Valuation Techniques For Coastal Ecosystem Changes in India and a Few Neighbouring Countries

Mr. Somnath Hazra[1] and Dr. Rajkumar Sen[2]

Abstract*: Coastal ecosystem play an important role in the environment of an economy barring the land locked economies. In this paper we have attempted to discuss valuation techniques for coastal ecosystem changes in India and a few other neighbouring countries. This paper is distributed over five sections, the first section being the introduction is devoted to the description of the objective, scope and the literature survey where ever exists. Though there are different types of valuation technique for high and low income economics yet there is no such appropriate methodology to estimate the changes of their coastal ecosystem over a period of time, such studies become important when economy adopt major economic policy changes directly and indirectly affecting its environment (India under the strategy of economic reform since 1990 affecting every aspects of economy including environment).*

In the second section we describe the salient features of different coastal ecosystem of different countries under study on the basis of available data a comparable manner as far as possible. We have taken here in adding to India the countries like Pakistan, Sri Lanka, Bangladesh, Myanmar, Indonesia. As India possesses very long coast line, we have consider here the coastal ecosystem in two different parts, based on the distinctive features. i.e. Eastern coast and Western coast. Island economies like Sri Lanka and Indonesia have there distinct ecosystem different from other.

In section III we attempted to describe the changes of the coastal ecosystem of these countries and their affect on human well being (measures in terms of accepted indicators of human development) where ever possible. The database of such change is extremely sketching and rarely recorded. We have tried as far as possible the estimate the changes and their impact.

Different valuation techniques for different type of environmental changes and measurement of human well-being as a consequence of such and also the appropriateness of valuation techniques to be applied for changes the coastal ecosystem discussed and analyzed in Section – IV. This section may be considered as the main thrust of this paper. The last section is meant for conclusion, policy prescription and suggested direction for future research in such valuation technique for measuring changes in the coastal ecosystems.

Key Words : Valuation technique, Coastal Ecosystem.

JEL Classification : Q51,Q57.

I. Introduction

The awareness of the acute problems due to forest degradation though came late in our country, is now growing gradually. Forest resources are one of the crucial ones among all resources and they also form the most crucial links in the ecosystem. Forests provide direct and indirect use values and also provide some environmental benefits such as watershed protection, micro- climate regulation, CO_2 sequestration, pollution control etc. Degradation of forest affects the economy and environment locally as well as globally and also imposes a burden on the future generations. In fact forest degradation is becoming a major constraint of growth and development of many developing countries.

Mangroves are one of the dominant features of coastal ecosystem of the tropics. While ecologically they have been considered an important component of coastal watersheds, they are continually exploited for aquaculture,

[1] Research Scholar, Rabindra Bharati University, 56A B.T. Road, Emerald Bower, Kolkata – 700 050, West Bengal, ***e-mail- somu_durg@rediffmail.com, Phone No. : 0933 0948126***

[2] Professor of Economics, Rabindra Bharati University, 56A B.T. Road,Emerald Bower, Kolkata – 700 050, West Bengal, ***e-mail- rk_sen25@rediffmail.com, Phone No. 033 25555613***

agriculture, urban development, tourism development and other economic activities. The mangrove vegetation of the world falls into two group;1)The old world mangroves.2)The new world mangroves. According to Tomlinson (1983), the old world mangrove is essentially the Eastern Hemisphere group including East Africa, India, South East Asia, Australia, and the Western Pacific. The total number of the true mangrove species in the area is 48,and the new world mangrove is essentially in the Western Hemisphere---- including West Africa, Atlantic, South America, the Caribbean, Central America, and Pacific and South America. The total number of mangrove species in this area is only 9.It is seen that latitudinal limits are largely set by low temperatures, and particularly by extremes of temperature. Rainfall had also strong influences over mangrove distribution. Reduction of salinity is another cause of limited growth of mangroves.

In many developing countries, the area covered by mangroves is decreasing rapidly due to human intervention. In some countries there has been intensive afforestation of mangroves for the purpose of coastal protection. Thus to make estimates for individual countries it is crucial that data should be up to date, but unfortunately this is seldom the case. The procedure of estimation covering the mangrove swamps has some methodological problems. In our paper we consider only few selected countries. These are: India (divided intoA (Eastern Coast), and B (Western Coast)), Bangladesh, Myanmar, Thailand, Indonesia, Sri Lanka. Our main emphasis is to find out the appropriate valuation technique for measuring changes in different coastal ecosystems in different geographical areas. Economic valuation needs to be undertaken when market fails to generate the true prices of resources. Our main stress is on the economic valuation which helps to compute the true prices of the resources and to achieve sustainable development through protection and development of mangrove forest.

There were many debates on the valuation of forests. It was pointed out that the market price did not reflect the true value of the forest. Some of the pioneers in the last century who looked at valuation of natural resources were Greg (1914), Hotelling (1934), and Lotka (1956). Lotka says about valuing life in the framework of biological species. Gery talked about the rent on extracted resources subject to exhaustibility. Hotelling thought about the effect of depletion of forests on human welfare. He investigated a link between the value of natural resources with the discount rate, which is an important parameter in national income accounting (*Kadekodi, 2001*). Fuchs (1983) says about the usefulness of willingness to pay for the valuation of human life/ health (*Banerjee, 2001*) Hanemann (1984) shows the relationship between the option value and quasi option value. El Sarafey (1989) has argued rules charging rent for exploitation of resources at the rates different from sustainable ones. Brandon and Hommann (1995) have presented a rough estimate of the total magnitude of economic costs associated with environment degradation in India. They also calculated the discounted present value of health/ life lost due to this. They suggest a methodology to estimate the environment- adjusted GDP at market price. The James and Murty approach (1999) can be utilized to arrive at the same estimate as a factor cost (*Banerjee, 2001*). Cummings, Brookshire and Schulze (1986) note that, for some applications contingent valuation gives the same result if we use the other methods for the valuation of same good. Michell and Carson (1989) reviewing about 170 empirical studies observed that contingent valuation method is a valid method. Again Carso, Hanemann, Kopp (1991) argue that contingent valuation method is a reliable measure (*Laksmanaswamy, 1998*). Most of the researchers highlighted on contingent valuation and its market behavior and the validity of contingent valuation with respect to India. So in this paper we are trying to find out the real picture of different valuation techniques for different environmental degradation in different geographic zones. This paper is divided into five sections. Section I is for introduction, objects, scope and survey of existing literature. In the section II we describe the features of different coastal ecosystems. In section III we describe the changes in the ecosystem in different countries, which affect the human well being. Different valuation techniques for different types of environmental change and measurement of human well being and also the appropriateness of valuation techniques for changes in coastal ecosystem--- occour in section IV and the last Section is for conclusion, policy prescription and openings for future research in the valuation method for changes in coastal ecosystem.

