VALUATION OF WETLAND RESOURCES FOR CONSERVATION AND DEVELOPMENT AS CENTRES FOR GROWTH OF SUSTAINABLE ECONOMY

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Dilip Sarma
Regn no. : 004/07

School of Management Sciences
Department of Business Administration
Tezpur University
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ABSTRACT

WETLANDS (also known as *Beel, Hola, Doba, Beeloni, Peetoni* etc.) are extremely productive natural resources often exceeding the productivity of intensive agricultural systems. The wetlands fulfill a large number of important and essential functions including being an important source for income generation. Yet, the wetlands are threatened continuously from degradation as well as from conversion by man for alternative use. While degradation is also due to the forces of nature, the conversion is primarily due to the economic forces caused by the population; the magnitude of which is dependent on the population density and its status.

WETLAND FUNCTIONS :

The functions and services which the wetlands generally fulfill can be listed as:

- Source of water supply for domestic, agricultural and industrial use.
- Recharge for groundwater aquifers and water supply to wetlands in lower catchment.
- Flow regulation and Flood control.
- Sediment and Nutrient retention by submerged vegetation.
- Maintenance of Gene bank.
- Significant Habitat for the life cycle of important plant and animal species.
- Providing means for inexpensive and environmentally sound mode of transport.
- Source of natural products (on site) aqua-flora and aqua-fauna
- Source of Natural resource (off site) namely fuel wood and organic fertilizer.
- Source of recreation , scientific study and of Eco– tourism
- Maintaining spiritual, religious and socio-cultural heritage, natural esthetics and sociological balance etc.

While these functions can be classified into five broad categories 1) Climatic 2) Bio-diversity 3) Habitat 4) Hydrological and 5) Water quality functions, The benefits can be classified, as listed below, based on how the benefits are derived :

(1) **Direct Extractive** benefits through extraction of water, aqua flora and fauna

(2) **Direct non-extractive** uses such as for recreation, eco-tourism, transport etc.

(3) **Indirect** benefits like recharging of ground water, protection from floods, nutrient cycling.

(4) **Optional source** for use in future, and

(5) **Passive**, intangible benefits such as for performing religious and/or cultural rituals practices.

MORIGAON AS THE STUDY AREA:

Morigaon district is an area which has a very high population density without any natural resources to harness other than the land and wetlands. The primary activity of the population is agriculture, the growth of which is limited due to annual floods.

However Being a confluence zone of many streams and rivers, Morigaon, has the highest number of wetlands among all the district of the state, with 183 wetlands covering an area of 11,658.0 hectares. It also supports over 11% of the district's population for their livelihood.

PROBLEMS:

Wetlands, in spite of providing the array of goods and services to the man, are threatened continuously from both degradation as well as conversion by him for alternative use. The pressure on the wetlands is primarily due to:

- **Population growth** demanding enhanced food production, shelter and other human activities.

- **Absence of property rights** leading to excessive use or unrestricted abuse ; And
- **Failure to assign right monetary valuation of goods and services** provided by the wetlands.

The study **"Valuation of the Wetland Resources for Conservation and Development as centres for Growth of Sustainable Economy"** is a step towards developing a holistic economic valuation model taking into account both tangible as well as intangible benefits of wetlands so that investment planning in development and preservation receive the right priority. Accordingly, the objectives of the study are defined as:

OBJECTIVES

1. To identify the economic activities associated with the wetlands,
2. To assess for qualitative status of the wetland for its ecological productivity,
3. To assess the economically relevant Bio-diversity - Aqua-fauna and Aqua-flora,
4. To assess the monetary values of Direct, Indirect, Passive or Optional benefits of the wetland eco-system in the study area,
5. To analyze the relationships between the wetlands and human activities so as to develop an 'Environmental Valuation Reference Inventory' (EVRI) for other similar wetlands,
6. And, ultimately, to suggest a strategy for preservation and development of wetlands as centres for growth of sustainable economy.

REVIEW OF LITERATURE

The literature review for the study has been categorized primarily for : a) Identification of wetland functions and benefits, b) Wetland valuation methods and techniques, c) Morigaon as the study area, d) Ethnological and cultural heritage of the population in the study area, e) philosophical insight to man-nature

relationship and f) Current perspectives to sustainable preservation and wise-use of natural resources and societal harmony.

METHODOLOGY AND PLAN OF RESEARCH

To fulfill the objectives of the study, the **methodology** adopted in conducting the study was made through different stages as stated under.

- The identification of the wetlands and the surrounding villages were made from the remote sensing map with village identification obtained from the Assam Remote Sensing Application Centre at Guwahati. The ground verification to the remote sensing data was made using a Global Positioning system

- The identification of wetland benefits derived by the people was made through a sample survey amongst 500 respondents from seventeen villages around Khandajan, Sonai and Erakolong wetlands.

- To assess the qualitative status of wetlands with respect to the biotic productivity, samples of water and soil were collected and tested in the Public Analyst's laboratory and the Soil Testing laboratory of Department of Agriculture, Government of Assam at Guwahati respectively.

- The survey for valuation and attitude was again through administration of questionnaires amongst 430 respondents from the population of 60 villages surrounding 45 wetlands. All interactions with the respondents have been through personal interview in Assamese language.

- The assessment of biodiversity was assessed through secondary survey of earlier research studies.

- The population related data and information have been acquired from secondary sources namely the Census Handbooks of India for Morigaon District for different years. Statistical Handbook of Assam, published reports

from the Departments of Agriculture, Fishery, Forests, Revenue, Industries, Election, and the Assam Remote Sensing Application Centre.

- ❖ The market prices of different species of fish have been collected from the retail markets at Morigaon and Jagiroad for a period of one week and the prices were recorded for three different sizes for each specie.

- ❖ The information related to assessment of cost of jute cultivation and labour productivity has been derived from early studies and the market price of jute has been taken from the wholesale market at Jagiroad.

Tools and Software Utilized for the study are as under:

- Data entry and Statistical Analysis through MS Excel and SPSS-10
- Mapping through AutoCAD Map 2000- i, Arc- View 3.2 and Google Earth.
- All Photo-documentation is through Photo-shop 7 and Corel 11.

In absence of the data on tourists' visitations, change of agricultural productivity due to irrigation facilities etc. the assessment of wetland valuation has been made by **Contingent Ranking Method**. Owing to the lack of base line data on other attributes, the verification of the accuracy of the method adopted has been limited to verification by indirect valuation of only one of the attributes, namely retting of jute, which has an established market price. Some **limitations** have also been due to the respondents' refusal to disclose information.

The gross economic valuation of wetland is assessment of all the classes of benefits derived from wetland in monetary terms, and hence can be expressed as the summation of all direct extractive (VDE), direct but non-extractive (VDNE), indirect (VI) benefits derived and the passive (VP) and bequest values (VBQ) assigned.

Total benefits (TV) of wetland is thus:

$TV = \sum VDE_i + \sum VDNE_j + \sum VI_k + \sum VP_l + \sum VBQ_m$, Where i, j, k, l, m, are components of each classification of benefits.

FINDINGS :

Adopting the above , the **findings** of the survey are :

- The quality of water so tested from eleven wetlands reveal that the water can sustain aqua-fauna, more specifically fish, with high productivity. Moderate pH, high DO, absence of toxicants, low turbidity are some of the favourable characteristics of the water from the wetlands in Morigaon.
- The soil samples from sixteen wetland-beds reveal that the soil is rich in NPK. The high fertility of the soil causes rapid growth of phytoplankton or vegetation which in turn enhances the productivity of the aqua-fauna. However, excessive growth of vegetation (eutrophication) is also observed in many of the wetlands.
- Although one hundred and twelve (112) species of fish have been identified in the wetlands of Morigaon, only twenty four (24) species are commonly found to be extracted for economic benefits.
- Although sixty three species of wetland and swamp vegetation have been identified only eleven species are identified to be extracted, of which five as vegetable and medicinal plants and six as raw materials for various utility products. Fodder for domestic cattle, especially during the flood season, is an important product of wetlands.
- The monetary valuation of wetlands in Morigaon without taking into account the willingness to pay for preservation and optional use is found to exceed the value of equivalent land area by several times. In terms of monetary value, the annual wetland benefits in Morigaon district are estimated at a low average of INR 144,904 per hectare to a high average of INR 252,240. The fact that the average willingness to pay by the respondent an amount of 290 INR per year for preservation exhibits the high productivity of the wetlands.

- The accuracy of the method adopted is reflected by the valuation of jute by Replacement Cost Method (labour productivity) assessed at 14600 INR as compared to 13912 (high) and 7992 (low) by Contingent Ranking Method.

- In assessment of the people's perception of wetland benefits and their attitude towards preservation and sustainable wise use, the findings of the survey are as under:

  - ❖ Awareness of wetland benefits exist among the population and 94% feel that *beels* are useful and should be protected.

  - ❖ In context to the ownership of the *beel*s for the sustained preservation, Wetland is perceived as an asset of common ownership.

  - ❖ If entrusted with the ownership, people are willing to shoulder the responsibility of preservation.

  - ❖ The apathy of the indigenous population towards the *beels* and the unrestricted exploitation is found to be primarily due to the ambiguous ownership and open access to exploitation.

  - ❖ 67% of the respondents are willing to pay (WTP) an amount of INR 290.00 per annum for preservation of the *beel*s.. The willingness to pay is a strong indicator for high productivity of the *beels.*

  - ❖ The habits and practices in fishing observed distinguish the respondents into two groups of varied ethos. While the indigenous population, irrespective of religion or ethnological classification, use nets of coarse mesh and implements with large gaps thereby allowing fry and fingerlings to escape, the immigrant settlers use very fine mesh nets to catch fish in the *beels*

  - ❖ The average size of the fish caught is gradually decreasing over the past years accompanied by loss of diversity.

  - ❖ Respondents belonging to the Hindu religion attach significant importance towards preservation of the wetlands so that they may

preserve the customs and traditions and also perform the religious rituals. Thirteen rituals have been identified which are performed on the wetlands and its shores.

In context of the wetlands of Morigaon district urgent investment for development or welfare is imperative which must take into account:

1. That the area under agriculture cannot be increased appreciably. In fact the area under agriculture is likely to decrease due to increased settlement, industries and surface communication.
2. The hazards due to floods in the district are likely to increase with time due to the siltation of the river Brahmaputra. Hence the cropping intensity in the district cannot be expected to increase beyond 160% of net sown area. This also limits the food production in the district. The district is fast becoming a food deficit district. As there are no employment opportunities in the industrial sector, conversion of the wetlands for agricultural use will become uncontrollable which in turn can only bring greater disasters.
3. The increased number of inheritors demanding fragmentation of landholdings, which are already very small, will make any form of investment in the agricultural sector economically unviable. Therefore the agricultural productivity is likely to decline in spite of higher efforts.
4. The wetlands of Morigaon, are valuable reservoirs of fresh water for the future besides being the only natural resource other than the land for sustenance of the population that is growing at an alarming rate.

SUGGESTION & RECOMMENDATION :

Any planning and strategy for preservation and development of wetlands in general needs to be envisaged with three perspectives—

1. Economic perspective,
2. Environmental perspective, and
3. Sociological perspective.

Taking into account all precautionary measures for safeguard of the wetland environment and the biodiversity, some of the economic activities which have been identified are:

A. Enhancing of fish production through development of aqua culture estates.

B. Development of selected wetlands as eco-tourism centers,

C. Development of selected wetlands as education center for life sciences (Zoology and Botany namely aqua fauna and aqua flora).

D. Development of seasonal water logged areas into intensive fishery stocking tanks.

The aquaculture estates are envisaged in the fringe areas more specifically in the derelict or degenerated parts of the wetlands. The developmental activities include fishery under Pen culture, use of floating cages, composite Horticulture farming, Duck breeding, Dairy Farming, and farming of aqua flora like water lily, Fox nut, lotus etc.

Policy Adjustment and adoption needs to be made to ascertain sustainability of investment and preservation as suggested below:

- The wetlands being a State matter, a bill needs to be introduced for enactment of a WETLAND ACT similar to the Forest Act incorporating the Indian Fisheries Act 1897, Assam Fishery Rules 1950, Assam Panchayat Act and other relevant Acts and Rules with provisions for preservation of fresh water, biodiversity and sustainable wise use. The Act will also need to define the ownership in such manner so as safeguard the rights of the future generations. A wetland policy is needed to be adopted till the time the bill is enacted.
- The Wetland Policy must incorporate the status of the *beels* (wetland) to be classified based on :

    a) Biotic inventory and diversity of species,

b) Economic considerations with provisions for long term lease or transfer of ownership to the village cooperatives/*Gram Panchayat* or any corporate body for sustainable development.

- Conversion of *beels* for any alternative use must be prevented. In case of any assessment for valuation for alternative use, non-market benefits including optional and existence value must also be taken into account

The *beels* of Assam in general and of Morigaon district in particular, are very rich in nutrients. The quality of water is suitable for growth of aquatic life. Even at a very conservative level of productivity @ 1500 Kg/hectare, the *beels* of Morigaon has a potential to produce over 17000 tonnes of fish annually. With the increase in production, the support activities which will become necessary are ice plants, cold storage, refrigerated vans, net making, boat making to name a few.

The *beels* of Morigaon district are very valuable resources with immense potential to facilitate production of food and in generating sustainable growth of economy in the district.

FUTURE SCOPE :

The above study needs to be extended for further research in developing a universal model for objective measure of sustainability of investment more specifically for natural resources and public welfare. Assessment of each benefit in a deterministic manner is not only time consuming but also expensive, and researchers without external funding cannot be expected to undertake such studies. Further, the large number of variables and their interdependency coupled with probabilistic nature of biotic productivity make such studies extremely complex. Study of any attribute or benefit in isolation may not have any real time relevance. Such an approach will demand custom research for each of the resources which again is expensive and time consuming. Therefore one such model suggested for future development is termed as 4E Model based on the principles of sustainability i.e. man in complete harmony with nature derived from the *Mahashanti Mantra* of the Hindus.

The fundamental assumption of the model is that a human activity is the ultimate outcome of value acquired by man as an individual and as a society. Although all activities, regardless of its motivation, have economic consequences, only those activities are sustainable which generate a surplus Economy, do not damage the Environment to the extent that nature can no longer regenerate, and do not cause conflict to the Ethos of the people to the extent that people can no longer adapt themselves to the changes.

In other words, a human activity becomes sustainable if, and only if, it is in harmony with the **Economy, Environment** and the **Ethos** while demanding the least **Effort/Energy** - the **Four E**s.

The model explains Thomas Malthus's principles of population growth and collapse, Scott Gordon's economics of open access resources (fishery) amongst others.

The benefits of the model are envisaged to provide:

- Complete understanding to the various factors (Four Es) and their sub-factors which shall facilitate better decision making for investment.
- That the spiritual development can lead to decreased requirement of energy to sustain human activity is easily explained by the model. It can also explain why Asian nations have higher capacity to sustain its population than the developed western world.
- Assessment of people's participation can be forecast prior to the investment.
- Priority can be set for investment in activities of higher sustainability.
- Above all, a universally acceptable approach to determine sustainability of investment more specifically in development and preservation of natural resources and public utility services.

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TEZPUR UNIVERSITY

This is to certify that the thesis entitled ***"Valuation of Wetland Resources for Conservation and Development as Centres for Growth of Sustainable Economy"*** submitted to the Tezpur University in the Department of Business Administration under the School of Management Sciences in partial fulfillment for the award of the degree of Doctor of Philosophy in Natural Resource Management Sciences is a record of research work carried out by Mr. Dilip Sarma under my personal supervision and guidance.

All helps received by him/her from various sources have been duly acknowledged.

No part of this thesis has been reproduced elsewhere for award of any other degree.

Date : 15/10/07

Place : Tezpur

(M.K.Sarma)
Supervisor
Designation : Reader
School of Management Sciences
Department of Business Administration

PREFACE

In 1986, while conducting a study to assess the industrial growth potential of Nagaon district (currently Nagaon and Morigaon districts) for the Government of Assam, I began to realize the important functions the wetlands fulfill in supporting the rural population of the district. In fact, I began to perceive the wetlands as a major resource for economic upliftment of the rural and economically underprivileged population. My enthusiasm to convert the wetlands to economy growth centres was not accepted as the associated activities in harnessing the benefits of wetlands could not be defined as an industrial activity. It took me yet another twelve years of casual learning and exposure to three international conferences including the First International Conference on Wetlands in 1995 at Kuala Lumpur to be able to realize the conflict between conservation and conversion. I also realized that for a nation like India with high population density, poor population status and limited resources, conservation of natural assets like wetlands was not possible without harnessing any economic returns. The need therefore, was to conserve through sustainable extraction of benefits. A complex dynamic balance between nature's regenerative capacity and human action in extraction and conservation must therefore be attained.

The functions and services which the wetlands in general fulfill are numerous; such as being the source of water supply for domestic, agricultural and industrial use, recharge for groundwater aquifers, flow regulation and flood control, balancing of microclimate, maintaining Gene bank as habitat for the life cycle of important plant and animal species, providing means for inexpensive and environmentally sound mode of transport, source of natural (on site) products such as fish , turtles , crabs , snails , frogs , snakes , avifauna , aqua flora such as Lotus , Lily, Reeds etc., source of natural (off site) products namely fuel wood and organic fertilizer, source of recreation , scientific study and of eco–tourism, maintaining and contributing to the natural processes of ecological, geo-morphological and

geological transformations, maintaining spiritual, religious and socio-cultural heritage, natural esthetics and sociological balance etc.

Although the importance of wetlands as natural assets have been advocated throughout the world projecting their extremely high productivity often exceeding the productivity of intensive agricultural systems, wetlands continue to suffer from the abuse in spite of the numerous national and international bodies that have been formed not only to bring about awareness and to impart education for conservation but also to mobilise the resources to undertake the physical works to conserve, develop and protect wetlands and their vast inventory of bio-diversity and valuable water.

The wetlands of Morigaon district play a dominant role in sustaining the population of the district. In spite of the fact that the primary occupation of 86% (including 11% being directly dependent on the products from the wetlands) of the working population of Morigaon district is agriculture that is dependent on the water from the wetlands, the wetlands of Morigaon district are being abused continuously. Encroachment for settlement as well as conversion for agricultural activities is rampant. While degradation is not only due to human activities but is often due to the forces of nature, the conversion is primarily due to the economic forces caused by the population; the magnitude of which is dependent on the population density and its status.

Defining the population status to be a gross summation of the economic standards, quality of population support services and infrastructure such as health care, educational infrastructure and other social benefits the population enjoys, Morigaon district can be stated to be a region with low population status with very high population density. It is observed that the environmental degradation, more specifically the degradation and conversion of wetlands in the district is fundamentally due to:

(1) **Population growth** demanding increased food production, shelter, secondary human activities etc.

(2) **Absence of property rights** leading to excessive use or unrestricted abuse; And

(3) **Failure to assign the right monetary values** to the goods and services that the wetlands provide to the people.

Amongst these fundamental forces, the lack of understanding of wetland services and goods alone is the foremost cause posing hindrance in formulating any legislature for protection and conservation or policy for the development of the wetlands. The economic forces on the natural resources are very strong in Morigaon district in particular. Such forces can only be resisted through logical and objective analysis which is possible only through assessment in economic terms such as cost and benefit or gain and loss.

This research study is an attempt to develop a methodology for **Valuation of the Wetlands** in general and in Morigaon District in particular through dynamic modeling in understanding of the complex interrelationship amongst various attributes determining the sustainability of human activity; and to identify the investment opportunities for development of these Wetlands as centres for sustainable growth of economy in the region.

(Dilip Sarma)

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ABBREVIATION & ACRONYMS

ARSAC	:	Assam Remote Sensing Application Centre
AWB	:	Asian Wetland Bureau
CRM	:	Contingent Ranking Method
CVM	:	Contingent Valuation Method
EIA	:	Environmental Impact Assessment
FAO	:	Food and Agriculture Organization
ICAR	:	Indian Council of Agricultural Research
NGO	:	Non Government Organisation
NPK	:	Nitrogen, Phosphorus and Potas
OECD	:	Organisation for Economic Co-operation and Development
TCM	:	Travel Cost Method
UNDP	:	United Nation Development Progamme
WTO	:	World Trade Organisation
WTP	:	Willingness to Pay

LIST OF NON-ENGLISH WORDS, TERMINOLOGIES, & ABBREVIATIONS

Non-English word/ Terminology	Original Language	Equivalent English words / Explanations
Artha	Sanskrit	Means
Beel	Assamese	Wetland
Bhur'	Assamese	A kind of raft made from local reeds known as Botabari that grows in the forests or from plankton stems.
Char	Assamese	Riverine sand deposit
Dharma	Sanskrit	Law & virtue
Dinga	Assamese	Small Boat
Doba	Assamese	Marshes
Doloni	Assamese	Wetland with the rooted flora
Dolonga	Assamese	A large device made from slit bamboo strips in form of a box for catching fish in relatively deeper waters. The device is filled with twigs and reeds and fish feeds to attract the fish into the device. The device is lifted periodically from time to time.
Ghat	Assamese	Jetty
Hola	Assamese	Feeder channel to the wetland
Jal	Assamese	Net
Jakoi	Assamese	An implement made from slit bamboo strips in form of a wide-mesh sieve for catching fish used mostly by women along the shallow shores of the wetlands.
Kama	Sanskrit	Needs and desire

Khaloi	Assamese	A Bamboo basket for keeping the Fish.
Mela	Assamese	Fair
Moksha	Sanskrit	Liberation
Mahaldar	Assamese	Fisherman Contractor
Mahasanti	Sanskrit	Eternal Peace
Mantra	Sanskrit	Principle
Nirvana	Sanskrit	Freedom through realization
Polo	Assamese	An implement made from slit bamboo strips in form of a basket for catching fish used mostly by men along the shallow shores of the wetlands.
Pitoni	Assamese	Wetland with the water surface covered floating flora
Puja	Assamese	Worship
Sepa	Assamese	An implement made from slit bamboo strips in form of a closed basket with trap for catching placed along the flow of water.

ACKNOWLEDGEMENT

This work is a compilation of my observations, experience, understanding, research and analyses of interrelations of various human attributes associated with Man's activities vis-à-vis nature in general and the wetlands in particular for the past ten years. It was in one fortunate interaction with Late Prof. M.C.Bora that I was encouraged to pursue the study with a scientific and logical perspective. He then accepted me as his student and guided me in this endeavour with untiring care and patience for the next three years till his sad and untimely death in November 2004. It was only through his teachings on System Dynamics that I could approach the problem with a holistic perspective. I shall always be indebted to him.

I am grateful to my teacher Dr. M.K. Sarma who accepted me as his student and guided me to the completion of this study when I was completely at a loss after the death of Prof. M.C.Bora. I shall forever remain grateful to him not only for his academic guidance throughout the study but also for the emotional support.

I am grateful to all the teachers of the School of Management Studies, Tezpur University for their encouragement and wise counsel throughout the period of this study.

I wish to record my gratitude to Assam Remote Sensing Application Centre (ARSAC) for providing the remote sensing data and maps of Morigaon district and the officers of the various departments of the Government of Assam who have provided the data and information needed for the study. I thank the officers of the Soil Testing Laboratory, Department of Agricultural, Government of Assam for testing of the soil samples and the Public Analyst, Government of Assam for testing of the water samples.

During the survey study, many religious counselors, village counselors, village elders and individuals provided insight to the societal ethos, cultural and religious heritage of the people of Morigaon and their intuitive knowledge of man's

relationship with nature which has been of immense help in understanding and analyzing the problems. I offer my sincere gratitude to all. I also thank all the respondents who were patient not only to understand the questionnaire and the purpose of the study, but took all the pain to provide true information so that the findings of the study are meaningful.

I am indebted to Dr. S.K. Dutta for all his help and guidance in understanding the agricultural economy of the district, Dr. M.M. Goswami for his help in identifying various species of fish and plants and to Mr. Bibek Sarma for his valuable help in collecting data, test-samples and in secretarial assistance in completing this work.

Constant encouragement and support from my wife, Aparajita and my son, Raktim made it possible for me to undertake this study.

I wish to acknowledge my deep gratitude to the philosophers, scholars and teachers whose contributions to the society inspired me to pursue this study.

In conclusion, I remember with deep sentiments and reverence my parents who always urged me to pursue academics as a career.

Tezpur, 6th October 2007

Dilip Sarma

CHAPTER - I

1.1 INTRODUCTION:

1.1.1 Emergence of Wetland as a Natural Resource:

WETLANDS (also known as *Beel, Hola, Doba, Beeloni, Peetoni* etc. in local parlance but with distinction in physical features) are extremely productive natural resources that often exceed the productivity of intensive agricultural systems. The importance of wetland has been advocated throughout the world, so much so, that numerous national and international bodies have been formed in most nations not only to bring about awareness and to impart education for conservation but also to mobilize the resources to undertake physical works to conserve, develop and protect wetlands and their vast inventory of bio-diversity.

The looming global disaster from acute shortage of freshwater has drawn attention of planners from all over the world and accordingly right priority has been set by all conscious governments for preservation of fresh water sources. India too will suffer from water stress. The global effort to address the problem was initiated in 1971 at the Ramsar Convention and since then, many water reservoirs have been designated as Ramsar sites so as to facilitate legislation for their preservation. The Government of India's effort to implement the river-linking project speaks of the gravity of the looming catastrophe. The global need therefore, is to preserve all available fresh water reservoirs (Sarma, 2000)

The wetlands, besides being major sources of fresh water, fulfill a large number of important and essential functions from maintaining a balance of ecology to being an important source for income generation. Considering the functions the wetlands fulfill, the importance for conservation, development and protection of the wetlands is most imperative. Yet, the wetlands are threatened continuously from degradation as well as from conversion by man for alternative use. While degradation is not only due to human activities but could also be due to the forces of nature (very often supplemented by human action such as deforestation ultimately causing erosion in the hills and siltation of the wetland beds), the conversion is

primarily due to the economic forces caused by the population; the magnitude of which is dependent on the population density and its status.

1.1.2 Wetland Function:

The functions and services which the wetlands generally fulfill can be listed as: (Asia Wetland Bureau, 1992)

- Source of water supply for domestic, agricultural and industrial use.
- Recharge for groundwater aquifers and water supply to wetlands in lower catchments.
- Flow regulation and Flood control.
- Sediment retention by submerged vegetation.
- Nutrients retention
- Toxicant Removal
- Balancing of microclimate.
- Providing a Carbon sink and in prevention of global warming.
- Maintaining Gene bank.
- Significant Habitat for the life cycle of important plant and animal species.
- Providing means for inexpensive and environmentally sound mode of transport.
- Source of natural products (on site) such as fish, turtles, crabs, snails, frogs, snakes, avifauna, aqua-flora such as lotus, lily, reeds etc.
- Source of Natural resource (off site) namely fuel wood and organic fertilizer.
- Source of recreation , scientific study and of eco-tourism
- Maintaining and contributing to the natural processes of ecological, geo-morphological and geological transformations.
- Maintaining spiritual, religious and socio-cultural heritage, natural esthetics and sociological balance.

The above functions have been classified into five broad categories: (Denny, 1997) (1) Climatic (2) Bio-diversity (3) Habitat (4) Hydrological & Hydraulic and (5) Water quality functions.

Man, since the early days of civilization, has exploited these wetlands to fulfill his needs and harness the benefits which have been classified into five categories based on how the benefits are derived or the uses made (Filion, 1997). They are -

(1) Direct **Extractive** benefits

(2) **Direct non-extractive** benefits

(3) **Indirect benefits**

(4) **Optional** use and

(5) **Passive** use

The example of **Direct Extractive** benefits are direct extraction of aqua fauna and flora like fish, turtles, crabs, aquatic birds, fox nut, lotus and lily seeds and roots, fodder for live stock, water for agriculture, industry and domestic use, organic manure, fire wood in fringe area etc. The **Direct but non extractive** uses are recreational use, eco-tourism, scientific data acquisition, retting of jute etc. The **Indirect** uses are the benefits like recharging of ground water, protection from floods, nutrient cycling, regeneration or purification of water, complex ecological functions that support life cycle and promote economic activities and human welfare. The **Optional** uses are a wide range of potential uses including those stated above which although not in use at present, but may become necessary and useful in the future. As an example, the water may not be used as a source for drinking purpose today but could become the only source in the future. The **Passive** use is referred to the **Existence value** and **Bequest value** of the wetland which may not be often tangible but which could be very important otherwise. For example, two hostile communities on either sides of a wetland could annihilate each other if not deterred by the very existence of a wetland. Many wetlands also have religious significance. One's desire for the continued existence of the wetlands could be purely out of sympathetic feelings towards other forms of life, love for nature or concern for future generations to come. Passive use is dependent on people's knowledge and concern for sustainable existence of life on the earth .There may be no intention of actually using or harnessing the benefits from the wetland.

1.1.3 Wetland Productivity:

The biological productivity of wetlands is determined by the complex interactive activities of the lentic zoo-organisms and hydrophytes including the phytoplankton. The energy needed to support these activities first enters the wetland ecosystem as light energy which gets converted to chemical energy by the process of photosynthesis. At the producer level, the primary productivity is thus the rate at which the biomass assimilates the energy from the sunlight, i.e. the growth of vegetation including algae. The secondary level is the growth of zoo-organism that either feeds upon the plants or interacts at higher level of the trophic structure. Numerous factors including some environmental factors determine the productivity of the wetland communities. (Agarwal, 2002)

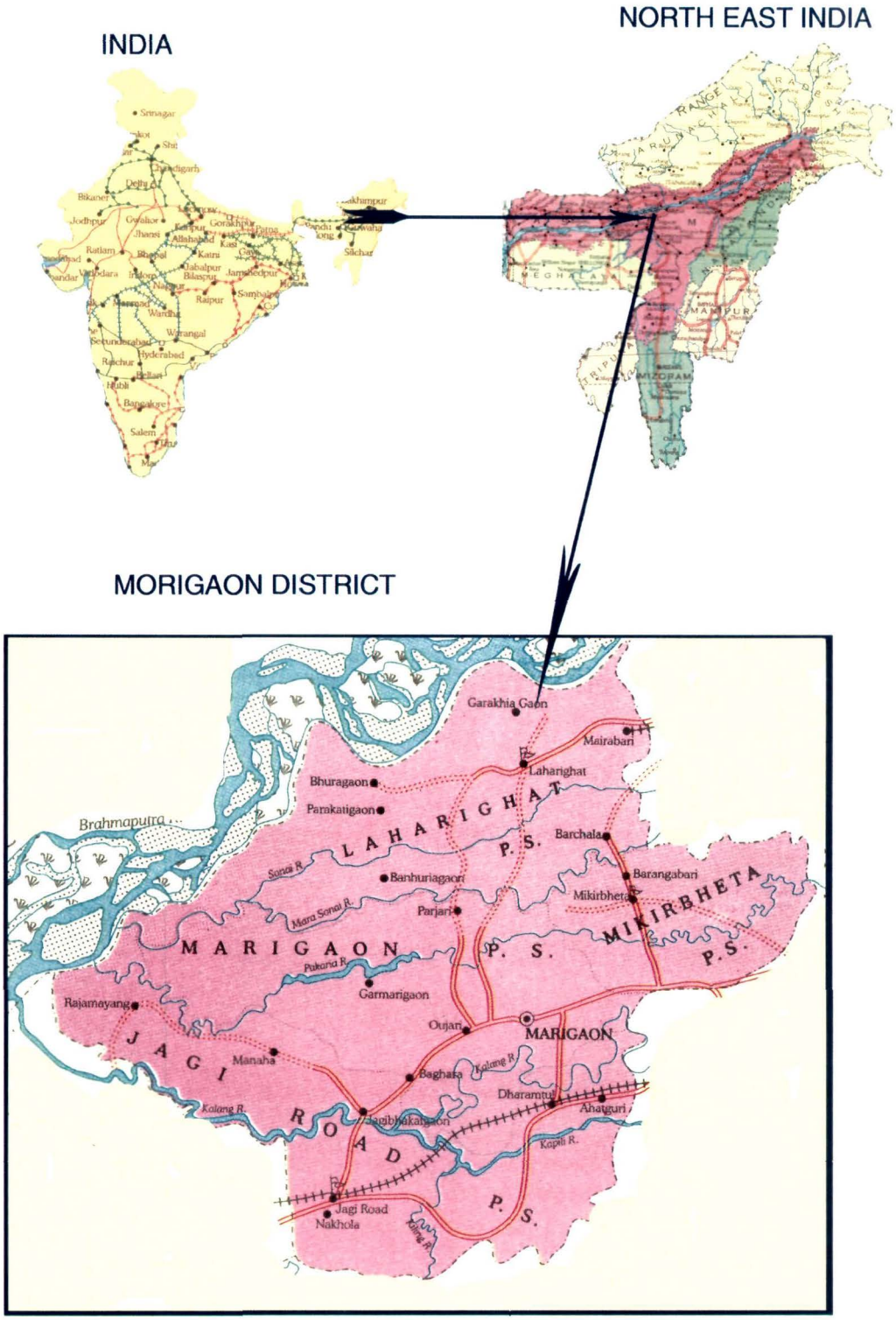
The wetlands fulfill a large array of functions and benefits to man as discussed above. These benefits are both market oriented as well as non-market in nature. More often than not, the benefits from wetlands are intangible in nature and such benefits can only be appreciated when the wetland is lost to mankind. It therefore, becomes necessary that the wetlands are preserved and developed not only for the benefits of the present generation but also for the future ones to come. Such a perspective gives rise to the concept of inter-generational rights over common resources such as the rivers, wetlands, forests etc. Needless to say, that the governing economics are based on the welfare services and public goods rather than on individual benefits. (Othman,1997)

1.2 MORIGAON AS THE STUDY AREA:

The study area of Morigaon district, located in the north East corner of India, is an area which has a very high population density without adequate natural resources to sustain the population other than the land and the wetlands (Refer Map No. 1 & Map No. 2). The forest cover is insignificant and there are no mineral resources. The district has no industrial activity other than one paper mill based on the forest resources from the neighbouring district of Karbi Anglong. The primary activity of the population is therefore agriculture, the growth of which is limited due to annual floods (Refer Map No. 4). Being a flood prone area, the district is not expected to have large scale industrial activities.

