Proceedings of
Technical Discussion on
Coastal Land Zoning

Working Paper
WP031

October 2004

Program Development Office
for
Integrated Coastal Zone Management Plan
(PDO-ICZMP)

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Prepared by

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EXECUTIVE SUMMARY & RECOMMENDATIONS

A technical session on "Coastal Land Zoning" was held at the BRAC Centre Inn on August 2, 2004. The workshop started at 9:45 with all participants briefly introducing themselves. The discussion followed in four sessions: inaugural, technical, concept presentation and open discussion. Dr. M. Rafiqul Islam, Team leader of PDO-ICZMP, moderated all sessions.

During inaugural session, Mr. Hasan Parvez, Principal Scientific Officer (Engi) of WARPO, delivered the address of welcome on behalf of the Director General, WARPO.

Mr. Abdul Halim Mia, Land Zoning Expert of PDO-ICZMP, presented an overview on "Coastal Land Zoning: Present Status".

During the technical session, a total of 8 presentations were made each giving an overview of land zoning related activities within each organizations or projects. These were from the Forest Department Soil Resources Development Institute (SRDI), Dept. of Fisheries, Char Development and Settlement Project (CDSP) of BWDB, Salt Project of BSCIC; Bangladesh Agricultural Research Council (BARC), Centre for Environmental and Geographic Information Services (CEGIS) and Bangladesh Parjatan Corporation.

The Conceptual Proposal on Land Zoning of the Coastal Areas was made by Dr. Henk Mutsears of PDO-ICZMP.

During the open discussion, a lively and useful debate happened with participation from presenters and others. Others from the Institute of Water Modeling, Fourth Fisheries Project, Dhaka University, Local Government Engineering Department, Shrimp Foundation participated in the discussion. In general, all were supportive of the exercise. Mr. Md. Badiul Alam, Deputy Secretary (Dev.), Ministry of Land, gave concluding remarks.

Recommendation

- ◊ Zoning exercise, initiated by the PDO-ICZMP, is a timely & praiseworthy effort. This should be continued beyond its initial planned period of six months.
- ◊ Land Use Policy (2001) should be used as a guiding document for coastal land zoning.
- ◊ Participation of all relevant agencies should be continued with the aim to produce the first version by December 2004.
- ◊ This effort should eventually be mainstreamed with the initiatives of the Ministry of Land. This present exercise has been rightly considered as the first step towards 'coastal land zoning, as described in the Land Use Policy. Even, at this stage, the Ministry of Land, should be involved with the process.
- ◊ To assist land zoning, the physical process of a particular area needs to be considered with collection of all relevant information; emphasis should also be given on to the socio-economic factors. Such initiatives in other countries, like, Malaysia could be consulted.
- ◊ Land use zoning should be demarcated using administrative boundary. Target should be at union level; even blocks could be considered if detailed information are available. However, for the present exercise, upazila boundaries will be the lowest tier, though it was acknowledged that upazila is a very heterogeneous entity;
- ◊ A working group comprising DoF, FD, BARC, SRDI, IWM, LGED, CEGIS will be formed to provide technical and supportive input to this exercise. This working group can be considered as precursor to task force as mentioned in the Land Use Policy.

The workshop continued up to 14:00 hrs.

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1 INTRODUCTION

The Integrated Coastal Zone Management Plan (ICZMP) is a multi-sectoral, multi-agency initiative. Among others, it provides a platform for relevant stakeholders to discuss cross-cutting issues concerning the coastal zone. Coastal land zoning is one of such issue.

The coastal region of Bangladesh is diverse, complex and conflicting in terms of physical and environmental conditions, land use, economic opportunities and risks. In a sense, diversity provides complexity to the planning and management of resources, which needs the identification of structures and possible measures for their sustainable management. That calls for the demarcation of more or less homogeneous sub-zones or land use classes, in line with the existing diversity of resources.

The need for land zoning as a planning tool has been recognized in many policy documents of the government and its importance is also recognized by the line agencies. The Land Use Policy (2001) emphasized:

- *Land use based zoning*
- *Ensure best use of land through zoning*
- *A zoning law nationally to allow local government to prepare zoning maps*
- *Special emphasis on coastal areas. Inter-agency taskforce to prepare definite outline of coastal zoning*

The first task was to examine what kind of zoning different line agencies would find useful and for what purpose it could be used. From preliminary discussions held individually with different line agencies, a general consensus emerged that "cross-sectoral development-oriented zoning" of the coastal areas is needed.

It was felt that a discussion among the different line agencies is needed which will help to come in consensus on the concepts and modalities as formulated for coastal land zoning. For this purpose, this "Technical Discussion on Coastal Land Zoning" was arranged.

2 INAUGURAL SESSION

A technical discussion on Coastal land zoning was held at BRAC Center, Inn, Dhaka on 2 August 2004 organized by PDO-ICZMP. The workshop started at 9:30 with Dr. M. Rafiqul Islam, Team leader of PDO-ICZMP, as the Moderator. At the onset of the program, Mr. Hasan Parvez, Principal Scientific Officer, WARPO, delivered an address of welcome on behalf of Director General, WARPO and briefly narrated the background of ICZMP and importance of coastal land zoning. All the participants briefly introduced themselves. Mr. Abdul Halim Mia presented background paper on Status of Coastal Land Zoning.

Address of Welcome

Hasan Parvez, Principal Scientific Officer (Engg.) WARPO
(on behalf of Director General, WARPO)

Bismillahir Rahmanir Rahim

Distinguished participants from different government and non-government organizations,

Ladies and Gentlemen

Assalamu alaikum!

It is in deed a great pleasure for me to be with you in this august gathering of representatives from various government and non-government organisations. I welcome you all at today's Technical Discussion on "**Coastal Land Zoning**" of ICZMP Project.