II. Features of different ecosystem

Now we describe the different features of different coastal ecosystems. Firstly, we describe India and then Bangladesh, Myanmar, Indonesia, Sri Lanka, Pakistan and Thailand.

India:

India has very long coast line which varies due to its ecological and geographical nature. On Indian mangroves most of the earlier publications are not based on any scientific technique but based on just a surface survey and the data on mangroves and mangrove ecosystem in India are not correct. According to the report of Mathauda and Waheed Khan in 1957 the Indian East Coast mangroves is 5,72,240 ha.. Again in 1992. according to the report of ISRO the area of Indian mangroves are estimated as 3,997 km^2,and the estimation of ISRO is considered to be 80% – 90% accurate. We have considered the Indian coastal ecosystem in two parts viz. eastern and western as not only the total coastline is too large but also they exhibit different geographical feature. As mentioned earlier India A represents the eastern coastal ecosystem while the western one is denoted as India B.

India A (East coast)

The mangrove ecosystem of the East Coast of India is mostly deltaic type and it is spread over five major deltas and estuarine mouths situated in four states. These important deltas of East Coast are (I) Ganga, (II) Mahanadi, (III) Krishna, (IV) Godavari, (V) Cauvery, these are situated respectively in West Bengal, Orissa, Andhra Pradesh, Tamil Nadu. According to Sidhu in 1983 the deltaic mangroves was 4,88,888 ha. in Lower Ganga , 12,000 ha. at Mahanadi, 5,210 ha at Krishna , 13,304 ha. at Godavari and 2,640 ha. at Cauvery . The coastline of Tamil Nadu extends about 950 km with about 46 large and small rivers. All these rivers carry fresh water and silt particles and dispose them in the coastal zone. Blasco in 1975 has also stated that no one can tell about the actual area of mangroves in this area. The deltas are in much stressed condition due to human interaction and exploitation, which results in discontinuous growth and habitation of mangroves in Cauvery delta, Penner delta, South Tuticorin, and Rameswaram.

Next we come to Andhra Pradesh coast line which is about 1014 km, and it is rocky and sandy coast. Both Godavari and Krishna delta belong to Andhra Pradesh. The local people exploit this coastal mangrove to meet the demand for fuelwood and animal fodder. In 1992 total mangrove area of Andhra Pradesh was 329.7 km^2.

The Orissa coast line is about 430 km and this coast is mainly in depositional stage with the sediments carried down by river Mahanadi. The delta which is formed by this river is known as Bhitarkanika. Bhitarkanika is the third important and popular mangrove habitat among the Indian mangals because of mangrove species diversity, quality to Mangals, important sanctuary and popular tourist spot. According to Blasco in 1977 the mangrove species of Orissa coast is very much degraded due to construction of harbours in Paradip and reclamation of lands for rice cultivation or for the construction of brackish water fisheries, fertilizer factories. The mangroves and mangrove ecosystem of Mahanadi delta (Bhitarkanika) is very much similar to the Ganga Delta (Sundarbans). According to the report of Jagtap in 1993 Orissa coast have the highest mangrove diversity in Indian mangals.

The Bay islands i.e. Andaman and Nicobar Group of islands have more than 350 islands with1986 km long coast line. According to Naskar and Guha Bakshi in 1992 near about 18% of total India Mangals occurred in this group of islands.

Sundarban is the largest deltaic region of the world and is situated at the southern part of West Bengal in India and spreading over to Bangladesh. Almost 62% of the Sundarban is situated in Bangladesh while the remaining western portion i.e., 38% of the region lies within India. The Southern area of South 24 Parganas district is known to us as Sundarban. Sundarban of West Bengal consists of 9630 sq. km. of mangrove swamps. There are 102 islands among which 54 have human settlements. Population is nearly 3.5 million. The Sundarban is the gift of the river Brambhaputra and Ganges. The land area is very low and full of forest. The Indian Sundarban lies at the apex of the Bay of Bengal and includes the areas bordering the Hoogly, Muriganga, Saptamuki, Thakuran, Gosaba, Vidya, Matla and Harinbhanga estuaries, known as Hoogly Matla estuarine complex *(Roy Choudhury,. 2003)*. In a broader sense the rivers Saptamukhi, Thakuran, Ajmalmari, Dhulibhasani and Matla (part) with all connecting the channels comprising about 1500 sq. km. comes under the area of wetlands. This area has a vast fish and floral and faunal resources including birds, tigers, crocodiles etc. Some ecologists consider wetlands as transitional ecosystem of a landscape that occupy a status intermediate between terrestrial aquatic ecosystems. These are most productive sites, which have a wide range of natural functions. The wetlands play a significant role of global cycling and

geochemical balance of carbon, nitrogen and sulpher. Sundarban wetlands have an enormous ecological, economic, commercial and socio- economic importance. Such land contains very rich components of bio- diversity. Sundarban is the only mangrove area where tiger survives. Total number of tigers, popularly known as Royal Bengal tigers according to latest census is 253. Since 1973 "Project Tiger" was initiated has an area of rich bio- diversity. People of Sundarban are mainly fisherman. They depend on the forest for fishing, wood and honey collection.