MAP NO - 1

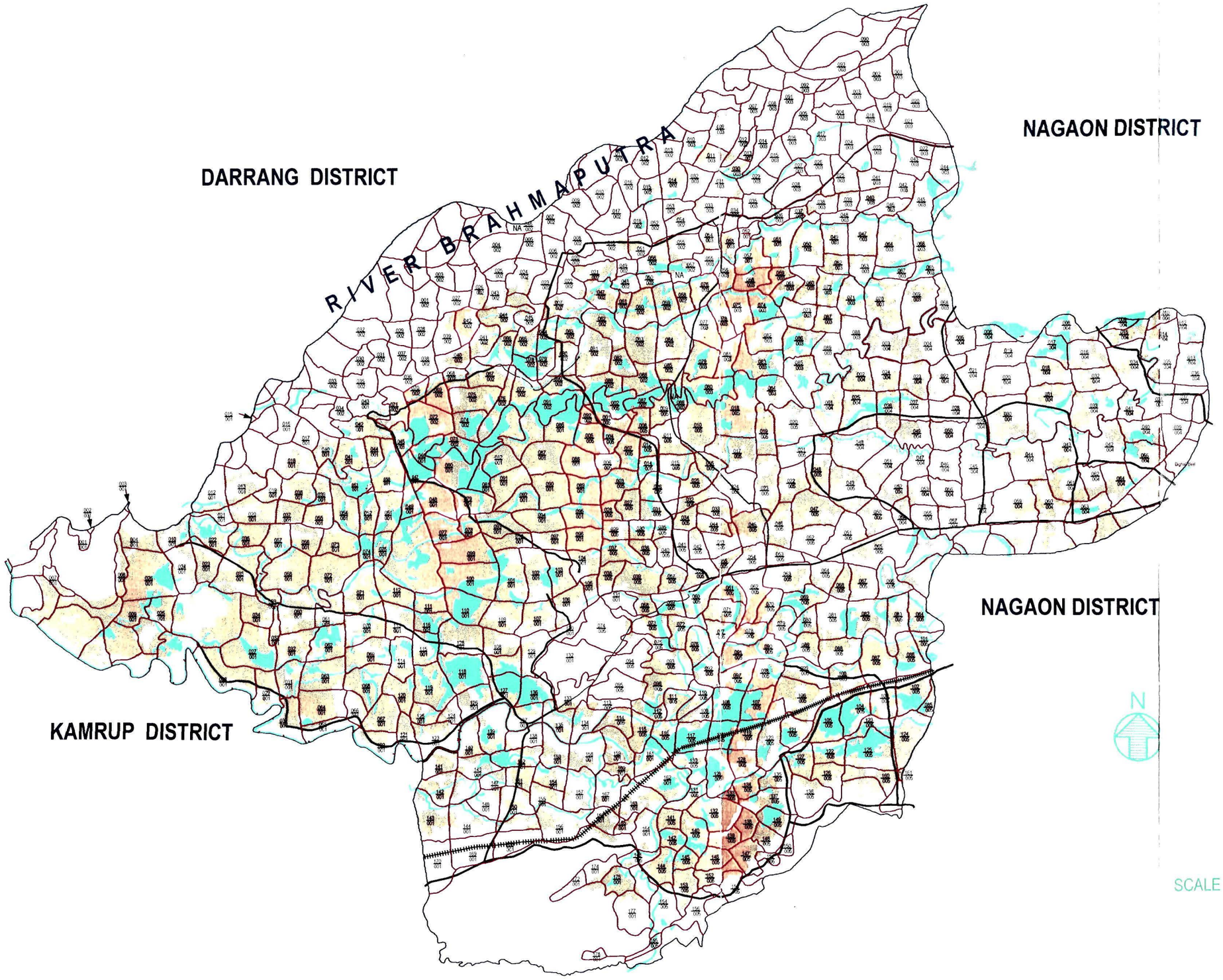
LOCATIONAL MAP OF MORIGAON DISTRICT



MORIGAON DISTRICT

MAP NO - 4 , IMPACT OF FLOOD

INUNDATED AREA AS ON 23 RD JULY 2004



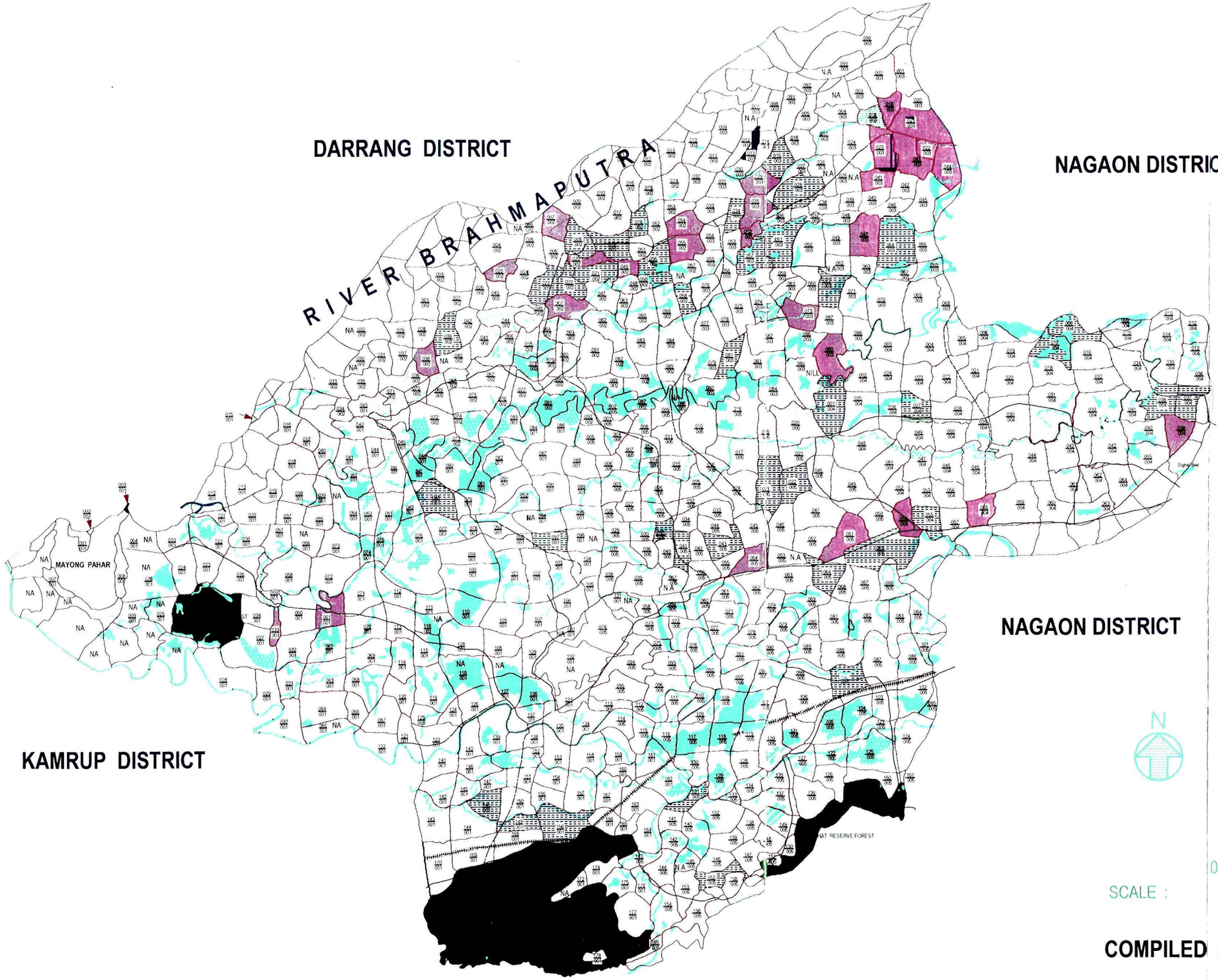
LEGEND	
	DISTRICT BOUNDARY
	VILLAGE BOUNDARY
	WETLAND
	FLOOD AFFECTED AREA
	RAILWAY
	ROAD
	BRAHMAPUTRA

SCALE : 0 KM 6 KM 12 KM

COMPILED FROM : FLOOD MAP, ARSAC , GUWAHATI

MORIGAON DISTRICT

MAP NO - 2, WETLANDS, POPULATION DENSITY, ROAD NETWORK & RAILWAY LINES



LEGEND	
	DISTRICT BOUNDARY
	VILLAGE BOUNDARY
	WETLAND
POPULATION DENSITY (PER SQ. KM)	
	BELOW 360
	361 - 730
	731- 1090
	1091 - 1450
	ABOVE 1450
	RAILWAY
	ROAD
	BRAHMAPUTRA BOUNDARY

SCALE : 0 KM 6 KM 12 KM

COMPILED FROM CENSUS DATA 2001

Creation of infrastructure mainly road network, is expensive as well as wasteful as the annual floods often wash away the roads. Further more, all such infrastructure not only reduce the land resources but also cause ecological problems by disturbing the topography of the region. The *beels* of Morigaon, on the other hand, provide ample opportunities for a large population to sustain themselves economically through sustainable harnessing of wetland benefits while preserving these valuable water resources for the future. These *beels* connected to the rivers and streams can also become a very effective network for transportation of goods and people throughout the district without causing any environmental problems. Being a confluence zone of many streams and rivers, the district has the highest number of wetlands among all the district of the state. Needless to say, a large percentage of the population is already harnessing the benefits of wetlands for their livelihood.

Morigaon also faces the problems of changing ethnography of the district (Map No.3). The district today is threatened by the ever increasing population, changing societal values, gross absence of industrial activity, non availability of other natural resources for economic sustenance of population, rampant environmental degradation (Map No. 5) to name a few. These are discussed in detail in the later chapters.

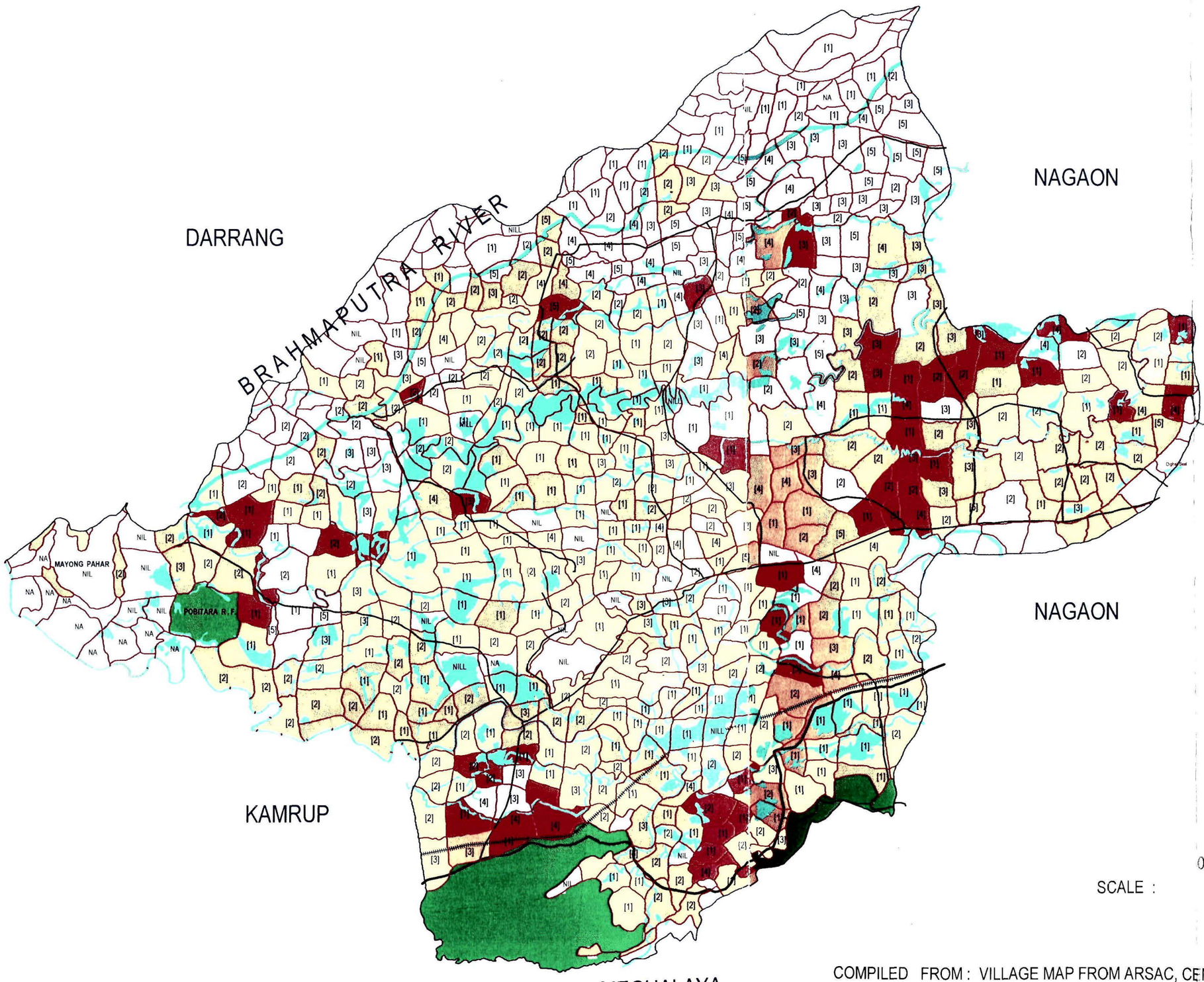
1.2.1 Historical, Physical and Demographic Perspectives

The district of Morigaon in the state of Assam, as exhibited in Map No. 1, lies between $26^0 3'18"$ and $26^0 30'54"$ north latitudes and $91^0 57'18"$ and $92^0 35'42"$ east longitudes covering a geographical area of 1704 Sq.km. The district is bounded by Nagaon district on the east, the Brahmaputra River on the north, Karbi Anglong district and state of Meghalaya on the south and Kamrup district on the west.

The district has one administrative sub-division, five revenue circles and five community development blocks. Morigaon had been a sub-division of Nagaon district until it was upgraded as a district with its headquarters at Morigaon in 1989. It consists of the area of the erstwhile Morigaon sub-division of the old Nagaon district. Morigaon, the headquarters of the district, is about seventy five kilometer away from Guwahati city and is forty five kilometers from Nagaon town. The nearest railway station to the district headquarter is at Jagiroad.

MORIGAON DISTRICT

MAP NO - 3 , COMMUNALITY & POPULATION DENSITY



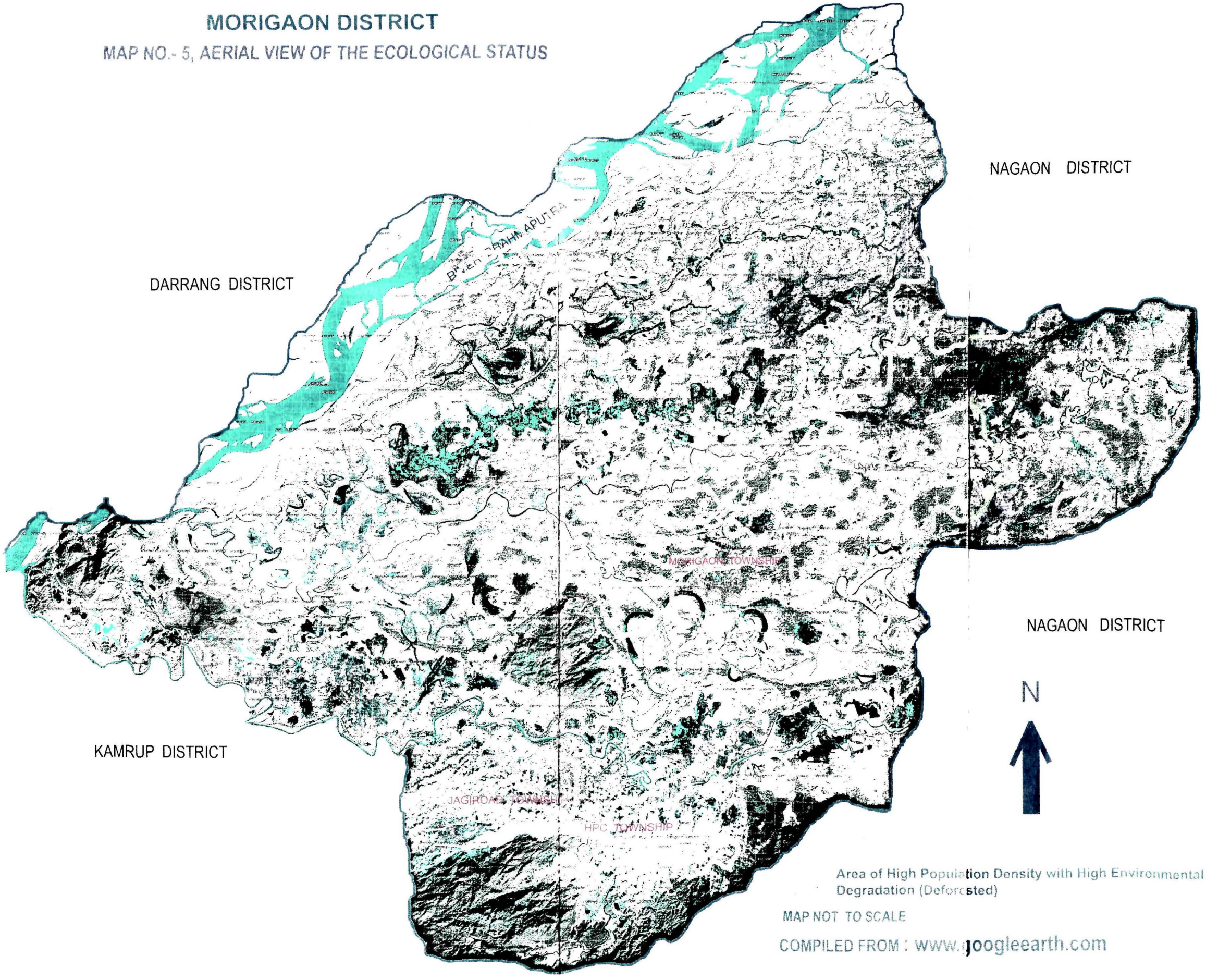
LEGEND	
	DISTRICT BOUNDARY
	VILLAGE BOUNDARY
	WETLAND
MAJORITY POPULATION	
	MIXED POPULATION
	HINDU (Other than SC & ST)
	MUSLIM
	SCHEDULE TRIBE
	SCHEDULE CASTE
POPULATION DENSITY	
[1]	BELOW 360
[2]	361 - 730
[3]	731- 1090
[4]	1091 - 1450
[5]	ABOVE 1450
NIL	NO POPULATION
	RAILWAY
	ROAD
	BRAHMAPUTRA BOUNDARY
	FOREST AREA

SCALE : 0 KM 6 KM 12 KM

COMPILED FROM : VILLAGE MAP FROM ARSAC, CENSUS DATA, VOTER LIST & FIELD ASSESSMENT

MORIGAON DISTRICT

MAP NO.- 5, AERIAL VIEW OF THE ECOLOGICAL STATUS



Area of High Population Density with High Environmental Degradation (Deforested)

MAP NOT TO SCALE

COMPILED FROM : www.googleearth.com

1.2.2 Origin of the Name 'Morigaon' :

The origin of the name of Morigaon is traced back to the 17th century by some historians. During the reign of Ahom King, Chandra Kanta Singha, two princes of Darrangi Konwar, the king of Darrang, fled from Darrang due to an internal feud with the king. The two princes along with 72 families (*ryots*) crossed the river Brahmaputra at Chaulkhowa Ghat and moved towards south and took shelter at a place known as Borbari. Borbari was then under sixth subordinate king of the Ahom king. The two princes were allowed to settle temporarily in Borbari. Later, Supradhawas Singha, one of the princes was declared as king of Sukhangog by the sixth local king as a mark of hospitality.

King Supradhawas had two sons named Ram Singha and Bhumi Singha. These princes and their followers left Sukhanagog in search of new lands. They proceeded through the jungles and after a few days, came to a place by the side of a big lake (*Beel*). There, they made rafts (known as *Bhur* in local parlance) from the reeds that grew in the forests and went further. Thus from that time, the place was known as "Bhurbandha". The princes with the followers settled in Bhurbandha for a short period. Later, one of the princes, Ram Singh, because of conflict with his brother, returned to his father's kingdom along with his followers. But Bhim Singh went forward and found a suitable place near by a lake *(beel)* and stayed there for sometime. As the *Beel* was a cut-off meander of the river Kolong, they named the *Beel* as Morikolong (referred to as a dead stream of the river Kolong). Prince Bhim Singha established a small village *(gaon)* to the east of the Morikolong *beel* and named it as Morigaon. The area came to be known as Morigaon thereafter.

Bhim Singh extended help to Ahom king in fighting against the Kachari, and the Jayantia insurgents. As a token of appreciation, the Ahom king rewarded and declared him as the subordinate king of Morigaon under the Ahom king (Census, 1991)

1.2.3 Physiography :

The topography of the district is characterised by an almost flat flood plain that merges with Karbi Anglong plateau on the south. The river, Brahmaputra flows on the northern side of the district. A number of physiographic variations are observed because of the gradual transition from the hills to the plains. On the eastern and southern sides of the district, there are a number of low hills which are the extensions of Karbi Anglong hills. The elevations of these hills vary from 100 to 300 meters. The flood plain along the river Brahmaputra and its tributaries suffers from regular floods during the rainy seasons.

Physiographically, Morigaon district can be classified into three regions, namely;

- The North-eastern Low Lying Plain,
- The Central and Eastern Built up Plain and
- The South western high plains interspersed with hillocks

North-eastern Low Lying Plain is characterized by a number of swamps, water logged low areas, lakes and marshes.

The Central and Eastern Built up Plain is an extensive alluvial plain which covers the southern part of the district. The region has a lattice network of numerous river channels and it characterized with lakes and marshes. Owing to the intrusion of water from the river Brahmaputra during the monsoons, many swamps and marshes are created within this built up plain.

The South western high plain, interspersed with hillocks, is an extension of the Meghalaya Plateau that forms the south western borders of the district and renders the topography with isolated hillocks interspersed by elevated plains, swamps and lakes.

1.2.4 Climate:

The general climate of the district is characterised by hot and wet summers and dry, cool winters. The overall climate can be divided as pre-monsoon, post monsoon and winter. The pre-monsoon occurs from the month of March to May. The rainfall during this period range between twenty to thirty percent of the annual

precipitation. The monsoon season starts in June and continues throughout the month of August. The post monsoon season extends from September to November; and thereafter, both temperature and rainfall decreases to a cold and dry winter which starts from November and continues up to February. Post winter, from the month of February to April, is generally dry and pleasant. The mean of maximum and minimum temperatures varies from 29.9^{0}C to 18.9^{0}C and the average annual rainfall is 421.71cm. Maximum rainfall is received from the south west monsoon during June to August. (Statistical Handbook, Assam, 2004)

1.2.5 Geology:

The major part of the district is covered by the alluvium of rivers Brahmaputra, Barapani, Kiling, Kolong, Kopilee, Sonai etc. consisting of unconsolidated pebbles, gravels, sand, silt and clay. Towards the southern part of the district, Pre-Cambrian rocks are exposed. The oldest rocks encountered in the district are of Archean age and they consist of Gneisses, Amphibolites, with intrusions of granites and pegmatite.

1.2.6 Soil:

The soil of the district varies from sandy to clayey loam. The soils range from most recent immature Entisols in the riverine (*Char*) areas to old mature Alfisols in high lands and hill areas. In *Char* areas, soil formations are mostly unstable on the river side. In areas near to the river Brahmaputra at Mayong- Pakaria- Bhuragaon-Moirabari region, the soil is mainly sandy loam in texture. Towards the southern part of the district, the soil is clayey loam in texture and in the central part between the rivers Kolong and Brahmaputra; it is a combination of Entisols and Inceptisols. Soil is generally acidic to near neutral in nature.

1.2.7 Land Use / Land Cover:

The major land use/land cover in the Morigaon district are Built-up land, Agricultural land, Forest land, Waste land, Water bodies and others (Grass/Grazing land).

Table : 1.1 Land Use of Morigaon District

Sl No	Land Use / Land cover Categories	Area in Hectares	%age to total geographical Area
1	Built-up land	259.00	0.16
2	Agricultural Land	117534.00	75.40
3	Forest Land	11833.00	7.58
4	Waste Land	7819.00	5.00
5	Water Bodies	12162.00	7.82
6	Others	6284.00	4.04
	Total	155891.00	100.00

(Source: Assam Remote Sensing Application Centre - ARSAC)

1.2.8 Forestry

Forestry does not occupy a significant place in the economy of the district. Only a small percentage of the population depends on forest for firewood as a source of energy, food and for materials to construct their houses besides earning the livelihood by extraction of forest products. The forestry is mainly divided into reserved forests and unclassified state forests. Unclassified state forests are simply wasteland under the government's possession. The statistics of forest area is not available separately. However the total forest area of the Nagaon and Morigaon districts is 1092.42 Sq Km. out of the total geographical area of 5534.60 sq. kms. The forest area comprises of 1008.28 Sq.Kms. of Reserved forest area and 84.14 sq. km. of proposed forest area. The forest area of the Morigaon district includes the Pobitora Wildlife Sanctuary, Sonaikuchi reserve forest, Khola Hat reserve forest and Bura Mayong reserve forest. (Census, 1991)

1.2.9 Drainage:

The river Brahmaputra, flowing from east to west along the northern boundary of the district, is the main drainage; and all the other drainage of the district, find their way into it. Its main tributaries within the district are Kopilee, Kolong, Kiling, Sonai and Pakaria. The Kolong (which earlier was a distributary of the river Brahmaputra) flows across the district towards south-west direction to meet the river Kopilee near Jagi. The stream then joins the river Brahmaputra at

Kajalimukh. The region between the rivers Kolong and Brahmaputra is drained by a large number of water courses. The rivers Kolong and Kopilee play an important role in drainage system of the district.

1.2.10 Wetlands (*Beel*) :

Morigaon district is a confluence zone for numerous tributaries and distributaries of the river Brahmaputra. These perennial streams along with well defined areas of water bodies, many of which are interconnected by feeder channels, form a complex wetland eco-system. These wetlands formed either by the hydraulic action of the river streams or by the general geomorphology of the region, cover 11,658.0 hectares of geographical area of the district. Morigaon district with 183 such wetlands (with unit area of over 2.5 hectares (ARSAC), refer Appendix-I), is ranked highest amongst all the districts of Assam in context to area under wetlands. It is also ranked highest amongst all districts of the state in context to the percentage of the population (11%) being dependent on the wetlands for their livelihood.

The wetlands or *beels* are further identified locally depending on its physical structure and associated vegetation such as *Biloni, Doloni, Pitoni, Hola, Doba,* etc. For example, a wetland covered with weeds and floating flora is known as *Pitoni*, with rooted flora like reeds and grass is known as *Doloni*, a feeder channel is known as *Hola* etc. These *beels* were once teemed with innumerable species of aqua-flora, aqua-fauna and avifauna (Sharma 1992).

Table 1.2 Categorization of Wetlands in Morigaon District

Sl No	Category	Numbers of Wetlands	Area in Sq.Km
1	Lake / Pond	37	9.355
2	Ox-Bow Lake / Cut off Meander	41	21.43
3	Swamp / Marsh	59	70.51
4	Tank	3	0.08
5	Waterlogged (Seasonal)	43	15.210
Total		183	116.585
In addition to the above, a total Area of 177.75 Hectares is covered by 79 wetlands which are smaller than 2.25 hectares in area.			

(Measured from District Map - by Survey Department, Govt. of Assam).

1.2.11 Demography

1.2.11.1 Population:

The total geographical area of the District which accounts for about 2.17 per cent of the state's total geographical area has 2.91% of the state population. The District is divided into 1 Sub-division and 5 Revenue Circles for administration and revenue conveniences. The 2001Census of India estimated the population of Morigaon at 776256 of which 398926 are males and 377330 females with a decadal growth of 21.35 per cent during the decade 1991-2001. The population growth in Morigaon, district as compared to Assam and India is exhibited in Table 1.3

Table : 1.3 Population Growth Rate of Morigaon compared to Assam and India.

Year	Morigaon District		Assam		India	
	Total Population	Growth Rate	Total Population	Growth Rate	Total Population	Growth Rate
1951	212468	NA	8028856	NA	361088090	NA
1961	291979	37.42	10837329	34.98	439234771	21.64
1971	392880	34.56	14625152	34.95	548159652	24.80
1981	536127	36.46	18041248	23.36	683329097	24.66
1991	639682	19.32	22414322	24.24	846302688	23.85
2001	776256	21.35	26655528	18.92	1027015247	21.35

Source : Census of India (1951-2001)

The population density of the district has gone up to 570 in 2001as against 375 in 1991 census. The circle wise distribution of population reveal that the population density is highest in the Laharighat Circle (939) followed by Mikirbheta Circle (635), Bhuragaon Circle (635) and Morigaon Circle (471) and the lowest density is seen in Mayong Circle (454).(refer Appendix I- table 5).

1.2.11.2 Literacy

The growth of literacy in Morigaon District has shown an increase to 58.5 per cent as per the Census 2001 with highest literacy rate observed in Morigaon Circle (69.9 per cent) while the lowest is in Laharighat Circle (46.9 per cent). The literacy rate in the two towns i.e. Jagirod and Morigaon is 83.2 percent and 85.0 percent respectively.

1.2.11.3 Classification of Population by Economic Activity:

The Census 2001 reveals that out of total working population of 262824 in the district, 176782 were main male workers, 23350 female main workers, 23648 marginal male workers and 39044 marginal female workers. 513432 were non-workers. Out of a total workers in Morigaon, 138083 were Cultivators (52.54 per cent), 51855 were Agricultural labourers (19.73 per cent), 8661 were engaged in household industries (3.30 per cent) and 64225 were other workers (24.44 per cent). Thus, 72.27 per cent working population was engaged in Agriculture (i.e. as cultivators and agricultural labourers). The district has no major industrial activities other than for the paper plant at Jagiroad. The tertiary or service sector is limited to population support services only. Services related to the industrial sector are almost non-existent. However, there has been a gradual shift to tertiary sector, the reason for which may be attributed to the increased opportunities of employment soon after upgrading Morigaon from sub-division to a district.

Table : 1.4 Changing Trend in Occupational Structure (Morigaon Dist.)

(Percentage of total Population)

Year	Primary (in %)	Secondary (in %)	Tertiary (in %)	Total (in %)
1961	28.34	3.38	1.66	33.38
1971	24.60	0.36	2.25	27.21
1991	23.38	0.70	3.17	27.25
2001	24.47	1.11	8.27	33.84

(Source : Census of India)

1.2.12 Agricultural Perspective of Morigaon District

Although Morigaon has an agrarian economy, extension and diversification of the agricultural sector is limited for the primary reason of devastating floods which inundates 60% the agricultural land every year as may be seen from Map no. 4. Therefore, multiple cropping is largely restricted and the maximum cropping intensity cannot be expected much beyond 160% unless there is a gross diversification from the current practices. The production of food is thus limited (Kar, 1998). The other constraint is the land holding pattern of the farmers who are marginal in nature and therefore, mechanization and higher technological inputs

cannot be expected. The agricultural production and productivity with the current inputs and practices are thus grossly limited as indicated below in table 1.5.

Table 1.5: Agricultural Perspective of Morigaon District.

Particulars	Area in Hectares
Total Geographical Area	1700400
Forest Area	17626
Land put to non-agricultural uses	20198
Barren and un-cultivable land	5120
Permanent pastures and other grazing land	8331
Land under Misc. trees groves not included in net area	4489
Cultivable waste land	690
Fallow land	939
Net Area Sown	**101372**
Total Cropped Area	**156749**
Area Sown more than once	**55377**
Cropping Intensity	**155%**

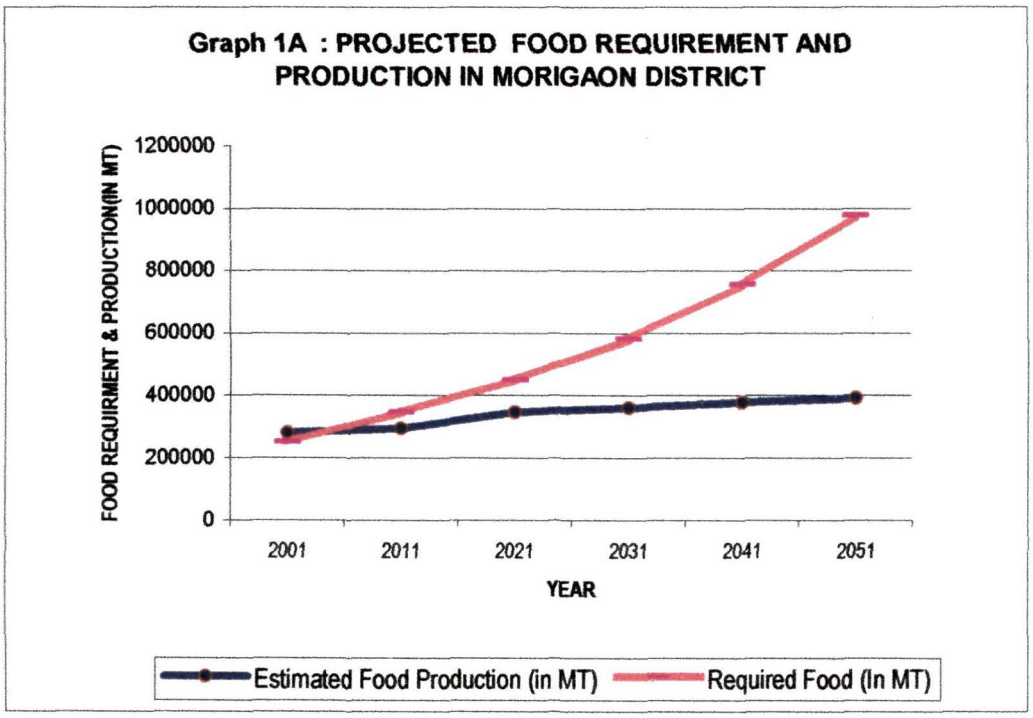
Source: Statistical Handbook, Assam, 2004

1.2.13 Population Growth and Socio-Economic Perspective of Morigaon District

Assessing the growth pattern since the year 1951, the population is projected up to the year 2051 which is exhibited in the table 1.6 and graph 1.A. The estimated food requirement to sustain the population and the envisaged production are also projected along with. (Refer Appendices IX and X)

Table 1.6: Estimated Food Production:

Year	Projected Population	Net Sown Area (in Ha)	Cropping Intensity	Estimated Food Production (in MT)	Required Food (In MT)	Productivity MT/ Ha	Surplus(+) Deficit (-) (In MT)
2001	776256	101372	155%	279740	251883	1.78	27857
2011	1069683	101935	160%	295418	346577	1.81	-51159
2021	1386109	112634	166%	345375	449099	1.84	-103724
2031	1796238	112634	166%	361006	581948	1.93	-302808
2041	2327458	112634	166%	376638	754096	2.01	-377458
2051	3015950	112634	166%	392270	977167	2.09	-584897



It therefore becomes a matter of extreme urgency to make immediate plans to invest and generate alternative to agriculture while enhancing the food production by two folds within next twenty years.

1.2.14 Wetland vis-à-vis Morigaon District:

Morigaon district, as stated earlier, has a unique geo-physical feature with gradually merging hill slopes with the river plains, isolated low hills distributed evenly throughout the district and is a confluence zone for numerous tributaries and distributaries to the river Brahmaputra that flows along the northern boundary of the district. From the economic perspectives, wetlands have played a very important part in sustaining the population. Extraction of fish has been the primary economic activity associated with the wetlands of Morigaon. However, there has been a loss of productivity and diversity of species (Yadav & Chandra, 1994) which has been the indicator for assessing the level of degradation of the wetlands. The loss of productivity is also exhibited in the reports (Biswas & Barua, 2001) by showing dominance of undersized fish in the fish landings in the North Eastern states. The productivity and the regenerative capacity of the wetlands of Morigaon are also on decline like the other wetlands of the state. With the limitation of the land resources,

and in absence of other natural resources in the district, the wetlands of Morigaon district are threatened for alternative use. Such threats can however be converted to productive opportunities through sustainable harnessing of wetland-benefits which have the potential to support a considerable percentage of the district's population by providing food security and means for growth of a sustainable economy.

1.3 Problems & Prospects:

Wetlands of Morigaon , in spite of providing the above stated array of goods and services for the benefit of man, are threatened continuously from both degradation as well as conversion by man for alternative use. While degradation has been also due to the forces of nature, conversion is primarily due to economic forces caused by the growing population.

In reference to the wetlands of Morigaon, the salient demographic perspectives of the district are:

(a) That the district has a very high rate of population growth.

(b) That population of the district has a very low status, (where the population status is termed as a gross assessment of individual quality such as economic well being, education, social status, the population support services it enjoys etc.).

(c) That the district is grossly backward in terms of industrial development which is reflected by an insignificant (1.1%) percentage of population being employed in the secondary sector. In fact, there is only one major industry in the district, namely the paper mill of Hindustan Paper Corporation Ltd. At Jagiroad producing paper from bamboo grown in the neighbouring district of Karbi Anglong.

(d) The district has no mineral resources which can generate opportunities for employment in extraction and processing.

(e) The population being grossly under-educated with little or no capital for diversification or mechanization of agricultural activities, the labour as well

as agricultural productivity of the district is very low. The awareness of the people in context of agricultural productivity and marketability of the agricultural product is limited to growing of rice and jute. The desire is therefore, to acquire as much land resources for the growing of rice.

(f) The infrastructure desired for any economic growth in the district is grossly lacking. The annual flood hazards pose a serious threat to the creation of any infrastructure such as roads, electrical power connectivity etc. which in turn has discouraged investments in the industrial sector.

(g) With respect to the ownership of the wetlands, the wetlands of Morigaon are owned by four government agencies namely the Revenue Department, the Forest Department, the Fisheries Department and the Assam State Fisheries Development Corporation Ltd. The current practice of harnessing of benefits from the wetlands is limited to extraction of fish by the process of leasing out to the highest bidder in auction bids amongst socially eligible community i.e. the Schedule caste fishermen community. As for the other benefits, there is no administrative rules and regulations. The people around the wetland harness the benefits as they desire. As the existing Assam Fishery Rules, 1950 has no provisions for sustainable extraction or wise use of wetlands, the bidders tend to extract as much of fish as possible during his lease period without any consideration for the regenerative capacity of the wetlands.