Probably you all know, the Integrated Coastal Zone Management Plan is a multi-sectoral, multi-ministry initiative, which deals with different issues of the coastal areas for its sustainable management. The present issue of Land Zoning for the coastal area is an important aspect, which I believe will contribute a lot to the total process of planning. I am pleased to report that Water Resources Planning Organization (WARPO) is proud to support this initiative. Coastal Zone is the area of special vulnerabilities & potentials.

Now, I would like to place before you a brief description on the importance of land zoning for the coastal area. Coastal areas of Bangladesh are important ecologically, as they provide a number of environmental goods and services to people. They frequently contain critical terrestrial and aquatic habitats, such as the mangrove forests, wetlands and tidal flats.

The other special feature of the coastal zone is its multiple vulnerabilities such as periodic cyclone and storm surges, salinity intrusion, pollution, and overall lack of physical infrastructures.

Coastal natural-resource uses reflect primarily subsistence agriculture with an emphasis on food production, e.g., paddy rice along with some cash crops and coastal fisheries, which provide a major food and income source. Also important, in some areas, is aquaculture with an emphasis on shrimp production for the export market, and some salt production for domestic needs. The other major uses of land are for settlements, forestry, industries, ship breaking industry, tourism, water-bodies and for environmentally important areas. To face and meet the demands, I believe an integrated approach of resource management through land zoning could play a vital role for the survival of coastal people. A proper land zoning can help:

- **To ensure planning of proper utilization of land of a particular area in order to achieve maximum economic benefits.**
- **To minimize conflicts, such as shrimp vs agriculture, forest vs settlement, salt vs agriculture etc.**
- **To maintain bio-diversity in the area.**
- **To grow awareness amongst planners, users, policy-makers and decision makers for rational utilization of land resources.**

Under this context, we can consider the challenging activity like - **Area wise integrated planning including zoning and sub-zoning** for the coastal area. The Government's commitments on this issue have been expressed through the adoption of policy documents for different ministries. Conflicts from land lead even to war when it is between countries. When it is within groups it may

end-up with anything. So the very important aspect of any land zone attempt must be supported by adequate laws, rules, regulation and above all, its proper implementation.

In this respect, I will request all the participants to come forward to contribute a lot in consensus building on this issue through detailed discussion and giving valuable suggestions.

I hope the dedicated services of the participants individually and collectively will pave the way of formulating land zoning for the coastal area by PDO-ICZMP.

This technical discussion is the beginning of the process and I wish all the success of it.

--Allah Hafez--

Coastal Land Zoning: Present Status

Abdul Halim Mia, Land Zoning Specialist, PDO-ICZMP

1. Introduction

Background

The coastal areas of Bangladesh composed of 19 districts with exclusive economic zone. It has total area of about 47,201 sq. km with population density 743 per sq. km. The coastal areas are important ecologically, as they provide a number of environmental goods and services to people. They frequently contain critical terrestrial and aquatic habitats, such as the mangrove forests, wetlands and tidal flats.

The other special feature of the coastal zone is its multiple vulnerabilities out of periodic cyclone and storm surges, salinity intrusion, erosion, pollution, and overall lack of physical infrastructure. Coastal natural-resource uses reflect primarily subsistence agriculture with art emphasis on food production, e.g., paddy rice along with some cash crops and coastal fisheries, which provide a major food and income source. Also important, in some areas, is aquaculture with an emphasis on shrimp production for the export market, and some salt production for domestic needs. The other opportunities that deserve special attention for sustainable resource management are:

- ◊ has coastal and marine resources, including mangroves, coastal and marine fisheries, shrimp, crab and salt;
- ◊ land generated through accretion processes; provides new settlement opportunities for the growing coastal population;
- ◊ on-shore and off-shore oil and gas fields and other potential energy sources like wind and wave energy;
- ◊ sea ports located at Chittagong and Mongla and surrounding industrial infrastructure; and
- ◊ tourism opportunities at coastal beaches, islands and in the Sundarban.

Why Coastal Land Zoning

The coastal natural resources especially the land resources are used for multi purposes, which have strong influences on the socio-economic development of the area. As the coastal areas are always under human and natural interventions so its land use is naturally diverse and complex. The land of the coastal area is intensively used for agriculture, settlements, forests, shrimp ghers, water bodies and Fisheries, salt production, industries and infrastructural development, tourism, preservation and management of environmentally important and special areas. These huge interventions in coastal land have resulted the following features:

- ➢ Conflicting land demand
- ➢ Demand for expansion in all land uses (urban area, settlement, shrimp etc.)
- ➢ Increasing demand for new uses (tourism, EEZ and others
- ➢ Encroachment of land by the local people and
- ➢ Absence of zoning