India B (Western Coast)

According to Sidhu in 1963 the total mangrove area in Indian west coast is about 1140 km^2, but according to Indian Mangrove Status Report in 1987 the west coast mangals in India is near about 850 km^2 including 200 km^2 mangrove zones of Goa. But most of the recent publications show that the mangrove coverage of Goa is only 20 km^2 and the total length of West coast is 3000 km. The major mangrove zones in the Western coast of India are the Gujarat coast, the Maharashtra coast, the Karnataka coast, the Kerala coast and the Goa coast. The total length of Gujarat coastline is about 1600 km and it is distributed over a few major zones. These are I) the Rann of Kachchh, II) The Gulf of Kachchh, III) the Gulf of Cambay, IV) the Saurashtra coast and lastly the South Gujrat coast, but mangals of all these zones are similar in qualitative sense. The mangroves and mangrove ecosystem of Gujarat coast is highly degraded due to continuous developing harbours and industrialization, which is going to an alarming situation and needed early protection and conservation. The Maharashtra coast is about 720 km long and the coverage was 210 km^2. The Maharashtra coast is categorized into following four groups.

I) Coastal seawater and semi fluid mud.

II) Salt marshes along the coast.

III) Salt marshes of the tidal creek.

IV) Interior drier marshes.

The moderate temperature range between 16^o C – 35^o C and the humidity 60% are beneficial for effective growth of mangroves species. The total length of the coastline of Goa is approximately 120 km. The mangrove zones of Goa are currently degraded by the construction of Konkan railway bridge at Zuari river. The Karnataka coast line is 320 km. According to the Government of India Mangrove Status Report the mangrove coverage in Karnataka coast is 60 km^2; the soil of this area is mainly clay, about 307 ha intertidal land have developed with good mangrove plants, and Sita-Swarna, Mulki and Kopal of this Karnataka state have minor fringing habitats. Some mangroves also exist in Netrabati near Kumta (*Naskar,et.al 1999*). The length of the Kerala coast is about 560 km.. Tremendous population pressure is threatening the natural ecosystem of Kerala. Urbanization, construction of harbours, fish farming, coconut farming, rice cultivation are the main causes of degradation of mangrove forest in Kerala coast. In Arabian sea the coral island is known as Lakhsadeep islands which are constituted by about 30 islands. According to Jagtap in 1984 Lakshadeep islands had near about 25 ha area coverage of mangrove.

Bangladesh:

The undivided Sundarbans is the single largest deltaic natural mangrove forest in the world which is located in the southern parts of the Khulna , Barisal , Noakhali and Chittagaon districts of Bangladesh and both the 24 Pargana's (South) and 24 Pargana's (North) districts of India (*Naskar et al.1999*) 62% of total undivided mangrove area is situated at Bangladesh. The mangrove forest under the Sundarbans of Bangladesh constitutes about 24% of total forest area of the country, which is estimated about 4100 km^2 in 1985. According to Das and Siddiqi Bangladesh Sundarbans mangrove forest is divided into 4 ranges in 55 compartments. The climatic and geographical condition is near about same as Indian Sundarbans. It is also said that the causes of exploitation of mangroves and mangrove ecosystem are also same as those for Indian Sundarbans.

Myanmar:

Total cover of mangals in Myanmar was 5200 sq. km. Bay of Bengal and the Andaman Sea are in its western part and the river Irabati is the principal river which flows into Bay of Bengal. The intertidal deltaic mangrove species are very much similar to the species composition of the mangals of Sundarbans and the Andaman mangals, and also the climatic features are almost the same.

Indonesia:

The largest Mangrove zones of the world are in Indonesia which is consisting about 13000 small and big islands and have a near about 81000 km long coast line; according to the report of Darsidi, in this country the distribution of the mangroves is concentrated in five major islands i.e. Java, Sumatra, Sulawesi, Kalimanthan, Irian Java and remaining are in small islands.

The following table gives a provincial distribution of mangrove coverage.

Sl. No.	Province	Mangrove Coverage (ha)
1	Aceh	54335
2.	North Sumatra	60000
3.	Jambi	65000
4.	Riau	276000
5.	South Sumatra	195000
6.	Lampung	17000
7.	West Kalimantan	40000
8.	Central Kalimantan	10000
9.	East Kalimantan	266800
10.	South Kalimantan	66650
11.	Jakatra	95
12.	West Java	28513.16
13.	Central Java	13576.87
14.	East Java	7750
15.	Bali	1950
16.	West Nusa Tenggara	3678
17.	East Nusa Tenggara	1830
18.	South Sulawesi	66000
19.	South- East Sulawesi	29000
20.	North Sulawesi	4833
21.	Maluku	100000
22.	West Irian	2943000
Total Indonesian Mangrove		4251011.03

Sri Lanka

In Sri Lanka mangroves and mangrove ecosystem are spread over throughout the east and west coasts including Jaffna Penninsula. In 1968 Arulchelvam estimated that the total Mangrove area in Sri Lanka is about 4000 ha, Sri Lanka Swiss Remote Sensing Project demarcated the mangrove area in Sri Lanka as 6296 ha, extending 1520 ha at Batticaloa, 54 ha at Amparai, 9 ha at Colombo, 723 ha at Gampha, 2970 ha at Puttalam and 1020 ha at Tricolnalee (*Naskar et.al 1999*). The National Mangrove Committee was placed in Ministry of Justice and now this is under Natural Resources Environment and Science Authority of Sri Lanka. In 1987 from the Report of Jayewardene, it is known that the soil of major mangrove zones are sandy to sandy loam. Climate of these mangal zones varies between 25^oC – 35^oC temperature and the humidity varies between 60% - 90% and from Oct to Dec the mean rainfall was 1000 mm and from May-July it was 1500 mm. In 1985 the total mangrove area is categorized by De Silva on the basis of their position / location and characteristics of flora like as –

(a) Riverine Mangroves (in the South and South West coast the mangroves grow along the estuaries and major river courses).

(b) Fringing Mangroves (Both in South and East Coast mangroves are extended along Shallow lagoons).

(c) Basin Mangroves (in the North and at the Vadamarachchi lagoon the mangroves grow in the basin).