(h) As observed from the Indian Fisheries Act 1897, the Assam Fishery Rules, 1950, the Assam Panchayat Act 1994 and the related Acts and Rules, there is no reference to any benefits and services derived from the wetlands or for the biodiversity of the wetlands. The people including the planners are therefore, unaware of the value of the benefits derived from the wetlands. Any valuation is compared with the market value of the equivalent agricultural land only. The indirect and intangible benefits of wetlands (which often exceed the tangible benefits) are not considered in any valuation of wetland.

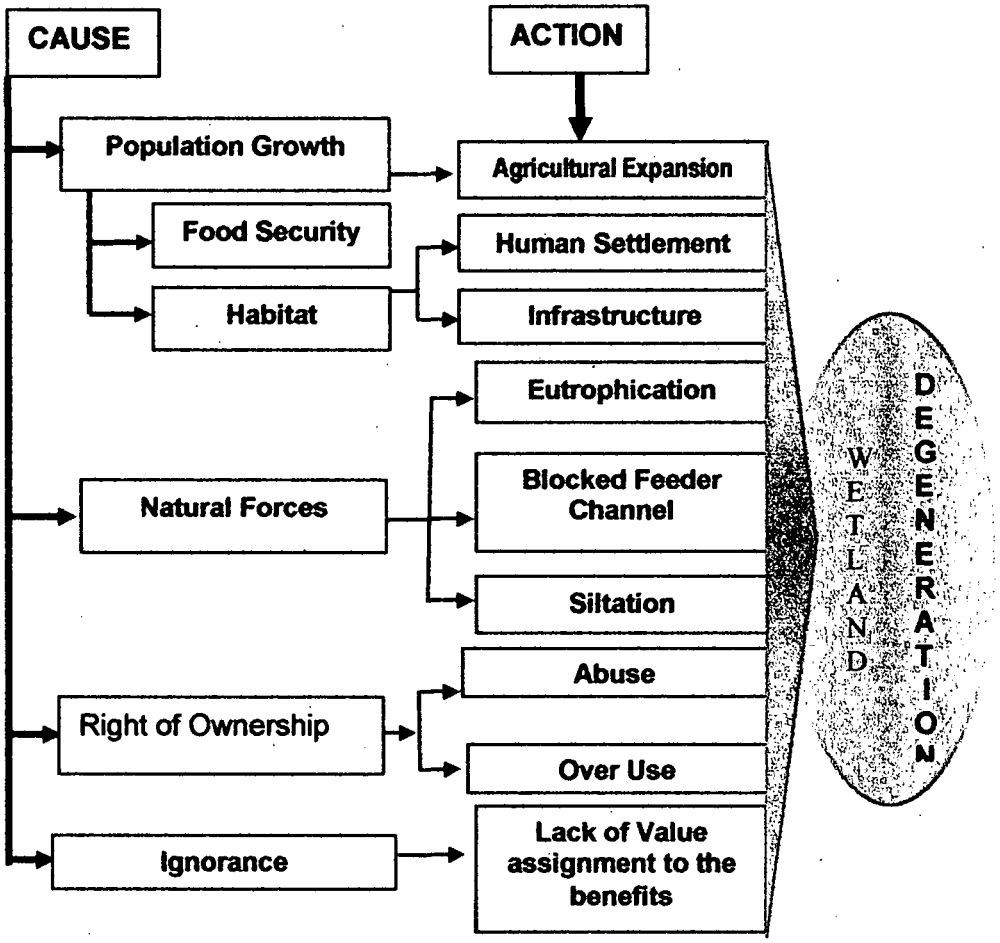
The threat to the wetlands of Morigaon, therefore, can be summarized primarily due to -

(1) **Population growth** demanding increased food production, shelter, secondary human activities etc.

(2) **Absence of property rights** that allows open access leading to excessive use or unrestricted abuse; And

(3) **Failure to assign right monetary valuation** to the goods and services that the wetlands provide to man.

Fig.: 1 : Cause & Action in Degradation of Wetland



The figure above exhibits the causes and thereby the human actions which lead to degeneration of wetlands. With the increase of population, the demand for food as well as shelter increases which leads to extension of the land resources for agricultural purpose as well as for habitation. The human habitat demands support infrastructure such as roads for transport and communication and services like health

care and education. Creation of infrastructure further demands land resources which in turn reduces the land for agriculture. With increase of population, wetland therefore becomes vulnerable for alternative use after destruction by reclamation for the land.

The natural forces which tend to degenerate the wetlands are siltation from the runoff carrying silt and organic matters. While silt deposits decrease the water storage capacity of the reservoir, the organic matter as well as the fertilizer from the agricultural fields in the fringe areas of the wetland tend to make the soil of wetland-bed extremely fertile which in turn propagates excessive vegetation. The excessive vegetation, also termed as eutrophication, tend to cover the water surface preventing the photosynthesis of the submerged vegetation of the wetlands which reiterates reduction of the biotic productivity of the wetland. In spite of the immense knowledge that man has acquired over thousands of years, he is still ignorant of the bio-diversity and their interdependency for sustainable existence. This ignorance coupled with his attitude (after having learnt to live as a family in a structured society) has made him blind even to the sustainability of his own survival. He is ignorant of the true value of the natural resources. The obvious result has been the excessive use or abuse of the natural resources from which he harnesses the benefits. Furthermore, his desire to possess makes him care what he owns and abuse what he does not. In case of the common assets like wetland, where the ownership is not by individuals and where the government acts as the custodian for the future generations, the tendency is to overuse or abuse the natural resources which in turn destroy their productivity or the regenerative capacity.

1.4 Definition of the Research Problem:

Although the wetlands of Morigaon are threatened very seriously by rapidly growing population of the district as stated earlier, the wetlands still provide ample opportunities for generation of food as well as productive employment through sustainable preservation and development of the wetlands. Needless to say, policy adjustment with respect to ownership, regulation and monitoring for wise use of these natural assets will have to be formulated and implemented. Investment strategies will need to be adopted with the perspective of long term sustainability. It

is only when people realize that the wetlands can contribute in a major way for sustenance of the population by way of providing food and other economic benefits, directly or indirectly, on a sustainable basis, that the wetlands will be preserved which in turn will assure the future stock of fresh water as well as the bio-diversity.

It is therefore imperative that a proper valuation of wetlands be made, taking into account all benefits and services rendered by wetland, so that the importance of preservations and development of wetlands can be appreciated.

This study **"Valuation of Wetland Resources for Conservation and Development as Centres for Growth of Sustainable Economy "** is a step towards developing a holistic economic valuation model taking into account both tangible as well as intangible benefits of wetlands so that investment planning in development and preservation of wetlands as centres for growth of sustainable economy receive the right priority .

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CHAPTER - II

A REVIEW OF LITERATURE: VALUATION OF WETLAND

Economic valuation of wetlands (*Beels*) means quantification of the value assigned to the wetland functions, components and attributes in monetary terms. The complex interactions amongst water, soil, topography, micro-organisms, plants, animals and man make wetlands one of the most productive eco-systems. Wetlands are responsible for providing an incredible array of goods and services that benefit man. Yet wetlands are threatened continuously from both degradation as well as conversion by man for alternative use. While degradation could also be due to the forces of nature, the conversion is primarily due to economic forces caused by the growing population. Filion (1997) identified that beneath the underlying causes of degradation such as price distortion (subsidies, under pricing of natural products and services like water for irrigation), income distribution inequalities and absence of full accounting (i.e. destruction of natural capital is not reflected in national accounts) there are even more fundamental causes of loss identified due to:

1) Population growth

2) Absence of property rights (permitting open access leading to excessive use or unrestricted abuse)

3) Failure to assign right monetary valuation to the goods and services that the wetlands provide to man.

Amongst the above fundamental causes, the lack of understanding of public valuation of wetland goods and services alone is the foremost cause posing hindrance in formulating any legislature for protection or conservation and wise use of wetlands. (Filion, 1997)

Denny observed that only a small part of the overall benefits derived from the *Beels* is valued by the normal market forces of demand and supply. A significant part of the benefits derived remain un-quantified as their values are not expressed in the market (Denny 1997).

When such goods or services have no explicit market expressions for costs and values, the effect on consumers must be measured indirectly through changes in consumer behaviour. Goods provided by nature or the public services by the government, have non-use values - the values individuals place on goods or services which they do not consume directly, often because an amenity or resource simply exists (known as existence value). It appears to have been first described by John Krutilla (1967).

2.1 Non-Market Valuation Methods and Techniques

The conceptual basis for non-market valuation is derived from applied welfare economics. Evaluation of desirability of public policies for preservation and development of wetlands fall into the domain of welfare economics (Othman, 1997).

Although no single method or technique can be adopted for all the goods or services and although each of the methods have been widely criticized for their inherent weaknesses, nevertheless, techniques such as Contingent Valuation Method (CVM), and Travel cost Method (TCM) provide a strong conceptual basis to elicit from individuals, the values they place on such goods and services. Reviewing the different methods and techniques, Filion and Adamowitz (1994) have categorized them into three categories:

(a) Methods for valuation based on **Actual market price**

(b) Methods for valuation based on **Surrogate market price**

(c) Methods for valuation based on **Simulated market price**

- Methods for valuation based on **Actual market price** are :

1. Market price of output method
2. Actual Expenditure Method
3, Change of Productivity Method
4. Appraisal Method.

- Methods for valuation based on **Surrogate Market Price** are :

1. Replacement Cost Method (also termed as Stated Preference Methods)

2. Travel Cost Method (TCM)
3. Expenditure based Method
4. Avertive / Defensive Method
5. Potential Expenditure Method
6. Hedonic Method

- Methods for valuation based on **Simulated market price** are:

1. Willingness to Pay (WTP) (also termed as Stated Preference Methods)
2. Willingness to Accept (WTA)
3. Contingent Valuation Method (CVM)
4. Contingent Ranking Method
5. Cash-less choice method.

The **non market value** of environmental goods is categorized into three components, existence, option and bequest values. An existence value is the value the public is **willing to pay** to some specific environmental amenities in order to keep them from being extinct or damaged.

Freeman (1993) and Pearce & Barbier (2000) have categorized the different methods based on the market consumer behaviour which are presented below in a tabular form as in table 2.1

Table 2.1 Categorization of Valuation Methods

Type of Benefit	**Observed Behaviour**	**Hypothetical Behaviour**
Direct :	**Market Price** (Direct Observed)	**Stated Preference** (Direct Hypothetical)
	• Competitive market pricing • Shadow pricing	• Contingent Valuation (WTP, Bidding games, Dichotomous choice)
Indirect:	**Revealed Preferences** (Indirect Observed)	**Choice Modelling** (Indirect Hypothetical)
	• Productivity Method • Avertive Expenditure Method • Travel Cost Method • Hedonic Pricing • Substitute Goods	• Contingent Referendum • Contingent Ranking • Contingent Behaviour • Contingent Rating • Pair-wise Comparison

2.2 Studies on Valuation of Wetlands:

One of the earliest attempts for putting monetary value on services provided by wetland ecosystem was done by Gosselink et al (1974) for the study on tidal Marshes of Florida. Batie & Wilson also made a similar study on system production of Virginia Coastal wetlands in 1978. The methodology adopted was based on Market price.

In 1987 Faber & Costanza conducted a study on South Louisiana wetlands which used both economic willingness to pay (WTP) and energy analysis to establish the social value of wetland systems. The economic approach considered the commercial recreational and storm protection values of wetland, while energy analysis evaluated the energy processed by the wetland.

Whitehead and Blomquist (1995) designed a study to estimate WTP for preservation of the Clean Creek wetlands in western Kentucky faced with problems of coal mining. The total economic value derived included the values from wetland functions and non-use or existence value. It was observed that introduction of alternatives to environmental goods lower the WTP values while information about complement raised the values. The authors therefore, emphasized for explicit information on the environmental goods and services being valued.

Green et al (1992) in a study discussed the feasibility of total economic value concept. The purpose was to estimate the value of restored wetlands for the proposal of nitrogen abatement of wetlands in Cotland Sweden. The author concluded that valuation can be improved by only through increased knowledge on the functions, but still, only a part of the value could be captured in monetary terms.

Barbier et al (1993) conducted a total valuation to assess the economic importance of Hadejia-Nguru wetlands in Nigeria and to estimate the opportunity cost of its loss by estimating some of the key direct-use values which the flood plains provided to the population through crop production, fishing and fuel wood.

Roberts and Leitch (1997) estimated some components of Mud Lake lacustrine wetlands for water supply, recreation and aesthetics, fish extraction and

flood control in which the valuation for flood control aspect alone amounted to $ 440 per acre based on the flood damages prevented .

Leschine et al (1997) estimated value of flood protection function of wetlands in western Washington through alternative substitute cost method. Two alternative projects considered for flood mitigation were - one by hydraulic structure and other by existing wetland system.

Costanza et al (1997) are widely quoted for their study on valuation of global ecosystem services of terrestrial bio-mass that was estimated at $ 12319 billion.

Economic valuation has also been used as an aid in decision making and evaluation of management options. Ruitenbeekin in 1992, in a study on the Bintuni Bay, Indonesia developed a cost benefit framework for evaluation of management options.

Kosz (1996) used economic valuation as a tool to assess the viability of developmental projects of Donau Auen National park which consisted of riverside wetlands. Recreational and non-user benefits were estimated through a WTP survey.

Very few valuation studies have been carried out on Indian Eco-system. Some major studies are by Murty and Menkhaus (1994), Chopra at al (1997), Rath (1997) James & Murty (1998) and James (1998).

Murty and Menkhaus considered economic aspects of wildlife protection in developing country- Keoladeo National park as a Case Study.

Chopra et al (1997) in the travel cost study conducted for the same wetland to reveal that travel cost is a significant determinant of the visitation rate.

In a study for Willingness to pay by residents of Mumbai in maintenance and preservation of Borivli National park using CVM, Hadker et al (1997) determined that the residents of Mumbai were willing to pay an amount of INR 20 Million per month for next 5 years for the environmental amenities provided by the park.

CVM has also been used by James & Murty (1998) to estimate the non-user benefits from cleaning of Ganges River where households were asked to reveal their preferences for three levels of water quality.

Some of the facts that emerge from the review of the studies are:

- Stake holders' perspective on valuation is not addressed. Wetlands valuation is subjected to inter-generational incidence. Willingness to pay by a valuer is not weighted by low income, education, caste and others which are relevant in countries like India (more specifically in districts like Morigaon with over 11% of the population being directly depended on the wetlands for their livelihood) .
- Lack of comprehensive valuation studies.

  There is dearth of comprehensive studies. Extraction of fish, reeds, recreational services are probably the most commonly assessed benefits. In the absence of any comprehensive study, it is difficult to base management decisions for resource allocation or for assessment of sustainability in resource utilization.
- Economic & Ecological aspects of valuation need to be integrated.
- The economic evaluation as Willingness to Pay is a measure of preference people hold for the environmental resources which does not include the intrinsic value of the wetland resource (Pearce et al 1997).
- The methods and techniques which have been well accepted in valuation of optional, passive, non-market and indirect benefits of wetlands today are the Contingent Valuation Method, Travel Cost Method and Avertive Cost Methods.

2.3 Contingent Valuation Method (CVM)

CVM is a survey method used to estimate the nonuse value of public goods; and is generally defined as the value people place on certain goods simply because those goods exist. The values are generally measured based on the willingness to pay (WTP) for improved environment or the willingness to accept (WTA) as compensation for damaged environment or to accept a condition of being deprived of the improved environment. The most appealing aspect of the contingent valuation method is that it facilitates estimate of total value rather than components of that total value (Frykblom, 1997).

Non-market values in damage assessment and decision making can be highly controversial. Proponents assert that excluding (not estimating) such values understate total values affected, often substantially, and biases decisions in favour of development. Critics counter that the measurement methodology is weak, and that such measures are not comparable to traditional measures of utilitarian values.

In a study for the State of Alaska, significant use of contingent valuation method was made to measure lost existence values caused by the *Exxon Valdez* oil spill in 1989. Eleven million gallons of oil was spilled into Alaska's Prince William Sound, damaging surface waters, coastal land (including beaches and wetlands), marine plants, birds, fish, and marine mammals.

In the above study Rand asserted that willingness to accept should have been used (rather than willingness to pay). The authors argued that willingness-to-pay yields conservative estimates as compared to willingness-to-accept.

In another case study, the contingent valuation was used to estimate the non market benefit of two environmental goods:

1) Improved water salubrity; and
2) Preservation of ecosystem against eutrophication.

The study has found that whatever the environmental goods be, the willingness to pay was observed to rise with income of the respondents. This case has been very evident in most developing countries where most people are concerned with their daily struggle to sustain their lives. The people are too poor to think about the quality of environment. For the rural poor people in most developing nations, environmental protection would take the back seat while the day to day struggle is for survival (Kolstad, 2000).

A contingent valuation survey usually includes several parts: (1) an indication of property rights; (2) an emphasis on disposable income; (3) a description of the good to be valued; (4) the anticipated effects on the prices of other goods; (5) the payment mechanism; (6) the questions; and (7) data about the respondent.

Contingent valuation surveys differ from conventional surveys in several important ways: First, contingent valuation surveys usually value goods with which respondents have little experience. Second, contingent valuation surveys use hypothetical markets that must be believed and understood by respondents. And third, extra effort is required by respondents to determine which goods they prefer and how much they would pay to obtain them.

These are some of the tests researchers have faced in designing valid and reliable contingent valuation surveys.

Contingent valuation is becoming more widely used in natural resource damage appraisal and in decision-making. Because it is a complicated and imperfect technique, CVM is and will likely remain controversial. Its application is an expensive and time-consuming research project, and a host of potential problems make the results of contingent valuation surveys controversial. However, when attempting to assess natural resources, environmental issues and public preferences, nonuse values are real, and often significant, possibly exceeding use values substantially. Proponents contend that contingent valuation is a theoretically valid way to estimate nonuse values.

2.4 Contingent Ranking Method

Contingent ranking is an extension of Contingent Valuation Method which may be adopted for gross valuation comprising of different attributes that may be market-driven as well as non market in nature. Summation of value of non market products and services with market driven products and services often raise controversy as they may not be comparable. For example, the existence or bequest valuation of certain natural asset (say a sun-set point) is not at all comparable to the market driven value of the plot of land. Therefore, the gross value of each of the attribute is ascertained through a process of ranking which is determined by administration of questionnaire amongst representative population. Having obtained the comparative ranking for each of the attributes, the monetary value is assigned

based on the valuation assessed for the market driven attribute with established market price. The gross value thus is the summation of valuation of all attribute.

2.5 Travel Cost Method (TCM)

The fundamental idea of TCM is the evaluation of travel expenditures by visitors to consume a non-market commodity (e.g. recreational service provided by wetlands). The demand function of the non-market commodity can be derived from the expenditure data indicating the commodity consumed at various stages of travel. It is the most widely used method adopted for valuation for recreational activities. The evaluation is a summation of various actual market expenditures and hence the value derived is reliable.

The gross weakness of TCM is that TCM can be used for only non-market commodity based on actual market expenditures on closely related goods and services.

2.6 Avertive Expenditure Method

Avertive Expenditure Method, is an assessment of damages that could be averted by way of investment. This, direct cost technique finds wide application in cost benefit analysis for investment in flood/flow control projects. The technique allows for the estimate of the cost of damage to crops, livestock, properties and other inherent costs such as cleaning up cost, rehabilitation/ resettlement costs and so on (Kneese, 1984). The benefits of the projects would then be extrapolated from the damage aversion. How much the damage that may be caused, is then translated into the benefits of the measures taken for aversion.

Fillion's classification of wetland benefits are summarized in tabular form as represented in Table 2.2. and classification of methods in table 2.3

Table 2.2 Classification of Goods, Services and Functions of Wetlands

Sl	Classification	Goods & services	Particulars
1.	Direct Extractive	• Fauna • Flora • Organic manure • Water supply	Fish, crab, turtle, frogs, snails, birds. Timber, fire wood, lily seeds, lotus, reeds, grass, medicinal plants & herbs. Peat. Drinking, Domestic use, Irrigation, Industrial use
2.	Direct, Non– Extractive	• Power Generation • Agriculture in flood plains • Retting of Jute or hemp • Recreation and Tourism • Scientific Research • Water Transport & Communications	
3.	Indirect	• Ground water recharge • Purification of water • Flow & flood regulation • Gene Bank • Nutrient retention/ removal • Carbon sink • Sediment removal/retention • Wildlife corridor • Toxicant removal/retention • Maintaining a balance of Micro-climate • Protection from natural forces like wind & waves	
4.	Passive value	• Religions & traditional use	
5.	Existence/ optional value	• Future stock of fresh water • Love for nature & all forms of life • Concern for future generations	

Table 2.3 Goods and Services: Methods for Valuation

Sl.No	Nature of benefit	Commodity / service	Methods to be adopted	Remarks /Reasons for adoption
1.	Direct extractive	Fish, turtle, crab, snail ,	Direct Market price and or	The goods are market based with established market value.
		Reeds, firewood , lotus, herbs	opportunity cost of labour involved	The costs of services are market based.
		Water for irrigation	Change productivity method	As the benefits cause changed output
2.	Non-extractive	Recreation, Tourism,	Travel cost method	Traveling being the primary expenditure and all activities being primarily related to people's movement
		Transport	Replacement cost method	There exists an alternative which can be assessed
3.	Indirect	Flood regulation	Preventive / Avertive cost method	Assessment is for averting or preventing the possible damages or losses.
		Ground water	Potential expenditure method	Comparative cost of alternatives
		Purification of water	-do-	- do -
4.	Passive and Bequest values	Religion & traditional	Travel cost method, Direct Market price	The benefits being often intangible and non-market based, the valuation is by CVM
		Future stock of fresh water Care for Nature Concern for future generation	Contingent valuation method with WTP & WTA through survey	Individuals' value perceptions of the benefits.

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CHAPTER-III

OBJECTIVE, SCOPE AND LIMITATION

In view of the urgent need for development and preservation of wetlands as centres for growth of sustainable economy in Morigaon district, a study for value assessment of wetlands is most imperative for the planners; and accordingly, the objectives, scope of the study and the limitations are defined as under:

3.1 Objectives:

The objectives of the study are:

1. To identify the economic benefits derived from the wetlands of Morigaon district.
2. To assess for qualitative status of the wetlands namely water and soil for their ecological productivity.
3. To identify the significant Bio-diversity namely :
   a) Aqua-fauna- such as Fish, Turtles, Crabs, Snails, Reptiles and amphibians, insects and Micro-organisms.
   b) Aqua-flora – such as Floating Macrophytes, Submerged Macrophytes, Rooted flora in water spread as well as littorel areas .
   c) Avi-fauna - Migratory, Nesting and domestic.
4. To determine the quantitative values of various Direct, Indirect, Passive or Optional benefits of the wetland eco-system in the study area using various methods and techniques such as Contingent Ranking Method, Contingent Valuation Method, Travel Cost Method, Replacement Cost Method, Potential Expenditure Methods etc. as may be applicable.
5. To analyze the inter-dependency and the relationship amongst various benefits from wetlands to the population.
6. To assess the Valuation of the wetlands so as to facilitate formulation of strategy or policy and to set priority for investment in development and preservation : And
7. Ultimately suggest a strategy for preservation and development of wetlands as centres for growth of sustainable economy.

3.2 Scope :

The geographical scope of the study covers the area of Morigaon district comprising 183 wetlands. Considering the objectives, the scope of the study has been for evaluation the wetlands of Morigaon district in monetary terms at the macro level so as to facilitate understanding of the benefits of the wetlands in a holistic manner vis-à-vis economic benefits derived from alternative activities.

The research study provides the scope for application of the methodologies adopted and the findings, both in terms of insight to the man-nature relationship in actual field conditions and the quantification or assessment of the benefits derived from the wetlands, in actual planning for investment in development and preservation of natural/environmental assets like forests and wetlands. The strategy for public awareness and education can thus be adopted easily as the people's needs and aspirations are well defined. The study provides the scope to transfer the benefits of environmental value references (environmental value reference inventory- EVRI) so created for similar assessment in other wetlands without incurring major expenditures in conducting custom research or losing time in doing so. In the process of planning for development, a study of similar nature will provide the very concept of sustainability of investment. The scope of the study embraces valuation of all natural resources as well as in benefit-cost analysis of investment for common assets and welfare services.

3.3 Limitation :

In view of the fact that the earlier studies on wetlands of Morigaon district have been on their geomorphological formation, biodiversity-more specifically for diversity of fish species, and impact on Elenga Beel from the polluting effluent of the Jagiroad Paper Mill, the base line data and information on the wetland of Morigaon are not available in any comprehensive manner. Therefore, the data and information so gathered for this study are limited to a few wetlands which have been physically accessible.

The qualitative status namely the quality of soil and water has been for assessment of gross quality which included 11 wetlands for water sample and 16 for the soil samples. The variation of quality within the wetland itself has not been considered as the objective of the

study is aimed at a macro level. Further, as there are no industrial and municipal effluents drained into these wetlands, no significant variations are envisaged.

In assessing the socio-economic status of the population living in close proximity to the wetlands and in identifying the wetland benefits, the survey was conducted in 60 villages around 45 wetlands as listed in Appendix XII.

For the purpose of valuation, the survey for this study was limited to the same population as stated above.

In absence of the data on tourists' visitations, change of agricultural productivity due to irrigation facilities etc. the assessment of wetland valuation has been made by **Contingent Ranking Method**. Although the trueness of the method adopted has been checked through verification by indirect valuation of one of the attributes, namely retting of jute, which has an established market price, further verification through valuation of other attributes could not be made due to lack of base line data as stated above.

Some limitations have also been due to the respondents' refusal to disclose information. As an example, although it is well known that all people extract fish from the wetlands for their own consumption, the same has not been reflected in the economic valuation as the respondents refused to divulge the information for the fear of any legal actions. Hence the data so acquired for extraction of fish from the wetlands are grossly understated. Likewise, the information on extraction of aqua flora and avifauna has also been suppressed.

The valuation is based on the biotic productivity and regenerative capacity which are cyclic in nature and hence the valuation of benefits is stated in terms of gross annual benefits for unit area (per hectare) of wetland.

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CHAPTER-IV

METHODOLOGY

4.1 Methodology:

Valuation of natural assets like wetlands need to be made through custom research taking into account the methods based on actual market prices, surrogate market prices as well as simulated market prices that may be applicable as stated in chapter II table 2.4. Conventional methodologies based on market driven values cannot be assessed for many of the goods and services from the wetlands which are non-market in nature. As the benefits derived from wetland are numerous and as each of the benefit have different level of importance for the beneficiary, the beneficiary's perception of valuation is equally important in deriving at the gross value of wetland.

To fulfill the objectives of the study, the methodology adopted in conducting the study was made through different stages as stated under.

a. To identify the benefits derived by the people from the wetlands of Morigaon district.

b. To assess the physical qualitative status of the wetlands, namely water and soil, for assessment of biotic productivity.

c. To assess the ranking of different attributes on a scale of 1-13 for the benefits derived by the respondent from the wetlands.

d. To identify the causes for degradation or degeneration of the wetlands of the district.

e. To assess the attitude of the population towards preservation of wetlands and identify the different factors which influence their attitude. To identify people's aspirations for development and sustainable preservation.

f. The valuation of the wetland was ultimately assessed by adopting Contingent Ranking Method as described earlier in Chapter II and as detailed in Chapter V.

All the above data and informations were collected through laboratory testing of samples, through person to person interview for primary data and from various agencies for secondary data which are described as under:

1. The identification of wetland benefits derived by the people and their socio-economic status was made through a primary sample survey from a population living in different villages around wetlands as described below.

2. For assessment of the qualitative status of wetlands with respect to the biotic productivity, samples of water from eleven wetlands were collected and tested in the Public Analyst's laboratory at Guwahati where as, the soil samples from the beds of sixteen wetlands were collected and tested at the Soil Testing laboratory of Department of Agriculture, Government of Assam. The procedures and precautions observed in collecting the samples were as per those advised by the respective laboratory professionals.

3. The identification of the wetlands and the surrounding villages were made from the remote sensing map with village identification obtained from the Assam Remote Sensing Application Centre at Guwahati. The ground verification to the remote sensing data was made using a Global Positioning system (RoyalTek pocket PC-Empus). The software adopted was GPS Tuner and Autocad Map 2000i ARC-VIEW.

4. After having identified the wetland benefits derived by the people, the second survey was made for valuation and attitude analysis again through administration of questionnaires amongst 430 respondents from the population of 60 villages surrounding 45 wetlands. All interactions with the respondents have been through personal interview in Assamese language.

5. The assessment of biodiversity was made through secondary survey of earlier research studies, namely the project sponsored by the Food & Agriculture Organization (FAO).

6. The population related data and information have been acquired from secondary sources namely the Census Handbooks of India for Morigaon District for different years. Statistical Handbook of Assam, published reports from the Departments of

Agriculture, Fishery, Forests, Revenue, Industries, Election, and the Assam Remote Sensing Application Centre.

7. The market price of different species of fish has been collected from the retail markets at Morigaon and Jagiroad, the two major towns in Morigaon district. This primary survey was made on two occasions in the months of January, 2004 and October, 2004 over a period of one week and the prices were recorded for three different sizes for different species.

8. The information related to assessment of cost of jute cultivation and labour productivity has been derived from earlier research studies and the market price of jute has been taken from the wholesale market at Jagiroad in the month of September (production season) 2005.

4.2 The Surveys

The study for identification and valuation of wetland benefits in Morigaon District was conducted through two surveys.

The first survey was aimed to understand the respondents' socio economic status, the available infrastructure, primary occupation, income etc. on one part and for assessing his knowledge about the benefit of the *Beels*, his perception of conservation and ownership in context of the *beels* nearest to his residence on the other. The assessment of the respondents' commitment towards preservation was also made through his willingness to pay for development and preservation of the wetlands which included monetary contribution as well as by way of labour input for related activities. This survey was conducted through a set of questions (in Appendix XI(A)), administered amongst about 450 respondents from a population of 11905 households in 60 villages living in close proximity to 45 *beels* (in Appendix XII). The survey was stratified amongst villages in proportion to the number of households covering about 5% of the households. The respondents within the villages were identified randomly (derived by taking groups of two digits from a list of random numbers that are less than the desired number i.e. not exceeding 5% of the number of households in the village) from the voters' list. In the event of the identified respondent not being available, the next number was considered. However, taking into account the inaccessible

villages and households, the actual number of respondents were reduced to 436. The survey was conducted in between March and May of 2004.

After having understood the respondents' attitudes and perception of wetland function and benefits, ownership of common property and their willingness to contribute towards preservation, it was necessary to quantify their value perception of each and every benefits of wetland derived by them in assessing the total valuation of the benefits rendered by *Beels* of Morigaon.

The second survey included assessment for value by rank, assigned for each and every wetland benefit derived by the respondents through a questionnaire (also annexed in Appendix XI (B)). While conducting the person-to-person interview, the set of questions were explained and discussed. The responses were recorded as summary of discussions on each question. This survey was conducted in an identical manner as discussed above. The survey was conducted between September 2004 and February 2005.

4.3 Design of Questionnaire

As the value assessment of the benefits from wetlands also include the non-market benefits, the techniques adopted was through Contingent ranking Method as explained earlier in chapter II. A market environment is required to be simulated in which these benefits are to be valued. Needless to state that absolute valuation cannot be expected as the perceived values will vary grossly from respondent to respondent. Hence, the method of ranking is adopted through a set a questionnaire. The questionnaire is designed with very short questions demanding very short and simple answers without any suggestions to create any bias opinion. As the non market benefits could not be readily understood by the respondents, it was necessary to explain and discuss the questions. Efforts were made to retain a logical sequence to the questions more specifically those designed for ranking and attitude analysis. The efficacy of the questionnaires was tested amongst a very small sample of 25 respondents prior to the actual survey. In context of the questions related to the respondents' attitude towards environment and the natural resources, no conflict was observed in responding to the questions. The major conflict was observed in assigning ownership of the wetlands for preservation and rights to extract fish. Confusion also

prevailed in trying to correlate environment with religion and culture as the distinction between cultural heritage and religion could not be made very clearly.

4.4 Value Assessment : Formula

As stated in the Chapter II, the gross economic valuation of wetland is assessment of all the classes of benefits derived from wetland in monetary terms; and hence can be expressed as the summation of all

Direct extractive benefits (VDE),
Direct but non-extractive (VDNE),
Indirect (VI) benefits
Passive (VP) value assigned
Bequest (VBQ) or existence value assigned.

Total benefits (TV) of wetland thus can be represented in a mathematical form as:

$TV = \sum VDE_i + \sum VDNE_j + \sum VI_k + \sum VP_l + \sum VBQ_m$, Where i, j, k, l, m, are components of each classification of benefits.

Tools and Software Utilized for the study are as under:

- Data entry and Statistical Analysis through MS Excel and SPSS-10
- Mapping through AutoCAD Map 2000- i, Arc- View 3.2 and Google Earth.
- All Photo-documentation is through Photo-shop 7 and Corel 11.

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CHAPTER V

ANALYSES OF THE SURVEY

The value assessment of wetland benefits of Morigaon district has been made through Contingent Ranking; and as stated earlier in Chapter IV, the methodology adopted was through survey amongst respondents. The analyses of the relevant parts of the two surveys conducted are:

5.1 Survey 1 – Survey I relates to the questionnaire1 in Appendix XIA which reveals primarily the respondents' status, namely his occupation, educational status, land holding and land use pattern, his religious and cultural beliefs and identification of the wetland benefits which he harnesses from the *Beels* of Morigaon.

- **Occupational Structure :**

  The table below exhibits the respondents' occupation for livelihood. For example agriculture is the primary occupation for 55.28% of the working population. However, some of them also have secondary occupation which account to 18.77% amongst them. The findings analyzed reveal that that a respondent may have different sources of income

Table 5.1 – Respondents' Occupation structure

Occupation	Percentage	Only as Primary Activity	Supporting Secondary Activity
Agriculture	55.28%	81.23%	18.77%
Fishing	5.96%	29.55%	69.66%
Daily Wage Labour	19.27%	84.00%	10.19%
Self Employed	3.44%	37.50%	56.82%
Trading	6.88%	58.82%	35.00%
Employed (Govt/Private)	8.72%	95.00%	3.51%
Others	0.69%	75.00%	25.00%

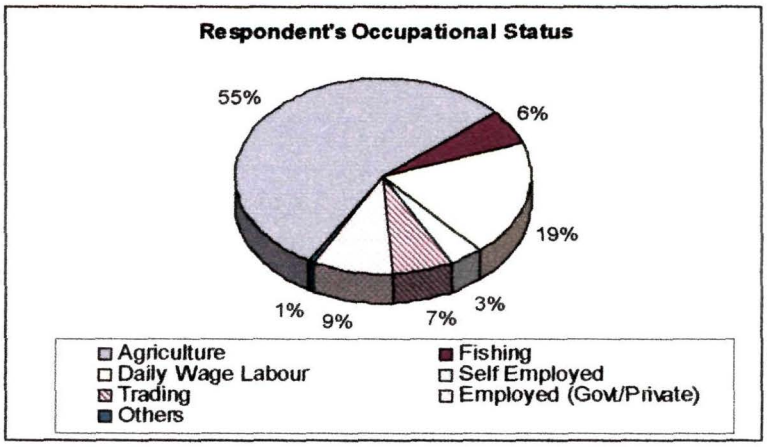

Fig. 5.1 Respondent's Occupational Status

Occupation structure of the population of Morigaon district is represented below in table 5.2 for comparison with the sample surveyed .

Table 5.2 Occupation structure of the population of Morigaon district

Year	Primary	Secondary	Tertiary	Total
2001	24.47% (72.31)	1.11% (3.28)	8.27% (24.41)	33.84% (100)

(Figures in parenthesis represents the percentage of working population)

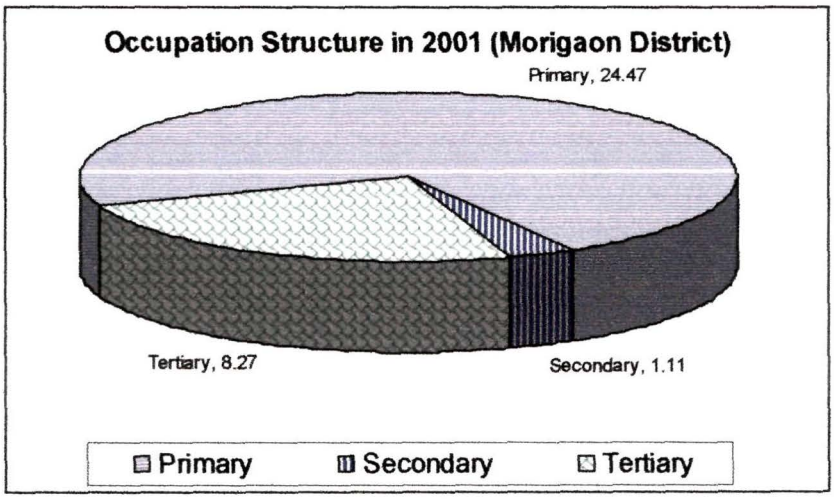

Fig. 5.2. Occupational Structure of the Population-Morigaon District

- **Respondent's Educational Status**

  The respondents' educational status is reflected in the table below. The figure indicated include all members of respondents' households.

