such simple actions like putting up signboards to protect a water body from being used for bathing or as a site for defecation. We can also have such complex programmes like searching for derelict wetlands near cities to use them for municipal sewage disposal. Such programmes have been already been taken up for a number of municipalities under Ganga Action Plan and its success will go a long way to develop low-cost sanitation technology in the country. It is heartening to note that the draft National Environmental Policy 2004, has recommended the East Calcutta Wetland approach to wastewater utilisation.

### **Three deficiencies**

Wetland management, nearly anywhere in developing countries, will have to meet three primary deficiencies. These are:

- a) Awareness gap (among the development experts, decision makers as well as the masses).
- b) Lack of appropriate policy and regulatory provisions.
- c) Lack of institutional support.

*Awareness Gap:* In modern India, even a decade back, people knew little about the worth of forests and trees. An intensive campaign and financial support have considerably improved the rate of new plantations. A similar campaign in favour of worth of wetlands will be necessary to conserve their resources. Since 1986 the Government of West Bengal celebrates the 16<sup>th</sup> of June as 'Wetland Day' as a beginning of the drive to enhance the wetland awareness amongst the people. Internationally 2<sup>nd</sup> February has been declared as World Wetland Day.

*Lack of appropriate policy and regulatory provisions:* Wetland conservation should have a National Act like Forest (Conservation) Act for their protection. It should be possible to draw up a Wetland Conservation Act on similar lines so as to strengthen the policy support in favour of appropriate use of wetland resources. At present other than the 73<sup>rd</sup> and the 74<sup>th</sup> Amendment of Indian

Constitution (see Annexure 3), no other legal arm is available to plan or implement conservation and wise use programme for wetlands. The Forest Act has sometimes been found to be ineffective, if not detrimental in ensuring wise use of wetlands and wetland resources. For conservation workers and academia it will be important to study the 73<sup>rd</sup> and the 74<sup>th</sup> Amendments of the Indian Constitution carefully. These two amendments are powerful tools for decentralised planning and empowering the poorer section of the community. Natural resource conservation initiatives can draw sufficient strength from these constitutional provisions.

*Lack of Institutional support:* There is still little institutional support in favour of wetland management and significant improvement of this condition is desirable. Wetland resource development has to emerge as a new area of development activity. It will be highly satisfactory if the culture of blind spending is not allowed to creep into the body polity. A process of continuous evaluation, investigation and monitoring will make the spending much more efficient. That is how a new approach to land use management is envisaged where the two nodes of institutional support – finance and research will operate independently to provide best support to each other for optimizing the efficiency of spending.

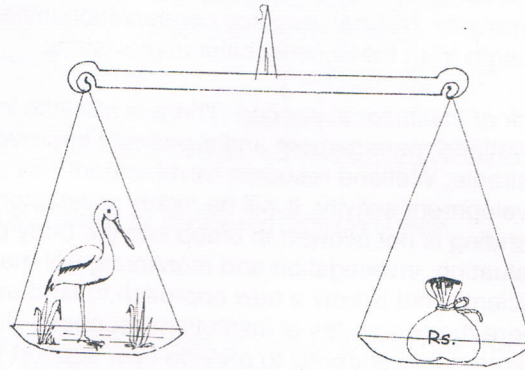
### **Valuation**

Wetland ecosystems provide goods and services to the society and therefore they are valuable to us. Measuring such values becomes important when many of these wetlands are found to be lost in favour of one or other development initiatives without any comparative assessment of the value of the changed land use vis-à-vis that of wetlands, which existed there.

For the goods and services which are marketed and the prices of which can be reasonably assumed to be undistorted, the task of valuation is reasonably simple. However, in many cases, wetland goods and services are not amenable to market regulations and are not traded in the market. In such a case, a hypothetical market has to be constructed and shadow-pricing techniques are the best available techniques for measuring such non-market values. A well-known method for this purpose is called Contingent Valuation, which aims at obtaining consumers' willingness to pay to conserve the wetland if the goods and services from the candidate wetland are lost because of any change in the land use. In the poorer parts of the world, especially where the understanding of the total wetland ecosystem is grossly inadequate, the limitations of the Contingent Valuation Method are obvious. However, attempts to reduce the unreliability of this method through advanced statistical techniques are being made.

More recently, WWF International has carried out a project on the economic value of the world's wetlands (Schuyt and Branden, 2004). Eighty-nine sites were selected from all over the world (not a scientifically defensible choice of sites, though) and some preliminary ideas have been delivered. Estimates have been conservative and are likely to give very different values after

another round of survey. Regional estimates show that Asian wetlands have the highest economic value at \$1.8 billion per year where the total global economic value of wetlands has been found to be \$3.4 billion. This value can be compared with what was found by Costanza et al where economic value of world's wetlands reads \$4.8 trillion (Costanza et al, 1997).



Economic valuation of natural resource systems can be a useful tool for decision-making. For example, preservation of an area in its natural state entails cost. Development options will have to be set aside if preservation is the chosen objective and the development benefits which are foregone are the costs associated with the preservation option. For wetlands, such costs can be the revenue due to the fisheries activities or agricultural income etc. For countries like India, decision-making rarely confronts a situation between preservation of a natural ecosystem in its pristine state and development of the area. In most cases, the natural ecosystems like forests or wetlands are inhabited by communities of people who in fact act as the gatekeepers of sustainable management of the ecosystem. Development projects in such ecosystem areas are legally bound to compensate for the lives and livelihood of the displaced ecosystem people, who become the refugees of development.

It is also true that valuation is just one element in the total stream of efforts to conserve a wetland. The decision-makers will have to take into account many other competing interests in deciding the best and wisest use of wetlands. Economic valuation can help such management decisions as long as the decision-makers are themselves in the know of the general objectives and the limitations of the valuation process. The Ramsar Bureau has published an excellent set of guidelines for the economic valuation of wetlands which can be the starting point for such a task taken up for any wetland (Barbier et al, 1997).