Scrub Mangroves (in the East and West Coast mangroves grow on the border of the lagoons)and over wash mangroves (in the small island, within Puttalam and Negambo lagoons at west coast and in the island of the estuary of the Mahaweli river of east coast, the mangroves are over washed), cover vast mangroves areas which are exploited due to heavy population pressure, development of brakishwater fisheries, coconut cultivation, holiday

resorts, especially for tourist development, harvest of firewood and tan-bark exploitation. Many other natural stresses may be the root cause for degradation of mangrove forest. These are tropical cyclones and typhoons, Geomorphologic alterations, tidal waves and storms etc.

Pakistan :

In Pakistan total mangrove and mangrove ecosystem are spread over through south eastern and western side. Total length of the coast line in Pakistan is 885 km which included 241 km long coast line in Sind province and 644 km long coast line in the Baluchistan province. In 1966 Khan estimated 249,486 ha mangrove area in the Indus delta and only 20 ha mangals along the Makran coast in the Baluchistan. In 1983 according to Mirza only 82000 ha. as Indus delta and among these about 26000 ha. tidal range covered with mangroves and the rest 5600 ha area are under no vegitation and water channels. According to Amjad and Khan in 1983 the total mangrove in Sind is 281,000 ha and 2000 ha in Baluchistan. The soil of these mangal zones are mostly sticky to very sticky. In these coastal mangal zones the average annual rain fall is estimated about 221.2 mm. As per report of Ansari in 1987 the average temperature during summer varies between $40^oC - 42^oC$ and at the winter season it comes down to 9.5^oC. The freshwater supplies to the coastal regions from Indus river system or distributaries viz. Ochito, Hyderi etc. For the construction of dams, barrages on the Indus river and others viz. freshwater storage in ponds, lakes, the upstream freshwater supply from the Indus river is reduced day by day, which is one of the causes of degradation of growth of mangroves in these areas. According to the report of Nasir and Ali in 1972, the eight mangrove species are found, and these species are spread over through Karachi, Indus deltaic zones, estuaries of Indus, and the vast tidal zones of Sind province. In Pakistan coastal area the coastal population are mainly engaged with fisheries and agriculture. The major and minor forest products of these mangals are firewood, minor timbers, poles, fencing materials, fodder leaves etc. In this area aquaculture, agriculture, mining have not much importance compared with other coastal areas in Asia and it is also noted that, the process of urbanization is very slow in this area. For rapid deforestation in costal area of Pakistan the problem of soil erosion is occurred and the result is continuous silt and sand disposition on the coastal water, which affect the fisheries in that region.

Thailand:

The total coastline in Thailand is 2600 km long and out of this about 9277 km is occupied by mangroves. These mangroves and mangrove ecosystem are distributed in the southern and southeastern parts of the country and on the Gulf of Thailand. The areas occupied in three parts of Thailand are 41824 ha, 33552 ha and 211,932 ha respectively. In 1987 according to the report of Aksornkoae, the total mangrove area in Thailand were classified in four regions:

Region 1 (the southeastern provinces mangroves of Thailand), Region 2 (upper part of Gulf of Thailand), Region 3 (The western side of the Gulf of Thailand), Region 4 (The eastern side of the Thailand mangroves facing the Andaman sea).

The property of soil of different mangrove zones depending upon the mangrove vegetations and positions from the coast. The tidal nature of region of Thailand also varies by the tides of different sea water. Climate of the mangal zones is very much variable, temperature varies between $27^oC - 29^oC$ and the humidity varies between 75% - 85%. These mangroves are exploited due to variety of uses, like fuel purpose, unauthorized fishing, tannin extraction, construction of dams etc. It is also noted that in 1979 near about 25000 ha, mangrove lands were converted to shrimp farm, and several hectares of forest land were converted for rice cultivation, coconut farming and urbanization; along with these industrialization had degraded large mangrove habitat in Thailand. According to Lohwongwatana in 1979, mangrove habitats are affected in Thailand due to high population growth in the coastal areas, rapid industrialization and consequent release of pollutants.

III. Ecosystem Changes and Human Well-being

Mangroves are one of the most extraordinary ecological formations occurring in the coastal lowlands of the tropics. These are neither land nor sea and they consist of trees with flying buttresses, and are adapted to brackish waters and unstable often highly saline soils. This type of vegetation provides fish nurseries, rich fishing ground and a vast number of both timber and non timber products. Mangroves are on a global scale, exposed to many single

destructive events. But the cumulative effects of natural disasters, clear- cutting over logging, fish and shrimp farming, industrial and domestic pollution, dredging and industrial and agriculture land reclamation as well as fragmentation threaten their continued existence. The world wide damage to tropical tidal forest is a process which has received little public attention. But the fact that the loss of mangrove wetlands has already reached alarming dimension. Mangrove forest often die a slow death, a process that sometimes last for many years and goes largely unnoticed. Loss of mangrove forests can have drastic effects on the local inhabitants for many years to come. Increased flooding and coastal erosion lead to loss of crops, villages and lives; local subsistence fisheries decrease or collapse altogether and many coastal communities undergo severe social changes relating to loss of incomes through loss of resources.

Without any doubt one can say that most of the mangroves throughout the world are jeopardized due to man. Some of the dominant reasons for the destruction of mangroves ecosystem are described in this section.

1) Mining and Mineral Extraction:

As the scarcity of industrial mineral ores rises, there is a corresponding increase in the mining of alluvial deposits in the tropical coastal zone. Indeed, in many areas of the world there are rich alluvial deposits of tin and chromium as well as other minerals associated with then such as titanium. The exploitation of ore bodies in the coastal zone takes place upstream, downstream and within the mangrove ecosystem. Mining within the system and adjacent areas are causing various destructive effects. The dominant effect is the deposition of other materials which are transported to and within the mangroves by surface water. Excessive sedimentation is detrimental to mangroves through its blocking role in exchanges of water nutrient, gases within the substrate and between the substrate and overlying the water, when this exchange is totally blocked the death of mangrove occurs within a period measured in days. The turbidity and increased siltation caused by dredging disposal also results in destruction of local corals and sea grass meadows, and their associated faunas.Mining activities are also associated with the crushing, washing, chemical flotation, screening and dewatering. This refining process is harmful for coastal zone, as the short term economic gains from extraction of the ore generally far exceeds the short term economic or natural value of the mangrove forest. However from the above discussion it is said that mining could be needed as a temporary land use if efforts were made to stimulate recovery or regeneration of mangrove forest. Such efforts however are rarely being made in spite of the increased mining activities in the coastal zone.