Table : 5.3 Respondents' Educational Status

Level of Education	Percentage
Illiterate	37.15
Below Class X	52.94
Class X - Class XII	7.91
Graduate	1.66
Post Graduate	0.21
Other & Technical	0.13

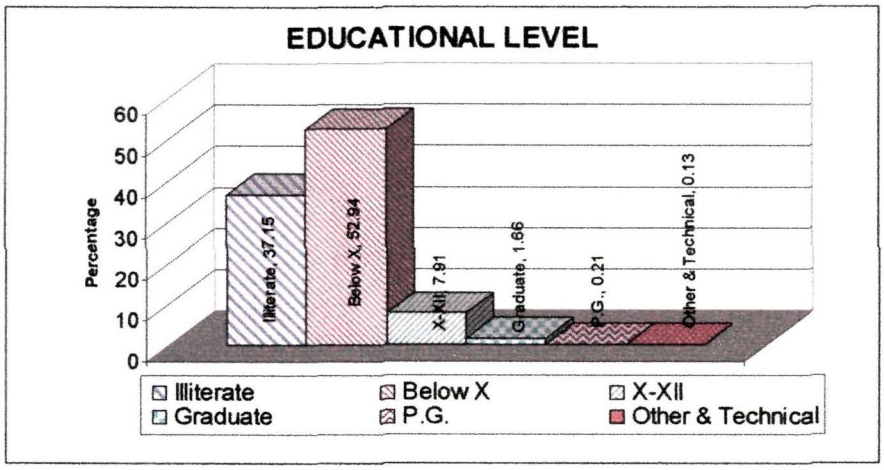

Fig. 5.3. Educational Level of the Population

- **Average Land Holding Size:**

  The average holding size of the respondents is 5.04 bigha

Table 5.4. Respondents' Average Landholding Pattern.

Land Holding and Distribution (*Bigha*)				
Total	High Land	Wet land	*Bari* (Homestead)	Waste Land
5.04	2.07	1.86	1.03	0.08

(where 1 *bigha* = 14400 Sq.ft)

5.2 Survey 2 - Survey 2 relates to valuation through Contingent Ranking Method determined through person to person interaction. Opinions and observations were also recorded for understanding of the perceptions of sustainable preservation.

- In assessing the intangible benefits of wetlands, 75.4% of the respondents feels that the existence of *beel* is important for performance of religious or traditional rituals. While all Hindus asserted the importance only 7.2% of the Muslim respondents feel that the existence of *beel* is important from their religious perspective. (Q. 6)

  Amongst the respondents who feel the *beels* are important for performance of traditional and religious rituals, the distance a person is willing to travel in order to perform the rituals on the *beel* shores is exhibited in table 5.5.

Table5.5: Respondents' Willingness to travel for performance of Rituals

	0-1Km(%	1-2Km(%)	2-4Km(%)	Beyond 4 Km (%)
All (75.4%)	100	49.88	8.96	0.24
Hindu (100%)	100	49.60	9.55	0.27
Muslim(7.2%)	100	52.78	2.78	0

- The Percentage of the Respondents who have any faith in Religious belief while others practice only. (Q. 7)

Table : 5.6 Respondent's Faith on Religious Belief.

Category	All respondent	Hindu respondent	Muslim respondent
Percentage	84.20	97.74	31.68

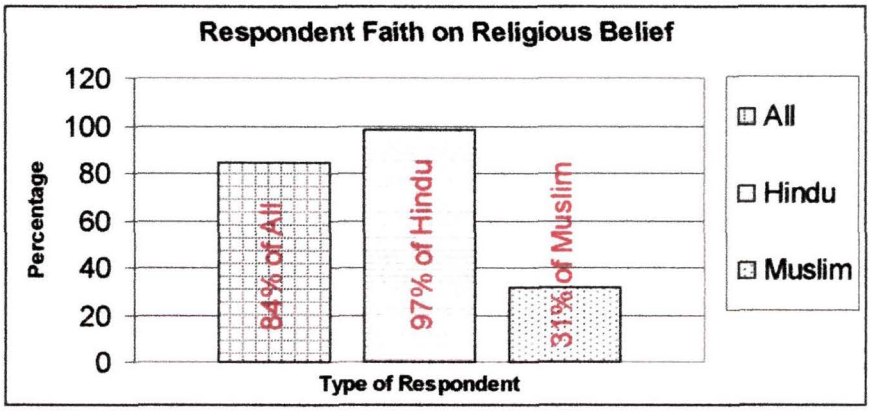

Fig. 5.6 Respondents' Faith on religious Belief

- Amongst those who have faith in their religious beliefs only 11.2% of the respondents believe that religious beliefs are related to nature. Amongst Hindu respondents 13.53% believe so whereas only 1.98% Muslim respondents believe that religious beliefs may be related to nature. (Q. 7 continued)

Table:5.7 Respondent's Faith in Religious Belief related to Environment

Category	All respondent	Hindu respondent	Muslim respondent
Percentage	11.20	13.53	1.98

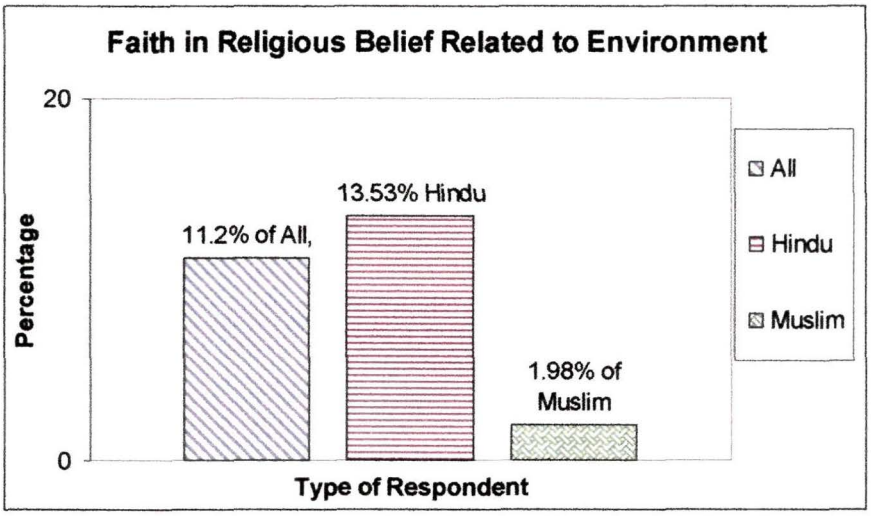

Fig. 5.7. Respondent's Opinion on religious belief related to Environment

- On Respondents' awareness of any Religious scriptures, rituals and teachings which support conservation of environment, the table 5.8 exhibits that only a small percentage of the respondents are aware that religious scriptures exist which refer to conservation of the environment . (Q. 8)

Table : 5.8 Respondent's Awareness on conservation of environment

	Yes (%)	No (%)	Not Aware (%)
All respondent	5.41	8.02	86.57
Hindu respondent	6.53	1.51	91.96
Muslim respondent	0.99	33.66	65.35

The conscious Hindus identified numerous references such as *Kalika Puran, Padma Puran, Sri Madbhagat, Vedas* etc. While one Muslim respondent made reference to the Holy Quaran on conservation of water.

- As for the perception on environmental education, almost all respondents feel that education in school and colleges for conservation of wetland will bring about awareness and help to preserve /develop the wetlands and is exhibited as under.(Q. 9)

Table : 5.9 Respondent's Perception on environmental education.

Category	Percentage
Amongst All respondent	99.20
Hindu respondent	99.75
Muslim respondent	97.03

- In an attempt to make gender segregation on environmental perspective, only 4.91% respondents opined that "women care more for preservation of wetlands". (Q- 10)
- Amongst all respondents, only 3% (1.75% amongst Hindus and 7.92 amongst Muslim respondents) feel that environment is basically for the benefit of mankind and must be harnessed fully. They feel that there is no harm if man has to exploit the nature completely. (Q. 11)
- Almost all the respondents are in the opinion that "Many people for his benefit exhibit their carelessness and have no concern for the environment". (Q- 12)
- Almost all (98.2 %) the respondent agree that "Spiritual development of human being is possible only when one is close to the nature". (Q- 13)
- "If we harness the benefits of the environment it is only right that we also take care to protect the environment". All respondent agree with the statement. (Q- 14)
- From the total respondent, 97.4% agree that "The animists worship rivers, trees, etc; it appears that environment is a manifestation of his prayers". (Q. 15)
- Only a small percentage, 6.80% among the respondents, states that environment is inanimate and man is a living entity and so there cannot be any interaction. (Q. 16)

- Amongst the respondent 2.13 % feel that environment is basically for the benefit of mankind and must be harnessed fully. There is no harm if man has to exploit the nature completely. (Q- 7)
- 98.6% of the respondents, 99.25% amongst Hindus and 96.04% of the Muslim respondents, feel that man will exist only as long as environment exists. (Q. 18)
- 99 % of the respondents advocate environmental awareness to people. (Q.20)
- Applying the Principal Component Analysis technique for the variables the following loadings are obtained for different perspectives on preservation:

Table: 5.10 Respondent's opinion on environmental awareness (factor loading)

Variable	**Loading**
To preserve environment for future economic benefit to self	0.63
To preserve environment for benefit of the future generation	0.76
To preserve environment purely out of love for nature Without any self interest	0.44
To preserve environment as performance of religious duties	0.61
To preserve environment for all the reasons above	0.65

- **Extraction Method: Principal Component Analysis.** (Q. 19)

"*To preserve environment for benefit of the future generation*" has the highest loading of 0.76.

The factors "*To preserve environment for future economic benefit to self* ", " *To preserve environment as performance of religious duties* " and " *To preserve environment for all the reasons above* ", are in the same group.

- The following table shows the Factor loading for Hindu, Muslim and all categories: (Q- 19). Fish has the highest rank and turtle the lowest.

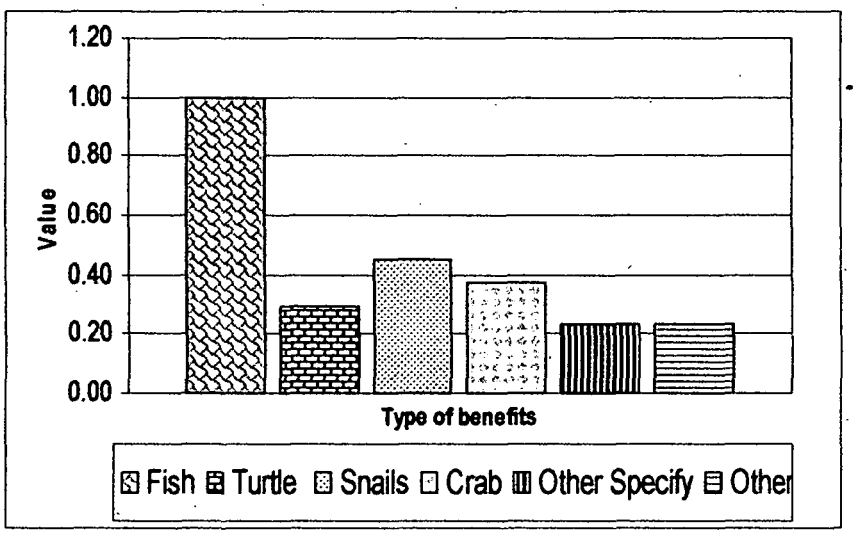

Fig. 5.8 Contingent Ranking for Extraction of Fauna

(Y Axis represents R_f/R_i, R_f - rank of fish, R_i - rank of the attribute)

- Likewise the ranking of flora is exhibited in Figure no. 5.9 with extraction of fodder and lotus having highest rank.

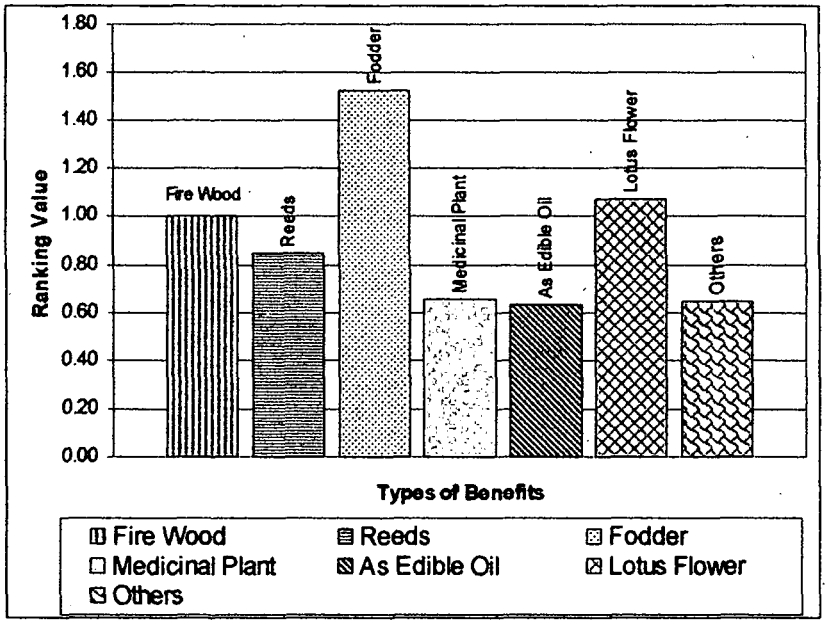

Fig. 5.9 Contingent Ranking for Extraction of Flora

(Y Axis represents R_f/R_i, R_f - rank of fish, R_i - rank of the attribute)

- Like the assessment for fauna and flora, the ranking of all attributes are compiled on the descending scale of 13, i.e. with higher ranking, the importance of the attribute to the respondent is lower. This approach was adopted only to facilitate easier understanding by the respondent. Accordingly the total ranking is assessed as indicated below in the table 5.11. The multiplying factor for quantification of the value is then determined by the total rank of fish divided by the total rank of the attribute. The quotient multiplied by the value of fish will result in the value attributed to the wetland. The summation of all values attributed will result in assessment of gross value

Table: 5.11 Ranking of Benefits derived from wetlands.

Function	**Rank (R)**	**R_f / R_i**
Drinking Water	3109	0.2
Domestic & Household Use	2460	0.26
Cultivating in *Beel* Area	1594	0.4
Retting of Jute	2755	0.23
Grazing Cattle	3464	0.18
Recreation	3558	0.18
Irrigation	792	0.80
Religious Customs	2875	0.22
Extraction of Fish (Rf)	**631**	**1.00**
Extraction of Fauna	2674	0.24
Extraction of Flora	4760	0.13
Extraction of Organic manure	5246	0.12
Transport & Communication	5821	0.11
Tourism	6307	0.10

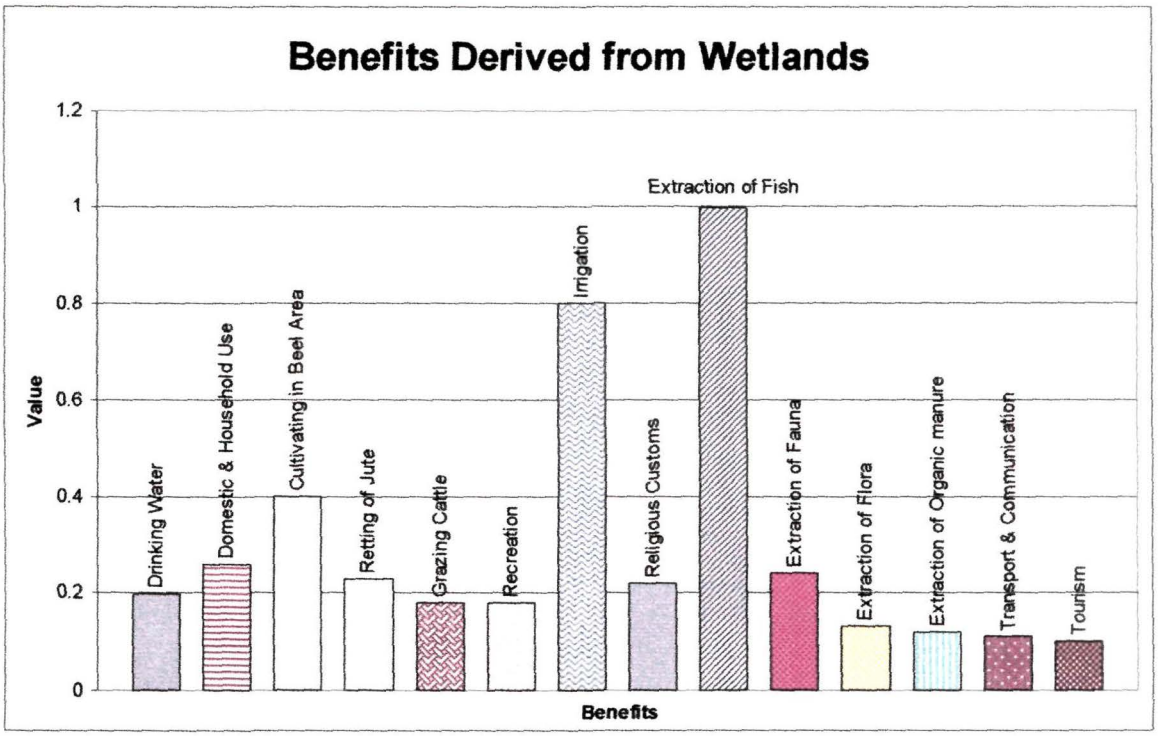

Fig. 5.9 Contingent Ranking for Wetland benefits

(Y Axis represents R_f/R_i, R_f - rank of fish, R_i - rank of the attribute)

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CHAPTER VI

VALUATION OF WETLANDS

Valuation, the act of assigning value, refers to the behavioural concept related to an individual or a group. It is the concept of the desirable individual choice of means and ends (Yuktananda,1989). Axiologically, value refers to cherished end. Value thus is perceived with two perspectives - temporal and spiritual. The temporal perspective results in assigning value for fulfillment of desire, whereas the spiritual perspective leads to aspiration for the value assigned. While the former explains the value perception of market driven products and services, the latter refers to non-market and often intangible benefits. Value in the simplest form is, however, best understood through economic value theory where it is quantified in monetary terms.

The foremost prerequisite to valuation of a wetland is to elucidate the benefits derived and functions which are being fulfilled by the wetland. It is only after identification of attribute and grouping for the type of benefit derived that the method for valuation can be adopted. Accordingly, the identification and the procedure for valuation are described as under:

6.1 Identification of Value Attributes.

The large array of functions and benefits identified which the wetlands of Morigaon are known to fulfill can be classified in five categories as stated earlier in chapter II and listed as under in table 5.1

Table 6.1 Goods, Services and Functions of Wetlands of Morigaon District.

Sl No	Classification	Goods & services	Particulars
1.	Direct Extractive	a. Fauna	▪ Fish, crab, turtle, frogs, snails
		b. Flora	• Lily seeds, lotus, reeds, fodder for cattle, Medicinal plants & herbs, fox nut.
		c. Organic manure	• Decomposed Floating macrophyte

Table 6.1 Goods, Services and Functions of Wetlands of Morigaon District.(Contd)

Sl No	Classification	Goods & services	Particulars
1.Contd.	Direct Extractive	d. Water supply	• Drinking & Domestic use • Irrigation • Industrial use
2.	Direct, Non– Extractive	a. Agriculture in flood plains and fringe area.	▪ Rice cultivation ▪ Fodder for cattle, grazing ground.
		b. Agricultural activity in water body	▪ Retting of Jute
		c. Recreation and Tourism	▪ Picnics in winter season
		d. Water Transport & Communications	▪ Transportation of people and goods.
3.	Indirect	a. Ground water recharge	▪ Ground water extraction for agriculture (STW)
		b. Flood regulation	▪ Damage prevention due to floods
		c. Wildlife Habitat	▪ National Parks, Sanctuary.
4.	Passive value	Religions & traditional uses	▪ Fairs ▪ Group and individual rituals
5.	Existence/ optional value	a. Future stock of water b. Love for nature & all forms of life	• Concern for future generations

It is observed that although all the extractive benefits are market driven, most products are not extracted with objectives to realize economic benefits. Some are extracted for personal consumption only. Amongst the extractive benefits, fish has a well established market base and the data related to its production and productivity is well recorded.

6.2 Procedure Adopted for valuation:

The procedure adopted for valuation is by Contingent Ranking Method in which comparative ranking is assigned by the respondent for every benefit derived by him from the wetlands. While a few attributes (benefits) of direct extractive nature may be summation of several sub-attributes (such as aqua-fauna comprising of fish, turtle, snails, molluscs etc. or aqua-flora comprising of lotus, fox nut (*Makhna)*, lily, fodder, reeds, medicinal and edible plants), the others could be singular in nature. The ranking method is thus extended to two levels; i.e. for ranking amongst sub-attributes within an attribute as well as amongst attributes.

Actual Market price valuation (average over a period) at the retail price level has been made for a significant extractive benefit namely fish which is then taken as the basis for valuation. Valuation for other attributes is then computed from their ranking. (For example, if the value of wetland on account of fish is INR 100 and rank of fish is 3 on a descending (in terms of value) scale of 10, then value of wetland due to any other attribute A with a rank of 6 will enhance the value by 100 x 3/6 = 50. In other words, the total value on account of fish and attribute A is INR 100+50 = INR 150. The gross value of wetland then is computed by summation for all the attributes.

Indirect benefits namely retting of jute is well realized in Morigaon district and the valuation of the same is described in detail later in this chapter and Appendix IV. The value realization on account of retting of jute in the wetlands is used for testing of the technique adopted.

Other attributes like Tourism, religious and cultural rituals may also be evaluated (by travel cost method combined with Actual expenditure method). Such valuation may also be then used for comparison to determine the accuracy of the method adopted.

6.3 Direct Extractive Benefits :

Direct Extractive benefits values are generally market-based and hence assessments for valuation are made on the market price which include the value derived from:

- Extraction of fish
- Extraction of other minor fauna (snails, crabs, turtle)
- Extraction of Lotus, *Makhana,* Lily seeds flowers
- Extraction of Fodder for Cattle
- Extraction of Organic Manure

Extraction of water is not considered as market commodity in the current study.

6.4 Extraction of Fish

A significant feature of *beels* of Morigaon is that the species of fish with the rivers as their habitat are also found in the *beels.* This is due to the annual floods which not only replenish the stock but also regenerate the quality of water and productivity of the *beels.* Although over one hundred species of fish have been identified to have their habitat in the

wetlands of Morigaon district as listed in Appendix III, only about twenty four species account for over 90% of the gross extraction for economic benefits.

Fish extraction is one of the primary economic activities associated with the wetlands of Morigaon. The current practice of extraction is through auction bidding for a tenure period of one to three years; and the highest bidder is awarded the contract. This practice is however limited to those wetlands which are registered and identified by the government for generation of state revenue. Generally the fish harvested is sold by auction at the landing to the highest bidder who transports the fish to the secondary or retail market where there may be another auction before being sold to the consumer. Although the price varies depending upon the species and the sizes, the consumer price is over 300% of the primary auction price at the landing. The species which are generally harvested from the *beels* of Morigaon are: *Rohu, Katla, Carp, Chitol, Kandhuli, Borali, Sol, Magur, Kaoi, Goroi, Chengeli, Puthi, Singora, Sal, Bhedbhedi, Patitmutura, Bami, Tora,* Prawn, and a few species of ornamental fishes. The prices vary from INR 40.00 to INR 400.00 for each kilogram.

Besides the commercial harvesting of fish from the auctioned *beels,* fish is caught by almost all the people inhabiting around the *beels* for their own consumption.

The valuation of the fish harvested through auction is assessed from the recorded statistics by the District fishery department for the volume of extraction. The price is recorded from two major retail markets namely Morigaon and Jagiroad where these fish are sold. These surveys were conducted over a prolonged period in order to arrive at reliable and stable prices.

Although the valuation of the total extraction of fish needs to incorporate market price variation due to diversity of species, size as well as the seasonal supply-demand scenario. Thus the total value : $TVAL_f = \sum X_{ij} \cdot P_{ij}$

where $TVAL_f$ is the total value of fish extracted and X_{ij} is the quantity of the i^{th} specifies with j^{th} size wise grading and P_{ij} is the unit price of i^{th} species with j^{th} size wise grading. The valuation is however assessed by gross averaging of prices based on proportional extraction of species. Accordingly the weighted average value (high) is INR 141 per kg. and (Low) 81 INR per kg. as derived in table 5.2 below.

Table 6.2 Commonly Extracted Species of Fish from *beels* of Morigaon District and their Market Valuation (Primary Survey)

Sl. No.	Fish Species	Common name	Size by Wt. in Kg.	% of Total extract by wt.	Price High – Low INR per Kg.
1.	*Chitala Chitala*	*Chital*	3 - 6	3 - 5	400 - 200
2.	*Notopterus otopterus*	*Kanduli*	.15 – 0.25	2 - 4	60 - 50
3.	*A.morar* (Ham-Buch)	*Boriola*	0.030- 0.040	4 – 6	60 - 40
4.	*Catla catla* (Ham-Buch)	*Bahu, Bhakua*	1.20 – 2.80	8 - 10	200 – 80
5.	*C..reba* (Ham-Buch)	*Lachim bhangan*	.05 – ..075	4 - 6	50 – 40
6.	*# Ctenopharyngodon idella*	*Grass carp*	0.80 – 1.40	4 - 6	100 -80
7.	*L. gonius* (Ham-Buch)	*Kurhi*	0.30 – 0.80	1 – 2	100 -60
8.	L. rohita (Ham-Buch)	*Rou*	0.50 – 3.00	7 - 10	250 - 100
9.	*Cyprimus carpio* (Linneaeus)	*Common carp*	0.80 – 1.40	5 - 7	120 - 80
10.	*Puntius chola* (Ham-Buch)	*Puthi*	0.020 – 0.025	2 – 5	50 – 40
11.	*Hypothalmichthys molitrix* (Valenciennes)	*Silver carp*	0.80 – 1.40	5 - 7	120 - 80
12.	*Wallago attu* (Scheidner)	*Borali*	1.00 – 7.50	3 - 5	200 - 80
13.	*Clarias batrachus* (Linnaeus)	*Magur*	0.10 – 0.20	5 - 6	200 - 140
14.	*Heteropneustes fossilis* (Bloch)	*Singhi*	0.060 – 0.080	4- 6	180 - 140
15.	*Monopterus cuchia* (Ham-Buch)	*Cuchia*	0.30 – 1.0	2 - 3	120 - 80
16.	*Oreochromis* mossambicus (peter)	*Tilapia*	0.150 – 0.20	2 - 3	60 - 45
17.	*Anabas testudineus* (Bloch)	*Kaoi*	0.070 -0.10	3 – 5	140 - 100
18.	*C. Labiosus* (Dey)	*Kholihona*	0.010 – 0.015	-	
19.	*C. marujius* (Ham-Buch)	*Sal*	1.20 – 2.50	1 – 2	120 - 80
20.	*C. gachua* (Ham-Buch)	*Chengeli*	0.08 – 0.10	3 – 5	50 - 40
21.	*C. punctatus* (Bloch)	*Goroi*	0.08 – 0.15	4 - 6	60 - 50
22.	*C. Striatus* (Bloch)	*Soul*	0.60 –2.00	4 -6	200 - 80
23.	*Macrognathus aral* (Bloch & Sclmeider)	*Tora*	0.10 – 0.15	2 - 4	50 - 40
24.	*Masracembelus* armatus (Lacpede)	*Bami*	0.20 – 0.50	2 - 4	50 – 40
Average weighted price per kg of fish (high-low)					141- 81

6.5 Valuation of Extractive benefits of aqua fauna

Based on the valuation for fish, the valuation of other commodities P_i (sub-attribute of aqua fauna) is assessed from their ranking within the group as indicated below in the table 6.3.

Table 6.3. Contingent Ranking and Valuation for Extractive Benefits (fauna) per hectare.

Sl No.	Sub-Attribute	Rank (R_i)	R_f/R_i	Pi= (R_fR_i)x P_f	
				High Av	**Low Av**
1	Fish	626 (R_f)	1.00	**60489 (P_f)**	**34749(P_f)**
2	Turtle	2159	0.29	17542	10077
3	Snails	1388	0.45	27220	15637
4	Crab	1675	0.37	22381	12857
5	Others (including Mollusc)	2705	0.23	13912	7992
Valuation of Extractive benefits of aqua fauna			$\sum P_i$	**141544**	**81312**

[The Unit benefit of Fish is estimated at INR 60489 (High Average), at INR 34749 (Low Average) per hectare calculated from wetland productivity @ 429 kg/ha (Source: AFDC)

6.6 Extraction of Flora

Amongst the benefits extracted by the people in form of aquatic flora from the *beels* of Morigaon, fodder for the domestic cattle ranks the highest. Although eighteen species have been identified which are commonly extracted, a very few are actually marketed for monetary returns. Others are primarily for consumption. The productivity of the aquatic flora is seasonal with the highest growth rates being in the winter season. The annual flushing by the floods is regular and hence the vegetation productivity is cyclic in nature. The species of aqua flora extracted from the wetlands of Morigaon are listed below in table 6.4.

Table 6.4 Wetland Vegetation in the *Beels* of Morigaon.(Source Primary survey)

Sl. No	Botanical Species	Common Name (Assamese)	Purpose of Extraction
1.	*Nllumbo sp*	*Padum*	Food and economic benefits
2	Naemphaea nouchali.	*Bhetphool*	Food & fodder
3	Euryale ferox	*Makhana*	Food
4	*Hydrilla verticillata*	*Panikher*	Building material
5	*Enhydra fleutuns*	*Helochi*	Food in form of vegetable
6	*Ipoma aquatica*	*Kolmou*	Food in form of vegetable
7	*Eichhornia crassips*	*Pani Meteka,*	Fertilizer
8	*Uticularia flexuosa*	*Pani singari*	Food in form of vegetable
9	*Typha sp.*	*Hogul, patidoi*	Making mats and utility goods
10	*Centella asiattia*	*Manimuni*	Medicinal herbs and also as food
11	*Eclipta prostrata*	*Jarmani ban*	Medicinal herbs plant
12	*Murdannia mudiflora*	*Hargal*	Decorative and utility goods
13	*Hymenachne assamica*	Hati dal	Fodder
14	*Isachne himalayca Panucum*	*Pani ghanh*	Fodder
15	*auritum*	*Pani ghanh*	Fodder
16	*Phramites karka Polygonum*	*Ekora*	Building materials
17	*Aeschynomrne aspera*	*Kuhila*	Floats for rods, handicraft goods,
18	*Alocasia esculentum Alpinia*	*Tara*	Utility goods.

6.7 Non Extractive Direct Benefits

Although the non extractive direct benefits include recharging of ground water, recreation, Transport and communication, retting of jute amongst several other benefits,

retting of jute has been considered for comparative evaluation through replacement market value on input output labour productivity.

6.8 Assessment of Passive and Optional Values:

Man's attitude towards both, environment and economics is strongly influenced by his value perception both as an individual as well as a member of his society. The value perceptions dictate the human action towards a desired state of existence and away from what is not desired. The value perception of an individual, however, does not remain static. It undergoes transformation at different stages of growth and development from birth to a mature human being and beyond. During early stages of development, currently accepted values, attitudinal interactions and shared behavioral norms are responsible for individual's initial value identification. Biological, physiological, social and ecological forces affect the individual in shaping his/her value domain. Value development is thus, dependent on the reciprocity of action between these forces and the individual (Yuktananda, 1989). With the individual's growth, the values also transform because of religious, cultural, educational, social and political influences. Environmental opportunities and limitations have a substantial influence on individual's value perception. Amongst the various attributes, the two major attributes which shape the individual's as well as societal value perception are religion and cultural heritage.

6.8.1 Religion Vis-à-Vis Environment:

In context to value transformation of an individual, his religion has profound influence which can only be understood through the spirituality of the religion the individual practices. In context to the study area of Morigaon district, it is relevant to understand that the early settlers in and around Morigaon comprised of numerous tribes like the Karbis, Jayantias, Bodos, Kacharis, Dimachas besides the Lalungs who are traced back to Tibeto-Burman, or Tai-Chin origin. The other settlers are the migrants from the central India and the immigrants from Bangladesh and Nepal. The religious beliefs of these group range from animists to idol worshippers like the Shaivite Hindus. Therefore, a comparative evaluation of the religious philosophies of different religions becomes important to assess the societal

value perceptions of the people of Morigaon. The two major religious groups in the district are Hindus and Muslims constituting over 99.8% of the population.

6.8.1.1 Hinduism :

Hinduism has been defined as an inheritance of thought and aspirations living and moving with movement of life. Such dynamic aggregate of aspiration and needs have been classified as the four ends of Hinduism namely *Dharma* (law & virtue) *Artha* (means), *Kama* (needs & desire) and *Moksha* (liberation). *Dharma* is the law, virtue or norm which sustains the universe. It constitutes the principles to be observed in man's life and all his relationships so as to sustain the social order and the physical environment. *Artha* and *Kama* operate at the physical and biological levels of human existence. The value attributed to things and services of need and desires (including the sensual pleasures) are defined by *Kama* whereas, *Artha* means the resources for sustaining oneself and in fulfilling his desires. While *Kama* and *Artha* provide the understanding of primal human urges which are the roots for man's drive for wealth and power, these powerful drives or urges, if not controlled, curbed and moderated by the guiding arm of *Dharma*, would have caused societal chaos and havoc in the physical environment. *Dharma*, thereby, brings about the harmony among *Kama*, *Artha* and ultimately *Moksha*. *Moksha* signifies liberation from all bondage and corresponds to the deepest longing in human heart which remains unappeased. It is the state of absolute freedom and eternal ecstasy. Thus, in Hindu system of values, *Moksha* is the value paramount (the *Parama Purusartha*) (Yuktananda 1989). As *Moksha* is not attained by all, a Hindu thus is a believer of rebirth and reincarnation. As the rebirth or reincarnation may assume any form of life, respect for all forms of life becomes an inherent value orientation of a Hindu (Prime,1994). The *Vedas*, the oldest known human documents in terms of religion, philosophy and literature, are the fountainhead of Hinduism. The word '*Veda*' itself signifies sacred knowledge and wisdom. The *Vedas* record what the man felt at the dawn of human consciousness to comprehend the environment enveloping his existence (Kishore, 2004). The *Rig Veda*, the earliest of the four *Vedas*, is composed with the prayers revealing man's curiosity about nature and his fervent prayer to the gods to ensure the basic necessities of life. The central theme of the *Rig Veda* is the five elements of life (earth, water, air, fire and sky) with energy as the central column for sustenance of life. By the time of *Yajur vedic* age,

man has learnt to live in harmony with his environment. His prayers are primarily for the sustainability of his existence in harmony with everything around him.. *Yajur Veda* (*Shukla*) which was purely liturgical and was useful for conducting religious ceremonies, emphasized on chanting the *Mahashanti Mantra*, the prayer for universal harmony : " *Om dyo shanti , Antarikshyam shanti , Prithwi shanti , Rapah shanti , Rowshadhayah shanti , Vanaspatayah shanti , Vishyea Devah shanti , Brahma shantih , Sarve shantih , Shantireva Shantih .. Sa ma shanti redhi ...*" – *(Yajur Veda)* [O God! By your grace unto the heaven be peace, unto the sky and the earth be peace, peace be unto water, unto the herbs and vegetation, unto all gods, unto Brahma and unto all objects. May peace reign all around, and may I also be at peace with everything in the universe (peace and harmony being used as synonyms)].