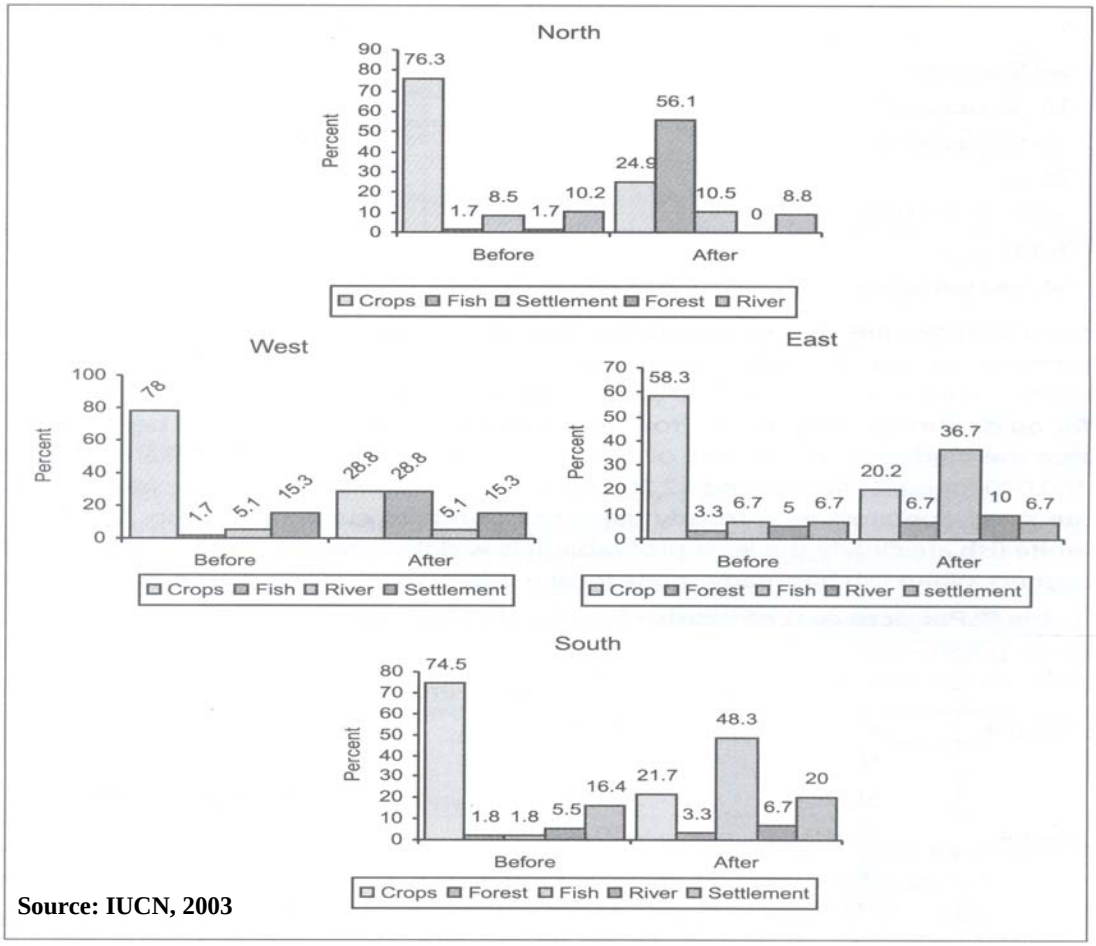
The above mentioned circumstances call for the demarcation of more or less homogenous sub-zones or land classes which will do justice to the existing diversity of resources.

Impacts of changes in land use

The introduction of shrimp farming in the coastal has undoubtedly increased the income of the farmers. But it has gradually changed the land use patterns of the area altering agriculture and mangrove areas into shrimp farming areas. The following figure mentioned below shows how

shrimp farming has affected other uses of land. This situation also deserves the proper zoning of land for its wise use and solving existing conflicts of interest of the local people.

Figure 2: Changing pattern of land use around a shrimp farm



Source: IUCN, 2003

The other issues of demanding land zoning

Ecosystem Degradation

The coastal zone of Bangladesh experience extensive ecosystem degradation. Some of the interventions to cause degradation are: drainage for agriculture; land use for commercial, industrial or residential purposes; conversion of land for aquaculture; construction of dykes for flood control and irrigation; discharge of pesticides and herbicides; domestic and industrial waste; hydrological alternation by canals; roads and other structures

Although the rate of destruction of mangroves is less as compared to the overall destruction of forests, comparison of aerial photographs from mid eighties to early nineties shows destruction annual rate over 2,000 ha (UNEP website). Responsible factors for the destruction of the mangrove forests are the removal of forest products for fuel, high pressure of grazing, haphazard fishing activities, human settlement, salt production and shrimp farming. The other specific impacts are:

- About 86,366ha of land eroded during 1973- 2000 (MES, 2001)
- 220 ha arable land is being reduced daily due to uses like road construction, industry, houses etc. (MOA/BARI- challenge & prospect of agril. for 21st Century, Agril. Conference report-2004)

- 70% of land of Barisal and Khulna division is affected by different degree of salinity, which reduces Agril. Productivity (Rahman & Ahsan, 2001),
- Climate Change Impacts coastal zone
- 50% of coastal lands faces different degrees of inundation

Population boom and declining land

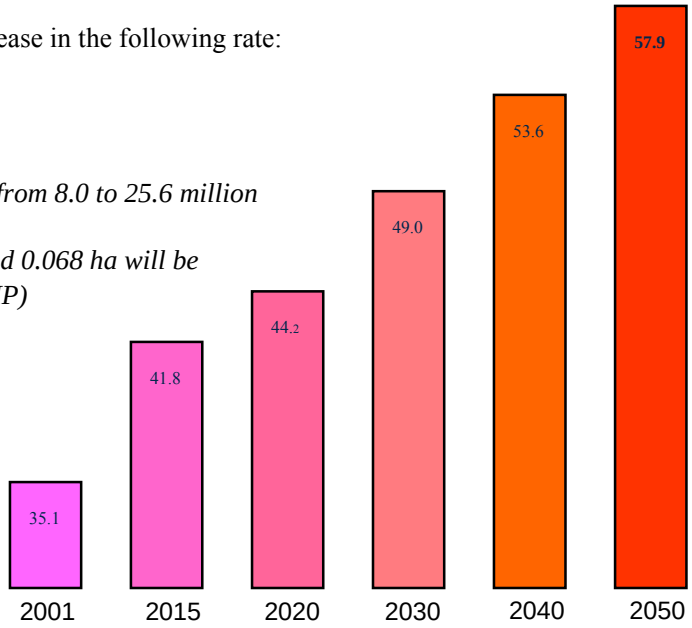
Between 1901 and 1991, 20 to 25 percent of the total population lived in the coastal area. This illustrates two issues. First, factors, which have contributed to the rapid population growth throughout Bangladesh, have also affected the coastal zone. Second, even though the coastal districts are vulnerable to natural disasters, choice of living in the coastal area has not changed over the years. Based on the assumption that the rate of increase of the population in the coastal districts will remain similar to those for the whole of Bangladesh, the coastal population may increase to 50-58 million by 2050, which will be an extra burden for the resources available in the coastal area.