2) Diversion of Freshwater: -

We have a popular misconception that mangroves are salt demanding plants when in fact mangrove development is best in areas, which have significant input of freshwater run off. Accordingly mangroves in arid, semiarid, and/ or seasonally arid environments are highly dependent on periodic inputs of freshwater in considering the major rivers, which have been dammed (e.g. Nile, Indus, Ganges etc.) the downstream effects on both coastal vegetation and nearshore fisheries, will become readily apparent in the form of large scale reductions of freshwater inputs caused by human water uses, such as irrigation or large water supply diversions out of the catchments. These problems arise from major engineering works such as dams and barrages. The diversion of freshwater from the mangrove ecosystem affects mangroves and associated fauna in a variety of ways.

3) Forest Exploitation:

Throughout the world, firewood and domestic fuel are decreasing in supply, while at the same time the demand is rapidly rising. To minimize the deficit mangrove forests are used directly by country people for firewood (e.g. India and much of Africa) or the wood is used directly or indirectly for serving small or large scale industry. On the other hand the wood is used in large scale for sale as a timber and for producing chip and pulp. For an example in Indonesia and East Kalimanthan forest are exploited for opening up of new land for colonization and development. It is seen that in some cases forests are exploited due to unsuccessful natural regeneration and huge demand for conversion to other forms of land use.

The coastal Swamp in saline, anaerobic environments were traditionally considered to be totally or marginally unsuitable for Agriculture and Aquaculture production. But with the improvements in research and increasing demand for arable land the saline, acidic soils of the mangrove environment are viewed as a major alternative for the

global increase in agricultural production.

Encroachment of mangrove areas for aquaculture ponds is not a new activity, in recent years number and scale of aquaculture projects increased day by day because fishery is very profitable and lucrative business. In 1977 it was estimated that 1.2 million ha. of mangrove forest in the Indo- Pacific region had been converted to aquaculture ponds.

4) Coastal Development:

The destruction of the mangrove forest and the conversion of mangrove lands to domestic and industrial development is a major problem in high income countries and are beginning to become a problem of consequence in developing countries. Most common forms of conversion are to housing and residential development, coastal tourist facilities and industry, including small port development, urban development etc. Road concentration and land modification is maximal and the on-site mangrove will be totally reclaimed. Industrial development results in a higher demand for water supply than residential settlement. Waste output tends to be higher. Road, channel construction and automotive pollution, sound pollution which are related to transport development will be of high intensity. It can be seen that in the history of the Sundarban continuous land reclamation since the beginning of British rule in 1770. In Indian Sundarban spreading over to Bangladesh near about 150,000 ha of mangrove forest were destroyed during the past 100 years. For reclamation of agriculture, settlement sites and road network and other economic activities of ever increasing coastal population in Southern part of India (i.e. in Kerala), near about 70,000 ha of mangrove forest were destroyed in the same period.

5) Solid Waste Disposal:-

Where human settlement is increasing day by day in coastal areas and also in urban areas, the garbage, solid wastes and liquid waste generation increased three to four times in most countries. Since most major tropical and subtropical urban centers are located on coasts or estuaries and since the coastal areas are traditionally known as wasteland therefore much garbage, solid waste are dumped in coastal areas and the liquid wastes are disposed off to the sea water which are harmful for mangrove ecosystem and which is also root cause of decrease in the growth of mangroves.

These are the causes how mangrove forests are degraded around the world now. Let us now discuss the economic role of mangrove forest for human well-being.

Mangrove forest or ecosystem may act as the Seaward barrier and check considerably the coastal erosion and minimize the tidal thrust like Tsunami or strong storm hit from the sea. The very recent disaster due to Tsunami on Dec 26, 2004 could not be destructive such in Indonesia, Thailand, Myanmar, Sri Lanka if the coastal areas were property protected or if the Mangrove forest were not destructed due to urbanization and development of tourist spots. The economy of Maldives depends largely on tourism revenues. With its tourism economy in disarray, the islands' recovery depends on foreign aid. The direct economic impact of the recent events will come through the negative effects on consumption and business activity in the areas affected. The two most affected sectors are probably tourism and fishing.

Mangrove waterways are the important spawning ground and nursery beds for several most economic marine or offshore prawn and fish species. It is said that the several species of prawns do not exist without mangroves ecosystem, some may breed or complete their life cycle in the shallow mangrove water.

The conflict between the exploitation of mangroves for human needs or for development and construction of agriculture farm in the mangrove reclaimed zone on the one hand and the conservation of mangrove forest and its adjacent coastal fisheries have been very acute in the South East Asian countries and regions including Sundarban. All these degraded mangrove due to fisheries may not be productive for a long time.

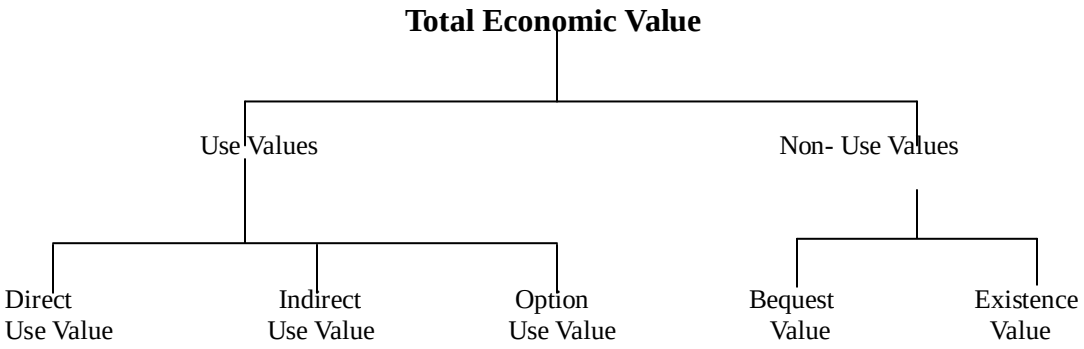
An important habitat for plants and animals is lost and many species may have disappeared from an area. This may involve decline in large water birds, mammals and spawning fish. The loss of species from an ecosystem will have serious knock on effects on the food chain. Loss of mangrove wetland means the loss of critically important wetlands for many migratory species. Besides these traditional uses the mangrove forest ecosystem also utilizes for

the harvest of natural forest products like timber, fuel wood, honey and war, tan barks etc.