## **Conclusion**

It has been argued that in large wetland areas, particularly in the South-east Asia, significant improvement has been achieved in agriculture by converting wetlands. A stinking pool does not add to the health of a crowded city, it is said. It may be true that preservation of any and every water body or wetland may not necessarily be the objective of wetland management. Yet, there are municipal areas in West Bengal where every single water body has been filled up and encroached upon. There is no source of water left to extinguish a fire hazard. The reservoirs and natural depressions have silted up and been encroached upon, resulting in critical shortage of irrigation water in the dry period. In fact, in the recent times, almost all over the world, a threatening change has taken place in the availability of fresh water. The crisis of shortage of fresh water is now well known and well documented. In view of the water crisis, wetlands and water bodies including the small water bodies assume phenomenal significance. The most striking feature of wetland is its dual role of storing rainwater on the one hand and being the foremost means of groundwater recharge on the other (Fig.6). Other than rivers in some way, in many parts of the world, no other ecosystem is as important as wetlands in ensuring sustainable water resource management. Unfortunately, this specific role of wetlands vis-à-vis the crisis of freshwater availability is amongst the least discussed issues in ecological restoration or for that matter natural resource conservation in general. We have two options: either we recognize this overriding significance of wetland conservation and take appropriate steps or we allow water crisis to multiply and civilization to die. The choice is ours.

In spite of this outstanding importance and many more ecosystem services that these wetlands cater to, wetlands in our country do not have their constituency. Wetland conservation as an agenda does not have adequate support base. The agencies and authorities who are responsible for deciding upon the future of a wetland or water body, do not themselves have peripheral, if at all any, understanding of the importance of this resource base. Urban planners, rural development experts, sanitary engineers, irrigation engineers, water resource engineers and planners, the whole host of these specialist authorities do not know much about the importance of wetlands and their conservation.

At the educational level, there is no systematic or compulsory exposure to wetlands and their importance. Only a few interested research scholars fall back upon this sidelined area of knowledge. Even among many wetland lovers, bird watching is the dominant passion.

Another example of this indifference, particularly amongst the educated people is seen in Kolkata city. Very few residents of this cultural hub of the East have much of a knowledge of what the East Calcutta Wetlands means



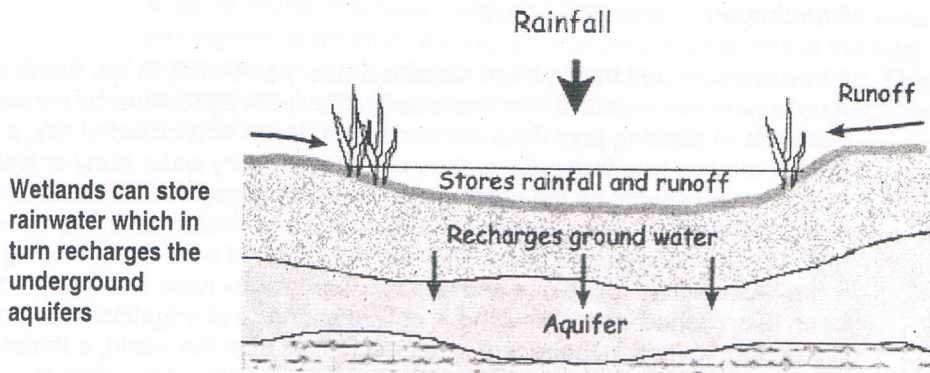
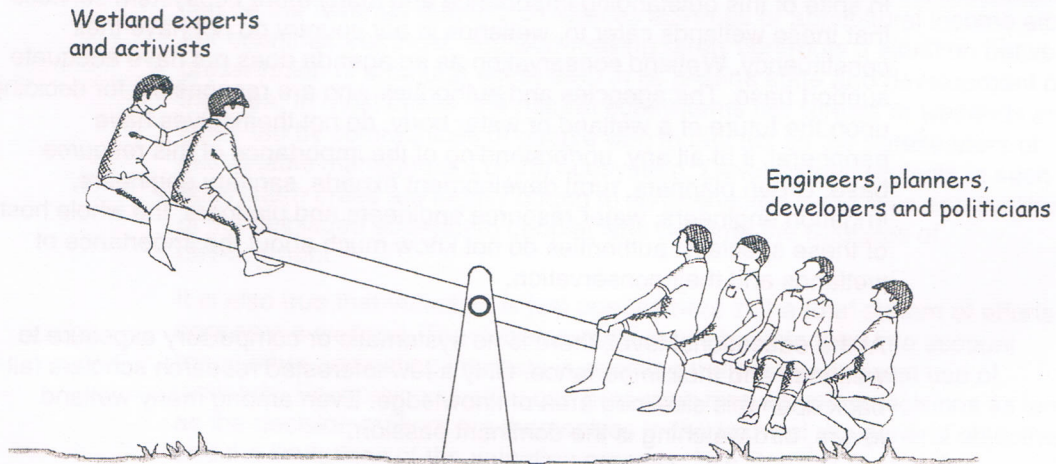


Fig.6: Wetlands for storage and recharge of water

to the city. This has been in spite of reasonably strong media coverage on this ecosystem. Not all of the agencies that are active in this wetland area are aware of their responsibilities in conserving the East Calcutta Wetlands.

Except few patches of excellence, this lack of understanding of the worth of this pre-eminent ecosystem is still prevalent throughout the country. This in turn is the cause of wetlands not having a constituency of its own. We have a long way to go.



Wetland conservation needs its own constituency – a strong support base.

## Sustainable Development – A Short Note

*Sustainable development has been a crucial incorporation in the theory of capitalist economic order.*

**T**he East Calcutta Wetlands can be perceived as a tutorial ecosystem for learning ecology, environmental management and more importantly, the basics of sustainable development. At this stage, therefore, a short note on sustainable development may be contextual.

Sustainable development has been a crucial incorporation in the theory of capitalist economic order in recent times. A brief review of some of the relevant features of capitalism may help in understanding better the context and meaning of sustainable development.

Capitalism is the most stable economic order to set its foot on the history of human civilization. Greed and exploitation are the prime movers of a capitalist society and capitalism finds no reason to hide the anarchy lying in resource distribution or access to the basic conditions of living or priorities of material consumption. That a small minority will be rich and powerful relegating a large majority systematically impoverished, is a matter of accepted premise rather than of any surprise or shame. There of course is a kind of cyclical appearance of instability in capitalism when uncontrolled greed leads to large-scale pauperisation. Too much of poverty in large numbers is a threat to capitalism. It renders loss of ability of the docile majority that works in lieu of a pitiful wage, accepting conditions of working which put an inferno to shame. Beyond a critical level of denial and exploitation, the juggernaut of capitalism comes to a halt. These are the moments of crisis for capitalism.