The chanting of the hymn - *Om Shanti, Shanti, Shanti* - is a ritual designed symbolically to create an awareness amongst all to be in harmony and peace with nature, society and self – ecological harmony, societal harmony and spiritual peace. (Prime, R. 1996)

With the value orientation influenced so strongly by the religious and social philosophy of Hinduism, it is only natural that numerous references on Man-Nature relationships be found in the religious scriptures of Hinduism. As an example, in the *Srimad Bhagavata,* Krishna, the lord incarnate, urges his father and other cowherd-men to worship the hills, forests and the cows for sustenance of the community which depended on the produce from the hills, forests and the cows instead of *Indra,* the demigod of power (Prime, 1996)

In fact it is for such profound influence of religion on the value perception of the Hindus that the Hindu settlers in Morigaon district are still caring about the natural resources like wetlands and their biodiversity.

6.8.1.2. Islam:

Islam came to reassess monotheism amidst a population with religions ranging from rank polytheism and gross idolatry to rigid atheism. The normal local polity was without any restraint. Life at all levels was undisciplined. It was amidst such chaos, Mohamed emerged as the messenger of God.

Value orientation of Islam establishes universal brotherhood of mankind and thus can be said to be the religion of services to mankind. Being a religion by practice, Islam preaches more of ethics than of philosophy. (Yuktananda, 1989).

As Islam emerged from social chaos, it has never distinguished between spiritual and temporal or religious values. Islam envisaged total way of life which excludes nothing. Yet reference of nature in relation to man is not found in the holy scriptures of Islam except for use of water. Trees and rivers are referred to in the Paradise, that too, for those good souls who are worthy to cross the *Al Sirat* (Radhakrishnan, 2004). It was probably the surroundings of the birth place of Islam which led to perceive paradise, the ultimate human aspiration, as a shady place where there are trees, rivers and gardens.

Unlike in other eastern religions, Islam does not believe in rebirth; and the soul after death, suffer or enjoy eternally depending on the faith and action in his lifetime. Man's relationship with nature is not reflected in Islam as we know today. The value orientation of all Muslims are however not same, more specifically amongst those belonging to the Indian sub-continent and Persia. These Muslims believed in final reunion of the soul with the eternal spirit and for this they needed to break all connections with extrinsic objects and pass through life without attachment (Ernst, 2000). These Muslims came to be known as Sufis, probably from the Greek word for sage (Sophos) or the Arabic woolen cloak (Suf) which they wore in Persia. In the words of Ibu Khadun:

> *'Sufism belongs to the sciences of the religious law that originated in Islam. .....The Sufi-approach is based upon constant application to divine worship, complete devotion to God, aversion to the false splendor of the world, abstinence from the pleasure, property, and position which the mass aspires, and retirement from the world into solitude for divine worship. ..... '*

The Sufi teachers (also known as fakir, Dervish or Pir) are free thinkers who had little to do with stern faith of the prophet. They composed poetry and songs, and were fond of music and dance which no pious Muslim would do. They had much more common with the Christianity, the Greek philosophy and the mystical speculation of Hindu Vedanta (Ernst 2000). As the Sufi teachers averted worldly possession and lived a life of a mendicant, they identified themselves with the poor and rural masses. In fact, the socio–economic

environment in India helped Sufism to flourish. They could attract people of all religions, castes and social stata. The influence of these *Sufi Pirs* like Moin-al Uddin Chisti, Badal Shah Madar, Nizum al Uddin Awaliya, Abdal Rehman Badr and others were so great that the prominence of religion was completely lost. The songs and poetry of the Sufi poets like Kabir ran parallel to the Hindu devotional songs of *Kirtan*

Such was the socio-religious environment in India in spite of the whims and erratic behaviour of some fanatic rulers till the middle of nineteenth century. The growth of fundamentalism amongst both Hindus and Muslims, inflamed by the British, polarized the society during the next century; and by the middle of twentieth century, the sub-continent was segregated into two parts due to religious conflicts.

In context to the study area of Morigaon district, the growth of fundamentalism in remaining part of the country did not make any impact till the independence. The influence of Sufi leaders in the district was very strong and in fact, even today, a large number of these Muslim mystics are seen scattered throughout the district. Some of them even practice *Tantric* feats. However with the influx of immigrants into the district as agricultural labour, the ethnological distribution has changed completely with very serious impact on the environment.

The followers of other religions are almost absent in the district except for a few Christians and Jains who constitute less than 0.2% of the district's population. Thus the religious philosophy of the other religions vis-à-vis environment has not been discussed. However, the Christian perspective of man-nature relationship is important for understanding the changing human values towards environment which the Church also has acknowledged.

The earlier Christian perception had been that the God delivered into the hands of mankind all animals and nature for his sustenance (Genesis 9). Hence, nature's creations are considered for the service to mankind - a homocentric value perception. Such value perception has however undergone a sea of change over the centuries: and now if a man is redeemed, there is new creation. Everything old passed away. (2 Corinthians 5:16) Today man should realize that all that he has, has been given to him by God and he has no absolute rights over anything in the world; he is not the creator but a creature. (Antonisamy, 1999).

6.8.1.3 Religion and Environment: The Current perspective

The relationship between religion and environment is being interpreted with renewed perspective during the past decade. Philosophers, religious leaders, scientists and the social leaders have begun to review the religious scriptures to understand the complex relationship between religion and nature. For example, in his World Day of Peace Message for 1990, Pope John Paul II stated - "we must go to the very heart of the present ecological degradation and address the profound moral prices of which destruction of environment but one troubling aspect. (Pope John Paul–II in massage 1990 No. 5)

"Prescinding from all philosophical discussion in this regard I like to postulate that it is impossible to separate religious believe – or lack of – and ethical consideration in the environmental field because of there intimate relationship". (Keenan, 2005)

The International Conference on Environment, Peace and Dialogue among Civilizations and Cultures 2005 at Tehran, concluded where many speakers stressed the need to integrate spiritual beliefs and value into international dialogue and to emphasize shared values. Others urged a stringer ethical commitment to environmental protection during war.

Several participants stressed the complexity of the links between the environment and peace, and said assessments and solutions should be holistic and address social, culture, economic and political dimensions.

The special panel on dialogue among civilizations recorded:

- John Grim's 'Forum on Religion and Ecology' outlined the Forum's work in generating dialogue. He said religious concepts of "eco-justice," such as the sacredness of the commons, should be retrieved and evaluated, and he noted that traditions are often viewed as being continuous and timeless, but that they are in fact internally diverse and constantly reconstructed.

  During the subsequent discussion, participants raised questions on the role of dialogue within civilizations, the possibility of redefining rationality, educating world leaders about the environment, integrating the environment into religious sermons, and moving from textual evaluation and dialogue to action.

- Mary Evelyn Tucker, Harvard forum on Religion and Ecology, pointed out that the only truly shared human value is the continuation of life on Earth. She said we should move beyond individualism and domination of the environment to emphasize participation and kinship with all life systems.

  (Summary report of International Conference on International Peace and Dialogue among Civilization and Cultural)

As the global action for sustainable development and green planet is dominated by the developed nations with majority Christian population, the emerging perception of ecology as stated above now forms the driving force of all human action in preserving the ecology. The impact of such initiatives is reflected in the government's initiatives in preservation of water bodies.

6.8.2 Environment and Culture, Traditions, Customs and Rituals Vis-à-Vis the *Beels*:

The interaction between man and nature has always been intimate and reciprocal, and has profound influence on each other. In fact, within the tribal societies, culture, which emerged from the nature, is so intricately linked with religion that it is difficult to differentiate between them. Attempting to understand the interplay between religion and nature amongst the *Oraons*, the fourth largest tribal group in India living in the border-areas of Jharkhand, Orissa and Chattisgarh states, Virginius Xaxa states "The *Oraons* order their ritual, music and dance on nature's signal, i.e. on the blossoming plants and trees, on the position of the moon, on the cycle of season, etc. For example, *Khaddi/Sarhul* , one of the most important festivals of the *Oraon*s is celebrated when *Sal* trees are in full blossom and the branches of white flowers dominate the rural landscape." (Xaxa, 1992)

"The belief of Indian tribal people, for example, that their culture was born and nourished in the forest, and their dependence for survival upon its continued existence, has imbued in them a respectful attitude towards nature, and has given rise to the development of the most basic principles of forest management." (Strong, 1992)

"Sacred forests are alive in at present, including the mangrove. Nothing could be removed from the ancient, traditional sacred forests; they were treated as what is now called

'biosphere reserves', a concept developed only recently in modern science." (Vennucci, 1992)

Warli tribe of India has been described as the first "Greens", with nature personified and worshipped as *Hirva* (green). Hirva is the source of all wealth. Pareira, 1992)

The earlier settlers of Morigaon district are believed to be from the Tibetan origin. Although their migration to the plains is shrouded in mystery, they probably reached the plains following the course of river Brahmaputra. The Karbis (a tribal community living in the hills) called them Lalung - the people who have been rescued from the waters. The Lalungs however preferred to call themselves as the Tiwas, meaning- the people who have come from the superior water (Bordoloi, Thakur et al 1987).

The name of the district itself originates from *beels*. Many places of the district were also given their names in association with the *beels*. Therefore, it is only natural that traditions, customs and rituals of the people of Morigaon be intricately interlinked with the *beels* of the district. Like the other tribal communities of India, the Lalungs consider traditions and customs as an invincible creative power for development which emanates from divine spirit The Lalungs, therefore, have rituals for every event. However, with settlers from other religious and cultural communities like the Bengali and Bihari Hindus, immigrant Nepalese and Bangladeshis, customs and traditions of these communities have also been adopted by the Tiwas. The major customs and religious rituals identified through the survey which are associated to the *beels* and performed by the people of Morigaon are:

1. *Bihu*
2. *Jon Beel Mela*
3. *Bathou Puja*
4. *Basantipuja*
5. *Chhat Puja*
6. *Asta Prahar Puja*
7. *Ganga Puja or Jal Puja*
8. *Banti Puja*
9. *Manasi Puja*
10. *Nabadya Offerings*
11. *Pinda Offerings*
12. *Dinga Offerings*

While some of these customs and rituals are community based, the others are personal in nature. The following table 6.5 indicates the above practices with their nature, the performing community, performing time of the year, objective of performance and specific place of performance.

Bihu: Bihu is a festival celebrated by all the Assamese people, irrespective of caste and creed. Bihu is celebrated mainly on two occasions. While Bhogali Bihu is celebrated in mid-January with a feast after harvesting the paddy, the Rongali Bihu is to welcome the Assamese New Year and to prepare for the new plantation of crop. This festival is celebrated for two days in Mid-April. The first day is to worship the cows while the next day is the New Year. The cattle are bathed in the *beels* and rivers, and are given herbal treatment all over their bodies to protect them from diseases. The cattle are fed with choicest vegetables and fodder. This is followed by a community bath and celebrations.

Jon *Beel* Mela: Jon *Beel Mela*, a fair, is held during the *Bihu* festival of the Tiwa (Lalung) community on the shores of the Jon *Beel*. The objective of the fair is to exchange Bihu greetings between the Lalung groups living in the hills and those living in the plains. The unique feature of the fare is the exchange of goods by barter trade. The total exchanges are often estimated to be over a millions rupees. (Refer Photo plate no. 12,13 and14). The fare is declared open by the Gobha King (Lalung King) who holds a feast with the fish caught from the *beel*. The community fishing follows on the next day for which people come from places which may often be over twenty kilometers away from the *beel*.

Bathou Puja: Bathou, the supreme deity of the Bodo-Kacharis, represent the five elements, *Panchabhut* (earth, air, water, ether and fire) out of which emerged human body and the entire universe. Bathou Puja is performed on the shores of specific *beels* during the third week of March with offerings of chicken and rice beer to the deity. The objective of the puja is for protection of the crops till the harvest.

Basantipuja Basanti puja is held on the 2nd day of *Baisakh* (the first month in Assamese calendar). As the name suggests, it is festival of the spring season and the prayers are for the welfare of the community as well as for the family during the year. The puja is performed on the bank of the *beels* primarily by the Bengali Hindu people.

Table No. 6.5 Some of the customs, traditions and Religious rituals associated with *Beels* and performed by the people of Morigaon.

Name of the Ritual/Custom	**Nature**	**Performing Community**	**Performing Time of the year.**	**Specific Location/ *Beel***	**Objective of Performance**
1. *a) Bihu Bhogali* *b)Bihu Rongali*	Community	Assamese (Hindus & Muslims)	Mid- January Mid- April	Paddy fields All *beels* & rivers	Celebration after harvest Community Bathing of cattle & Community bath.
2. *Jon Beel Mela*	Community	Assamese (Primarily Tiwa)	Mid-January	Jon *Beel*	Community Fishing and Barter exchange of goods between the people from the plains and the Hills. Community feast offered by the Gobha king.
3. *Bathou Puja*	Community	Assamese (Bodo community)	3rd week of March	Rogiya *Beel* Sondaba *Beel* Hatiya *Beel*	Worship with sacrificial offerings of goat, pig and pigeon are made to the goddess of water . Sacrificial offerings are not made in Sondaba *beel.*
4. *Basanti puja*	Community/ Individual	Bengali Hindus	Mid- April	Pakaria *Beel*	Worship and Offerings made to the goddess for collective as well as individual welfare.
5. *Chhat Puja*	Community	Bihari Hindus	November	Manaha *Beel*	Community bath and offering prayers to the Sun God for overall sustainability.
6. *Asta Prahar Palnam*	Community	Bengali Hindus	October	Bhur *Beel*	Community singing in praise of the gods for community welfare.
7. *Ganga Puja or Jal Puja*	Individuals	*Mahaldar/* Bengali Hindus	Prior to fishing	All *beels*	The offerings are made by the person undertaking lease contract to catch fish in *Beels.*

Table No. 6.5 Some of the customs, traditions and Religious rituals associated with *Beels* (Continued).

Name of the Ritual/Custom	**Nature**	**Performing Community**	**Performing Time of the year.**	**Specific Location/ *Beel***	**Objective of Performance**
8. Banti Puja	Individual	Assamese	All year	Manaha *Beel*	Prayers are offered in the evening hours of every Saturday or Sundays after lighting earthen lamps. There is a belief that pains are cured if one bathes in the *Beel* after offering prayers.
9. Manasi Puja	Individual	Bengali Hindus	June- July	Sagalikata *Beel*	Prayers are offered for the welfare of the family and the domestic cattle. 2.5 Kgs of Salt and Sugar are poured into the *Beel* after performing the puja.
10. Astami Snan	Community	Bengali Hindus	April	Pakaria *Beel*	Community bathing before performing Basanti Puja.
11. Nabadya Offerings	Individual	Assamese & Bengali Hindus	All year	All *beels* and rivers	Ritual offering for the welfare of the family and relatives.
12. Pinda Offerings	Individual	Assamese & Bengali Hindus	All year	All *beels* and rivers	Ritual offering to the dead. Performed for ten days from the date of death and once every year thereafter.
13. Dinga Offerings	Individual	Assamese & Bengali Hindus	All year	All *beels* and rivers	Ritual offering for the welfare of the family and relatives.

Chhat Puja: Chhat Puja is performed primarily by the Bihari Hindu community. The prayers are offered after bathing in the rivers and *beels*. The ritual is related to worship of the Sun God and is performed during the month of November.

Ganga Puja or Jal Puja : As the name suggests, Ganga or *Jal puja,* is a general worship of the *beels* and rivers for the protection of the community as well as for the family. The *puja* is performed primarily by the Bengali Hindu people and the contract labourers engaged by *Mahaldars*, the fishing contractors.

Banti Puja : *Banti Puja* is performed with specific objectives. It is believed that by bathing in Monoha *Beel* after performing *Banti Puja*, one is relieved of pains. The *puja* is performed during the evening hours on every Saturdays or Sundays by lighting earthen lamps. The *puja* is performed by all communities.

Pinda Offerings: *Pinda* offering is a personal ritual performed by all Hindus on death in the family in which the sons or the brothers offer prayers on the shores of the wetlands. The prayers include offering of food to the deceased ones and his forefathers which is discharged into the waters so that the fish and other aqua fauna can consume. Depending on the community and the caste of the deceased person, such offerings are made up to the 11^{th} day after death. The performer bathes in the water after discharging the offerings into the waters. Thereafter, similar offerings are made on every death anniversary.

Dinga Offerings: *Dinga puja* is performed on the shores of the rivers and *beels* and offerings are made directly to the river or wetlands. A *Dinga* or boat, made from the trunk of a banana plantain, is loaded with all the items of the offering and the *Dinga* is floated away. Generally raw fruits and vegetables are offered although at times even ducks are also offered. The people then leave the place of worship without looking back.

Some of the other rituals which are also performed near the *beels* are: *Asta Prahar Puja, Manasa Puja, Nabadya Offerings* etc. These however are adopted rituals of the district and are performed mainly by the Bengali Hindus.

The valuation of a non-market wetland benefits in providing the opportunities to perform individual as well as community based religious rituals, customs and traditions is thus assessed through contingent ranking method as discussed earlier.

6.9 Economic Valuation of Wetlands by Contingent Ranking Method:

As defined earlier in Chapter IV and V, the economic valuation of wetland is the assessment of all the classes of benefits derived from the wetlands in monetary terms. Therefore mathematically expressed as the summation of all direct extractive (VDE), direct but non-extractive (VDNE), indirect (VI) benefits derived and the passive (VP) and bequest values (VBQ) assigned.

Total benefits of wetland (TV) thus is:

$TV = \sum VDE_i + \sum VDNE_j + \sum VI_k + \sum VP_l + \sum VBQ_m$, Where i, j, k, l, m, are components of each classification of benefits.

Considering the identified benefits and services derived from the wetlands of Morigaon district, the individual benefit is derived from the rank it holds in comparison to that of fish. The assessed monetary value of a specific benefit is the product of the quotient of the rank of fish with that of the benefit; And accordingly the gross valuation of Wetland benefits thus is summarized in Table 6.6 as below.

Table 6.6.: Contingent Ranking Valuation of Benefits from Wetland of Morigaon

Sl No.	Function	Rank (R)	R_f / R_i	$Pi= (R_f/R_i). P_f$	
				High Av	Low Av
1	Drinking Water	3109	0.2	12098	6950
2	Domestic & Household Use	2460	0.26	15727	9035
3	Cultivating in *Beel* Area	1594	0.4	24196	13900
4	Retting of Jute	2755	0.23	13912	7992
5	Grazing Cattle	3464	0.18	10888	6255
6	Recreation	3558	0.18	10888	6255
7	Irrigation	792	0.80	48391	27799
8	Religious Customs	2875	0.22	13308	7645
9	Extraction of Fish (Rf)	**631**	**1.00**	**60489**	**34749**
10	Extraction of Fauna	2674	0.24	14517	8340
11	Extraction of Flora	4760	0.13	7864	4517
12	Extraction of Organic manure	5246	0.12	7259	4170
13	Transport & Communication	5821	0.11	6654	3822
14	Tourism	6307	0.10	6049	3475
Benefit of wetland functions per hectare (high- low)				**252,240**	**144,904**

Gross Valuation of Benefits from Wetland of Morigaon District is assessed at 252,240 INR (High) and 144,904 INR (Low) per hectare per year.

The assessment of value derived from retting of jute is 14600 INR as compared to the value assessed at 13912 INR (high) and 7992 (low) by Contingent Ranking Method.

6.9.1 Retting of jute

Retting of jute is a process where the mature jute stem is kept submerged in water for period of three to four weeks in order to separate the fibrous outer covering from the stem. In Morigaon district, the jute is kept submerged in the *beels* for convenience and cost efficacy. The area under jute production in Morigaon district in the year 2003-04 has been 2800 hectares with a yield of 25760 bales. The average yield has been 1.65 tons/ha. At the current price of 2000.00 INR per quintal, the average revenue earned is 33000.00 INR per Hectare. The water-spread area required for retting is 1200 square meter (single layer) for every hectare of plantation.

Discounting for the inputs namely seeds, manure, fertilizers, pesticides and other working expenses incurred for growing of jute in Morigaon district, the productivity can be assessed in terms of input labour which amounts to 59.2% of the total input costs. While the average labour input required is 191.64 man-days for the complete process of production, 17.19 man-days or 8.97% of labour input is required for retting. Accordingly, the benefit on labour input is 19536 INR per hectare of plantation and on account of retting is 1752 INR (Dutta, 1993).

The value potential assessed of the wetlands of the district on account of retting of jute is thus INR1752 per 1200 square meter or 14600 INR per hectare per year.

In absence of any baseline data for all indirect or non extractive benefits such as for incremental production of agricultural commodities due to implementation of irrigation facilities, tourists visitation, communication etc. all valuation assessment has been made through contingent ranking.

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CHAPTER VII

SUMMARY OF FINDINGS AND OBSERVATIONS OF THE STUDY

In pursuance to the objective of the study adopting the methodology as stated in chapter IV in order to understand Man's dependence on the *wetlands vis-à-vis* in harnessing the benefits, the findings of the sample survey are :

7.1 Findings

- The water samples so tested from the eleven wetlands reveal that **the quality of water can sustain aqua-fauna, more specifically fish, with high productivity.** Moderate pH, high DO, absence of toxicants, low turbidity are some of the favourable characteristics of the water from the wetlands in Morigaon which indicates the high productivity of the wetlands. The detail test reports of water from various *beels* are enclosed in Appendix VIII.

- The soil samples from the wetland-beds reveal that **the soil is rich in Nitrogen, Phosphorus and Potassium (NPK)** and the reason can be attributed to the no-point runoffs from the agricultural fields being drained into the wetlands. The high fertility of the soil causes rapid growth of phytoplankton or vegetation which in turn enhances the productivity of the aqua-fauna. However, often excessive growth is vegetation (eutrophication) is also observed in many of the wetlands. Some shallow and small wetlands have even degenerated due to eutrophication. The detail test reports of soil samples from sixteen *beels* are enclosed in Appendix- VII.

- Although **one hundred and twelve (112) species of fish have been identified** in the wetlands of Morigaon, only twenty four (24) species are commonly found to be extracted for economic benefits. The list of the diversity of fish species of Morigaon district is closed as Appendix V. Whereas the list of the commonly extracted fish species are included in chapter VI, table 6.2

- Although **sixty three species of wetland and swamp vegetation have been identified** (as enclosed in Appendix VI) only eleven species are identified to be

extracted. Of the eleven species, five species are extracted for consumption as vegetables and medicinal use and six are extracted as raw materials for various utility products. Fodder for domestic cattle, especially during the flood season, is an important product of wetlands.

- The monetary valuation of wetlands in Morigaon without even taking into account the willingness to pay for preservation and optional use is found to exceed the value of equivalent land area by several times. In terms of monetary value, **the wetland benefits in Morigaon district are estimated at a low average of INR 144,904 per hectare per annum to a high average of INR 252,240** as against benefits from land resource through intensive agricultural activities (rice + jute) which cannot exceed INR 48,000 per hectare. The fact that the average willingness to pay by the respondent an amount of 290 INR per year for preservation exhibits the high productivity of the wetlands. The significant economic advantage of wetlands being that it demands little or no capital inputs which enhances the productivity of human efforts as compared to other human activities where man-made capital plays a dominant role.

- The accuracy of the method adopted is reflected by the valuation of jute by Replacement Cost Method (labour productivity) assessed at 14600 INR as compared to 13912 (high) and 7992 (low) by Contingent Ranking Method.

7.1.1 The other relevant findings are:

In assessment of the people's perception of wetland benefits and their attitude towards preservation and sustainable harnessing of benefits (wise use) the findings of the survey are as under:

- Awareness of wetland benefits exist among the population as 92% of the population which has knowledge about the benefits of the *beels* and **94% feel that *beels* are useful and should be protected.**

- In context to the ownership of the *beels* for the sustained preservation, , 60% feel that a village cooperative should own the rights to use the *beels*, 31% feel the village *panchayat* be the owners and 5% think that the government should continue while 4% has no comments. None advocate individual ownership. **Wetland thus is perceived as an asset with common ownership.**

- Identifying the use of the *beels*, 89% considers a *beel* as a source for fish, 49% use the fringe area for cultivation in the winter months. **Hence wetlands of Morigaon are perceived as a major resource contributing to the food security of the district. .**

- As for the investment for development, 47% feel that village cooperative should meet the expenses for preservation and development, 30% feel that village panchayat should invest. While17% puts the responsibility on the government, 6% has no comments. Individuals are not considered at all. **Thus if entrusted with the ownership, people are willing to shoulder the responsibility of preservation.**

- 67% of the respondents are willing to pay (WTP) for preservation of the *beels*. Of the 67% WTP, 95% do not want to commit the amount whereas 5% are willing to contribute an average amount of INR 290.00 per annum. However 68% of the respondents are willing to render their services in lieu of money and 21% have no opinion. Given the opportunity to manage and preserve the *beels*, the local population is willing to pay both in cash as well as in form of labour to develop and preserve the *beels* with a sustainable perception. **The willingness to pay is a strong indicator for high productivity of the *beels*.**

7.2 Observations :

- The habits and practices in fishing observed have clearly made distinction into two groups. While the indigenous population, irrespective of religion or ethnological classification, use nets with coarse mesh and implements with linear gap of more than 10 mm (Photo plate No. 18-21) thereby allowing fry and fingers to escape , the immigrant settlers use very fine mesh nets (mesh size less than 2mm) to catch fish

in the *beels* as elucidated in photo plate No.22 and 23. The value perception of wetland benefits and attitude towards sustainable harnessing differ grossly between the two groups.

- The apathy of the indigenous population towards the *beels* and the unrestricted exploitation is found to be primarily due to the ambiguous ownership and open access to exploitation. Short term lease to highest individual bidder for harvesting of fish generates antagonism from the population surrounding the *beel.* The local population tend to cause harm rather than to preserve the *beel* as they are deprived of the benefits from the *beel.* The lessee, on the other hand, extracts as much as possible without any considerations for the regenerative capacity of the *beel* .

- The average size of the fish caught is gradually decreasing over the past years accompanied by loss of diversity.

- Due to the regular annual floods which inundate almost the entire district, all the cultured fisheries are designed for a period of six to seven months only.

- Respondents belonging to the Hindu religion attach significant importance towards preservation of the wetlands so that they may preserve the customs and traditions and also perform the religious rituals. In ranking of the factors it is ranked at the 3rd highest by the Hindus whereas it is ranked at 2nd lowest by the Muslims. A Hindu is willing to travel up to an average distance of 2 Kilometres to perform such rituals and traditions spending 2-3 hrs for traveling alone. However for the *Jon Beel Mela,* people travel from over 25 km to participate in the community fishing festival.

- Cultural distinction is observed between the indigenous Muslim population and the immigrant Muslim settlers. While the indigenous Muslim population performs the traditional rituals such as bathing of the cattle during *Bihu,* community bathing in *Bihu* and Id or in the *Jon Beel Mela,* the immigrants do not perform such rituals.

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CHAPTER - VIII

SUGGESTIONS AND POLICY FORMULATION

One of the major hindrances in decision making for investment in development and conservation of wetlands (also true for most natural resources) has been the limitation of knowledge in assessing the benefits of investment. The planners consider only the economic benefits derived from the market based goods and services even for investment in public welfare. Such shift of attitude has become more pronounced under the WTO regime of free economy. Non market benefits such as aversion of defensive expenses incurred for the unemployed, upkeep of law and order or for damages caused by hazards from natural and man-made calamities are never considered as benefits. Sustainability of investment is hardly ever addressed. Most economists tend to view growth in GNP or GNP per capita as a sign of healthy economy. (Costanza, et al. 1997)

It is also observed that in all economic investments, the natural resources like air, water and soil are considered without any value attached to it. What is considered in economic valuation is the cost of obtaining the goods and services at the desired quality e.g. the cost-benefit analysis for a town water supply scheme is evaluated for treatment, pumping and distribution of water to the consumers without considering the cost of water itself. Such presumptions are no longer valid as the natural resources are limited and exclusive. Not only the value of water needs to be assessed but the benefits which may be derived in the future are also needed to be considered.

In context of the wetlands of Morigaon district, any invest for development or welfare must take into account of the following:

- In view of the saturation of the area under agriculture in Morigaon district, horizontal increase in area cannot be increased appreciably. In fact the area under agriculture is likely to decrease due to increased settlement, industries and surface communication.
- The hazards due to floods in the district are likely to increase with time due to the siltation of the river Brahmaputra. Hence the flood inundated areas, being over 40% of the agricultural land is unlikely to be used for the second crop. (Map No.4)The cropping

intensity in the district therefore cannot be expected to go beyond 1.6. This also limits the food production in the district. As seen in the graph-1A, the district will become a food deficit district in the very near future. The food security to the population in the district is seriously threatened. As there are no employment opportunities in the industrial sector, conversion of the wetlands for agricultural use will become uncontrollable. The process can only bring greater disasters.

- The increased number of inheritors demanding fragmentation of landholdings, which are already very small, will make any form of investment in the agricultural sector economically unviable. Therefore the agricultural productivity is likely to decline in spite of higher efforts - a situation identical to Scott Gordon's 'open access fishery activity.
- The wetlands of Morigaon, are valuable reservoirs of fresh water for the future besides being the only natural resource other than the land for sustenance of the population that is growing at an alarming rate.

8.1 SUGGESTION:

With the above reality, it is imperative that investment for development in the Morigaon district need to adopt a renewed approach for sustainable benefits.

8.1.1 Preservation and development of wetlands as centres for growth of sustainable economy:

Any planning and strategy for preservation and development of wetlands in general and those of Morigaon district in particular must be envisaged with three perspectives-

1. Economic perspective.
2. Environmental perspective. - and
3. Sociological perspective.

Economic perspective includes sustainability of the investment in development which must generate adequate economic benefits in future not only to support the beneficiaries but also to preserve the natural resource on the long term perspective.

Environmental perspectives must include all activities to enhance the natural productivity of the wetland without causing damage or intervention to the ecology of the wetland system.

Sociological perspectives must embrace all the communities living in the fringe area who are dependent on the wetland so as to make them the responsible custodians of the precious natural capital of the nation. It is for this reason alone that the economic sustainability is important for sustainable preservation of Wetland.

Any human intervention will cause a conflict to the wetland eco-system. The best way to preserve wetland resources is to leave them alone for self-regeneration. However, in regions of high population density with low population status like in Morigaon district, where over 11% of the population is directly dependent on the wetlands for their livelihood, no natural resources can be expected to be left alone as the people have no alternative livelihood. These people will continue to exploit these resources for economic benefits. The strategy therefore suggested, is to supplement the regeneration capacity of nature and regulate the use and extraction so as to maintain the productivity in a sustainable manner. The activities related to development therefore, need to be restricted to the fringe areas without damaging the water-spread areas. e.g. if any effluent from a industry is drained into a wetland, treatment of the effluent must be carried out before it flows into the water body. Likewise, breeding of domestic birds, namely ducks, should be contained within the fringe area through process of camouflaging or physical barrier so that intermingling with migratory birds can be eliminated.

Taking into account all precautionary measures for safeguard of the wetland environment and the biodiversity, some of the economic activities which have been identified are:

A. Enhancing of fish production through development of aqua culture estates.

B. Development of selected wetlands as eco-tourism centers,

C. Development of selected wetlands as education center for life sciences (Zoology and Botany namely aqua fauna and aqua flora).

D. Development of seasonal water logged areas into intensive fishery stocking tanks.

8.1.2 Enhancement of fish production through development of aqua culture estates:

The aquaculture estates are envisaged in the fringe areas more specifically in the derelict or degenerated parts of the wetlands. The development includes clearing of the floating macrophytes, removing of rooted weeds, reclamation of water spread area by pen construction for developing into fish breeding and stocking tanks.

8.1.3 Pen culture:

The swamps, marshes and water-logged areas in the fringe areas of wetlands are more suitable for pen culture. This pen culture can be taken up in the fringe area of the *beel* with high shoreline (through embankment) in the reclaimed swamps and any unused water areas of depth between 1- 1.5 mtr. The size of the pen may be restrained up to 0.5 ha of water spread area. The advantages of pen-culture fishery are - 90-100 % fish recovery and free circulation of nutrients into the pens eliminating the need of investment for fish feed.

The estate must also have eco hatchery, brooding tank and separate breeding tanks for fry and fingerling sizes of fish. These tanks may also be **floating cages** in order to enhance productivity (safe from predators) and to prevent losses during floods.

Integrating the fishery activities, the following will enhance the economic sustainability as well as labour productivity. They are:

8.1.4 Composite Horticulture farming:

Composite horticulture with fishery becomes economically attractive for reclaimed wetlands in which embankment is created on reclamation. The wetland bed-soil being rich in NPK, no fertilizer is required for any plantation. The ICAR experiment at Patna can be adopted with the adaptation to the local conditions. Banana and coconut plantation

intercropped with vegetables (bush and creepers) have already been successfully attempted at the ICAR Patna centre.

8.1.5 Duck Breeding :

Duck breeding is a very common practice of the people living in the neighbourhood of wetlands as the required food for the birds are available in the wetlands and no additional feed is required. Organized in a scientific manner, breeding of duck will enhance sustainability of wetlands by providing feed (droppings of the birds) for the stock of fish on one hand and additional economic benefits from meat and eggs on the other.

8.1.6 Dairy Farming:

Dairy farming is one of the existing major activities of the fringe area primarily due to the availability of green fodder from the *beels*. The fact that major percentage of milk in Assam comes from indigenous cattle speaks of the importance of cattle rearing at household level. There exists tremendous scope for development of dairy sector in the neighbourhood area of wetland.

8.1.7 *Singara* (Water Lily rhizome), Lotus stem (*Nilumbo sp*) and Gorgon or Fox nut *Makhana* (*Eurayle ferox Salib)* Processing:

The rhizome of Water Lily (*Naemphaea nouchali),Singara,* is a nutritious food which is converted to flour for making bread after drying and grinding. It can also be consumed in raw form. *Singara* is widely harvested in most wetlands of Morigaon. The stem Leaf and flower is collected as fodder for domestic cattle.

Gorgon or Fox nuts, commonly known as *Makhana* is an extremely nutritious food that grows in many of the wetlands of Morigaon district. The seeds of *Makhana,* collected from the bed is dried and roasted after removing the shell and is consumed by preparation of various kinds of delicacies and recipes. It contains 9.7% easily digestible protein, 76% carbohydrate, 12.8% moisture, 0.1 % total minerals, 0.9% phosphorus & 1.4% fe. gm. It also contains useful medicinal properties.(ICAR,2006)

Likewise Lotus stem is consumed both as vegetable as well as in pickled form.

The *Singara*, Lotus stem and *Makhana* farming and processing units are expected to be major income as well as employment generating activity besides producing additional food in the district.

Being aqua flora, all the above products are free from chemicals and fertilizers.

8.1.8 Development of selected wetlands as eco tourism centres.

Many of the wetlands of Morigaon are known for their natural scenic beauty. The Pobitara sanctuary is a habitat for the one horned rhinoceros. Ample opportunities exist to develop *Garanga beel,* adjacent to sanctuary, as a major tourist attraction. Like wise some of the selected *beels* can also be developed as eco-tourist centres with the objective of preservation. Needless to emphasize that development must with natural settings without creation of any structure that may pose as threat. For example, any support and essential services like public convenience, food court etc. may be placed away from the *beels.* Certain recreational facilities such as paddle boats and canoe are eco-friendly and helps in regeneration of water quality by process of aeration. Additional attractions may be created to enhance their attractions such as *Bee-* resort accommodation, Aqua tunnel , sculpture gardens, recreation facilities including water sports, children park, minor adventure sports, toddlers' park, educational parks such as mini botanical garden, mini zoological park , open air geographical park etc. Morigaon, being in close proximity to Guwahati city, Nagaon and Jagiroad towns, such centres are likely to be of great attraction. Such centres will also help in imparting field level education to the children in the field of life sciences and environmental science. Economic sustainability is envisaged from all the above services and also from the support services such as cafeteria and food court, public conveniences, parking facilities, first aid facilities, communication facilities etc.

Floriculture in the eco-park will not only render additional beauty but will also activities be undertaken by various *Gram Panchayats*, Self Help Groups, NGOs, and individual entrepreneurs of the neighborhood area.

However, it is only expected that such development will tend to generate organic growth which may have detrimental impact on the environment in general and hence the caution or regulatory actions to be taken right from the planning stage itself. A few examples of such cautions are:

a. prevention from use of any polluting machinery such as engines using hydrocarbon fuel,
b. use of non-biodegradable packaging materials
c. Physical segregation of the breeding areas for domestic birds like ducks.