IV. Different Valuation Techniques and Their Appropriateness: -

The mangrove should be preserved with care, to keep in safe or to protect it from loss or to preserve it in its existing state. Mangroves are known as coast protector or sea defence. It has become obvious that many of the benefits from investment in these fields are just those that are most difficult—or perhaps impossible to measure in money terms. The recreational experiences are found at the coast, and environmental values also in the coastal habitats and resources. In this respect the term ecological evaluation is used to refer to the relative evaluation of features of ecological interest while the term economic valuation refers to attempts to place an economic value in monetary terms on such features. The valuation task is to determine how much better off or worse off individuals will be as a result of a change in environmental quality. The value of this change is measured in terms of how much of something else an individual is willing to give up to get this change or how much they would accept in order to permit the change to occur. The decision about the appropriate measure of economic well being depends on primarily on what the use of the measure. Policymakers can ask a range of different questions, so the welfare measure will have to be tailored appropriately. They may wish to select only policies which make at least one person better off and no body worse off--- known as Pareto criterion. This approach avoids the problem of comparing between observable well- beings of different individuals. This is especially likely when the policy will affect large number of people in different areas and sectors.

Policymakers may choose a weaker decision rule which says that a policy is acceptable so long as those who gain could compensate those who lose and still be better off, which is the 'Hicks- Kaldor' compensation test. Pareto improvement criterion is possible to operate if the government takes the role of levying taxes and making transfer payments between gainers and losers. The task that remains is then to measure changes in individual well- being. Well-being can be affected by changes in prices (both explicit and implicit) and/ or qualities of goods and services. If goods and services are broadly substitutable, then trade off can be made and values established. Accepting money as a measure of value, the rate at which a particular individual is prepared to trade off goods and services against one another, is equal to that individual's own maximum willingness to pay (WTP) for the goods or services in question. More accurately this can be said that, it is the payment required to make an individual indifferent to a choice between the situation before the change and the situation after the change; this payment can be positive or negative depending on whether the individual gains or loses from the change. Negative payments are refused as the individuals willingness to accept (WTA) compensation for the change. The important thing is to note that both compensating variation (evaluating the payment before the change) and equivalent variation (payment is evaluated from the position after the change) hold some level of well being constant when the value of a change is being estimated. But it is not true for the calculated WTP, which can be explained with the help of the market demand curve. The 'Substitution' effect is relevant for well being measurement. Estimating changes in well being from ordinary demand curves will result in values, which are biased by the inclusion of this income factor (called consumer surplus). Willing (1976) argued that in most cases income effect is not significant. But it is significant when estimating changes in environment which result in total destruction or creation of some new natural resources. The money value of a change in individuals well being due to change in environmental quality is called total economic value. Total economic value is divided into use value and non-use value. Use value is sub divided into direct use value and indirect use value and option value. Again on the other side non use value is sub divided into bequest value and existence value. Direct use values are derived when an individual makes actual use of facility, for an example visiting a park, or, going to fishing etc., indirect use value arises when we get the functional benefits such as, forest ecosystem etc., and option use value is an individual WTP for the option of using an asset at some future date. Bequest value is derived from use and non use values environmental legacies, and existence value is value from knowledge of continued existence. This is demonstrated below.



From valuation we get a link between change in environmental quality or physical change of environment and the human well being. A number of approaches are available for determining the economic value of environmental changes; these are 1) Travel Cost Method, 2) Hedonic Pricing Method, 3) Contingent Valuation Method.

Travel Cost Method:- To measure the non- market benefits Travel Cost method (TCM) is suitable. It is one of the indirect methods, TCM values a recreational site or characteristic by using the value of the time and other cost incurred in visiting the site as a proxy or for what a visitor would be willing to pay to visit the site. The most basic version of TCM is a continuous demand model for a single site, in which individuals maximize utility by choosing the number of visits to the site subject to monetary and time constraints. This maximization generates the individual's demand function for the site, from which consumer surplus can be calculated and aggregated across the individuals. From the features of TCM it is seen that it is not appropriate to capture non- users values, it can only quantify the user- value of the environmental amenity. In TCM the information collected from the households, may lead to transaction.

Hedonic Price Method: - The Hedonic price method is based on the premise that a goods or service can be defined as a bundle of characteristic or attributes that together determine the price of the good via the demand for or supply of the characteristics in the good market. In this situation everyone can reveal the preferences for the marketed and non-marketed goods. The hedonic pricing approach applies econometric techniques to data on private good characteristics and prices to derive estimates of the implicit prices for the environment quality. For an example when making a decision to buy a house or rent an apartment which one may consider many factors such as number of bedrooms, the age of the house/apartment, the site of the garden, garage availability, etc. These are known as the site characteristics. Again it is also important to the buyers and sellers to know such as how far it is from major employment area, availability of good school, availability of good transport link,etc ; these are known as neighborhood characteristics, and it is also important to know the environmental characteristics i.e. air quality, noise levels scenic views etc. This method is widely used to study the implicit prices of changes in air quality, noise, and proximity to waste sites. A fairly recent survey of much of these works can be found in Smith and Huang (1995), whilst Farber (1998) surveys work on proximity to waste sites specifically when the environmental change is marginal or if we assume the individuals are identical then we are able to use the Hedonic pricing method for measurement of welfare changes.

We can also estimate the changes in welfare via the estimated bid function. Some drawbacks can be identified to the use of this technique, these are: -

i) Many environmental goods are not linked to the house market. The Hedonic price method will not work for those goods even which goods are so liked to the housing market the value of goods by this method estimated partially.

ii) It is must assume that the buyers and sellers are well informed for the housing market.

iii) The individuals WTP for a house will not depend on the current levels of environmental attributes but also future levels; because it has an investment and the individuals must look for his capital gain.