Not that those who run the capitalist economic order are unaware of it. Being the conquerors, how can they be so dull and naive? That to protest is the normal and rational behavioural response to denial of rights which are so openly enjoyed by a few others, cannot be unknown to those who deny them. The excellence of the mechanism of comprehensive exploitation lies in putting a flawless 'damping' mechanism that renders the exploited majority, a voiceless, radarless and senseless aggregate. It is also true that this phenomenon of 'reaction damping' (Ghosh, 1978) is not new to human society (Fig.7).

The history of mankind is the history of exploitation. The theory and practice of contending the voice of protest against various kinds and degrees of exploitation have also been as old as the history of torture and culture. The credit of capitalism lies in perfecting them. Three time tested methods for inflicting confusion and fragmentation (as opposed to clarity and consolidation) amongst the exploited majority are:

- *Fear*
- *Fantasy*
- *Falsehood*

These are the basic ingredients of the most pervasively, if not perversely, used bromide to dampen the natural human instinct of protest against denials.

Capitalism has also perfected the art and science of protest management. A specialization that has silently been researched, practised and perfected to telling effect in diffusing even the most powerful forms of social protests like armed struggles and guerrilla warfare.

The mechanism of reaction damping allows exploitation to increase without the appearance of the resultant protest

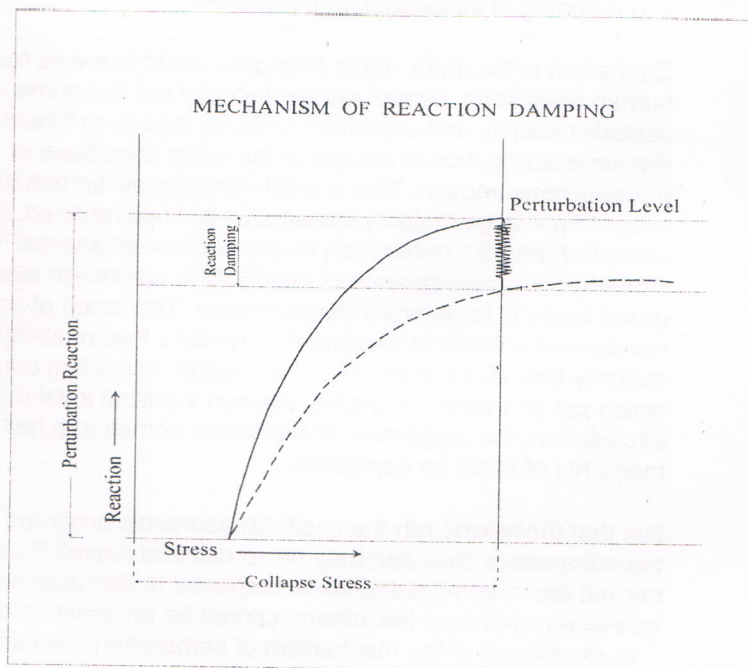


Fig. 7: Mechanism of Reaction Damping

Armed struggles, these days, are more often than not reported to be installed and instituted by the richest and the powerful. Not that protest management is any invention of capitalism. Some of the trade union leaders with fists high up in the morning, shouting slogans against the employer may be found sneaking into the comfortable drawing room of the employer in the evening to get his cut for taming, regulating and misdirecting the legitimate protest of the workers. The same recipe of protest management is now being practised to destabilize poorer countries.

That the capitalist economic order remains virtually unchallenged owes to a large extent to its incredible ability in damping and confusing the legitimate voice of protest all over the world. The invincibility of capitalism is rooted in perfecting the mechanism of 'reaction damping' to some superlative standards.

But as it happens in history, even the most well guarded defence are caught unawares. And that is exactly what happened during the latter half of the last century. After blocking all the avenues of social rebellion against the powers-that-is, Capitalism tumbled helplessly in negotiating the "rebellion of nature" (Ghosh, 1999). The events thereafter can be comprehended in the following discussion.

### **Sustainable impoverishment**

It is imperative for the human race to transform nature but it also has to honour a set of limits, which dictate the transactions. These are the basic prerequisites of nature conservation. The limits themselves are transient, depending upon the progressively improving scientific knowledge and traditional wisdom in exploiting nature. Over the last few decades, to sustain the infinite greed of the wealthy minority, resulting in shameful inequity in consumption patterns, most of these limits have been and are still being systematically trespassed. As a result, and expectedly, nature has aggressively retaliated and posed a serious threat to the entire humanity. This act is termed *rebellion of nature*.

This discussion, however, is not focussed at measuring the extent of damages to nature and society. It, instead, examines the historical significance of the rebellion of nature vis-à-vis the forward march of capitalism.

### *What is Exploitation?*

It may be useful to discuss the phenomenon of 'exploitation' before we focus on nature's rebellion against over-consumption. Exploitation can be defined as an unequal transaction. It has two basic categories: exploitation within the society (of the humans by the humans) and exploitation of nature. Both these forms of exploitation have been unavoidable prerequisites for all the modes of production since the dawn of civilisation. Again, every event of exploitation beyond the limit of tolerance (limits are rarely clearly visible) causes

perturbation and may even lead to the collapse of the very system of which it is a part. Thus, exploitation is both unavoidable and a fatal act of humans in the existing social order and mode of production. In fact, exploitation pervades all the basic stages of development including input mobilisation, transformation, output distribution and waste disposal. So ubiquitous is the presence of exploitation that giving examples will be a redundant exercise. There are relatively recent examples, which combine exploitation of nature and humans or for that matter combine social and natural environmental issues.

As for example: in 1972, Ecuador produced 60,000 barrels of oil per day from 50 wells – a daily average of 1,200 barrels higher than an average Middle East well and a thousand times greater than an average US well at that time. Previously, Ecuador was said to have no oil and the country reeled under the yoke of poverty.

In hindsight, it is clear that this was a myth propagated by oil barons of the west who found it profitable to project Ecuador as a no-oil land where it could sell. Why else did so many oil experts pretend to sniff around and smell not a whiff of oil?