Coastal population is assumed to increase in the following rate:

2001 35.1 million
2015 41.8 million
2050 57.9 million

Urban Population will be increasing from 8.0 to 25.6 million

Present per capita of Agricultural land 0.068 ha will be decreased to 0.030 ha by 2050 (NWMP)



The figure mentioned above indicates the tremendous rate of population increase, which will ultimately give extra pressure on coastal land resources. Under these circumstances question may arise whether there will be land for economic activities in future.

Emerging of Land Zoning Concept

The impacts and vulnerabilities as mentioned above create an atmosphere of insecurity and uncertainty, which lead to risk minimizing strategies that discourage investment in the coastal areas. The long-term development of the coast will depend upon creating greater security and reducing or eliminating many of these threats but how. Under these circumstances, the following options may come up but in real sense all of these cannot be implemented.

- We cannot create another Bangladesh or can we?
- We need to maintain food and water security for increasing population
- We need to adapt to declining natural resources
- Area wise integrated planning including zoning & sub-zoning

The land-zoning concept thus derived needs special attention for its implementation in the coastal areas.

Area wise Integrated Planning including Zoning and Sub-zoning

This issue has been mentioned giving importance in the Coastal Series 2- "Living in the Coast". It is mentioned here that along with conventional sector wise planning, integrated planning should be attempted. Benefits of sector wise planning are often not evident. People can correlate themselves easily with area wise planning. A gradual shifting of planning is needed form sector wise planning to area wise planning? Budgetary resource allocation can gradually be linked to area development plans. Upazila should be considered as the lowest unit of development. This will allow local level participation in planning, prioritisation and implementation.

An immediate need of this planning will be land zoning and sub-zoning. Land zoning has been advocated since eighties. Because of competing and demanding land use, an attempt should be made to introduce land zoning in the coastal zone.

Policy Statements

The resource potentials as well as vulnerabilities identified in the coastal areas offer opportunities that can form the basis of a process of **sustainable development** in the coastal zone through resource conservation and management. The different zones created through land zoning will give sense to the people that zones, which are suitable for suggested purposes, should not be used for other purposes. The government policy documents highlighted the importance of land zoning for integrated planning of resource management. Some of the important policy statements are mentioned below:

National Land Use Policy 2001

- *Land use based zoning*
- *Ensure best use of land through zoning*
- *A zoning law nationally to allow local government to prepare zoning maps*
- *Special emphasis on coastal areas. Inter-agency taskforce to prepare outline of coastal zoning*

The National Water Policy, 1999

- *Frame rules, procedures, and guidelines for combining water-use and land-use planning*
- *Designate flood risks zones and take appropriate measures*
- *Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities.*
- *Brackish aquaculture will be confined to specific zones designated by the Government*

The National Agricultural Policy, 1999

- *Land zoning program will be taken up by the Soil Resources Development Institute (SRDI) on priority basis.*

Draft Shrimp Strategy (2004)

- *Areas suitable for shrimp cultivation will be identified using a land zoning process which will limit brackish water shrimp aquaculture to coastal areas*
- *The objective of land zoning is to optimise land use*
- *The zoning process should therefore involve all stakeholder groups*

Coastal Zone Policy (2004) draft

- *Actions shall be initiated to develop land use planning as an instrument of control of unplanned and indiscriminate use of land resources.*
- *Strategies for new chars will be developed.*

- *Zoning regulations would be formulated and enforced in due course*

Initiation of the land zoning

Although the government could not implement all the policy statements or commitments given in different policy papers regarding land use but these give some kinds of initiations to think over the importance of land zoning. The following initiatives we can think in this respect:

- *Despite strong policy commitment, national land zoning is yet to be initiated*
- *We can start in the coastal zone*
- *Through inter-agency discussions, we have agreed on defining the 'coastal zone'*
- *Our attempt is now to agree on land zoning within coastal zone*
- *The task is not easy but achievable*

Few micro-level initiatives

There are some sectoral activities of conducting land zoning /mapping is going on in the coastal area by different line organizations. The approach set out in this paper attempts to analyze and capture this special character and outline a process that could form the basis of conducting land zoning in an integrated approach for the sustainable resource development of the area. It is expected that the output coming from this activity would contribute a lot to the total process of formulating the concept proposal of coastal land zoning.

- Coastal Land use Zoning in the SW under SEMP of UNDP, CEGIS
- Productivity Development Zones (PDZ) in Noakhali (CDSP)
- These are useful and excellent tools for specific areas
- We aim for such detailed mapping but not at this stage
- We are talking about zoning through staged exercises

What PDO-ICZMP will do

The PDO-ICZMP will initiate the integrated land zoning with the consultation with different line agencies. A conceptual proposal for the coastal land zoning has been prepared and zoning exercise on it will be carried through consensus of different line agencies.

An inter- agency discussion has been arranged today for exchanging views and suggestions on it and hopes to come in consensus on coastal land zoning.

By this time we have had some preliminary discussions with different government organizations. From discussions with them a general consensus emerges that cross-sectoral development-oriented zoning of the coastal areas is urgently needed. The purpose would be to enable the government to assess possible land use options for different areas and choose the best options on the basis of potentials and limitations. There is widespread concern that the lack of regulatory measures and even of information to base such measures on, is leading to chaotic situations. Different groups want to set aside certain areas for their sector, for example for forest plantation or shrimp culture, which may conflict with the interests of others or with government's stated policies. An objective of integrated management is to find the best compromise on the basis of physical and socio-economic potential and limitations and cross-sector zoning could assist this process by making the options transparent.