8.2 Policy Adjustment and Adoption:

- The wetlands being a State matter, a bill needs to be introduced for enactment of a WETLAND ACT similar to the Forest Act incorporating the Indian Fisheries Act 1897, Assam Fishery Rules 1950, Assam *Panchayat* Act and other relevant Acts and Rules incorporating provisions for preservation of fresh water, biodiversity and sustainable wise use. The Act will also need to define the ownership in such manner so as safeguard the rights of the future generations. A wetland policy is needed to be adopted till the time the bill is passed.
- The Wetland Policy must incorporate the status of the *beels* (wetland) to be classified based on :

    a) Biotic inventory and diversity of species,

    b) Economic considerations with provisions for long term lease or transfer of ownership to the village cooperatives/*Gram Panchayat* or any corporate body for sustainable development.

- While defining the wise-use of the *beels*, all provisions of the relevant Acts more specifically for preservation of ecology and biodiversity must be incorporated.

Although some of the aspects of preservation are laid down within the framework of the Indian Fisheries Act 1897 and the Assam Fisheries Rule 1953, the emerging needs

for preservation and sustainable harnessing of the benefits from the wetlands demand immediate review of these Acts also.

- Conversion of *beels* for any alternative use must be prevented. In case of any assessment for valuation for alternative use, non-market benefits including optional and existence value must also be taken into account along with the valuation for all market-based and tangible benefits. The policy must also define the methodology for valuation for the non-market benefits. Strategy to compensate for the loss of value to the *beel* must also be defined within the provisions of the policy. An Environmental Impact assessment as well as a Sociological Impact Assessment be made mandatory for any conversion of even the derelict wetlands.

8.3 Conclusion:

North East India with 19150 Km of rivers, 23972 hectares of reservoir, 143,740 hectares of *beels*, 40,809 hectares of ponds and 2780 hectares of rice-cum-fish culture area is considered as one of the *hot spots* of fish bio-diversity in the world (Kottelat and Whitten 1996). The diversity reported ranges from 172 (Ghosh & Lipton, 1982) to 187 (Mahanta et al, 1998). 34 species have been evaluated to have higher market demand than the Indian major carps where as 19 have similar economic value (Sarkar & Ponniah, 2000).

The *beels* of Assam in general and of Morigaon district in particular, are very rich in nutrients. The quality of water is suitable for growth of aquatic life. Even at a very conservative level of productivity @ 1500 Kg/hectare, the *beels* of Morigaon has a potential to produce over 17000 tons of fish annually. With the increase in production, the support activities which will become necessary are ice plants, cold storage, refrigerated vans, net making, boat making to name a few.

The *beels* of Morigaon district are very valuable resources with immense potential to facilitate production of food and in generating sustainable growth of economy in the district.

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CHAPTER IX

FUTURE SCOPE

This study for valuation of wetland is probably the first study made towards assessment of valuation of any natural resources of north east India, let alone the wetlands. It is for this reason alone that the base line data are not available. Further, the extensive research for valuation of each benefit in a deterministic manner is not only time consuming but also expensive, and researchers without external funding cannot be expected to undertake such studies. Further, the large number of variables and their interdependency coupled with probabilistic nature of biotic productivity make such studies extremely complex. Study of any attribute or benefit in isolation may not have any real time relevance. Such an approach will demand custom research for each of the resources which again is expensive and time consuming. Therefore the need will be to develop a model approach with selected indicators which may be derived through statistical analysis. One such model is suggested for future study which is based on the principles of sustainability i.e. man in complete harmony with nature derived from the *Mahashanti Mantra* of the Hindus as stated in chapter VI.

The model considers that a human activity is the ultimate outcome of value acquired by man as an individual and as a society. Although all activities, regardless of its motivation, have economic consequences, only those activities have been sustainable which generated a surplus Economy, did not damage the Environment to the extent that nature could no longer regenerate, and did not cause conflict to the Ethos of the people to the extent that people could no longer adapt themselves to the changes.

In other words, a human activity becomes sustainable if, and only if, it is in harmony with the **Economy, Environment** and the **Ethos** while demanding the least **Effort/Energy** - the **Four Es**.

Such harmony however, is not readily visible but can only be appreciated only when the conflicts arise. A study of global demography identifies the regions where such imbalances or conflicts amongst the four Es exist. Defining the population status to be a

gross summation of economic status of the population with the available support services it enjoys and the opportunities it avails for a better quality of physical life, the global demography can be broadly classified into four categories : (Bora & Sarma, 2004).

I) Low population density with low population status (LDLS).

II) Low population density with high population status (LDHS).

III) High population density with low population status (HDLS).

IV) High population density with high population status (HDHS)

Although every human activity, (being exclusive in nature), causes conflict amongst the Four Es but such conflicts have become more pronounced in the regions with High population density with Low population status; often termed as developing nations. It is in these regions that the human activities are observed to be of low productivity and bear immediate impact on the environment as the population is more and more dependent on the natural resources for its livelihood. The economic pressures on the natural resources (matter-energy source) in these regions are so high that no resources are left alone for natural regeneration of its capacity/productivity. Sustainable extraction of economic benefits with preservation is the only way to protect the natural assets from being grossly abused and destroyed. The environmental degradation amongst the developed nations has, however been due to hedonistic consumerism. (Durning, 1992)

9.1 Economics :

With respect to conflict of economics, beyond the level of sustenance of life, an activity must have a net surplus generation (i.e. production minus consumption including wastage). The rate of development is dependent on the rate of generation of net surplus. The activity however keeps changing, both in quantity as well as in quality, due to many reasons amongst which change of population is primary. The gap between production and consumption is the ultimate conflict. Such conflict can be positive as well as negative. The net surplus if considered as a negative conflict, the net deficit is considered as positive conflict.

The societal economic conflicts also arise as private cost and benefits are often compared with total societal costs and benefits by the local polity. Likewise, the per capita income based on gross national product (GNP) may be a wrong indicator of economic status without taking into account the defensive expenditures and depreciation of natural capital: Hicksian income

In case of depleting resources, Salah El Serafy (1988) developed an elegant model towards sustainability of income from non-renewable or depleting natural resources. His method involves converting a finite set of income from a depleting resource to an infinite series of true income such that the capitalized values of the two series are equal. In other words, there is no loss of income even after the resource is exhausted (Costanza, et al 1997).

9.2 Environment :

An ecosystem is a flexible, ever changing network. Its flexibility is a consequence of multiple feed back loops that keep the system in a state of dynamic equilibrium (Capra, 2002). Any human activity therefore causes conflict to the environment. Such conflicts continue to change (grow) with the change (growth) of population. Some activities, however, may supplement the process of regeneration of the environment or ecosystem by nature (resilience). Thus the conflicts are both positive as well as negative. The environment comprises not only of air, water and soil but also the biodiversity in totality.

9.3 Ethos :

The Ethos is a very complex summation of large number of functions such as religions, cultural heritage, habits and practice, education, economic & social status, politics, inter and intra-group relationship etc. Grossly, it can be summarized as the human nature, value orientation or outlook. Ethos determines the choice of action, the acceptability or capacity to accept the outcome of an activity. The traditional people are the custodian of the evolutionary experience of mankind. They hold vital and rare wisdom based on their success at managing a sustainable environment, as their ability to exist in harmony with the ecosystems such as forests, that developed cultures are decimating, testifies." (Roy Burman, 1992)

The traditional wisdom of the resource-scarce Laddakhi Buddhists has set the example of sustainability to the modern society through its traditional practice of zero wastes. The philosophy of zero waste led to formation of ZERI (Zero Emission Research Initiative) promoted by Gunter Pauli in the early 1990s (Capra, 2002)

The conflict of ethos can be gauged by the level of chaos within the society such as strikes, crimes, political upheavals, ethnic or group clashes etc as indicators of positive conflicts or fairs, festivals, group functions, celebrations as indicators of negative conflicts.

9.4 Energy

The conflict of human society is primarily due to the conflict in the process of matter-energy conversion. While matter is limited, energy is not limited to the planet only. Only depleting resources like fossil fuel, forest products are limited. Energy from sunlight, wind and ocean current are still non exclusive in nature. While matter-energy transformation will follow the laws of thermodynamics, any system from simple physical to complex ecological or social system tends to operate at the maximum power conditions as was exhibited by H.T. Odum and Pinkerton (Odum & Pinkerton. 1955).

9.5 The Model :

The system comprising the human activity and the four Es is perceived as a dynamic system where each of the attribute is dynamic, which varies not only due to the changing population but also due to the impact of one factor on the others .The four Es, being inseparable, must be considered with a holistic approach. As the absolute status of the Es has no relevance in the continuously changing scenario; and as only the conflicts are visible and not the harmony, the model is conceived with assessment of conflict caused by the human activity on a comparative scale.

In presenting the dynamism of the interrelationship amongst the four Es with the context to human activities, the physical model conceived is with a simple mechanism of a rotating body at the end of a string for each of the factors with the same centre of rotation. The mass of the body 'M' represents the conflict (three bodies – Economy-Mec, Environment-Men and Ethos-Meth) and the length of the string 'Rec, Ren and Reth'

represent the extent of human activity in relation to the three Es respectively. The apex angle at which the body rotates represents the status. The level of the centre of rotation is always at a higher level indicating the basic aspiration of man desiring to attain a higher status. The angle at which the body rotates, determines the required velocity and hence the **Energy** to maintain the balance. Fig-9.1 and 9.2 depicts the concept of the model.

The body maintains the state of dynamic balance under the variables forces, namely the weight, the centrifugal force, and the centripetal forces. The centrifugal force is the force tending to break the balance which is being countered by the centripetal force , the system resilience, maintaining the balance.

In the event of any increase in any one of the variables, e.g. increase of radius **r** i.e. increase of the population density, increase of conflict **m** due to resource limitation or in any effort to raise the population status, higher velocity is demanded to maintain the level. In other words a higher level of Energy input is required.

During this transient stage when the population is growing and the influence of one on the other is not immediate, the three bodies move at different speeds with different gradient. But with increased population and geographical constraints when the influence of one factor on the other becomes immediate, the three bodies will then tend to move under similar dynamic conditions. The steady-state condition is continuously changing with a gradually decreasing gradient indicating that higher and higher Energy is needed to raise the status. The steady-state condition of growth tends to continue with decreasing energy efficiency as is explained by H. Scott Gordon while formulating the problems of open access to natural resource (Gordon, 1954) as depicted in fig- 9.4.

The decrease in the gradient indicates increased level of saturation; that is to say that the human activity results in decreased surplus, higher degradation of the environment (reduced regeneration) and higher conflict of ethos (reduced social harmony). A situation may be reached when the gradient tends to becomes zero at which point the system is expected to collapse i.e. no amount of energy will produce net surplus, the environment will have lost the regenerative capacity.

However, before such a situation arises any or all of the following are likely to happen:

a) Mass migration takes place

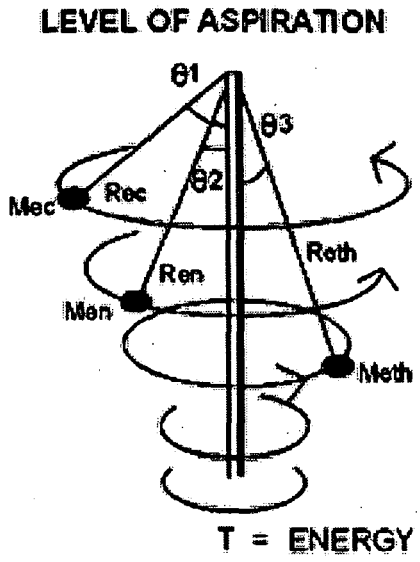
b) War and complete social disorder and

c) The land becomes completely barren.

The model thus is in complete conformity to Malthusian model for population growth and collapse as depicted in fig- 9.3 (Malthus, 1798 [1963]).

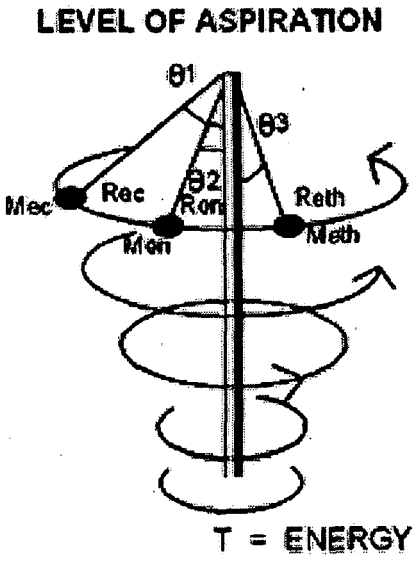
The model also explains why the global carrying capacity of *Homo americanus* would be much lower than the carrying capacity for *Homo Indus,* because an American consumes much more than what an Indian does. (Costanza, et al 1997)

Pictorial Representation of the Model :



AT INITIAL TRANSIENT STATE

Fig – 9.1



AT STEADY-STATE (θ 1 = θ2 = θ3)

Fig: - 9.2

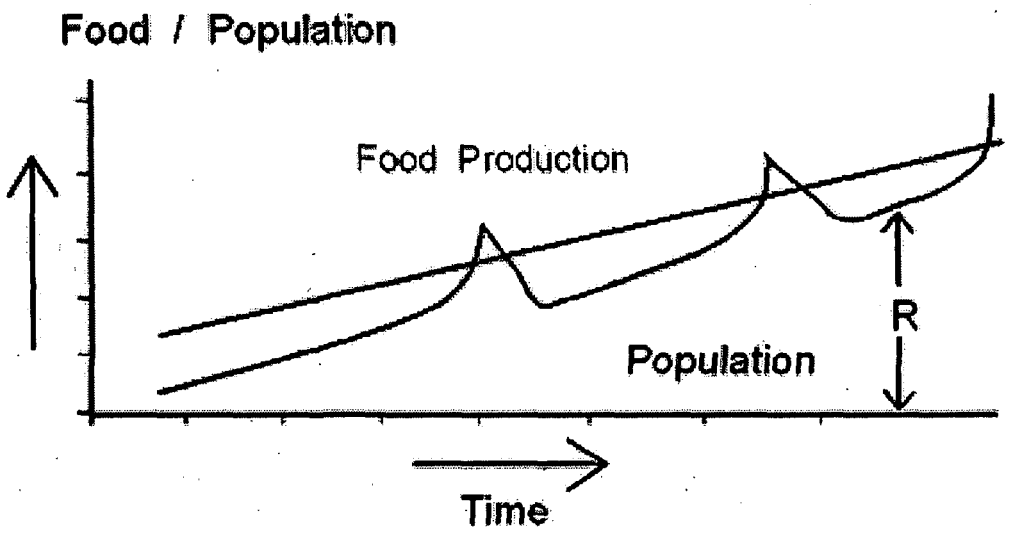


Fig : 9.3 Thomas Malthus's Model of Population Growth (Increase in R)

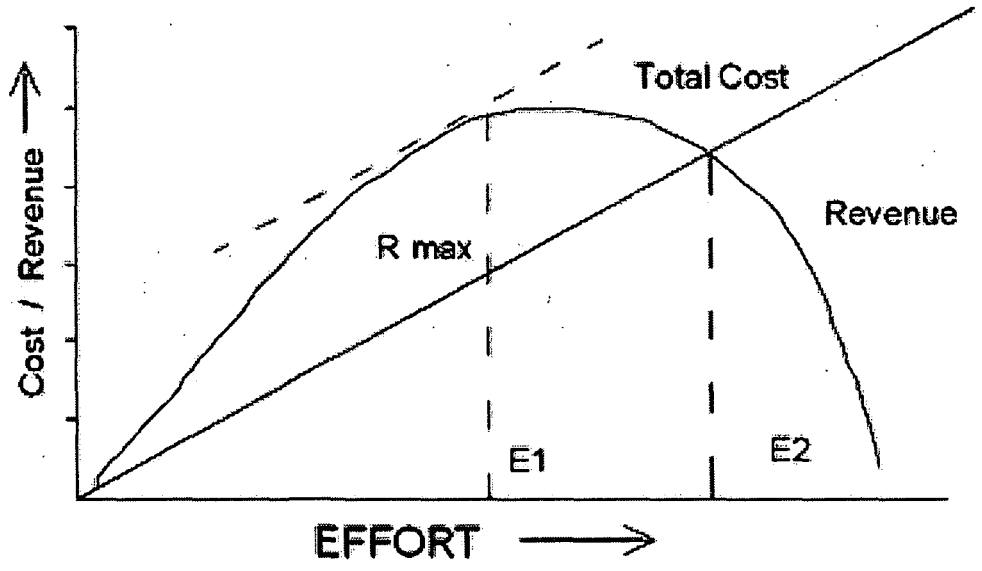


Fig : - 9.4 Scott Gordon's Economic Formulation of Open Access to Natural Resources

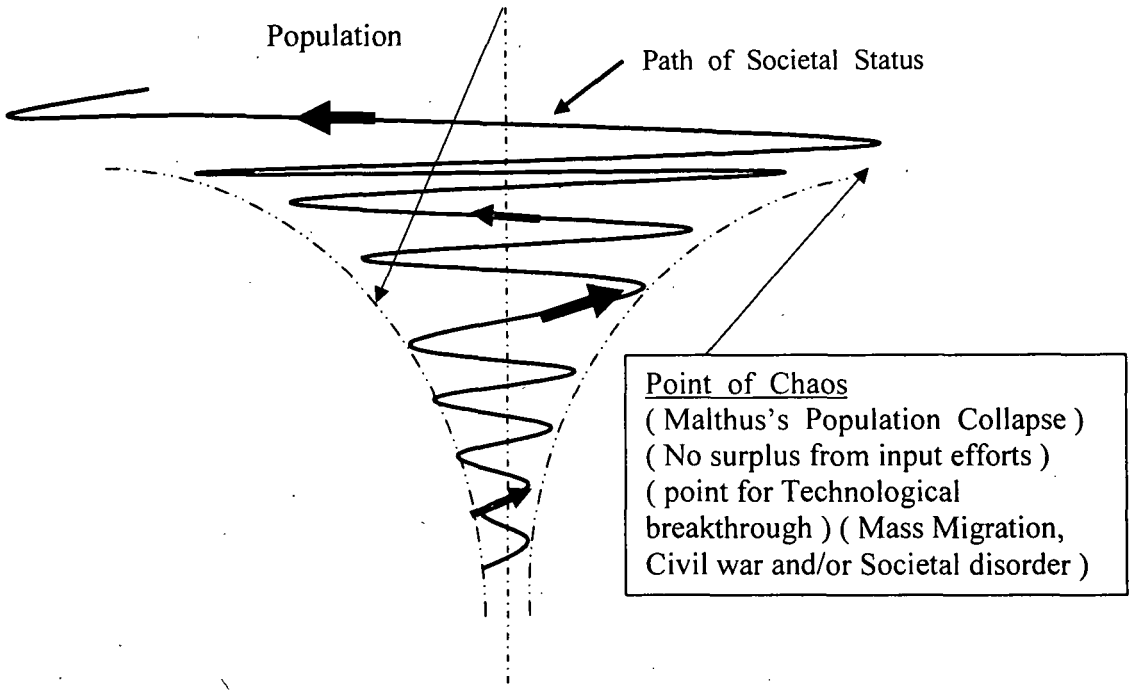


Fig- 7.5 : Growth And Collapse Of Population & Its Status

The benefits of the model are envisaged to provide:

- Complete understanding to the various factors (Four Es) and their sub-factors which shall facilitate better decision making for investment.
- That spiritual development can lead to decreased requirement of energy to sustain human activity is easily explained by the model. It can also explain why Asian nations have higher capacity to sustain its population than the developed western world.
- Assessment of people's participation can be forecast prior to the investment.
- Priority can be set for investment in activities of higher sustainability.
- Above all a universally acceptable approach to determine sustainability of investment more specifically in development and preservation of natural resources and public utility services.

■■■■

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APPENDICES

APPENDIX – I

WETLANDS OF MORIGAON DISTRICT

Table -1: Lake & Pond:

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Hectares)	Turbidity	Vegetation
1	Punhati Duba	Lake / Pond	26:13:20	92:28:52	27.50	27.50	Low	NV
2	Habari Beel	Lake / Pond	26:10:42	92:06:32	12.50	12.50	Low	
3	Dekhal Beel	Lake / Pond	26:11:47	92:08:27	62.50	62.50	Moderate	
4	Donga Beel	Lake / Pond	26:09:22	92:10:22	10.50	10.50		
5	Doani Beel	Lake / Pond	26:16:17	92:17:06	20.00	20.00		
6		Lake / Pond	26:16:59	92:17:04	20.00	20.00		
7		Lake / Pond	26:16:45	92:19:16	5.00	5.00		
8	Juguni Beel	Lake / Pond	26:23:38	92:17:38	61.00	61.00		
9	Amguri Beel	Lake / Pond	26:27:07	92:18:34	5.00	5.00		
10		Lake / Pond	26:22:01	92:20:43	7.50	7.50		
11	Goroimari Beel	Lake / Pond	26:20:26	92:21:52	40.00	40.00		
12		Lake / Pond	26:18:31	92:18:43	7.50	7.50		
13		Lake / Pond	26:16:48	92:29:38	12.50	12.50	Low	
14		Lake / Pond	26:16:03	92:02:43	10.00	10.00	Moderate	
15	Dablang Beel	Lake / Pond	26:15:12	92:10:51	12.00	12.00	Low	
16	Garal Beel	Lake / Pond	26:19:01	92:09:59	110.00	110.00	Low	
17		Lake / Pond	26:13:35	92:25:08	10.00	10.00	Low	NV

APPENDIX – I , WETLANDS OF MORIGAON DISTRICT , Table -1: Lake & Pond: (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Hectares)	Turbidity	Vegetation
18		Lake / Pond	26:11:43	92:22:57	25.00	25.00	Low	PV
19	Solmari Beel	Lake / Pond	26:13:26	92:23:42	7.50	7.50	Low	NV
20		Lake / Pond	26:14:38	92:22:45	5.00	5.00	Low	NV
21		Lake / Pond	26:08:57	92:20:49	12.50	12.50	Low	NV
22		Lake / Pond	26:08:43	92:20:20	12.50	12.50	Low	NV
23	Bhar Beel	Lake / Pond	26:08:18	92:20:55	85.00	85.00	Moderate	VF
24	Bokamari Beel	Lake / Pond	26:08:12	92:18:42	55.00	55.00	Low	
25	Bar Jalah	Lake / Pond	26:07:13	92:18:16	120.00	110.00	Moderate	
26		Lake / Pond	26:06:47	92:17:44	5.00	5.00	Low	
27		Lake / Pond	26:07:12	92:17:39	17.50	17.50	Low	
28	Aram Beel	Lake / Pond	26:06:22	92:16:01	20.00	20.00	Low	
29		Lake / Pond	26:07:49	92:15:51	12.50	12.50	Low	
30	Udmari Beel	Lake / Pond	26:08:09	92:16:02	15.00	15.00	Low	
31	Thakurduba Beel	Lake / Pond	26:09:21	92:16:04	22.00	22.00	Low	
32		Lake / Pond	26:10:45	92:16:20	25.00	25.00	Low	
33	Bordol Beel	Lake / Pond	26:10:37	92:15:45	30.00	30.00	Low	
34	Kanphala Beel	Lake / Pond	26:18:49	92:15:47	15.00	15.00	Low	
35	Leng Kangrang Beel	Lake / Pond	26:21:21	92:15:37	2.50	2.50	Low	
36		Lake / Pond	26:17:12	92:06:56	7.50	7.50	Low	NV
37		Lake / Pond	26:15:05	92:09:50	7.50	7.50	Moderate	NV
	Total				**935.50**	**935.50**		

Table: 2 Swamp / Marsh

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Ha)	Turbidity	Vegetation
1		Swamp / Marsh	26:13:33	92:00:53	7.50	7.50		PV
2	Kanioni Dalani	Swamp / Marsh	26:14:17	92:01:53	70.00	70.00		PV
3	Bikni Duba	Swamp / Marsh	26:14:52	92:02:12	60.00	60.00		PV
4		Swamp / Marsh	26:14:57	92:03:43	10.00	10.00		PV
5		Swamp / Marsh	26:12:39	92:05:09	95.00	95.00		PV
6	Hayara Beel	Swamp / Marsh	26:13:15	92:07:16	105.00	105.00		PV
7		Swamp / Marsh	26:12:44	92:08:40	5.00	5.00		PV
8		Swamp / Marsh	26:12:52	92:08:57	25.00	25.00		PV
9		Swamp / Marsh	26:12:59	92:09:26	30.00	30.00		PV
10		Swamp / Marsh	26:11:59	92:02:29	12.50	12.50		PV
11		Swamp / Marsh	26:12:59	92:09:58	45.00	45.00		PV
12		Swamp / Marsh	26:12:14	92:10:16	7.50	7.50		PV
13	Saliha Beel	Swamp / Marsh	26:13:23	92:10:16	115.00	115.00		PV
14		Swamp / Marsh	26:13:42	92:10:48	15.00	15.00		PV
15		Swamp / Marsh	26:14:31	92:11:24	300.00	300.00		PV
16	Saru Manaha Beel	Swamp / Marsh	26:12:06	92:11:15	305.00	305.00		PV
17		Swamp / Marsh	26:13:54	92:13:00	40.00	40.00		PV
18	Dibika Beel	Swamp / Marsh	26:13:42	92:13:42	12.50	12.50		PV
19		Swamp / Marsh	26:14:37	92:13:59	82.50	82.50		PV

APPENDIX – I, WETLANDS OF MORIGAON DISTRICT, Table: 2 Swamp / Marsh (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Ha)	Turbidity	Vegetation
20		Swamp / Marsh	26:11:47	92:12:59	345.00	345.00		PV
21		Swamp / Marsh	26:10:30	92:12:01	37.50	37.50		PV
22	Jon Beel	Swamp / Marsh	26:09:45	92:12:28	140.00	140.00		PV
23	Haria Ghat	Swamp / Marsh	26:20:00	92:18:22	955.00	955.00		PV
24		Swamp / Marsh	26:25:35	92:17:01	17.50	17.50		PV
25	Moritali Beel	Swamp / Marsh	26:24:11	92:19:30	25.00	25.00		PV
26		Swamp / Marsh	26:23:35	92:20:08	17.50	17.50		PV
27		Swamp / Marsh	26:20:51	92:18:30	50.00	50.00		PV
28		Swamp / Marsh	26:19:08	92:19:24	35.00	35.00		PV
29	Dhali Gaon	Swamp / Marsh	26:19:50	92:24:31	55.00	55.00		PV
30	Patuakata Beel	Swamp / Marsh	26:23:11	92:23:57	115.00	115.00		PV
31	Bartal Beel	Swamp / Marsh	26:26:37	92:23:38	15.00	15.00		PV
32	Dighali Beel	Swamp / Marsh	26:21:22	92:29:37	152.50	152.50		PV
33	Bikni Duba	Swamp / Marsh	26:15:04	92:02:08	30.00	30.00		PV
34	Diburuati Beel	Swamp / Marsh	26:16:09	92:02:55	22.50	22.50		PV
35		Swamp / Marsh	26:16:11	92:03:30	35.00	35.00		PV
36		Swamp / Marsh	26:19:01	92:07:35	12.50	12.50		PV
37		Swamp / Marsh	26:19:40	92:08:08	15.00	15.00		PV
38		Swamp / Marsh	26:18:20	92:11:41	1350.00	1350.00		PV
39		Swamp / Marsh	26:21:55	92:10:14	22.50	22.50		PV
40	Barasibandha Beel	Swamp / Marsh	26:22:04	92:14:20	75.00	75.00		PV

APPENDIX – I , WETLANDS OF MORIGAON DISTRICT , Table: 2 Swamp / Marsh (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Ha)	Turbidity	Vegetation
41		Swamp / Marsh	26:15:32	92:12:21	77.00	77.00		PV
42	Gulmari Beel	Swamp / Marsh	26:11:22	92:25:14	105.00	105.00		PV
43	Letamari Beel	Swamp / Marsh	26:13:53	92:24:04	54.50	54.50		PV
44	Sipri Beel	Swamp / Marsh	26:10:49	92:22:51	180.00	180.00		PV
45		Swamp / Marsh	26:10:13	92:23:56	225.00	225.00		PV
46		Swamp / Marsh	26:13:29	92:23:12	97.00	97.00		PV
47		Swamp / Marsh	26:12:55	92:21:55	7.50	7.50		PV
48		Swamp / Marsh	26:10:25	92:21:24	70.00	70.00		PV
49		Swamp / Marsh	26:09:59	92:21:52	5.00	5.00		PV
50		Swamp / Marsh	26:09:52	92:22:27	17.50	17.50		PV
51		Swamp / Marsh	26:11:31	92:19:07	20.00	20.00		NV
52	Kharputia Beel	Swamp / Marsh	26:10:29	92:19:29	765.00	765.00		PV
53		Swamp / Marsh	26:09:51	92:20:40	50.00	50.00		PV
54	Bokamari Beel	Swamp / Marsh	26:09:14	92:19:03	117.50	117.50		NV
55		Swamp / Marsh	26:10:17	92:17:17	62.50	62.50		NV
56	Mukhtapat Beel	Swamp / Marsh	26:11:17	92:17:02	40.00	40.00		NV
57	Manikpur Beel	Swamp / Marsh	26:14:46	92:18:04	92.50	92.50		NV
58	Banmuri Beel	Swamp / Marsh	26:21:10	92:13:21	170.00	170.00		PV
59		Swamp / Marsh	26:08:56	92:15:20	30.00	30.00		PV
Total					**7051.00**	**7051.00**		

(Total 59 Nos of Swamp / Marsh type Wetlands)

Table: 3 Waterlogged (Seasonal)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area (in Ha)	Turbidity	Vegetation
1		Waterlogged (Seasonal)	26:14:03	90:02:43	15.00	15.00	Low	PV
2		Waterlogged (Seasonal)	26:12:55	92:02:06	15.00	15.00	Low	PV
3		Waterlogged (Seasonal)	26:12:44	92:02:22	5.00	5.00	Low	PV
4		Waterlogged (Seasonal)	26:02:25	92:13:00	25.50	25.50	Low	PV
5		Waterlogged (Seasonal)	26:14:57	92:09:36	5.00	5.00	Low	PV
6		Waterlogged (Seasonal)	26:14:11	92:09:30	7.50	7.50	Low	PV
7		Waterlogged (Seasonal)	26:10:49	92:14:38	128.50	128.50		PV
8		Waterlogged (Seasonal)	26:10:28	92:14:37	12.50	12.50		PV
9		Waterlogged (Seasonal)	26:18:07	92:17:05	5.00	5.00		PV
10		Waterlogged (Seasonal)	26:18:12	92:16:37	7.50	7.50		PV
11		Waterlogged (Seasonal)	26:18:19	92:16:24	2.50	2.50		PV
12	Haruakhanda Beel	Waterlogged (Seasonal)	26:25:47	92:17:47	10.00	10.00		PV
13		Waterlogged (Seasonal)	26:24:09	92:20:53	10.00	10.00		PV
14		Waterlogged (Seasonal)	26:22:41	92:20:52	169.00	169.00		PV

APPENDIX – I, WETLANDS OF MORIGAON DISTRICT, Table: 3 Waterlogged (Seasonal) (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Veg	Total Area (in Ha)	Turbidity	Vegetation
15		Waterlogged (Seasonal)	26:17:34	92:21:08	15.00	15.00		PV
16		Waterlogged (Seasonal)	26:25:54	92:25:45	250.00	250.00	Low	VF
17		Waterlogged (Seasonal)	26:21:46	92:28:12	130.50	130.50	Low	VF
18	Mikirbheta Beel	Waterlogged (Seasonal)	26:18:49	92:27:09	17.50	17.50	Low	PV
19		Waterlogged (Seasonal)	26:15:07	92:07:07	7.50	7.50	Low	PV
20		Waterlogged (Seasonal)	26:16:25	92:07:33	37.50	37.50	Low	PV
21		Waterlogged (Seasonal)	26:15:52	92:08:28	130.00	130.00	Moderate	PV
22		Waterlogged (Seasonal)	26:16:40	92:09:25	127.50	127.50	Moderate	PV
23		Waterlogged (Seasonal)	26:18:49	92:14:54	32.50	32.50	Low	NV
24		Waterlogged (Seasonal)	26:16:35	92:14:00	15.00	15.00	Low	NV
25		Waterlogged (Seasonal)	26:12:22	92:25:10	32.50	32.50	Moderate	PV
26		Waterlogged (Seasonal)	26:09:32	92:21:40	30.00	30.00	Low	PV
27		Waterlogged (Seasonal)	26:12:29	92:20:04	5.00	5.00	Moderate	NV
28		Waterlogged (Seasonal)	26:12:19	92:19:24	10.00	10.00	Low	NV
29		Waterlogged (Seasonal)	26:12:24	92:18:33	25.00	25.00	Moderate	

APPENDIX – I , WETLANDS OF MORIGAON DISTRICT , Table: 3 Waterlogged (Seasonal) (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Veg	Total Area (in Ha)	Turbidity	Vegetation
30		Waterlogged (Seasonal)	26:07:54	92:17:27	25.00	25.00	Low	
31		Waterlogged (Seasonal)	26:08:55	92:17:43	55.00	55.00	Low	
32		Waterlogged (Seasonal)	26:09:17	92:17:21	5.00	5.00	Low	
33		Waterlogged (Seasonal)	26:09:11	92:17:01	5.00	5.00	Low	
34		Waterlogged (Seasonal)	26:10:11	92:16:23	10.00	10.00	Low	
35		Waterlogged (Seasonal)	26:05:04	92:17:44	5.00	5.00	Low	
36		Waterlogged (Seasonal)	26:05:12	92:17:30	7.50	7.50	Low	
37		Waterlogged (Seasonal)	26:18:01	92:22:48	20.00	20.00	Low	
38		Waterlogged (Seasonal)	26:18:13	92:16:00	5.00	5.00	Low	
39		Waterlogged (Seasonal)	26:20:56	92:16:17	20.00	20.00	Low	
40		Waterlogged (Seasonal)	26:18:05	92:16:02	7.50	7.50	Low	
41		Waterlogged (Seasonal)	26:18:14	92:07:07	12.50	12.50	Low	
42		Waterlogged (Seasonal)	26:18:22	92:07:49	15.00	15.00	Low	PV
43		Waterlogged (Seasonal)	26:15:35	92:09:58	45.00	45.00	Low	VF
	Total Area				1521.00	1521.00		

Table: 4 Ox-Bow Lake / Cut off Meander

Sl No	Name/ Identification	Category	Latitude	Longitude	Area (ha) excl. Veg	Total Area	Turbidity	Vegetation
1	Bagabari Beel	Ox-Bow Lake / Cut off Meander	26:13:43	92:00:56	12.50	12.50	Moderate	NV
2	Dipuji Jan	Ox-Bow Lake / Cut off Meander	26:13:25	92:01:28	5.00	5.00	Moderate	NV
3		Ox-Bow Lake / Cut off Meander	26:13:18	92:02:45	40.50	40.50	Low	NV
4	Haduk Beel	Ox-Bow Lake / Cut off Meander	26:14:41	92:03:31	35.00	35.00	Moderate	NV
5	Garukhua Beel	Ox-Bow Lake / Cut off Meander	26:12:34	92:04:50	35.00	35.00	Low	NV
6	Nakara Beel	Ox-Bow Lake / Cut off Meander	26:12:19	92:06:36	100.00	100.00	Low	NV
7	Doipara Beel	Ox-Bow Lake / Cut off Meander	26:13:24	92:08:04	35.00	35.00	Low	NV
8		Ox-Bow Lake / Cut off Meander	26:14:27	92:08:38	20.00	20.00	Low	NV
9		Ox-Bow Lake / Cut off Meander	26:14:03	92:09:30	15.00	15.00	Moderate	NV
10		Ox-Bow Lake / Cut off Meander	26:14:31	92:12:36	47.50	47.50	Low	NV
11		Ox-Bow Lake / Cut off Meander	26:15:44	92:15:46	12.50	12.50		NV
12		Ox-Bow Lake / Cut off Meander	26:16:49	92:15:36	10.00	10.00		NV
13		Ox-Bow Lake / Cut off Meander	26:24:03	92:18:54	10.00	10.00		NV
14	Kuhimari Beel	Ox-Bow Lake / Cut off Meander	26:24:55	92:16:53	10.00	10.00		NV

APPENDIX – I, WETLANDS OF MORIGAON DISTRICT, Table: 4 Ox-Bow Lake / Cut off Meander (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Veg	Total Area	Turbidity	Vegetation
15	Katani Beel	Ox-Bow Lake / Cut off Meander	26:26:16	92:19:48	45.00	45.00		NV
16		Ox-Bow Lake / Cut off Meander	26:24:26	92:20:11	17.50	17.50		NV
17		Ox-Bow Lake / Cut off Meander	26:20:49	92:23:09	2.50	2.50	Low	NV
18	Ataimari Beel	Ox-Bow Lake / Cut off Meander	26:22:32	92:23:28	25.00	25.00	Low	NV
19		Ox-Bow Lake / Cut off Meander	26:27:11	92:24:35	12.50	12.50	Low	NV
20	Gatanga Beel	Ox-Bow Lake / Cut off Meander	26:19:44	92:29:43	20.00	20.00	Low	NV
21	Charipuria Beel	Ox-Bow Lake / Cut off Meander	26:19:31	92:28:59	22.50	22.50	Low	NV
22		Ox-Bow Lake / Cut off Meander	26:15:55	92:26:25	582.50	582.50	Moderate	NV
23	Mori Suti Beel	Ox-Bow Lake / Cut off Meander	26:15:41	92:05:53	35.00	35.00	Low	NV
24		Ox-Bow Lake / Cut off Meander	26:17:51	92:07:30	10.00	10.00	Low	NV
25		Ox-Bow Lake / Cut off Meander	26:17:41	92:07:19	5.00	5.00	Moderate	NV
26	Chagalikata Beel	Ox-Bow Lake / Cut off Meander	26:17:15	92:08:00	115.00	115.00	Moderate	NV
27		Ox-Bow Lake / Cut off Meander	26:21:42	92:10:32	15.00	15.00	Low	NV
28	Son Duba	Ox-Bow Lake / Cut off Meander	26:22:02	92:12:47	250.00	250.00	Moderate	VI
29		Ox-Bow Lake / Cut off Meander	26:13:24	92:25:38	13.00	13.00	Low	NV

APPENDIX – I, WETLANDS OF MORIGAON DISTRICT, Table: 4 Ox-Bow Lake / Cut off Meander (Continued)

Sl No	Name	Category	Latitude	Longitude	Area (ha) ex. Veg	Total Area	Turbidity	Vegetation
30		Ox-Bow Lake / Cut off Meander	26:14:05	92:25:26	25.00	25.00	Low	NV
31		Ox-Bow Lake / Cut off Meander	26:14:43	92:24:51	52.00	52.00	Moderate	VF
32	Dondua Beel	Ox-Bow Lake / Cut off Meander	26:14:27	92:21:53	40.00	40.00	Low	NV
33	Dondua Beel	Ox-Bow Lake / Cut off Meander	26:14:02	92:21:50	117.00	117.00	Moderate	PV
34	Damal Beel	Ox-Bow Lake / Cut off Meander	26:12:08	92:21:03	20.00	20.00		NV
35		Ox-Bow Lake / Cut off Meander	26:11:00	92:18:58	15.00	15.00	Low	NV
36	Mora Kolong Beel	Ox-Bow Lake / Cut off Meander	26:14:36	92:19:22	140.00	120.00	Moderate	
37	Saran Beel	Ox-Bow Lake / Cut off Meander	26:13:38	92:17:27	92.50	92.50	Moderate	
38		Ox-Bow Lake / Cut off Meander	26:18:45	92:28:30	5.00	5.00	Low	
39		Ox-Bow Lake / Cut off Meander	26:18:07	92:07:15	2.50	2.50	Low	
40		Ox-Bow Lake / Cut off Meander	26:17:46	92:08:25	50.00	50.00	Moderate	NV
41	Gobra Beel	Ox-Bow Lake / Cut off Meander	26:18:55	92:13:21	25.00	25.00	Low	NV
		Total	**2142.50**			**2142.50**		

Table: 5 Tank

Name	Category	Latitude	Longitude	Area (ha) ex. Vegetation	Total Area	Area in Sq.KM	Turbidity	Vegetation
	Tank	26:16:06	92:17:51	2.50	2.50	0.025		
	Tank	26:24:09	92:19:47	2.50	2.50	0.025		
	Tank	26:17:59	92:27:16	2.50	2.50	0.025	Low	
			Total	**7.50**	**7.50**	**0.08**		

79 Nos of < 3x 3 mm type of wetlands which are smaller than 2.25 hectares, Total Area - 177.75 Hectares,
Where names are not indicated, the same have not been identified with distinct entity.