It was a US Colonel, Leonard Clerk, who first told the American press in 1947 that there were oil reserves in Ecuador comparable to those in the Middle East. A French technician, Jacques Boulanger, contracted by the government, wrote an official report with reference to 1963. Published by their Planning Board, the report said: "The reason for the country's oil situation is, on the one hand, the inactivity of many of the concessionaires and on the other, the very limited activities of producing firms, because for them it is more convenient and more profitable to import oil at the present prices than to drill for it in Ecuador".

What happened in Ecuador continues today, all over the world. The Ecuador Syndrome can be recognised in many global events whose hidden thrust is to keep the weak weaker. It has made a mockery of democracy as a determinant of the rationale for human life, or to improve the quality of life of the poor.

Let us take another example. On the 5<sup>th</sup> of June 1993, UNEP took a pledge to break the vicious cycle of environment and poverty. At that time, in Somalia, there was hardly any food to eat. The warlords who promised to protect the relief organizations and ensure the success of food distribution were themselves in the business of looting. In the countryside, farmers were chopping down nearby forests for firewood and eating seed grain. In such a situation of calamity, some advanced countries sought the opportunity to exploit. They were found to be silently dumping their toxic wastes off the coast of Somalia, which had some of the most spectacular beaches and rich coral reefs in the world. Somalia cannot be any rare example of how the vicious cycle of poverty and environment operates and the poor become the victims of intense exploitation.

More glaring is the example of 23<sup>rd</sup> July 1993 when eight children who were sleeping in the open on a street, in the heart of a metropolitan city in South America, were decimated. The city got rid of the polluters! Between 1988 and 1990, in the same country, 4611 children were executed. The country's poverty statistics improved.

It is also true that 'clear felling' of children is only a crude version of similar exploitations elsewhere. All these are to reduce the problems for those with a penchant for decent living. Such 'marginal' happenings do not necessarily affect the learned minority, many of whom are keener to protect their career interests and collective bargains. There are others who sense opportunities and discuss poverty to become rich. Indeed, poverty studies are paying rich dividends.

That the exploitation of nature and of humans takes place simultaneously as well as separately, is well known. The fact that is of some consequence is the absence of any real challenge to this system of exploitation. Although capitalism, the present world order, has itself been experiencing intermittent crises for having recorded progressively increasing inequity in consumption pattern, the system seems to be resilient enough to successfully thwart its collapse.

In such a time, when there was not enough action to stop the continuity of the order of consumption inequity, an unexpected challenge came from nature. Limits to natural resources were exposed and nature's inability to assimilate unlimited waste was demonstrated in so convincing a manner that these retaliations shook the world order more emphatically than any previous crisis of capitalism. Never before was it more apparent that continuing with the present gross inequity in consumption pattern would lead to unsustainable development and finally to the collapse of civilisation.

#### *History, Ecology and Nature*

Secretary General U. Thant's Report of 1969, presented to the UN General Assembly marked the beginning of a search for a comprehensive answer to the crisis emerging from relations of humankind with the environment. The report noted that threatening signs were visible long ago - demographic explosion, inadequate integration of powerful technology with the requirement of the environment, destruction of cultivated land, unplanned development of urban areas and the ever-growing danger of extinction of many forms of animal and plant life. On the basis of the report the UN General Assembly decided to hold a 'global conference on man and environment - a decision that led to the Stockholm conference in 1972.

Observing the conflicts arising within the society, since the beginning of civilization, was sufficient for understanding the basic historical process. Since the 1970s, humans realised that nature could no longer be taken for granted and environmental issues relating to the misuse of nature were prominently discussed and a new frame of reference for the study of history fell contingent. No longer was it sufficient to understand the basic agenda of

human action only by observing the conflicts occurring within the society. Conflicts with nature began to dictate the course of human history in a big way. It became imperative to include the study of conflicts with nature along with the study of conflicts taking place within society, to understand more fully the history of humankind.

Why this rebellion of nature? There are two basic reasons. The poorer countries continued with uncontrolled growth of population and the rich countries continued with their phenomenal spree for improving their lifestyle that needed more and more of nature exploitation. Thus when the population is doubling most rapidly, an average person in an industrial country consumes more than 4,800 kg of coal equivalent in his lifetime against a meagre 527 kg available for an average person in a developing country. And, therefore, the humans confront an adamant and threatening nature. In a finite system, perturbations are unavoidable if the boundaries are not respected.

Rebellion of nature, since the 70s, has exposed the limitations of the classical definition of the history of mankind as the history of class struggle. It may be appropriate to define the history of humankind as the history of exploitation – exploitation of nature by humans and exploitation of humans by humans.

#### *Protest management*

It is well known that exploitation of humans exceeding a level of tolerance, results in protests. This is a natural human response. Expectedly, this behavioural response is well known to the exploiters. To encounter such protests there has been a whole range of intellectual and experimental rigour largely in secret. Those who sponsor 'knowledge' did not perhaps desire the discipline of 'public response management' to be thrown open in public.

An example may explain the tool more convincingly. The incident took place at a metropolitan railway terminus during a period of prolonged social unrest. A commotion started during busy office hours when a particular local train reached the terminus with about 2000 commuters. The situation was ripe for taking a violent turn, for the passengers were unhappy with the behaviour of a policeman. At that time, a bearded person stood up on a packing box and delivered an exciting speech against the establishment. He condemned the rulers for keeping such traps for deliberately provoking the common people on non-issues while the actual task was to overthrow the regime. The lecture continued for about an hour, the crowd, meanwhile, gradually dissipated. The person was an officer of the intelligence department and was carrying out his official responsibility of staging a mock protest to take off steam from the hyped up psyche of the commuters. The example demonstrates the strength of a 'planted protest' and the infinite potential of this tool in behavioural manipulation. It is only likely that the environmental movement is already infected with this PP (planted protest) virus and yet so little is discussed about it.

The fundamental prerequisite for protest management is behavioural manipulation for dissipating the intention to protest or misdirecting the objective of protest. It is only natural that the normal response of the exploited will be against the order of disparity causing progressively increasing imbalance. To retain an imbalance in favour of a few within a society, it is necessary to blunt the forces of reactive equilibrium inherent within the system. The caretakers of status quo of an unbalanced social system need essentially to maintain a continuously vigilant agenda to dump, buffer and confuse the spontaneous response of the masses, eager to reduce the imbalance.