3 TECHNICAL SESSION

The inaugural session was followed by technical session. Dr. M. Rafiqul Islam, Team Leader, PDO-ICZMP moderated the session. There were ten papers presented in this session by the resource persons of different government and non-government departments/agencies.

Prospect of Participatory Forestry in Degraded Coastal Forest Land

Ashit Ranjan Paul, Divisional Forest Officer, Noakhali, Forest Department (FD)

Abstract

Mangrove plantation has been raised in the newly accreted char land under Noakhali Forest Division for the last 35 years to prevent loss of life and property of coastal people from cyclonic storms and associated tidal surges. Char land taken for afforestation is newly accreted one, which is not suitable for any other purposes. But as soon as the land is raised, it becomes suitable for agriculture and dwelling. Local land less encroachers frequently encroached upon these forest area destroying the existing mangrove plantation.

Introduction

It is known to all that coastal ecosystem is delicate, dynamic and complex. Accretion and erosion takes place simultaneously in the coastal areas with eventual neat loss of arable land. Consequently, land-less people are increasing at an alarming rate. These land-less peoples are encroaching upon forestland with active support of the local influential and political leaders. Often by the Forest Department alone and sometime Forest and Police Department jointly have tried to evict them. Due to socio-political reason, it was not possible to evict them. The encroaches are still damaging forest resources as Forest Department failed to evict them and Government is losing huge amount of revenue. So in this adverse situation, it becomes difficult to keep control over the afforested mature land. Here people-oriented participatory forestry can be commenced to rehabilitate the encroachers or land-less following integrated program of poultry, pisciculture, animal husbandry, agroforestry and other income generating activities can be adopted.

The southern part of Bangladesh near the Coast of the Bay of Bengal is vulnerable to natural calamities. Almost every year tidal surges and cyclonic storms visits these coastal areas, which cause heavy damage to human lives and properties. Protection from cyclone damage afforded by the Sundarbans natural forests led the Forest Department in 1966 to commence a programme of afforestation over the greater district of Noakhali, Chittagong, Patuakhali and Barisal. The success of the plantation programme resulted in setting some additional objective like stabilization of lands for agriculture, production of timber, pole and fuel-wood, creation employment opportunity and development of suitable environment for wildlife, fishes and other estuarine and marine fauna.

The afforestation programme gained momentum with fund from the World Bank in 1978 and by 2003 around 0.15m hectares of plantations have been raised under different Coastal Afforestation Divisions. Out of these Noakhali Coastal Forest Division covering around 54,000 ha of afforested areas over newly accreted char land.

Present Scenario:

Mangrove plantations are solely raised and maintained 'oy Forest Department and it is a wonderful creation in the World. But Forest Department is facing obstacles in managing existing forest resources. Char land taken for afforestation is mostly accreted which is not suitable for any other purposes. But as soon as the land is raised and become suitable for agriculture and dwelling, local landless people encroach the forest area destroying the existing plantation.

The above mentioned problems are prevailing more or less in all the coastal Forest Divisions, But this is maximum in Chittagong and Noakhali coastal belt. The Noakhali Forest Division is facing the problems since last. For instance 15000.00 acres of afforested Boyar Char has been encroached by the local land less and at present about twenty thousand families are residing there. Similarly in

and around the Boyar char (e. g. Char Nangulia, Char Mazid, Char Laxmi, Char Rahaman etc.). It should be mentioned that these sorts of encroachment problem is prevailing over the char areas, which are adjacent to main land of Noakhali, Encroachment is absent ill the detached and offshore island.

With help of other law enforcing agencies Forest Department tried to solve the encroachment problem in several ways, but the results were not satisfactory. To conserve the existing matured forest, to protect the encroachment process as well as to recover the forest land several types of offensive and defensive steps have been taken. As a result 9 No's of forest field office/camp have been damaged, around 50 forest and Police personnel have been assaulted, Government fire arms (of Police and Forest Department) have been looted ai1d one field level forest official have been killed by the encroachers/ miscreant. Due to socio-political reason, it was not possible to evict the encroachers and recover the forest land.

Right at this moment, the land less/encroacher are interested to get official rehabilitation. On the other hand some influential and elite's are interested to use the raised land for other non agricultural purposes like shrimp/fish culture, and they are trying to collect document from the land department /local administration for different purpose over the degraded forest land. Because land department assume that Forest Department have no right over the land which become matured or over 20 years, So in this adverse condition it becomes difficult to keep control over the afforested mature land by the Forest Department. Now a time has come to think over the proper or scientific management of mature land, considering the multifaceted aspects of the problems

The coastal forests are subject to tremendous biotic interference including human pressure. The illegal settlers did not think about the continuity of the plantations, which need to be maintained for their safety against natural calamity. Thus the people have illegally occupied in many areas the raised forest land. On the other hand people who were engaged in fishing, they used LO build dams in the mouth of the creeks and there by disrupted the tidal inundation and caused water stagnation affecting the mangrove vegetation. Such interference along with the policy of converting the reserve mangrove forest td shrimp/fish farms and human settlement led to the drastic depletion of the mangroves side by side the uncontrolled grazing seriously affect the regeneration of mangrove species. As a result the forest land become unsuitable to support mangroves and their replacement by non mangrove tree species is required to fully stabilize the lands for productive and protective purposes.

Recommendations:

Now a compromise is needed between forestry practices by the Forest Department and genuine need for cultivable land by the home less people. It seams that people are also interested in raising forest crop in addition to agriculture, horticulture, fishery, poultry etc.) once given the opportunity, support and just share.

It is important to mention that the Government of Bangladesh promulgated Forest Policy in 1994, and the policy laid emphasis on people oriented programmes to manage the environment, preserve existing values, conserve plants and animals and maximize benefits to local people.

There is a vast degraded forest land which can be use for different' purpose like, agriculture, horticulture, fish/shrimp culture, poultry animal husbandry, tourism, forestry etc, Side by side a large number of homeless erosion victims are residing over there, So a scientific sustainable productive as well as protective management programll1e is very much essential.