The contingent valuation method

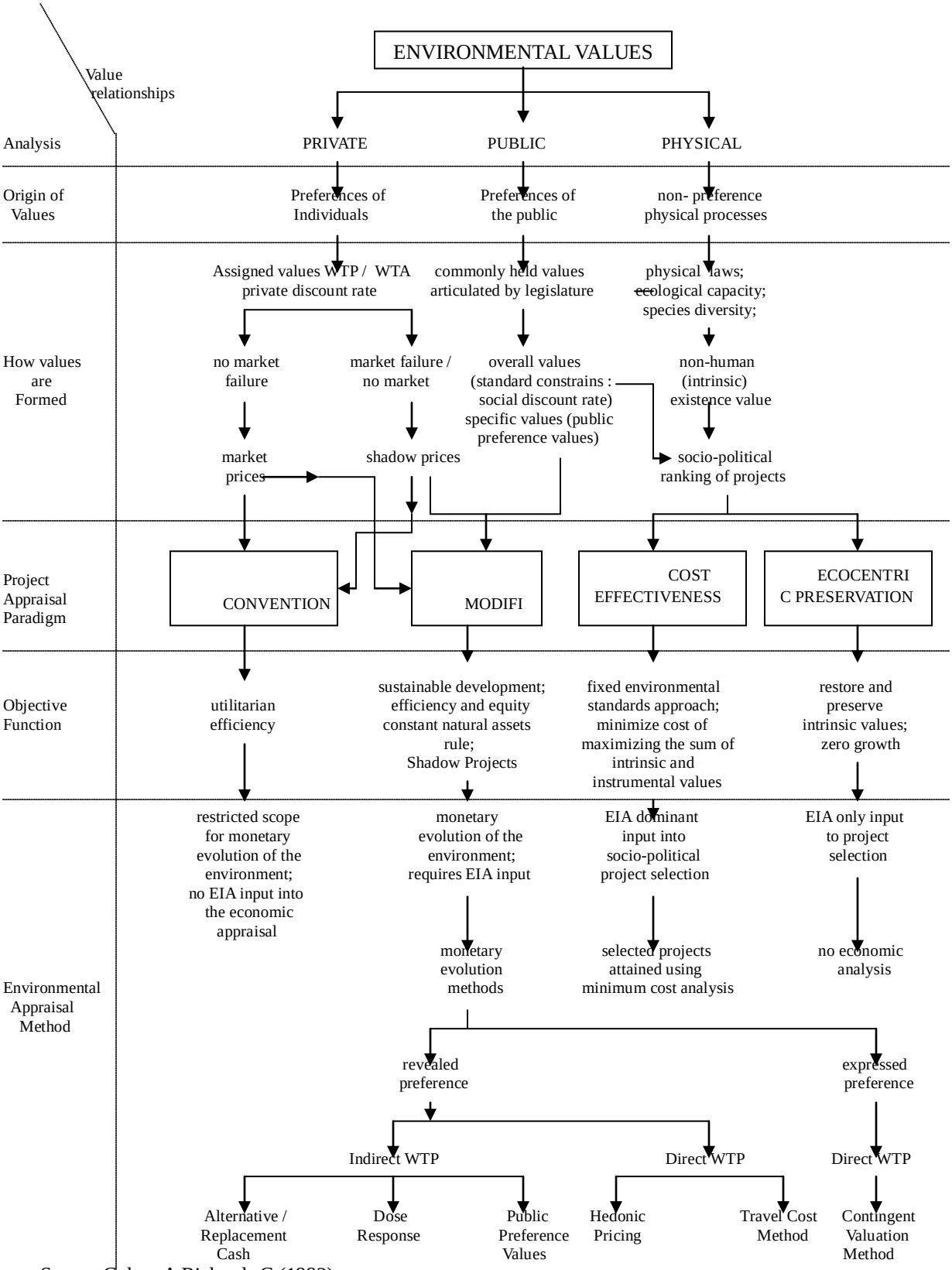
This is another method of valuation; it is used to be estimated for wide range of commodities, which are not traded in the market. This method is originally proposed by Davis in 1963. This approach is simply ask the people how much they would be willing to pay or how much they would be willing to accept as a compensation for any specified environment quality improvement happen. This is a stated performance technique. This technique has six stages. These are as follows: -

1. Setting up hypothetical market.
2. Obtaining bids.
3. Estimating mean WTP and/or WTA.
4. Estimating bid curves.
5. Aggregating the data.
6. Evaluating the CV in exercise.

It is highly acceptable valuation method for estimating the values of wide range of situation, from the benefits of preserving global bio-diversity to the benefits of improving a city air quality or protecting local wetland. It is capable for measuring both use and non-use values. This technique is applied successfully in developing countries to water supplies, water quality, and forest resources etc. The literature has identified various forms of potential bias that exist in this technique these are; I) Strategic bias – arises if respondents intentionally give responses that do not reflect their true values, II) Hypothetical Bias – arises because respondents are not making real transactions.

From the literature survey it is identified that the contingent valuation technique is most appropriate for the valuation of coastal ecosystem. But the infrastructure is not same for developed and developing country and it is also noted that the different coastal ecosystem have significant geographical nature, so our question is that is it possible to estimate the value of different coastal regions of different geographical nature by applying a unique valuation method? The developing country has excessive income inequality problem, data collection problem, problem of proper training to generating the awareness of the role of our environment. These problems are very much affected to the use of contingent valuation method for valuation of coastal ecosystem.

A systemic presentation of this discussion is given below.