The sinister objective of this behavioural manipulation is to keep the masses unconscious or uncritical or perhaps not sufficiently conscious and critical to recognise the enemy, or feel strong enough to protest. This is the social imperative of a rigged global order. After all, if suddenly there are no juvenile delinquents, no prostitution, no gamblers, no bootleggers and clandestine buyers of liquors, and if suddenly millions of the impoverished shake off the effects of bromide and rise from their slumber, the problem will not be for those who will rise, but for those whose rights to enslave humanity get challenged by the awakened.

In modern times, a quiet revolution has swept the world in the area of behavioural manipulation. Larger and larger communities and target groups are adopting the specific psyche tailored for them by those who rule. In fact, those who run the system have perfected the art and science of dampening the legitimate human responses to assaults and seem to have obtained a decree to perpetuate the plunder. Effective use of the same tool of public response management is now visible and is set to invade environmental movements too. That the rich minority dislikes parting with their illegitimate wealth is known to be a classical instinct of such humans. But the tendency of leading international environmental agencies set to make compromises with the desires of the rich minority cannot be chance directed.

It is a matter of concern because such compromises will lead to tailor-made campaigns based on what can be termed as sponsored knowledge, whereas the environmentalists are expected to promote spontaneous, uninhibited form of knowledge of nature, natural resources and their interaction with humans. This is why eminent northern environmentalist Lester Brown, in one of his latest books could only find change of tax structure as the most important recipe to global environmental well-being (Brown, 2001). It is not surprising that Lester Brown fails to see the significance of traditional wisdom in designing sustainable development in the poorer parts of the world. What however is painful is that northern experts compulsively think that whatever they know within the confines of their boundaries is equivalent to total global knowledge. That there can be a few things to learn from the south, their minds are not trained to identify.

It is a matter of concern, further, because the defeat of environmentalism will not end up in the victory of the rich minority who are enjoying at the expense



of the common people; it will result in the collapse of civilisation. Environmentalism, therefore, is not in a position to accommodate compromises.

### **A new roadmap**

The need for conserving nature and natural resources has gained rapid ascendancy for ensuring survival of human civilization and this could not have happened as an arbitrary choice of a few nature lovers, howsoever powerful they might be. This has been an unavoidable situation evolving out of greed-based development, which took over the reigns from the fading power of colonial rule. In 1949 President Harry Truman came up with the concept of 'development'. He could find the entire world, which was breaking the chains of imperialism one after another as 'underdeveloped'. Suddenly the goal of the globe became 'development'. The underdeveloped countries, irrespective of their awesome diversity, had to take recourse to the path of development. Only USA and a handful of European countries were the 'developed' countries and the rest of the world came to be known as 'underdeveloped'. These countries had to have a single point goal of attaining higher and higher growth so that they can once become 'developed' (Sachs, 2001). The strategic essence of greed-based development has been to remain indifferent to nature.

Let us get back to the discussion on 'development', or more precisely the impact of the greed-based development. An excellent summary of greed-based development has been made by Paul Ekins (Ekins 1992).

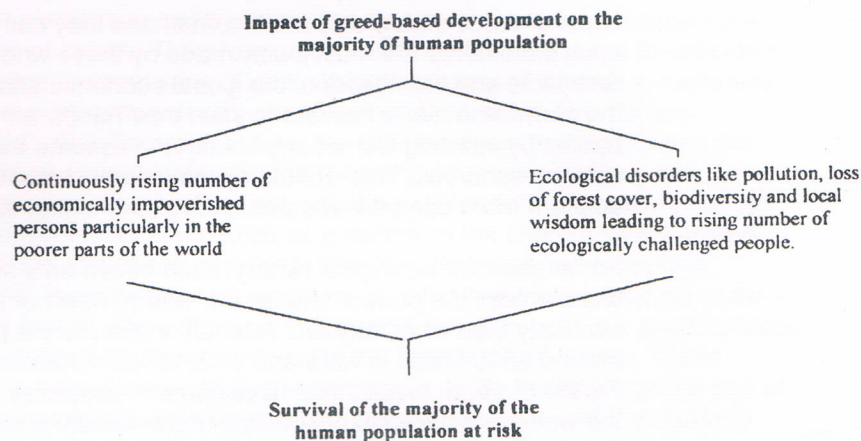
*..four interlocking crises of unprecedented magnitude, all of which have the potential for the destruction of whole peoples and some of which threaten the extinction of the human race itself. The four crises are:*

- *the existence and spread of nuclear and other weapons of mass destruction and the overall level of military expenditure;*
- *the affliction with hunger and absolute poverty of some 20 percent of human race, mainly in -what is misleadingly called- the Third World;*
- *environmental pollution and ecosystem and species destruction at such a rate and on such a scale that the very biospheric processes of organic regeneration are under threat;*
- *intensifying human repression resulting from the increasing denial by governments of the most fundamental human rights and the inability of increasing numbers of people to develop even a small part of their human potential.*

In the present case we may leave the issues of war and human rights out of our scope, not because they are less relevant, but in order to indulge ourselves in a relatively simpler framework of understanding. A few examples

of these distressing realities may not be out of place. More than 40 percent of the world's original 6 million square miles of tropical forests have disappeared. The rate of deforestation has been estimated to be nearly 30,000-37,000 square miles every year while that for desertification or addition to the world's deserts is 6 million hectares each year. The annual deforestation rate in Thailand between 1965 and 1989 was 2.6 per cent, while the economy registered a very high rate of growth between the 1970s and 1980s. Topsoil of the earth is getting eroded at an estimated 25 billion tons per year.

The uncomfortable side of the coin we all know as "development" in the context of natural resource conservation in the poorer parts of the world



It has only been since the of 60s of the last century, when series of outstanding findings describing the fearsome damages to natural resources and biodiversity called for a halt to the on going march of 'development'. When all the avenues of social protest were taken care of with remarkable dexterity, capitalism experienced a rude shock from what has been termed here as the *rebellion of nature*. Nature did not agree to act as a limitless sink to all waste that the greedy development generated. It also exposed the limits of availability of natural resources, which were once assumed to be infinite.