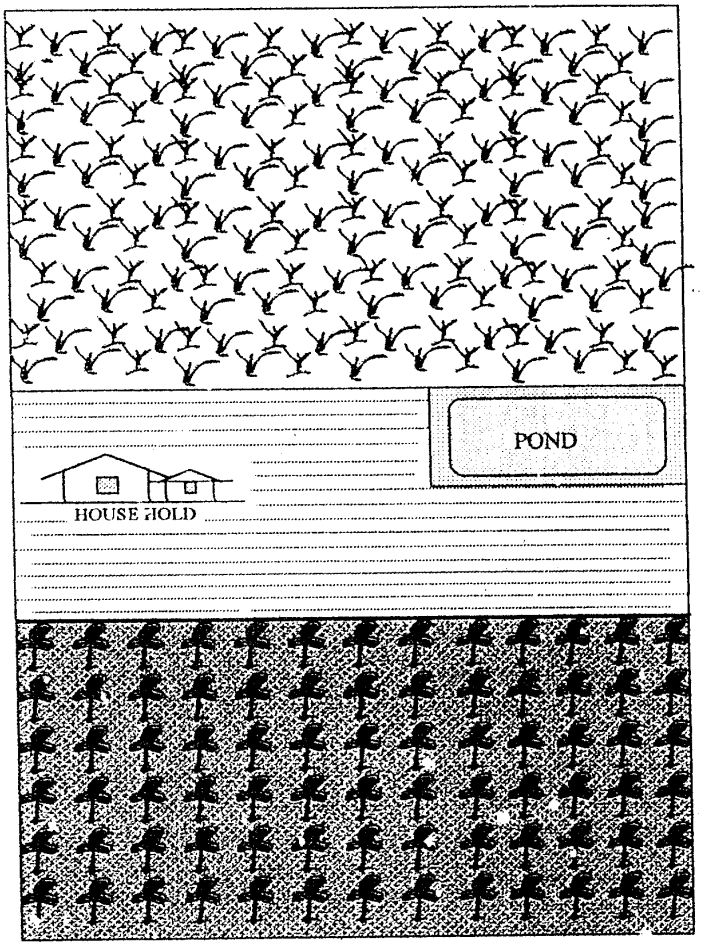
It is important to mention here that an inter-ministerial (MOEF, MOL, MOLPA) decision have been taken for the degraded mangrove areas, that the one third area will be used for shrimp/fishes, one third for rehabilitation and one third for forestry.

First of all the land should be demarcated as per, suitability of different purposes. by side considering the protective measure from natural calall1ities and fulfill the demand of fuel, house building material, timber, fodder etc. a participatory forestry programme should be taken. So exclude the area which will *be* demarcated for shrimp/fishery, the rest area can be include for rehabilitation as well as participatory forestry purpose with a sustainable management approach.

Here a people oriented participatory forestry can be launched. By rehabilitating the homeless victims an integrated programme including poultry, pisciculture, agriculture, animal husbandry, agro-forestry and other income generating activities can be adopted.

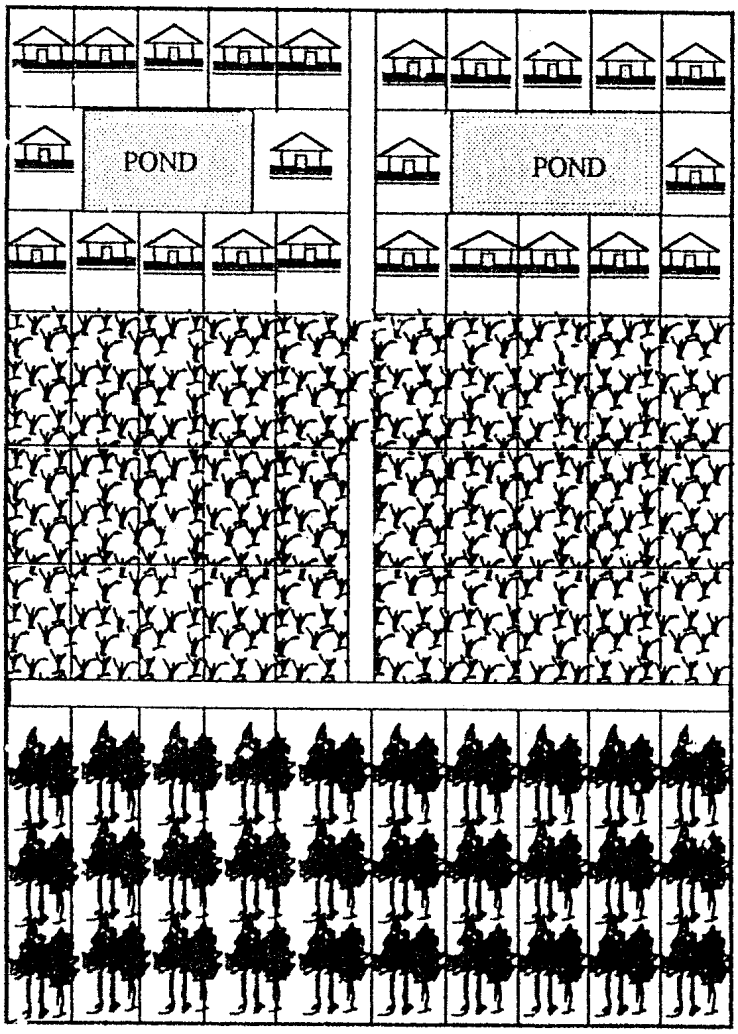
Incorporating the above mentioned productive purpose different types of rehabilitation models (Model-A, B, C, D, E) have been prepared which are as follows:

Model-A : Ideal Family Based Model



- 50% Area for Agriculture
- 15% for Household (Kitchen garden, Goat rearing, Poultry, Animal husbandry, Fish culture etc.
- 35% Area for Forests (Fuel, Pole, Medicine and Timber).