Table – 6

Beels under Assam Fishery Development Corporation (in Morigaon District)

Sl.No.	Name of the beel	Water area in Ha.
1.	NO.32 Daipara	20.97
2.	No.35 pakaria	90.07
3.	No.43/44 Pabhakati sunduba	16.40
4.	No.45 Udari	30.06
5.	No. 46 Morakollong	61.90
6.	No. 47 Morakollong	21.20
7.	No.50 Nakhanda	31.0
8.	No.77 Dandua	53.0
9.	No. 79 Damal	16.0

Beels under the Revenue Department

Sl.No.	Name of the beel	Water area in Ha.
1.	No 5 Sonaidadi Part III	86.0
2.	No.1 Morasonai	39.33
3.	No. 10 Kollong Nadi	29.53
4.	No.22 Dharala	4.70
5.	No.26/26 (A) 34 Mariadubi Dharabeel Gr.	8.80
6.	No.29 Nekera Nekeri	45.95
7.	No.38 Merisuti	19.79
8.	No.48 Thekera	29.20
9.	No.49/51Patuakata/ Bhulakata/ Saikata/ Morasonai	39.57

Sl.No.	Name of the beel under Assam Fishery Development Corporation	Water area in Ha.
10.	No.106 Lalibeel	39.0
11.	No.129 Haria dablong	14.48
12.	No.147 Manipur	33.05
13.	No.151/153/ Karmari/ Nandini	49.05
14.	No.155/156 Borjalah / Newa	85.80
15.	No.174 Dhali	15.60
16.	Chagalikata	22.04
17.	Charan	72.70
18.	Dewra	8.80
19.	Sonai	124.13
20.	Mokasonai	39.33
21.	Kuji	41.0
22.	Manaha	21.06

Sl.No.	Name of the beel under the Revenue Department	Water area in Ha.
10.	No.11 Kollong Nadi part V	
	No. 25 Dhipujijan	242.43
	No.28 Garanga	
	No.103 Garsang.	
	No. 104 Malia Gr.	
11	No 107 Hathia	40.17
12.	No.110 Era Kollong.	29.53
13.	No.122 Garalu	18.41
14.	No.125 Suna	22.66
15.	No.145 Chaliha	10.66
16.	No.149/150 Borbeel/Kacharijan gr.	10.06
17.	No.165/166/167/168 purana senai / chala / garanga / sukraj gr.	55.16
18.	NO.162/163/164 Khandajan/sidhali/ galua gr.	30.90
19.	No. 171/173 saruthal/gerali	49.58
20.	No.157/158 Nangalkuri/Chakchaki	22.67

APPENDIX - II

LIST OF 1991 CENSUS VILLAGES IN MORIGAON (Reference to the Maps)

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
001/010	Chanaka Gaon	040/010	Gagalmari
002/010	Gamariguri	041/010	Gagalmari No.2
003/010	Barhaitari	042/010	Kacharigaon
004/010	Kalsila	043/010	Bahakajari
005/010	Loomati	044/010	Merar Mabi
006/010	Mayang Pathar	045/010	Khatarbari Mikirgaon
007/010	Dhekiabari	046/010	Garoimari
008/010	Burha Mayang	047/010	Nandinibari
009/010	Chengmari	048/010	Chhota Garjan
010/010	Hatimuria	049/010	Bamunjari
011/010	Kachasila	050/010	Barkurani
012/010	Katahguri	051/010	Lecheribari
013/010	Garubandha	052/010	Gagalmari Achegar
014/010	Khanda Khaita	053/010	Gagalmari No.1
015/010	Pakariguri	054/010	Borgaon No.2
016/010	Phaliamari	055/010	Garakhia Dhap
017/010	Kariguri	056/010	Sidhaguri
018/010	Phaliamari Habi	057/010	Marisuti Tup
019/010	Phakhaite	058/010	Patekibari
020/010	Hati Bhange	059/010	Marisuti Pam
021/010	Teteliguri Gaon	060/010	Kuranibari
022/010	Murkata Pathar No.1	061/010	Bura-buri gaon
023/010	Murkata Pathar No.2	062/010	Khulani gaon

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
024/010	Raja Mayong	063/010	Garumara Doloni
025/010	Kanjuli Pathar	064/010	Satsapari Doloni
026/010	Chengmari pathar	065/010	Bor Doloni
027/010	Pabitara P.G.K	066/010	Buha Pahar
028/010	Theng Bhanga	067/010	Borjari No.1
029/010	Diprang	068/010	Borjari No.2
030/010	Barpak Jungle	069/010	Belimara
031/010	Buha Dalani	070/010	Jhargaon
032/010	Makara habi	071/010	Karchuma Bari
033/010	Kukuari	072/010	Kaorihagi
034/010	Hatigarh P.G.R	073/010	Bargaon No.1
035/010	Sildubi Gaon	074/010	Achighar
036/010	Barmur Pathar	075/010	Lecharipar
037/010	Bhaluka Jari	076/010	Balimukh P.G.R
038/010	Barmari	077/010	Kachari Jan
039/010	Barmari Pam	078/010	Gar Jan
079/010	Karati Pam	124/010	Sarukoloi
080/010	Kapao Jari	125/010	Barkoloi Pathar
081/010	Belar Bari	126/010	Chatabari
082/010	Bangal Para (sukati Puta)	127/010	Dimaruguri
083/010	Gabhura lup Pathar	128/010	Kongar Gaon
084/010	Gabhura lup	129/010	Khula Gaon
085/010	Temi Herua	130/010	Ghagua Mari Gaon
086/010	Bharal lup	131/010	Ghagua Pahar
087/010	Katah Jari	132/010	Kumai Pahar

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
088/010	Bata Bari	133/010	Kumai Gaon
089/010	Khana Gharia	134/010	Jagi
090/010	Kata Jari Pathar	135/010	Darangia Gaon
091/010	Bangal Para	136/010	Kachari Gaon
092/010	Satsapar Dalani	137/010	Bhakat Gaon
093/010	Gagal Mari Pam	138/010	Baghjap
094/010	Kahua Habi	139/010	Natun Bangal Bori
095/010	Laokhua Bari	140/010	Bongalbori No.1
096/010	Gar Mari	141/010	Dongabori No.1
097/010	Bar Garmari	142/010	Dongabori No.2
098/010	Pani Kaori	143/010	Guri Pathar
099/010	Khukati Puta Habi	144/010	Kujadal
100/010	Chota Gamari Guri	145/010	Bangalbori No.2
101/010	Gamari Guri	146/010	Khutradal
102/010	Bebejia Habi	147/010	Kakor Jalah
103/010	Saru Bari	148/010	Saku Maku
104/010	Bhaluka Guri	149/010	Ghunusha
105/010	Babaka Bari	150/010	Paliguri
106/010	Miz Ghagua	151/010	Chenimari
107/010	Bibika	152/010	Jon Beel
108/010	Barukata	153/010	Bangthai Gaon
109/010	Kal Bari	154/010	Khar Beel
110/010	Raomari Bill	155/010	Dayang
111/010	Hariabari	156/010	Tegheria

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
112/010	hariapar	157/010	Bangfar
113/010	Bardampur	158/010	Hatia Mukh Gaon
114/010	Hati Utha Gaon	159/010	Hatia much Pathar
115/010	Manaha kachari Gaon	160/010	Thakurdova
116/010	Majarbari	161/010	Bihita
117/010	Manaha	162/010	Naldhara
118/010	Saru Manaha Bill	163/010	Sindhisar
119/010	Belarguri Gaon	164/010	Bamun Gaon
120/010	Barsaloni Pathar	165/010	Roumari
121/010	Maba Hatia	166/010	Deosal
122/010	Khana Jan	167/010	Udmari Pathar
123/010	Barkoloi	168/010	Na-Khula Grant
169/010	Na-Khula	174/010	Gaon Galia
170/010	Pachim Nagaon	175/010	Kamarkuchi
171/010	Na-Khula Pahar	176/010	Phakali
172/010	Sonaikuchi N.C.	177/010	Kuthari Bagicha
173/010	Garanga Kuchi	178/010	Sonaikuchi
Bhuragaon Circle			
001/020	Durabandhi	038/020	Baralimari
002/020	Bihabari Beel	039/020	Jengpori
003/020	Bihubari Kachari gaon	040/020	Barunguri No.1
004/020	Baruating	041/020	Dungarpar
005/020	Pabhakati	042/020	Baramari Kachari gaon
006/020	Burakati	043/020	Lengeribori

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
007/020	Bhuragaon Town	044/020	Lengerigaon
008/020	Kupatimari	045/020	Sunduba tup
009/020	Barkur No.1	046/020	Bhuragaon
010/020	Seujipathar	047/020	Bhakuamari Pam
011/020	Kahitali	048/020	Balipara
012/020	Mitmari	049/020	Phalihamari Pathar
013/020	Jatiabori	050/020	Jaribor
014/020	Tulsibori	051/020	Hatilarua Pathar
015/020	Kapurpura	052/020	Tengaguri Kachari Gaon
016/020	Maloakhanda	053/020	Batabari
017/020	Barkur No.2	054/020	Mohmari Pathat
018/020	Barholomkanda	055/020	Otalabori
019/020	Balikhunda	056/020	Fengaguri
020/020	Odalbheta Pathar	057/020	Dhubang Khaiti
021/020	Phalihamari Pam	058/020	Bhuyanbari Pam
022/020	Batalimari	059/020	Ouguri Pam
023/020	Barduba Tup	060/020	Bechamari Duba
024/020	Dighaliati	061/020	Bhakuamari
025/020	Nalahu gaon	062/020	Pukarkata
026/020	Barukata Chaharia	063/020	Barashi Bhanda
027/020	Chaharia Gaon	064/020	Pukalagi
028/020	Sutirpar	065/020	Banmuri Beel
029/020	Jur Beel	066/020	Banmuri
030/020	Baibor Pathar	067/020	Tabtala
031/020	Haiborgaon	068/020	Darangi Gaon

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
032/020	Mirikamari	069/020	Japari Gaon
033/020	Kherkata	070/020	Hindu Japori
034/020	Kubertari	071/020	Rupahi Beel
035/020	Baralimari Beel	072/020	Borpathar No.1
036/020	Betani	073/020	Borpathar No.2
037/020	Garia Gaon	074/020	Dighaliati Pathar
075/020	Raumari	085/020	Haria Beel
076/020	Salmara Pam	086/020	Kharu Herua Beel
077/020	Jamadari	087/020	Kanphali Tup
078/020	Naljari	088/020	Gerua Beel
079/020	Rajabari	089/020	Patrabari
080/020	Niz Gerua	090/020	Gosaibari
081/020	Gerua Ati	091/020	Salmara Beel
082/020	Kamarbori	092/020	Pakaria Beel
083/020	Amaraguri	093/020	Barunguri
084/020	Garapar	094/020	Sandahkhaiti Kachari Gaon
Lahorighat Circle			
001/030	Leruamukh	033/030	Bagalipara Gaon
002/030	Goroimari Pathar	034/030	Rajagadhuma Pathar
003/030	Bhajakhati Gaon	035/030	Barkhabal Pathar
004/030	Moderguri	036/030	Borbori

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
005/030	Sunari Gaon	037/030	Haldhibori
006/030	Dhekarimari	038/030	Narsingbori
007/030	Dhumkura Gaon	039/030	Dungarpar
008/030	Sialmari Kachari Gaon	040/030	Gariabori Gaon
009/030	Sialmari	041/030	Gariabori Pathar
010/030	Bari Gaon Pathat	042/030	Durabandhi beel
011/030	Garakhia Khuti	043/030	Moirabari Gaon
012/030	Harongtoli	044/030	Hatimuria
013/030	Chutia Gaon	045/030	Sagunbahi Pathar
014/030	Roumari Beel	046/030	Durabandhi Gaon
015/030	Chenimari Gaon	047/030	Lachanabari
016/030	Solmari	048/030	Lalirpar
017/030	Ulubari	049/030	Bahalmukh
018/030	Bhajakbaity Pathar	050/030	Barbori
019/030	Barchapari	051/030	Amaraguri
020/030	Bheluguri	052/030	Dhingarati
021/030	Tatikata	053/030	Maritali Pathar
022/030	Moirabari Town	054/030	Bagalipara Pathar
023/030	Barthal Kachari Gaon	055/030	Chetuai Khaiti
024/030	Barthal Doloi Gaon	056/030	Dhupguri
025/030	Hahchara	057/030	Chatiantoli
026/030	Hahchara Bori	058/030	Jengarbori Gaon
027/030	Hugaltoli	059/030	Batobori
028/030	Dattalbori	060/030	Duamari

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
029/030	Dakhin Chenimari	061/030	Demaguri
030/030	Pambargaon	062/030	Bhelbari
031/030	Kataiani Gaon	063/030	Gunaibori
032/030	Mikir Gaon	064/030	Lengribori
065/030	Shaharia pam	080/030	Patiabandha
066/030	Shaharia Gaon	081/030	Boribandha Gaon
067/030	Uralkata	082/030	Boalgari
068/030	Saru Sala	083/030	Lelaibori
069/030	Palah juri	084/030	Lahari Pam
070/030	Barchalagaon No.2	085/030	Garamari Beel
071/030	Patuakata	086/030	Mahmara beel
072/030	Udkati	087/030	Sapkati
073/030	Kachari	088/030	Barchalagaon No.1
074/030	Titatala	089/030	Nagabandha
075/030	Mahdala Bari	090/030	Chitalmari Colony (Char)
076/030	Bhuyanbari Pathar	091/030	Chitalmari Pathar (Char)
077/030	Barangani Pathar	092/030	Garoimari Coloni (Char)
078/030	Chalsingabari	093/030	Chapori (Char)
079/030	Lamdhurunga		
Mkirbheta Circle			
001/040	Kalikajari	027/040	Kalmubari
002/040	Hatibat Simalu Guri	028/040	Thengkhali

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
003/040	Dangria Gaon	029/040	Mikirbheta gaon
004/040	Baranga Bari	030/040	Hakudang Bori
005/040	Bori Gaon	031/040	Saria punji
006/040	Ranga Daria	032/040	Parali Guri
007/040	Fumuka Bori	033/040	Etakali Sabukdhara
008/040	Sil Pukhuri	034/040	Barshila
009/040	Kuji Satra	035/040	Bar Hulung
010/040	Bualguri	036/040	Pub Bori Gaon
011/040	Gakhajua	037/040	Mulan Kamura
012/040	Simaluguri	038/040	Bar Manipur
013/040	Tup Gaon	039/040	Paghali
014/040	Haladhiati	040/040	Kasaibori
015/040	Kabumati	041/040	Sutamanipur
016/040	Khalapia	042/040	Bhakatgaon
017/040	Bhehguri	043/040	Ghumatigaon
018/040	Dura Bori	044/040	Bhumuraguri
019/040	Dighali Pathar	045/040	Niz-Saraibahi
020/040	Surat Bori	046/040	Ghurabak Pathar
021/040	Parasu fangani	047/040	Barchakabaha
022/040	Satari Bori	048/040	Mikirgaon
023/040	Tamuli Bori	049/040	Tarajan
024/040	Tara Bori	050/040	Garmari
025/040	Sukdol Borbori	051/040	Patuakata
026/040	Sukdol Saru Bori	052/040	Najorbori
053/040	Barama Pathar	060/040	Majgaon

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
054/040	Jaluguti	061/040	Kapahera
055/040	Fukunabori	062/040	Palahguri
056/040	Rahdhala	063/040	Niz-Mikir Gaon
057/040	Kashadhara	064/040	Sunaruguri
058/040	Barbhogia	065/040	Bamunbori
059/040	Kahibari		
Marigaon Circle			
001/050	Kaliajari	036/050	Pakamura
002/050	Sinajuri	037/050	Katalamura Bari
003/050	Kanphala Bari	038/050	Bahakajari Pathar
004/050	27.No. Block	039/050	Barunuri
005/050	Chankata	040/050	Bar Manipur
006/050	Dachika Bari	041/050	Manipur No.1
007/050	Bali Pathar	042/050	Manipur No.2
008/050	Latha Bari	043/050	Ahatguri natuagaon
009/050	Donbaha	044/050	Bhairaguri
010/050	Parajari	045/050	Sidhabari
011/050	Dighal Bari	046/050	Naokata
012/050	Nagal toil	047/050	Kachamari pathar
013/050	Dheki phala Bari	048/050	Katahguri
014/050	Boal Guri	049/050	Sapkati
015/050	Bhakar Bari	050/050	Lochana Bari
016/050	Rupah Bari	051/050	Niz Dandua
017/050	Garmari	052/050	Daloi Chuba

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
018/050	Patidaya	053/050	Gashbari N.C.
019/050	Chalabari	054/050	Raja Gaon
020/050	Khatar bari	055/050	Ghoramora Pathar
021/050	Bhur Bandha	056/050	Nagaon
022/050	Ouguri	057/050	Aujari Pathar
023/050	Baranga Bari	058/050	Ulubari
024/050	Chatanguri	059/050	Aujari Gaon
025/050	Malputa	060/050	Basana Ghat
026/050	Udari	061/050	Raina Pathar
027/050	Pat Komai	062/050	Bura Gaon
028/050	Block No.29	063/050	Pachatia Morigaon
029/050	Jarabari	064/050	Bari Gaon
030/050	Saru Duani	065/050	Ban Para
031/050	Chutia Khal	066/050	Luka Kuchi
032/050	Bhagamur	067/050	Salmari
033/050	Konmar Gaon	068/050	Salmari Morigaon
034/050	Chakdhar Bari	069/050	Dandua Bilor tup
035/050	Doani	070/050	Maidhali Pathar
071/050	Mora Kolong No.2	113/050	Tetelia Gaon
072/050	Singi Mari	114/050	Bardal pathar
073/050	Baghara Gaon	115/050	Jurgaon
074/050	Baghara Pathar	116/050	Hati Halanga
075/050	Silsako Gaon	117/050	Mikir Bari
076/050	Bakari Chapari	118/050	Sunabari Pathar
077/050	Morakolong No.1	119/050	Barbari Pathar

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
078/050	Tengaguri	120/050	Bihubari
079/050	Hekenamara	121/050	Uttar Dharamtul
080/050	Salmari No.1	122/050	Bhalukaguri
081/050	Salmari No.2	123/050	Charal Pam
082/050	Belguri	124/050	Ahatguri Gaon
083/050	Patra Bari	125/050	Barbari
084/050	Dihuki Chanaka	126/050	Anjari
085/050	Thekera	127/050	Pub-Dharamtul
086/050	Mori Kolong	128/050	Manta Bari
087/050	Rupai Bori	129/050	Sonabari Gaon
088/050	Naramari No.1	130/050	Sonabari Diksong
089/050	Naramari No.2	131/050	Mati Parbat
090/050	Charai Hagi	132/050	Basundhari Gaon
091/050	Gunamara No.1	133/050	Muladhari Gaon
092/050	Gunamara No.2	134/050	Silbheta
093/050	Kalbari	135/050	Dakhin dharamtul
094/050	Khokhang Gog	136/050	Hatkhola
095/050	Tetelia pathar	137/050	Alichinga
096/050	Jeranga Bari	138/050	Bhogduba Beel
097/050	Oubari	139/050	Bhogduba Habi
098/050	Damal	140/050	Bar Jalah
099/050	Telahi Bhakatgaon	141/050	Block No.8
100/050	Mikir Gaon	142/050	Sarumati Pathar
101/050	Thekera Guri	143/050	Barkhal
102/050	Morakolong	144/050	Palahguri

Village Code /Circle Code	Name of Village	Village Code /Circle Code	Name of Village
103/050	Ahatguri Pam	145/050	Barati
104/050	Sipiri	146/050	Dahuti Habi
105/050	Darala Dubi	147/050	Dabali Makaria
106/050	Bangal Dhara	148/050	Niz-Khola
107/050	Athu Bhanga	149/050	Khola Pathar
108/050	Karai Guri	150/050	Banpara Darapani
109/050	Dahuati Padua pukhuri	151/050	Makaria
110/050	Azar Bari	152/050	Barpayak No.1
111/050	Merua Gaon	153/050	Kumar Bari
112/050	Karaibari	154/050	Killing Bagicha
155/050	Amguri	160/050	Oa Panbari
156/050	Nelly Bagicha No.1	161/050	Khoma Par
157/050	Nelly Bagicha No.2	162/050	Baragop
158/050	Barpayak No.2	163/050	Gegera N.C.
159/050	Khola Hat		

Name of Block	Total No. of village
Mayong	178
Buragaon	94
Laharighat	93
Mikirbheta	65
Morigaon	163
Total	**593**

APPENDIX – III

POPULATION PROFILE OF MORIGAON DISTRICT

Table : 1 POPULATION ANALYSIS 1951

Sl No		Area in Sq. Km	Total Population	Male	Female	Population Density	Gender Ratio
1	Mayong Circle	448.99	38374	20916	17458	85	835
2	Bhuragaon Circle	181.56	29648	15904	13744	163	864
3	Laharighat Circle	195.25	51107	27570	23537	262	854
4	Morigaon	349.96	48682	24988	23694	139	948
5	Mikirbheta Circle	186.2	44657	23341	21316	240	913
	Morigaon District	1361.96	212468	112719	99749	156	885

Source : Census of India

Table : 2 POPULATION ANALYSIS 1961

Sl No	Revenue Circle	Total Area In Sq. Km.	Total Population	Male	Female	Population Density	Sex Ratio Female /1000 Male	Total ST	Male ST	Female ST	Sex Ratio Female /1000 Male	Total SC	Male SC	Female SC	Sex Ratio Female /1000 Male
1	Mayong Circle	448.99	57648	30934	26714	128	864	9449	5054	4395	870	10022	5415	4607	851
2	Bhuragaon Circle	181.56	43764	23314	20450	241	877	2418	1258	1160	922	5760	3125	2635	843
3	Laharighat Circle	195.25	72549	38531	34018	371	883	6598	3390	3208	946	786	438	348	795
4	Mikirbheta Circle	186.2	57086	29632	27454	139	926	9482	4823	4659	965	2904	1549	1355	874
5	Morigaon Circle	349.96	61015	32038	28977	306	904	18633	9530	9103	955	10281	5340	4941	925
	Morigaon District	**1362**	**291979**	**154449**	**137613**	**214**	**891**	**46580**	**24055**	**22525**	**936**	**29753**	**15867**	**13886**	**876**

Source : Census of India

Table : 3 **POPULATION ANALYSIS 1971**

Sl No	Revenue Circle	Total Area In Sq. Km.	Total Population	Male	Female	Population Density	Sex Ratio Female / 1000 Male	Total ST	Male ST	Female ST	Sex Ratio Female /1000 Male	Total SC	Male SC	Female SC	Sex Ratio Female /1000 Male
1	Mayong Circle	448.99	81507	42928	38579	182	899	17288	8693	8595	989	14695	7943	6752	850
2	Bhuragaon Circle	181.56	61480	32146	29334	339	913	5209	2649	2560	966	11703	6166	5537	898
3	Laharighat Circle	195.25	97166	50542	46624	498	922	8824	4441	4383	987	1512	933	579	621
4	Mikirbheta Circle	186.2	69190	35691	33499	372	939	15491	7864	7627	970	4014	2111	1903	901
5	Morigaon Circle	349.96	83537	43569	39968	239	917	20755	10523	10232	972	15822	8263	7559	915
	Morigaon District	**1362**	**392880**	**204876**	**188004**	**288**	**918**	**67567**	**34170**	**33397**	**977**	**47746**	**25416**	**22330**	**879**

Source : Census of India

Table : 4 **POPULATION ANALYSIS 1991**

Sl No	Revenue Circle	Total Area In Sq. Km.	Total Population	Male	Female	Population Density	Sex Ratio Female /1000 Male	Total ST	Male ST	Female ST	Sex Ratio Female /1000 Male	Total SC	Male SC	Female SC	Sex Ratio Female /1000 Male
1	Mayong Circle	448.99	157973	82044	75929	352	925	22479	11398	11081	972	38529	20112	18417	916
2	Bhuragaon Circle	181.56	96858	50331	46527	533	924	10421	5259	5162	982	17321	9095	8226	904
3	Laharighat Circle	195.25	149396	77214	72182	765	935	10251	5110	5141	1006	1655	869	786	904
4	Mikirbheta Circle	186.2	100924	51069	49855	542	976	19394	9636	9758	1013	6500	3358	3142	936
5	Morigaon Circle	349.96	134531	68955	65576	384	951	35938	18077	17861	988	24131	12329	11802	957
	Morigaon District	**1362**	**639682**	**329613**	**310069**	**470**	**941**	**98483**	**49480**	**49003**	**990**	**88136**	**45763**	**42373**	**926**

Source : Census of India

Table : 5 **POPULATION ANALYSIS 2001**

Sl No	Circle	Total Area In Sq. Km.	Total Population	Male	Female	Population Density	Sex Ratio Female /1000 Male	Total SC	Male SC	Female SC	Sex Ratio Female /1000 Male	Total ST	Male ST	FemaleST	Sex Ratio Female /1000 Male
1	Mayong Circle	448.99	203641	105074	98567	454	938	46334	24103	22231	922	29346	14808	14538	982
2	Bhuragaon Circle	181.56	106140	55083	51057	585	927	17616	9237	8379	907	11946	6083	5863	964
3	Laharighat Circle	195.25	183420	94828	88592	939	934	1392	760	632	832	10640	5332	5308	995
4	Mikirbheta Circle	186.2	118220	60028	58192	635	969	7254	3658	3596	983	22229	11167	11062	991
5	Marigaon Circle	349.96	164835	83913	80922	471	964	27750	14127	13623	964	46569	23407	23162	990
	Marigaon	**1361.96**	**776256**	**398926**	**377330**	**570**	**946**	**100346**	**51885**	**48461**	**934**	**120730**	**60797**	**59933**	**986**

Source : Census of India

Table : 6 **DISTRIBUTION OF POPULATION BY SCHEDULED LANGUAGES IN MORIGAON DISTRICT – 2001**

Language	Population
Assamese	529239
Bengali	68131
Hindi	12641
Kannada	8
Malayalam	56
Manipuri	46
Marathi	18
Nepali	1707
Oriya	195
Punjabi	88
Tamil	18
Telegu	169
Urdu	27

Source : Statistical Handbook of Assam -2003

Table : 7 POPULATION IN FIVE YEAR AGE-GROUP BY RESIDENCE AND SEX (2001)

Age-group	ASSAM				MORIGAON				Group %
	Persons	Males	Females	% of total Population	Persons	Males	Females	% of total Population	
1	2	3	4	5	6	7	8	9	
All ages	26655528	13777037	12878491		776256	398926	377330		
0-4	3033998	1539293	1494705	11.38	100556	51028	49528	12.95	
5-9	3603701	1838233	1765468	13.52	116140	59058	57082	14.96	
10-14	3332643	1717969	1614674	12.50	98657	50864	47793	12.71	40.62
15-19	2610793	1368367	1242426	9.79	72021	38712	33309	9.28	
20-24	2315138	1157866	1157272	8.69	63310	31363	31947	8.16	17.44
25-29	2315931	1125381	1190550	8.69	64838	31043	33795	8.35	
30-34	1978201	1006114	972087	7.42	55358	27795	27563	7.13	
35-39	1921570	1020991	900579	7.21	52094	27411	24683	6.71	
40-44	1369116	765738	603378	5.14	37522	20996	16526	4.83	
45-49	1142350	633848	508502	4.29	30684	16810	13874	3.95	
50-54	843595	467765	375830	3.16	23424	12588	10836	3.02	
55-59	599152	317679	281473	2.25	15556	7976	7580	2.00	36.00
60-64	577084	288977	288107	2.16	16459	7983	8476	2.12	
65-69	382083	191204	190879	1.43	10098	4922	5176	1.30	3.42
70-74	296029	157066	138963	1.11	8920	4754	4166	1.15	
75-79	135531	75158	60373	0.51	3928	2191	1737	0.51	
80+	169639	88180	81459	0.64	6234	3157	3077	0.80	
Age not stated	28974	17208	11766	0.11	457	275	182	0.06	2.52

Source : Census of India – 2001

Table 8 CHANGING OCCUPATIONAL STRUCTURE IN MORIGAON DISTRICT (1961, 1971, 1991)

Name	Primary					Secondary					Tertiary				
	Total	Male	Female	% of total population	% of total working population	Total	Male	Female	% of total population	% of total working population	Total	Male	Female	% of total population	% of total working population
1961	82733	66628	16105	28.34	84.91	9867	1059	8808	3.38	10.13	4835	4431	404	1.66	4.96
1971	96650	95831	819	24.60	90.42	1430	1430	0	0.36	1.34	8847	8589	258	2.25	8.28
1991	149529	136058	13471	23.38	85.81	4472	3589	883	0.70	2.57	20248	18381	1867	3.17	11.62

Source : Census of India

Table 9 POPULATION STRUCTURE - RELIGION WISE, AGE WISE DISTINCTION & OCCUPATIONAL STRUCTURE.