The matter was seriously considered, analyzed and understood by those who rule the world, the rich. So much so, that in course of the last two decades they have comprehensively incorporated the concern for nature into their mainstream developmental strategies. Sustainable development has now become a theme of the establishment. Environmentalism, as well as ecology, have ceased to be subversive sciences any more. Capitalism has thus avoided a crisis, if not its collapse. Ironically, this has also allowed a longer lease of life for all of us. After all, what would capitalism do with such a large-scale death and disability of the masses if the wrath of nature were not tamed? Admittedly, this is hardly a conventional way of looking at sustainable

development. Therefore it deserves a closer look.

On one count at least, the 1992 Rio Conference is a watershed in modern environmental history. We do not talk any more of 'development'; we talk of 'sustainable development'. This change in defining development is aimed at respecting the thresholds of nature. Population is going up, so also is the waste that modern civilisation is producing, whereas resources have become scarce and random disposal of waste has brought the gates of inferno closer to mankind. We are also saying that we are overdrawing from nature, leaving our children and their children high and dry. That is to say we are borrowing from our future generations without their consent.

None of these statements are incorrect and they can hardly be argued. And such statements are most loudly made by those who rule the world, the architects and caretakers of the global economic and social order. They are the same who never hesitate to stain their hands with the blood of newborn babies by inflicting war on any country, to assume their hegemony on the natural resources. This dichotomy makes the context of environmental concern more complex and provokes closer examination.

For students of ecological history, such statements of concern for social welfare from the powers that be are neither new nor are they taken more seriously than what they are. After all, these are the power blocks spending around \$800 billion in wars and \$400 billion in narcotics annually. Furthermore, to expect that 'development' expenses be used essentially for the welfare of the weaker sections of the society is an unsympathetic demand on one's naiveté. The development researchers in our country have found out that on an average no more than 14 percent of the expenses earmarked for alleviating poverty, actually reaches the target group in our poverty alleviation schemes. The rest can be most euphemistically called 'infrastructural costs'. Nothing has happened in the history of the present economic order, which is much different from this. 'Development' expenses are primarily invested to make profit. Unless profit is made, there will not be any capital accumulation. Without increasingly accumulating capital, the capitalist economic order will collapse. There is nothing ugly or holy about profit. And for that matter 'development' as a procreator of profit has never stopped servicing the capitalist economic order since its inception. 'Development' as a service has always been and is still being continuously rendered, and has therefore remained perforce sustainable.

This is not to mean that 'development' does not include social welfare. On the contrary, welfare of the masses is an integral part of mainstream development planning. It is unwise to deny access to the basic minimum conditions of living, lest the majority of the working population fails to deliver. They must participate actively in production and development to procreate profit. Without continuous and increasing input of their skill, intellect and labour, how can profits multiply? It is essential that the working men and women, their children and their children survive and deliver. Why otherwise should there be yearly expenses of \$6 billion for the basic education for all,

\$9 billion for water and sanitation for all and \$13 billion for basic health and nutrition? Never mind if Europe spends \$11 billion in buying ice-creams or \$50 billion in buying cigarettes and a very lowly \$105 billion for alcoholic drinks. One may read more about this from 1998 Human Development Report.

In this manner, things were generally under control and capitalism was sailing without any serious threat to its perpetuality, but for the unpredicted backlash of nature refusing to provide inexhaustible stock of resources or work as a safe sink for limitless pouring of waste. The wheels of capitalism had to stumble and take stock. Intelligent as they must be, the caretakers of this small planet took no time to realise that it is imperative to respect the thresholds of nature. Therefore a new roadmap honouring the thresholds of nature became necessary. 'Sustainable development' is such a customised icon, the new roadmap for the present economic order. Gro Harlem Brundtland's *Our Common Future*, the UN document that elaborates the concept of 'sustainable development' has however avoided any criticism or restraint on the current growth rates and never raised the question that the crisis in environment is so much an outcome of the contemporary growth pattern of the developed countries. The UN document has remained steadfast to the fundamental requirement of the capitalist economic order – unabated growth. Nevertheless, sustainable development is a good concept. It can be defined as one that respects the thresholds of nature. These thresholds were discovered by the ecologists, firstly to challenge the use of nature as a universal sink for dumping untreated waste and thereafter to remind the limits of availability of natural resources. Sustainable development, therefore, is essentially about living creatively with nature and reducing the assaults of modern consumptive living.

## Traditional Practices and their Ecological Interpretations

*The poorer parts of the world with much richer stock of knowledge in transacting with nature sustainably, enjoy a decided advantage in this new epistemological playfield and stand a bright chance of drawing up superior and implementable development plans.*

A few years ago, during my occasional trips to villages in Bengal, I noticed the poor health of the children who would invariably flock around any outsider. 'Why are they so thin?' I asked. 'Why will they not be?' commented an elderly person, a little sarcastically may be. 'The paddy fields only a few decades back were filled with fishes', he said. 'Now they are no more. Pesticide application may not have had desired results on insects but has been really lethal on the fish. And these fishes, which were small in size, were the source of protein for the children. Therefore, we are now getting the results', he said. Indeed, I could not have enjoyed a lesson in ecology better. What could have been a million dollar donor-aided project to find the cause of such 'sick-baby-syndrome' was threshed out so simply by a local wise person who grew with the system. He is one of thousands of such wise men, mostly unknown and unsung heroes of human civilisation. These wise men knew and continue to know humankind's transactions with nature much more comprehensively than their mainstream counterparts. Are we ready to listen to them? Perhaps it is too premature to come up with an affirmative answer.

Unmarked though, there is a striking fallout of the change in the road map in the capitalist economic theory for honouring the thresholds of nature. The large number of village people in China, India, Africa, Latin America and in such other places who also form the majority, have a remarkable understanding of nature and have evolved a scintillating repertoire of traditional practices. The poorer parts of the world with much richer stock of knowledge in transacting with nature sustainably, enjoy a decided advantage in this new epistemological playfield and stand a bright chance of drawing up superior and implementable development plans. This they will do by blending modern science and traditional wisdom relatively quickly. This can lead to greater self-reliance and sustainability of the poorer countries.

A few examples may be helpful. Let us take the case of a simple technique for disaster avoidance used by the villagers in Sagar Island in Sundarban area of West Bengal. A small loop made of nylon rope can be found 'sprouting' on the ground. It looks in the least as being of any consequence.