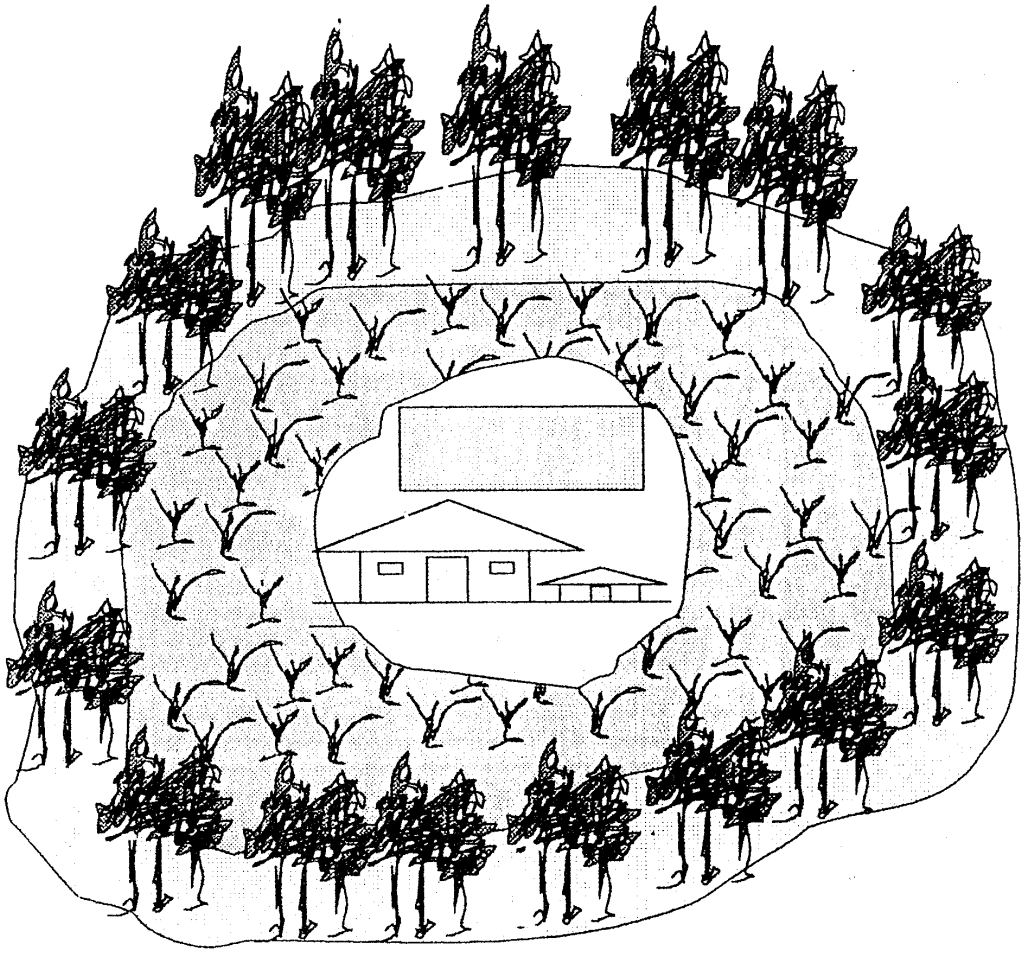
Model-B : Cluster village Model for 50 Families



Total land = 1.5 Acres x 50 = 75 Acres

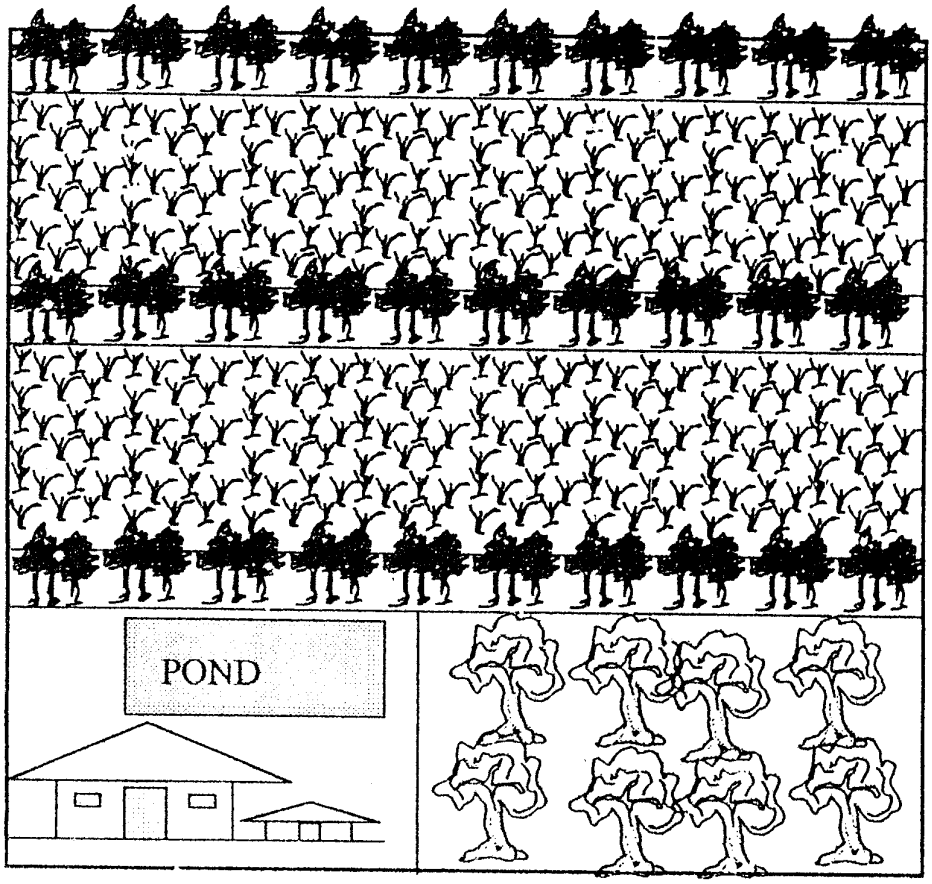
0.75 Acres of Agri. plot for each family	0.75 x 50	=	37.50	Acres
0.15 Acres of land for every household	0.15 x 50	=	7.50	Acres
1.50 Acres of Pond for every 2 families	1.50 x 2	=	3.00	Acres
1.0 Acres of land for Internal road & other purposes		=	1.00	Acres
Community Based Forest Areas		=	26.00	Acres
	Total	**=**	**75.00**	**Acres**