Source:Coker, A Richards,C (1992)

V. Conclusions

Ecological sustainability of mangrove ecosystem is more important and it can be achieved through grass root level plans and programmes. A national policy is needed for protection of mangrove ecosystem and wetlands. Environment degrading development programmes were responsible for depletion of several species of flora and fauna. No one was serious about conservation of natural habitat and genetic resources of coastal ecosystem. The only objective of the Government was to produce more and more food and urbanization by any means. This type of development activities are planned on a sustainable basis with long term objectives rather than with short term objectives and immediate benefits. Protection of mangrove ecosystem can be made through minimizing the current use pattern of mangrove and encouraging indirect and non- exploitative uses of the mangrove forest on a sustainable basis. To provide for a sustainable livelihood security of the population it is not enough to stop only at the ecological sustainability of the mangrove ecosystem. It is also essential to provide the population, especially the lower strata, with alternative sources of fuel wood and building materials. A green tax can be imposed on all depletive users of mangroves and wetlands of coastal ecosystem to cover the social cost of the reduced biodiversity or ecological damage. Such a tax can be used to ecological fund to be used for restoration or other preservatory efforts and also to improve GDP. There is need to take concrete steps to ensure the sustainable management of the coastal ecosystem. Given the economic and ecological significance of coastal sustainability of mangrove forest and wetlands of coastal ecosystem. From a system's point of view the sustainable development will be one that improves the quality of life while living the carrying capacity of supporting ecosystem.

References

Agarwal, Anil (1997): *The challenge of the Balance- Environmental Economics in India* Proceedings of National Environment and Economic Meeting, pp 101- 110, pp 207- 260, Centre for Science and Environment, New Delhi.

Agarwal, Anil (1992): *The Price of Forests.*Proceedings of a seminar on the Economics of the sustainable use of Forest Resources, pp 1-62, Center for Science and Environment, New Delhi.

Allaby, Michel (ed. 1998): *Dictionary of Ecology*, Oxford University Press, New York.

Balakrishnan M (1993): *Environmental Problems and Prospects in India*, pp 1-93, Oxford and IBH Publishing Co. Ltd., New Delhi.

Banbithi (July 2002): *Environment and Aranya Saptaha Issue* Forest Department Government of West Bengal.

Banbithi (July 2001): *Forest and Environment Issue*, Forest Department, Government of West Bengal.

Bagirath and Rao, D. Mohan (2001): Forest Degradation in India: Extent and Determinants, pp 631- 651*Indian Journal of Agricultural Economics*, Vol- 56, No. 4 (Oct- Dec).

Bergh, Jeroen C.J.M Vanden (1999): *Handbook of Environmental and Resources Economics.* Edward Elger Publishing Limited, Cheltanham.

Bhattacharya, Rabindra N. (2001): *Environmental Economics- An Indian perspective*, Oxford University Press, New Delhi.

Bjorustad, J.D. and Kabu, R.J. (1996): *The Contingent valuation of Environmental Resources*, Edward Elgar, Chettenhan, U.K

Chandrakanth, M.G (2002): Valuation of Natural and Environmental Resources : Methodology and Estimation, *Indian Journal of Agriculture Economics*: Vol- 57, No.1.

Coker, A. Richards, C(ed) (1992): *Valuing the Environment*, JOHN WILEY and SONS, England.

Dasgupta, A.K. and Pearce D.W. (1972): *Cost Benefit Analysis* pp 19- 53, pp 90- 94 Macmillan Press Ltd. London.

Ferguson, Ian.S. (1996): Sustainable Forest Management Oxford University Press, Australia

Georgiou, S, Whittinton, D. Pearce, D Moran, D. (1997). : *Economic values and the environment in the developing world*, Edward Elgar, Cheltenham, U.K.

Kadekodi, Gopal, K. (2001): Valuation of Natural Resources--- What We Have Learnt from Indian Experience. *Indian Journal of Agricultural Economics*, Vol.56, No.3

Kopp, J.R., Pommerechne, W.W. Schwarz, N (1997): *Determining the value of Non marked Goods*, Kluwer Academic Publishers, Massachusetts.

Kulkarni, Sharad (1983): Towards a social Forest Policy, PP 191- 196, *Economic and Political Weekly* on 5th Feb.

Laksmanswami, T (1998): Economic valuation of the Pristine Quality: Some Issues, pp 42- in Anil Agarwal (ed): *The Challenge of The Balance- Environmental Economics in India Proceedings of Natioanl Environment and Economic Meeting*, Centre for Science and Environment, New Delhi.

Mitchell, R.C. and Carson R.T. (1989): Using Survey to value Public Goods, The *Contingent Valuation Method----Resources for the Future*, Washington D.C. pp 55-90. John Hopkins University Press, Baltimore U.S.A.

Mishan, E.J. (1982): *Cost Benefit Analysis------ An Informal Introduction.* Pp 22-110, pp 408-432 George Allen and Uniwin (Pvt.) Ltd, London.

Naskar, Kumandranjan (2002): Sundarban Bipannya Prakriti, pp 9-17, *Yojona (Bengali),* March.8, Esplanade East, Kolkata.

Naskar, K and Mondal, R. (1999): *Ecology and Bio diversity of Indian Mangroves*, Daya Publishing House, Delhi.

Nayek, B (2001): Economic- Ecologic Values of Indian Forest – A Case Study,*Indian Journal of Agriculture Economics*, Vol-56, No.-3

Rao, N.S. (2001): Sustainable Forest Management, pp 28-32, Kurukshetra, March. Ministry of Rural Development, Government of India.

Reddy, V Ratna: Behra Roy, Anandarup (1984): *Cost Benefit Analysis Issues and Methodologies*, pp 12-17, pp 27-30,John Hopkins University Press, Baltimore

Roy, Biswanath: *West Bengal Today--- A Fresh Look*, pp 107- 123, Mittal Publications, New Delhi.

Shekar, C (2001): Externally Effects of CPR Degradation,*Indian Journal of Agricultural Economics*, Vol. 56, No3.

Russel, S.C. (2001): *Appling Economics To The Environment* , Oxford University Press, New York.

Sengupta, Ramprasad (2001): *Ecology and Economics*, pp 157-167, Oxford University Press, New Delhi.

Singh, V.P. and Odaks, K. (2004):*Mangrove Ecosystem Structure and Function*, Scientific Publishers (India), Jodhpur.

State forest Report (1999: Forest Survey of India, Dehradun

Tisdel, Clem (1993): *Environmental Economics*, pp 69-128, 140-169, 239- 249Edward Elgar Publishing Limited, England. .