But the same loop saves the thatched roof of the adjacent hut from blowing away during windstorms. With the indication of an approaching storm, the owner or the occupier of the hut ties another rope with the loop, bringing it over the roof, while the other end is tied around a heap of stones to act as a dead weight. The other end of the loop is tied to a dead weight, embedded about five feet underneath the ground (Fig.8).

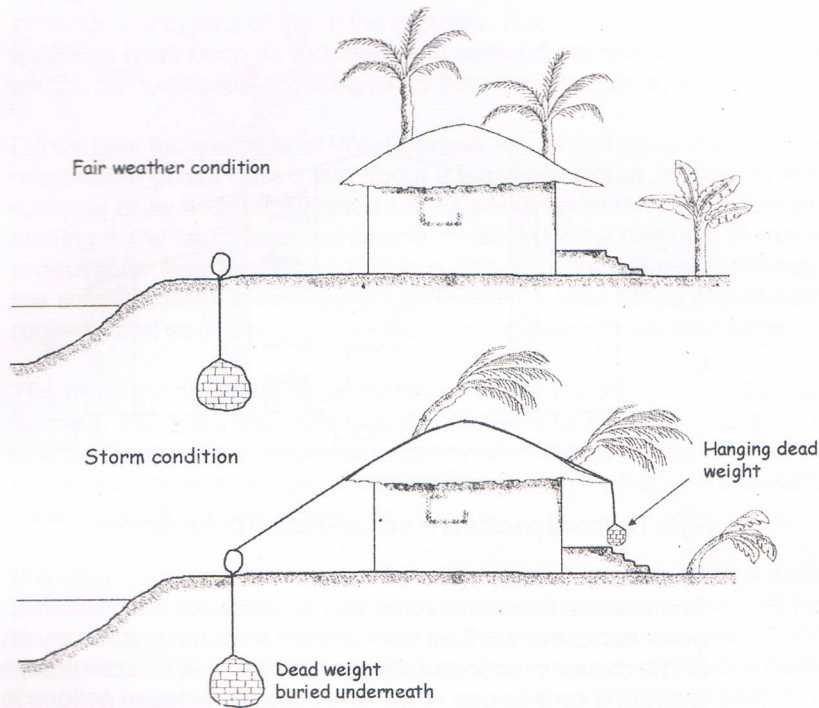


Fig.8: Disaster management – people's technology

The above example is very simple yet quite effective a demonstration of local wisdom and creativity in disaster avoidance. It will be useful to take up another example, which is a little more complex and connects the roles of religion, welfare and cultural richness in exemplifying a unique practice of in-situ conservation of rice seed diversity. For generations, it was a family trait to preserve about fifty varieties of rice seeds in a specially made wooden chest (*sinduk*). The rice seeds were kept in small wooden chambers within the chest specially designed for the purpose. The chest or *sinduk* was placed in one of the best corners of the dwelling unit at the ground floor.

The corresponding first floor was the '*thakur ghar*' or the room for worshipping the family deity. *Thakur ghar* was a compulsory provision for any well to do family. The diversity of seed variety was retained to be specifically used for preparing rice-based preparations as offerings to the many Gods

and Goddesses throughout the year. This was a religious compulsion for Hindu Brahmin families and they believed that they are doing it for the welfare of their children. Inter-generational equity is one of the two basic planks of sustainable development (Fig.9).

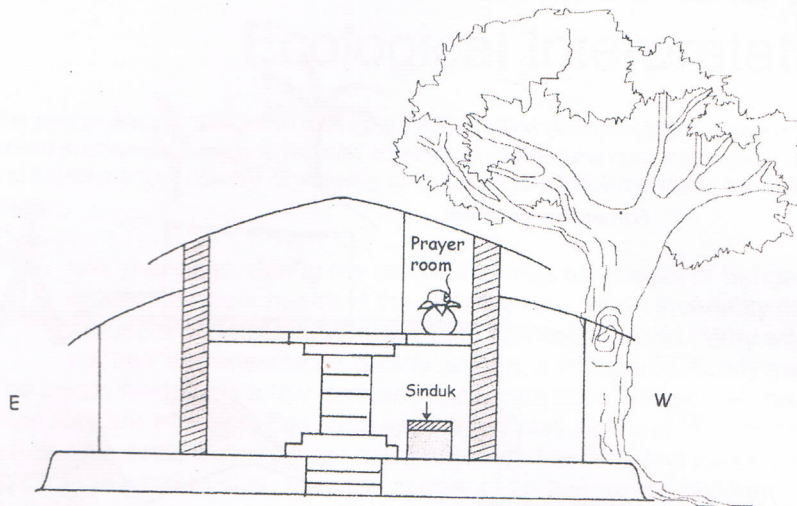


Fig.9: Traditional practice of *in situ* conservation of rice varieties

The present economic order has no place for such futuristic ideas. On the other hand, the spiritual faith derived from the customary rituals acts as a prime mover in successfully maintaining 'in-situ' conservation of rice seeds. Indeed, it evokes one of the most desirable social actions leading to inter-generational equity through preservation of the diversity of seed varieties. A deeper observation of this practice will bring out the amount of scientific thinking that has gone into this custom. The seeds were changed every second year. The temperature and humidity were given due priority in selecting the storage place. The chest itself would only be used by only a few senior persons. In one case, the great old lady who looked after the seeds did not have any formal education. She used to identify the seeds by placing different types of coins in each of the seed chambers and surely she knew what were the seed varieties and where she was preserving them. Today, these brilliant customs are fading out rapidly. A very small section, almost insignificant in number, are talking and writing about inter-generational equity. The glorious heritage of preserving this equity is being relegated to oblivion.

Examples of such knowledge systems are prominently displayed all through the length and breadth of this country. Many of these practices have a fairly long history of sustainable management of natural resources, outstanding

dexterity in ecological engineering and understanding of the functions of nature.

Wetland products are one of the oldest resource bases for providing livelihood support. The oldest of such products must be rice and fish, for which we can easily travel back a few thousand years to reach the earliest history. Rice and fish have, since the last century, received significant amount of institutional support and in many cases have been able to enhance the quality of life of the growers. Not all traditional commercial practices have been as fortunate and wetland practices, in case of many plants, fail to provide anything more than a subsistence livelihood.