Community / Religion Segment	Population	Percentage of total population	Literates	Age group 0- 6 yrs		Working Population						
				Population	Percentage of population segment	Total workers	Percentage of total population	Cultivators	Agricultural workers	Household industry workers	Other workers	Non-workers
Hindus	405302	52.21	239410	62550	15.43	158725	20.45	88453	23177	5934	41161	246577
Muslims	369398	47.59	126976	85933	23.26	103527	13.34	49456	28593	2719	22759	265871
Christians	759	0.10	375	160	21.08	290	0.04	97	46	4	143	469
Sikhs	69	0.01	60	6	8.70	32	0.00	0	0	0	32	37
Buddhists	84	0.01	44	19	22.62	30	0.00	8	6	0	16	54
Jains	308	0.04	267	28	9.09	106	0.01	5	2	1	98	202
Others	5	0.00	3	1	20.00	2	0.00	1	1	0	0	3
Religion not stated	331	0.04	157	61	18.43	112	0.01	63	30	3	16	219

Source : Census of India- 2001

APPENDIX- IV

COMPARATIVE ECONOMICS OF JUTE and PADDY CULTIVATION (per hectare)

Input costs of Jute vis –a - vis paddy cultivation in Rupees			
Sl No.	**Particulars**	**Amount in INR**	
		Jute	**Paddy**
1.	Seeds	600.00	480.00
2.	Manures & Fistulas	140.00	72.00
3.	Pesticides	56.00	26.00
4.	Working Expenses	265.00	115.00
Total		**1061.00**	**693.00**

Table : Labour Input for Jute vis-à-vis Paddy Cultivation (No. of Man days)			
Sl No.	**Particulars**	**Jute**	**Paddy**
1.	Land Preparation	30	30
2.	Sowing of seeds / Transplanting	24	24
3.	Inter culture	18	18
4.	Harvesting	20	20
5.	Transportation from the field	11	11
6.	Drying	4	4
7.	Retting	17	0
	Total Man-days	**124**	**107**

Source: Dutta, S.K. (1993) Ph.D. Thesis, Dibrugarh University, Assam

APPENDIX - V

INVENTORY OF FISH SPECIES IN WETLANDS OF MORIGAON,

[RECORDED, 2004-2006]

Sl.No.	Fish Taxa / Species	Conservation Status	Habitat	Common name
	ORDER : OSTEOGLOSSIFORMES Family : Notopteridae			
1.	*Chitala Chitala*	EN	R, W	*Chital*
2.	*Notopterus Notopterus*	TH	W,W	*Kanduli*
	ORDER : ANGULLIFORMES Family : Anguilidae			
3.	*Anguila bengalensis bengalensis*	NE	R,W	*Nadal bami*
	ORDER : CLUPIFORMESE Family : Clupeidae			
4.	*Gudusia Chapra*	TH	W,R	*Karati*
5.	*Hilsa (Tenualosa) ilisha* (Ham-Buch)		R,W	*Ilish*
	ORDER : CYPRINIFORMES Family : Cyprinidae			
6.	*Chela cachius* (Ham-Buch)	NE	W,R	*Chela danikana*
7.	*C. labuca* (Ham-Buch)	NE	W,R	*Laupati*
8.	*Salmostoma bacaila* (Ham-buch)	NE	W,R	*Chelkeni*
9.	*Amblypharyngodon mola* (Ham-Buch)	NE	W,R	*Chelkani*
10.	*Aspidoparia jaya* (Ham-Buch)	VU	R,W	*Boriola*
11.	*A. morar* (Ham-Buch)	TH	R,W	*Boriaoa*
12.	*Bengala elanga* (Ham-Buch)	NE	W,R	*Eleng*
13.	*Brachydanio rerio* (Ham-Buch)	TH	W,R	*Dorikona*
14.	*D. devario* (Ham-Buch)	TH	W,R	
15.	*Esomus dandricus* (Ham-Buch)	TH	W,R	*Dorikona*
16.	*Parluciosoma daniconius* (Ham-Buch)	TH	W,R	*Dorikona*
17.	*Parluciosoma rasbora* (Ham-Buch)	NE	W	*Dorikona*
18.	*Catla catla* (Ham-Buch)	VU	W,R	*Bahu, Bhakua*
19.	*Cirrhinus mrigala* (Ham-Buch)	TH	W,R	*Mrigal*
20.	*C..reba* (Ham-Buch)	EN	W,R	*Lachim bhangan*
21.	*# Ctenopharyngodon idella*		R,W	*Grass carp*
22.	*L bata* (Ham-Buch)	TH	W,R	*Bogobhangan*
23.	*L. calbasu* (Ham-Buch)	TH	R,W	*Mali*
24.	*L. gonius* (Ham-Buch)	NE	R,W	*Kurhi*
25.	*L. nandina* (Ham-Buch)	EN	W,R	*Nadini*
26.	*L. rohita* (Ham-Buch)		R,W	*Rou*

Sl.No.	Fish Taxa / Species	Conservation Status	Habitat	Common name
27.	*Oreichthys cosuatis* (Ham-Buch)	NE	W,R	
28.	*Cyprimus carpio* (Linneaeus)	TH	W,R	*Common carp*
29.	*O. cotio cunma* (pay)	TH	W,R	
30.	*Puntius chola* (Ham-Buch)	NE	W,R	*Puthi*
31.	*P. conchonius* (Ham-Buch)	VU	W,R	
32.	*P. gelius* (Ham-Buch)	NE	W,R	*Puthi*
33.	*P. phutunio* (Ham-Buch)	NE	W,R	*Phutuki puthi*
34.	*P. Sarana sarana* (Ham-Buch)	VU	R,W	*Cheni puthi*
35.	*P. sophore* (Ham-Buch)	NE	W,R	*Puthi*
36.	*P. terio* (Ham-Buch)	NE	W,R	*Ghena puthi*
37.	*P. ticto* (Ham-Buch)	NE	W,R, HS	*Ghena puthi*
38.	*Hypothalmichthys molitrix* (Valenciennes)		W,R (Ex)	*Silver carp*
39.	# *Aristichthys nobilis* (Richardson)	NE	W,R (Ex)	
	Family : Balitoridae			
40.	*B. Dario* (Ham-Buch)	NE	R,W, HS	*Batuk*
41.	*L. goalparensis* (pillai & Yadani)	NE	R,W	
42.	*L. guntea (Ham-Buch)*	NE	W,R	*Boria*
43.	Somileptes gongota (Ham-Buch)	NE	W,R	
	ORDER : SILURIFORMES Family : Bagridaw			
44.	*Aorichthys aor* (Ham-Buch)	EN	R,W	*Guzi*
45.	*A Seenghala* (Sykes)	EN	R,W	*Ari*
46.	*Batasio batasio* (Ham-Buch)	NE	R,W	
47.	*Mystus bleekeri* (Dey)	VU	W,R	*Singara*
48.	*M. cavasius* (Ham-Buch)	TH	R,W	*Singara*
49.	*M. menoda* (Ham-Buch)	NE	R,W	*Gagal*
50.	*M. tengara* (Ham-Buch)	NE	R,W	*Singara*
51.	*M.vittatus* (Bloch)	VU	W,R	*Singara*
52.	*Rama chandramara* (Ham-Buch)	VU	W,R	
53.	*Rita rita* (Ham-Buch)	EN	R,W	*Ritha*
	Family : Siluridae			
54.	*Ompok bimaculatus* (Bloch)	EN	R,W	*Pobhoa*
55.	*O. pabda* (Ham-Buch)	EN	R,W	*Pabhoa*
56.	*O. pabo* (Ham-Buch)	EN	R,W	*Pabhoa*
57.	*Wallago attu* (Scheidner)		R,W	*Borali*
	Family : Schilbeidae			
58.	*Clupisoma garua* (Ham-Buch)	VU	R,W	*Neria*
59.	*Eutropichthys vacha* (Ham-Buch)	EN	R,W	*Bacha*
60.	*Pseudotropius atherinoides* (Bloch)	EN	R,W	*Gomna*
61.	*Silonia silondia*	EN	R,W	*Kosh*
	Family : Pangasidae			
62.	*Pangasius pangasius* (Ham-Buch)	TH	R,W	*Pangus*
	Family : Sisoridae			
63.	*Gagata cenia* (Ham-Buch)	NE	W,R	*Gagata*
64.	*G. gagata* (Ham-Buch)	NE	W,R	*Gagata*
65.	*Hara hara* (Ham-Buch)	NE	W,R	

APPENDIX – V Inventory of Fish Species In Wetlands of Morigaon (Continued)

Sl.No.	Fish Taxa / Species	Conservation Status	Habitat	Common name
66.	*H. jerdona* (Dey)	NE	W,R	
	Family : Claridae			
67.	*Clarias batrachus* (Linnaeus)	VU	W,R	*Magur*
68.	*Heteropneustes fossilis* (Bloch)	VU	W,R	*Singhi*
	Family : Chacidae			
69.	*Chaca chaca* (Ham-Buch)	EN	W	*Chalmakua*
	ORDER : BELONIFORMES Family : Belonidae			
70.	*Xenentodon cancila* (Ham-Buch)	NE	W,R	*Kokila*
	ORDER CYPRINIDONTIFORMES Family : Aplocheilidae			
71.	*Aplocheilus panchax* (Ham-Buch)	VU	W,R	*Opar Chakua*
	ORDER SYNBRACHIFORMES Family : Synbranchidae			
72.	*Monopterus cuchia* (Ham-Buch)	TH	W	*Cuchia*
	ORDER : PERCIFORMES Family : Ambassidae			
73.	*Chanda nama* (Ham-Buch)	NE	W,R	*Chanda*
74.	*Pseudambassis. Lala* (Ham-Buch)	NE	W,R	*Chanda*
75.	*P. ranga* (Ham-Buch)	NE	W,R	*Chanda*
	Family : Nandidae			
76.	*Badis badis* (Ham-Buch)	NE	W,R	*Randhoni becha*
77.	*Nandus nandus* (ham-Buch)	TH	W,R	*Gedgedi*
	Family : Cichlidae			
78.	# *Oreochromis mossambicus* (peter)		W, (Ex)	*Tilapia*
	Family : Mugilidae			
79.	*Rhinomugil corsula* (Ham-Buch)	NE	R,W	
80.	*Sicamugil casasia* (Ham-Buch)	VU	R,W	
	Family : Gobiidae			
81.	*Glossogobius giuris* (Ham-Buch)	VU	W,R	*Panimutura*
82.	*G. Gutum*	EN	W,R	*Panimutura*
	Family : Anabantidae			
83.	*Anabas testudineus* (Bloch)	NE	W,R	*Koi*
	Family : Belontidae			
84.	*Colisa fasciatus* (Schneider)	NE	W,R	*Kholihona*
85.	*C. Labiosus* (Dey)	NE	W,R	*Kholihona*
86.	*C. lalia* (Ham-Buch)	NE	W,R	*Kholihona*
87.	*C. sota* (Ham-Buch)	NE	W,R	*Kholihona*
88.	*Ctenops nobilis* (Mc clelland)	EN	W	
	Family : Channidae			
89.	*Channa barca* (Ham-Buch)	CR		*Borka cheng*
90.	*C. marujius* (Ham-Buch)	TH	W	*Sal*
91.	*C. gachua* (Ham-Buch)	NE	W	*Chengeli*
92.	*C. punctatus* (Bloch)	NE	W	*Goroi*
93.	*C. stewarti* (playfair)	TH	W	*Pahari cheng*
94.	*C. Striatus* (Bloch)	TH	W	*Soul*
95.	*C. orantimaculatum* (Musikasinthorn)	EN	W	

Sl.No.	Fish Taxa / Species	Conservation Status	Habitat	Common name
96.	*C. bleheri*	EN	W	*Nagacheng*
	ORDER : XI MASTACEMBELLIFORMES Family : Mastacembelidae			
97.	*Macrognathus aral* (Bloch & Sclmeider)	NE	W,R	*Tora*
98.	*M. Pancalus* (Ham-Buch)	NE	R,W	*Tora*
99.	*Masracembelus armatus* (Lacpede)	NE	R,W	*Bami*
	ORDER TEFRAODONTIFORMES Family : Tetraodontidae			
100.	*Ttraodon cutcutia* (Ham-Buch)	NE	R,W	*Gangatop*

(Source : Dr.M.M. Goswami for UGC (DRS) Project, Department of Zoology, Gauhati University)

Index : R = River, W = Wetland, NE = Not evaluated, EN = Endangered, TH = Threatened, CR = Critically Endangered, VU = Vulnerable

APPENDIX - VI

Wetland Vegetation in the Beels of Morigaon.

Sl. No	Botanical Species	Common Name	Purpose of Extraction
1.	*Salvinia cuccullata*	Water Fern	-
2	*Azolla sp.*	Water Velvet	-
3	*Pistia sp.*	**Barpuni**	-
4	*Nllumbo sp*	*padum*	food and economic benefits
5	*Naemphaea nouchali.*	*Bhetphool*	food & fodder
6	**Euryale ferox**	*Makhana*	food
7	Ceratophyllum demersum	***Bottle Brush***	-
8	*Hydrilla vrticillata*	**Panikhar**	-
9	*Nchamndra altrnifolia Ottlia*	-	
10	*alismoids*	-	
11	*Vallisnria spiralis*	Eelgrass	-
12	*Enhydra fleutuns*	*Helochi*	food in form of vegetable
13	*Ipoma aquatica*	*Kolmou*	food in form of vegetable
14	*Najas indica*	-	-
15	*Potamogtion octundrus Eichhornia*	Pond weed	-
16	*crassips Aponogeton sp.*	*Pani Meteka,*	fertilizer
17	*Caldsia parnassifolia Alternnthra*	Hyacinth	
18	*sssilis Nymphoides cristala*	-	
19	*Nymphoides indica*	-	
20	*Jussiaa repens*	-	
21	*Trapa bispinosa*	-	
22	*Uticularia flexuosa*	-	
23	*Limnophyla heterophyta*	-	
24	*Hygrorhiza aristata*	*Pani singari*	food in form of vegetable
25	*Myriophyllum sp.*	-	
26	*Spiodela sp.*	-	
27	*Typha sp.*	-	
28	*Lemna s.*	-	
29	*Elodea sp.*	-	
30	*Woulffia sp.*	*Hogul, patidoi*	Making mats and utility goods
31	*Cyclosorus spp*	Lesser duckwood	
32	*Cyclosorus spp.*	-	
33	*Pouzolzia hirta*	water meal	
34	*Cyperus iria Acrous sp.*	*Dhekia*	
35	*Cyperus pilosus*	-	
36	*Lochris atropurpuria*	-	
37	*Fimbristylis sp.*	Sweet flag	
38	*Scirpus spp.*	-	
39	*Oldenlandia diffusa.*	-	
40	*Ludwigia perenalis*	-	
41	*Osbekia crinata*	-	
42	*Melastoma sp.*	-	
43	*Centella asiattia*	-	
44	*Blumea alata*	-	
45	*Eclipta prostrata*	-	
46	*Eupotorium odovatum*	*Manimuni-*	Medicinal herbs and also as food
47	*Carex indica*	-	
48	*Murdannia mudiflora*	*Jarmani ban*	Medicinal herbs plant
49	*Murdannia triquetra*	-	-

Sl. No	Botanical Species	Common Name	Purpose of Extraction
50	*Digitaria prurins*	*Hargal*	Use in making decorative and utility goods
51	*Hymenachne assamica*	-	
52	*Isachne himalayca Panucum*	-	
53	*auritum*	*Hati dal*	
54	*Panicum repens*	*Pani dal*	Fodder
55	*Paspulum orbiculare*	*Pani ghanh*	Fodder
56	*Phramites karka Polygonum*	*Pani ghanh*	
57	*praetermissum*	-	Building materials
58	*P. hydroopiper*	*Ekora*	
59	*Seceharum spontaneum*	-	
60	*Aeschynomrne aspera*	-	Making fishing-rod floats, ornamental handicraft goods,
61	*Alocasia esculentum Alpinia*	*Kochu Pachum*	
62	*allughas*	*Kuhila*	
63	*Pontedria sp*	*Tara*	

(Source : Dr.M.M. Goswami for UGC (DRS) Project, Department of Zoology, Gauhati University)

APPENDIX –VII

Status of Sample Soil Test

Sl No	Name of Wetland	Acidity	Nitrogen In Organic %	Phosphorus Kg/ Acre	Potash Kg/ Acre
1	Lali Beel	6.7	1.84	1.341	High
2	Sunduba Beel	6.65	1.46	2.54	High
3	Bheloupara Beel	5.70	1.33	1.07	High
4	Kachdhara Beel	4.50	2.60	1.625	High
5	Dandua Beel	4.67	1.65	3.885	High
6	Jaluguti Beel	4.70	3.36	4.595	High
7	Bor Beel	6.25	High	10.089	Medium
8	Solmari Beel	6.16	High	10.874	119.16
9	Mora Sonai	6.26	0.42	2.68	79.01
10	Udari Beel	6.60	0.60	4.779	21.68
11	Hatiya Beel	6.01	High	7.88	High
12	Bher Jamuna Beel	6.15	1.27	3.426	122.84
13	Khandajan Beel	6.17	0.26	1.625	66.10
14	Kalikajari Beel	6.10	0.94	2.35	106.89
15	Thakurduba Beel	6.08	High	9.27	High
16	Charan Beel	6.05	0.48	3.426	99.34

Sample tested at the Soil Laboratory, Department of Agriculture, Government of Assam, Guwahati

APPENDIX- VIII

Status of Chemical Analysis of Water Sample in some selected Wetlands of Morigaon District

Sl No	Name of Wetland	pH	Turbidity in NTU	Free Co_2	Total Alkalinity	Carbonate	Bi Carbonate	N	P	D.O.	BOD	COD
1	Thakurduba Beel	6.90	42.00	4.10	20.00	-	20.00	-	0.20	5.10	4.60	11.20
2	Bor Beel	7.40	12.00	6.10	24.00	-	24.00	-	0.19	6.40	2.20	11.20
3	Jaluguti Beel	7.90	10.00	4.10	78.00	-	78.00	-	0.20	5.00	2.90	20.00
4	Dandua beel	8.10	10.00	5.30	144.00	-	144.00	0.48	0.02	6.90	2.00	9.60
5	Ragiya beel	8.00	20.00	4.00	32.00	-	32.00	0.14	0.20	4.90	4.40	22.40
6	Khandajan beel	7.30	15.00	4.00	92.00	-	92.00	-	0.20	-	-	8.00
7	Solmari Beel	6.60	12.00	4.20	30.00	-	30.00	-	0.20	-	-	17.60
8	Charan beel	7.20	14.00	4.20	106.00	-	106.00	-	0.25	-	-	11.20
9	Udari beel	7.90	12.00	4.40	146.00	-	146.00	-	0.20	-	0.70	1.60
10	Kalijari beel	7.80	14.00	4.40	108.00	-	108.00	-	0.06	-	1.00	20.00
11	Mora Sonai Beel	7.72	15.00	4.10	86.00	-	86.00	0.22	0.03	-	5.00	14.00

Sample tested at Public Analyst's Laboratory, Government of Assam, Guwahati.

APPENDIX- IX

Population Projection of Morigaon District

P(t)=A.exp(bt)					
Year t	**P(t)**	**LogP(t)**	**DLogP(t)**	**(1/h)DLogP(t)**	**LogP(t)-.025935764t**
0	212468	12.266547	0.317890493	0.031789049	12.26654667
10	291979	12.584437	0.29682234	0.029682234	12.32529897
20	392880	12.88126	0.310867775	0.031086778	12.36298311
30	536127	13.192127	0.176599181	0.017659918	12.41471269
40	639682	13.368726	0.193511185	0.019351118	12.33217368
50	776256	13.562238			12.26654667
Total				**0.129569097**	**73.96826178**
Average			B=	0.025913819	12.32804363
			A=	225944.2645	

P(t)=PoE(at)

	t	**P(t)**
1951	0	225944
1961	10	292781
1971	20	379390
1981	30	491618
1991	40	637046
2001	50	825492
2011	60	1069683
2021	70	1386109
2031	80	1796138
2041	90	2327458
2051	100	3015950

APPENDIX- X

PER CAPITA REQUIREMENT OF FOOD (gms/day) AT THE NATIONAL LEVEL

Foodstuff	in gms
Cereals	396
Pulses	43
Leafy Vegetables	58
Other-do-	45
Roots & tubers	40
Milk	200
Fats & Oils	31
Sugar/Jaggery	31
Total	880

Source: Indian Council of Medical Research
Ref: http://www.fao.org/docrep/x0172e/x0172e00.htm

Year	Projected Population	Required Food (In MT) [per capita requirement (880gms) x Total Population]
2001	776256	251883
2011	1069683	346577
2021	1386109	449099
2031	1796238	581948
2041	2327458	754096
2051	3015950	977167

(Projected population from APPENDIX- IX, Food Requirement calculated from the above)

APPENDIX – XI (A)

QUESTIONNAIRE (I) (Phase – I)
VILLAGE DATA SHEET

1. Name of the village
2. Name of nearest urban center & distance from it
3. Modes of communication from the urban center
4. Population data

- Total population.....
- No. of households.....
- Male .....
- Female.....
- Age wise distribution-(less than 15 years .....15 to 45 yrs .....45 to 60 yrs ..... above 60 yrs.....
- Working population : Male ---------- Female ----------
- Occupation data (No)

Sl no	Occupation	Primary	Secondary	Tertiary
1	Agriculture			
2	Fishing			
3	Daily wage			
4	Self Employed			
5	Trading (Specify)			
6	Employed (govt/Private)			
7	Other			

- Education data (nos)

Illiterate	Below X	X-XII	Graduate	Post graduate	Other & Technical

- Ethnological data (nos)

Hindus	Muslims	Christian	Schedule Tribe	Schedule Cast	OBC & Others	MOBC

- No. of families (Persons) living below poverty line .....

INFRASTRUCTURE

- School

Primary ..... Middle ..... High ..... Madrasa ..... Secondary ..... Others .....

- Health care

Dispensary .....PHC .....Hospital .....

- Support Services
- Agri Service center ..... Vety. service center .....
  - Safe during water (specify) .....
  - Irrigation facilities (STW/ canal / LIS / surface water (specify and describe)
  - Electric Power connected : No. of houses connected .....

■■■■

APPENDIX –XI (A) (Continued)

QUESTIONNAIRE (I) (Phase – I)

VALUATION SURVEY FOR THE MORIGAON DISTRICT WETLANDS

- Name of the village ..... • Distance from the nearest urban center ..... Km
- Name of the associated Wetlands..... • Distance from the village .....Km

1. Name of the respondent .....
2. Address .....
3. Age .. ..
4. Occupation .....

Sl. No.	Occupation	Primary	Secondary	Tertiary
1.	Agriculture			
2.	Fishing			
3.	Daily wage			
4.	Self employed			
5.	Trading (specify)			
6.	Employed (Govt/Private)			
7.	Others			

5. No. of household members : ..... Adult (M/F) ...../..... Children (M/F)...../
6. No. of earning members (M/F)...../.....
7. Education

Name of relationship	Illiterate	Below X	X-XII	Graduate	Post graduate	Others & Technical Specify
i. Respondent						
ii.						
iii.						
iv.						
v.						
vi.						
vii.						
viii.						
ix.						
x.						

8. Land holding and distribution (area in Bigha/Katha/Lesa)
   a) High land :..... b) Wetland.....c) Bari (Household) ..... d) Wasteland .....

9. Land use (area in Bigha / Katha / area)
   a) Agriculture .....b) Household (Bari).....c) Forest (Incl. Bamboo plantation) .....

   d) Grazing & fodder .....e) Plantation.....f) Fishery.....g) Others (Specify) .....

10. No. of livestock :
    a) Ploughing bullock/buffalo ----------/----------
    b) Dairy cattle Cow / Buffalo /goat --------/--------/-------
    c) Duck /poultry / pigeon ---------/----------/----------
    d) Others like (Prgs)----------

APPENDIX –XI (A) , Valuation Survey for the Morigaon District Wetlands (Continued)

11. Family annual income (Value in Rs.)

ACTIVITY	ANNUAL EARNINGS in Rupees
Agriculture	
Fishing	
Diary	
Service	
Business	
Others (Specify	
Total	

Total income (Rs. per annum) – < 24000, 24000-48000, 48000-96000, 96000 - >144000
(if respondent is reluctant to divulge only)

12. Do you have knowledge about the benefits of Beels. Yes / No
13. Do you feel Beel are useful and should be protected. Yes / No
14. If yes, who should protect the Beels: Government / Gram panchayat / collectively / individually.
15. Do you use the beel for any religious, ritual or traditional purpose - Yes / No. (specify)
16. Do you let your cattle graze in the fringe / littoral area of the beel - Yes / No
17. Do you feel the beel helps to maintain the water level of the ground water table - Yes / No.
18. How does the beel help / harm you during the floods (Describe briefly)
19. Does the beel bring happiness and joy to you or it brings sorrow (Describe)
20. Would you say the beel is useful to maintain the bio diversity? OR would you suggest that the beel should be used for something else.
21. Would you like to maintain / preserve the beel so that your children can enjoy what you and your forefathers enjoyed.
22. Who is your opinion? Should be the owners - individuals / Village panchayat / government / village cooperative.
23. If you feel strongly that the beel should be preserved and developed. Who should pay for the preservation and development **Individual / village panchayat / government / village cooperative**
24. Do you feel you should also pay for preservation Yes / No

    If yes, how much are you **willing to pay** annually to develop and maintain.
25. (If not writing to pay) what are the reasons-
    1. Cannot afford.
    2. Do not need benefits from the beel
    3. Do not feel preservation is important.
    4. Do not believe in collective ownership.
    5. Fear exploitation an ultimate destruction.
27. Would you contribute your service (labour)for maintenance and development. If yes
    - How many days of labour you are willing to contribute free of cost ----------days
    - How many days wages.....days.

APPENDIX- XI (B)
QUESTIONNAIRE-II (Phase –II)

Valuation survey for the Morigaon District Wetlands

- Name of the village: ..... Distance from nearest urban centre.....
- Associated wetlands/forest..... (Distance).....

1. Name of the respondent : ..... Age:..... (M / F)
2. Religion / Community / Tribe / Cast : / / / Occupation:
3. Literate : PG/ G / HS / Matric / Below X / Illiterate
4. Total family member : (Male: Female:)
5. What are the festivals and ceremonies for which you associate with the wetlands (*Beels*)?

Festival	Personal or family ceremonies	Personal and community rituals

6. Do you feel the existence of waterbody (*beel* and river) is important from the point of view of your being able to perform the above ceremonies and rituals? **Yes No**

If yes; how much distance are you willing to travel away from your home to perform the rituals/ceremonies? [0 – 1 km] {1 – 2 Km] [2 – 4 km] [Beyond 4 km]

7. Do you have any faith in the religious belief , **Yes No** If yes, is it related to the environment **Yes No** If yes in which way ----------
---

8. Does the religion that you practice have any scripture or any teaching or any ritual which support the conservation of the environment **Yes / No / Not aware**

If yes, a) What are the rituals that you offer ----------
b) What type of books & teaching ----------

9. Do you feel that the education in school all colleges for conservation of wetland will bring about awareness and help to preserve/develop the wetlands (*Beels*)? **Yes No**

10. Do you feel that the women care more for preservation of wetlands? **Yes No**
If yes in which way ----------
---

11. Environment is basically for the benefit of mankind and must be harnessed fully. There is no harm if man has to exploit the nature completely. **Yes No**

Appendix- XI (B) Questionnaire -II (Continued)

12. Many people for his benefit exhibit their carelessness, it appears that they have no concern for the environment. Yes No

13. Spiritual development of human being is possible only who are close to the nature. Yes No

14. If we **harness** the benefits of the environment it is only right that we also take care to protect the environment. Yes No

15. The **animists** worship rivers, trees, etc, it appears that environment is a manifestation of his prayers. Yes No

16. Environment is inanimate and man is a living entity and so there cannot be any interaction. Yes No

17. Environment will be exploited as long as man wants it. Yes No

18. Man will exist only as long as environment exists. Yes No

19. Is the respondent dependent on the beel Yes No - if yes for what use:

Sl No	Goods/service/ Functions		Ranking (0-10)	Assign Value (Rs.) (If Possible)
1	Drinking water			
2	Domestic & Household use			
3	Cultivating in beel area (winter)			
4	Retting of jute			
5	Grazing for cattle			
6	Recreation			
7	Irrigation			
8	Religious Customs/ traditions/ Ceremonies/ rituals etc.			
9	Extraction of Fauna			
To be ranked on scale of 7	a. Fish			
	b. Turtle			
	c. Snails			
	d. Crab			
	e. Others, specify			
	f. Others			
10	Extraction of Flora			
To be ranked on scale of 7	a. Fire wood as fuel			
	b. Reeds/ Thatch/ Broom grass			
	c. Fodder for cattle			
	d. Medicinal plant (specify)			
	e. As edible plants (specify)			
	f. Lotus flower/ stem/seeds			
	g. others (specify)			
11	Extraction of organic manure			
12	Transport & Communication			
13	Tourism			

Appendix-XI(B) Questionnaire -II (Continued)

20. Do you preach or advocate environmental awareness to people around you ? **Yes** **No**
If yes, do you do so:

1. to preserve environment for future economic benefit to self	
2. to preserve environment for benefit of the future generations	
3. to preserve environment purely out of love for nature without any self-interest	
4. to preserve environment as performance of religious duties .	
5. to preserve environment for all the reasons above	

Note: To be ranked in the scale of 5

- Comments :

■■■■

APPENDIX- XII

List of Villages and Wetland Surveyed for Valuation (Phase- II)

Sl No	Village Name	Associated Wetland	Total Number of Household
1	Udmari Gaon	Bar Beel	201
2	Jurgaon	Besamari Beel	153
3	Bholgalaghat Gaon	Bhagamur Beel	168
4	Bhurgaon	Bhur Beel	168
5	Borthol kachari Gaon	Borthol Beel	465
6	Bardampur	Chaliha Beel	173
7	Kalbari	Charan Beel	155
8	Damal	Damal Beel	165
9	Simaluguri	Dhali Beel	83
10	Tarabori	Dhali Beel	314
11	Alichinga Gaon	Dimal Beel	209
12	Bar Pathar	Garalu Beel	49
13	Bar pather(I)	Garalu Beel	33
14	Japari Gaon	Garalu Beel	160
15	Kalikajari	Garanga Beel	682
16	Khatorbori	Garanga Beel	209
17	Majorbori	Garukhunda	217
18	Sapkati	Gelgeli	325
19	Vakobori	Gelgeli	254
20	Lawbhurunga	Haria Beel	353
21	Balimukh	Hariya beel	95
22	Patuwakata	Hatimara	206
23	Jaluguti Gaon	Jaluguti Beel	497
24	Niz Bhurbandha	Jia Sonari	291
25	Pachim Junbeel Gaon	Jun Beel	21
26	Gonamara	Kadari	58
27	Kashadhara	Kashadhara Beel	146
28	Khandajan Gaon	Khandajan Beel	161
29	Singimari Gaon	Khandajan Beel	24
30	Kuhwati gaon	Kuji Beel	190
31	Kujisatra Gaon	Kuji Beel	249
32	Batalimari	Lali beel	205
33	Dhupguri Gaon	Lali Beel	135
34	Joribor	Lali beel	277
35	Lalighat	Lali Beel	61
36	Manaha	Manaha beel	314

APPENDIX- XII, List of Villages and Wetland Surveyed for Valuation (Continued)

37	Manaha Kachari Gaon	Manaha Beel	169
38	Mora Kolong Gaon	Mora Kolong Beel	43
39	Dangaria Gaon	Mora Sonai	217
40	Sarusola	Mora Sonai	360
41	Malputa	Mori Beel	14
42	Garumara Doloni	Nekera Nekeri Beel	230
43	Kurani Bori	Pakaria Beel	600
44	Charaihagi	Patuakata	73
45	Roumari	Raumari Beel	145
46	2 no Bhurgaon	Sagalikata Beel	168
47	Borbori	Sola Beel	387
48	Saru Bari	Sola Beel	159
49	Solmari II	Solmari Beel	291
	Bhyanbari Pam	Sondoba Beel	152
50	Barbari Gaon	Sukunya Beel	152
51	Banmuri	Sunduba	167
52	Dungarpur	Sunduba	105
53	Lengari	Sunduba	83
54	Sundubatup	Sunduba	139
55	Kaliabari Gaon	Sunputa Beel	153
56	Thakurdoba Gaon	Thakurdoba Beel	77
57	Thekeraguri Gaon	Thekera Beel	125
58	Konwar gaon	Udari	79
59	Makhanda	Valupara	172
60	GaruKhuti	Voluwakata Beel	179
			11905

PHOTO GALLERY

WETLAND FUNCTIONS AND BENEFITS:

Plate No : 1 AGRICULTURE

Plate No : 2 SOURCE OF FOOD & NUTRITION - FISHING

Plate No : 3 SOURCE OF FOOD & NUTRITION - FISHING

Plate No : 4 SOURCE OF WATER FOR IRRIGATION

Plate No : 5 HABITAT FOR MIGRATORY & DOMESTIC BIRDS

Plate No : 6 RETTING OF JUTE

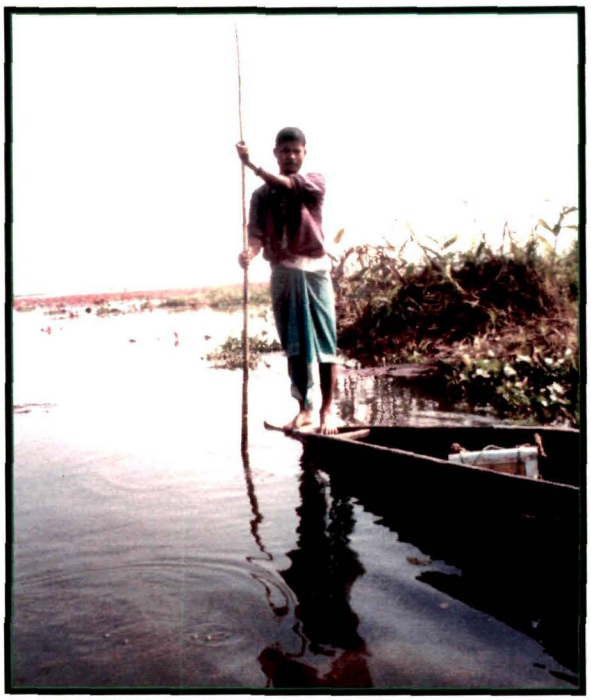

Plate No : 7 TRANSPORTATION & COMMUNICATION AS WATER WAYS

Plate No : 8 TRANSPORTATION & COMMUNICATION AS WATER WAYS

Plate No : 9 SOURCE OF RECREATION – PICNIC SPOT

Plate No : 10 INTANGIBLE BENEFITS – RELIGIOUS PRACTICES

Plate No : 11 COMMUNITY FEASTING – IN JON BEEL MELA

Plate No : 12 BARTER EXCHANGE IN JON BEEL MELA

Plate No : 13 EXHIBITION AND SALE – IN JON BEEL MELA

Plate No : 14 EXHIBITION AND SALE – IN JON BEEL MELA

Plate No : 15 COMMUNITY FISHING (DURING JON BEEL MELA)

Plate No : 16 COMMUNITY FISHING - (DURING JON BEEL MELA)

Plate No : 17 IMPACT OF RECREATION ON WETLAND

FISHING IMPLEMENTS :

Plate No : 18 FISHING IMPLEMENT - *GHAT JAL*

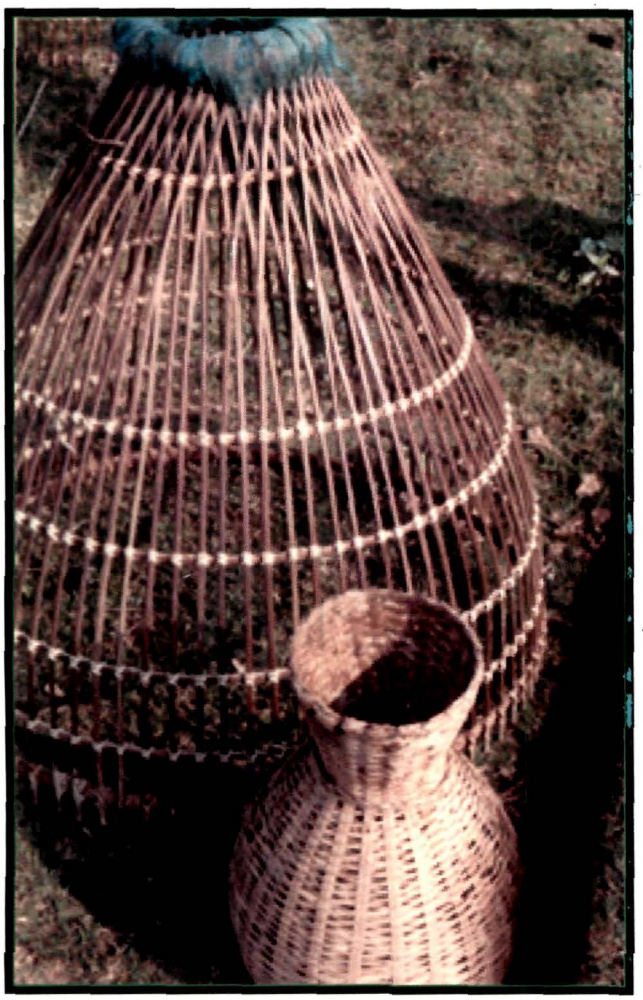

Plate No : 19 FISHING IMPLEMENT - *POLA & KHALOI*

Plate No : 20 FISHING IMPLEMENT - *JAKOI*

Plate No : 21 FISHING IMPLEMENT - *CHEPA*

Plate No : 22 FISHING IMPLEMENT - *GHOKOTA JAL*

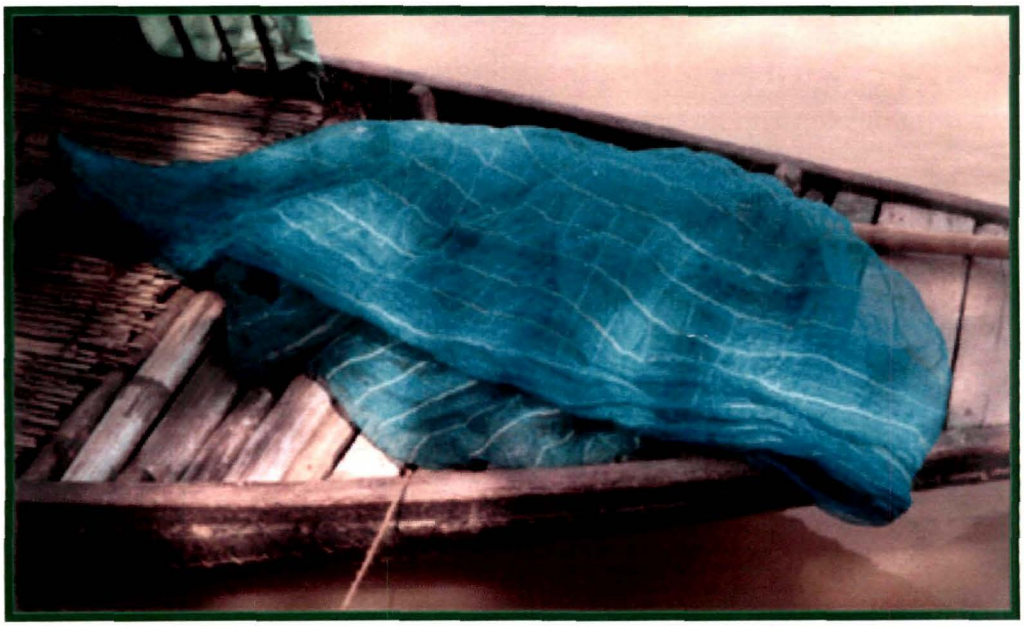

Plate No : 23 FISHING IMPLEMENT - FINE NETS