Let us take the example of West Bengal, which has been discussed earlier. A reasonable guess will be that about 2.5 million people, in most of the districts, draw their subsistence from a set of secondary wetland plants. More striking is the fact that these people depend upon a diversity of wetland products for their sustenance. This is because West Bengal, although one of the smaller states in terms of area, displays a wide range of hydraulic regimes and varied physico-chemical parameters of soil and water.

The most gainful commercial practice in the wetlands in West Bengal is fish farming. The state has vast expanse of low-lying swamps, marshes and natural depressions. Such ecosystems are habitats for commercial reeds, sages and other emergent macrophytes, many of which are harvested by the rural people for a subsistence living.

It is also a fact that, but for fish farming, most of the commercial wetland practices are age old and time tested. The indigenous culture that has grown on the wetlands has a history of more than three hundred years (NBSAP, 2002). It has been found that social and economic compulsions have forced the rural people in various districts to go in for commercialisation of wetland products obtained from plants like *Typha elephantina* and *Typha domingensis* (hogla), *Cyperus corymbosus* (madur kathi), *Trapa natans* (paniphal) etc. These apart, several other wetland plants are also harvested as supplementary vegetables and medicinal plants. Consumption of a few varieties of green herbs (locally called shak) is on the rise.

In the East Calcutta Wetlands, the local people have created the world's largest ensemble of wastewater fish ponds which perform the twin functions of recovering copious amounts of nutrient available in the municipal wastewater and at the same time purifying the wastewater to desirable standards. They are the forerunners in establishing the new world view of "waste as resource" touted relentlessly by the leaders and thinkers of modern environmental movement only recently. Similarly, the marine fishing community in the coast of Bengal, for more than a century have been displaying their traditional skill in blending the knowledge of sea-bed architecture, aquatic life in the coastal waters and the variations in climatic conditions and have proved themselves as one of the best in sustainably managing the marine fish stock of Sandhead fishing ground.



The farmers of our country have shown the ability in adopting modern technical skills. This has enhanced the wealth of our nation substantially. A good example will be the case of the West Bengal fish farmers who learned the technique of induced breeding of fish so well. So also has been the case with modernizing the sericulture practice. Both these happenings have brought remarkable change in the life and livelihood of a large number of village people. In fact, they are showcasing the best practices in sustainable management by blending traditional wisdom and modern technology.

The potential of using traditional and indigenous resource practice is also important in the area of water conservation. A number of States in our country have understood this significance and are reorienting their water management plans accordingly. A large number of rural people in our country live in a paradoxical situation of having to negotiate with flood and drought every year and in the same place. In most of such cases, sustainable modernization of traditional water use practices can give the best answers.

It has been appropriate to say no to big dams. But it is equally, if not more important, to take up the task of rehabilitating traditional water management practices with whatever modification and improvements local situations may demand. It is a pity that the same country which developed the phenomenon of creating ponds as an inseparable theme of life, is on its way to forgetting the significance of this outstanding ecosystem in our national life. No expenditure will be ill utilised if it is spent for educating each student of our country how important these ponds are.

A section of the specialists are alienating themselves from the very knowledge base upon which the country has grown and evolved for hundreds of years. They are provoking the village people to get rid of their time-tested wisdom in exchange of a handful of temporary and instant benefits. As it is for any engineering practice, traditional engineering or resource-use techniques are retained only through continuous practice. The knowledge system flows from one generation to the other while working together. If for about twenty to thirty years at a stretch the rural people can be thwarted from falling back upon their own traditional stock of knowledge and lured to adopt some such alien techniques that will give them some temporary but attractive instant gain, the very edifice of the traditional knowledge system will collapse. After such a thing happens, the rural people will have reached a dead end, even as they find none of such benefits are proving to be sustainable. In fact, in many cases, they lead to colossal losses in the long run. This exactly is what has been happening in many places of our country, especially in the field of agriculture and healthcare.

There are instances where aggressive marketing of agro-chemicals has dismantled the age-old ethic of a farmer who used to be patiently observing, never in a hurry to introduce any new systemic change. He has now lost his sense of proportion, his inherent ability to anticipate. The wisdom of

sustainable agriculture, which is the hallmark of a good farmer, is gradually being lost. Courtesy, rapid profit and mindless modernization.

The result of this shortsighted use of pesticides in agriculture is showing up. The news about the detection of the presence of pesticides in groundwater by the Indian Council of Agricultural Research was available close on the heels of Coca-Cola- Pepsi media storm that erupted after a respected New Delhi-based environmental NGO reported its findings that soft drinks samples in the city contained pesticides at worrisome levels. We must thank the makers of such glorious drinks for honestly transferring the entire amount of the pesticides that they had collected from the groundwater of our country to the consumers and unintentionally throwing a backhanded challenge to the high and mighty lobby of the global agro-chemical corporations. This, however, is only the tip of the iceberg. As we will get to know more about many other things, the rural environmental agenda will assume central importance in our country. Also, with this, will rise the importance of traditional and indigenous knowledge to draw up the detailed and specific work programmes.

One of the better outcomes of the environmental debate has been to begin looking at science more comprehensively, understanding that science is an outcome of social process. That science is and will remain crucial for better human living is not to be debated. What however, was almost forgotten is that, science is not the only knowledge base to fall back on. In fact, in many instances, science is found to be rooted in traditional knowledge and local wisdom. In July 1999, attaching due importance to traditional knowledge, UNESCO in collaboration with International Council for Science organized the World Conference on Science (WCS) and declared, inter alia,

*Declaration on science and the use of scientific knowledge*

*Considering ..... that traditional and local knowledge system as dynamic expressions of perceiving and understanding the world, can make and historically have made, a valuable contribution to science and technology, and that there is need to preserve, protect, research and promote this cultural heritage and empirical knowledge.*

A note of caution will be pertinent. Search for traditional practices for alternative knowledge base does not mean any random adoption of whatever the local or indigenous people are doing. These will have to be short listed by preliminary enquiry in order to ascertain their scientific validity by scientists who have the proper mindset for carrying out such work. Thereafter, the most important task of ecological interpretation will have to be taken up with sufficient analytical vigour. Subsequent task will involve mainstreaming the lessons and simultaneously conserving the original practice in its place.

We can always learn good things from the achievements and initiatives of the developed countries. We can also incorporate them into our traditional knowledge base. But, for the poorer parts of the world, the key here is in recognising the advantage of owning a decidedly superior knowledge base in