Model-C : Nucleoplasma Model for individual Family



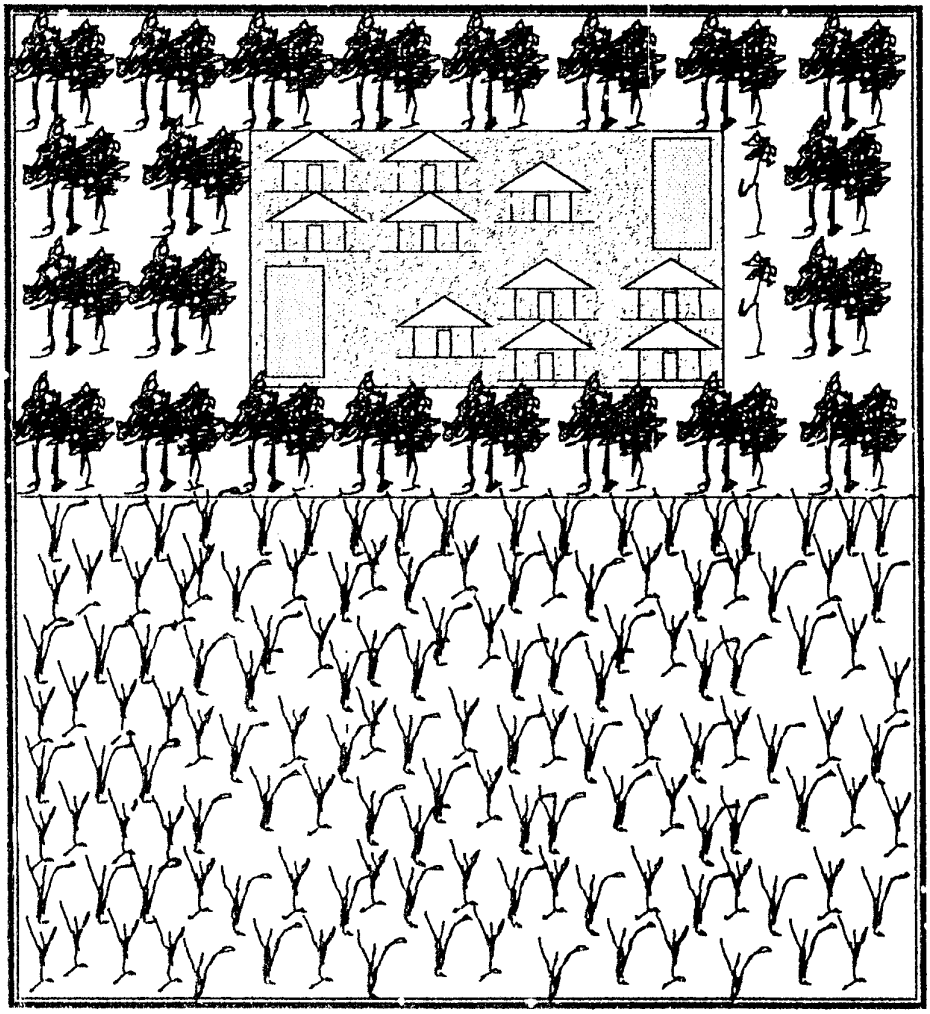
- 15% Land for Household, Pond, Kitchen Garden etc.
- 50% Land for Agriculture
- 35% Land for Shelter Belt.

Model-D : Integrated Farming System Model for individual Family



- 15% Area for Household (Kitchen garden, Poultry, Animal husbandry, Fish culture etc.
- 23% Area for Fruit gardening
- 40% Area for Agriculture
- 22% Area for Forest.

Model-E : Community Based Model



- 2 No's of Ponds (1.00 x 2 = 2.00 Acres) for 10 Families
- 10 No's of Agri. plot (0.75 x 10 = 7.50 Acres) for 10 Families
- 0.50 Acres for internal road and other purposes
- Community Based Forest Land 5.0 Acres for 10 Families.

Management Proposals

1. Land less families can be rehabilitated by single or by group.
2. Rehabilitated family will be allotted a definite area of wood land. He will look after it in order to prevent him from natural havoc.
3. A definite chunk of land can be allotted for agriculture, poultry, fishery and homestead.
4. Rehabilitated family will raise and maintain the wood land as per given prescription. After final harvesting the distribution of benefits will be as follows:

Rehabilitated family	-	65%
Land owning agency/DA	-	10%
Local Union Council	-	05%
Tree Farming Fund	-	10%
Forest Department	-	10%
Total	**-**	**100%**

5. Rehabilitated family will grow agricultural crop according to his desire and will consume the whole yield.
6. There will be a provision for single/joint management system for poultry and fisheries.
7. Vacant spaces in and around the homestead will be planted up with fruit trees and rehabilitated family will consume the whole.
8. Different income generating devices like poultry, animal husbandry will be encouraged in the project area and in some cases micro-credit may be allowed.
9. To reduce increased pressure on fuel wood rehabilitated family may be supplied with solar kiln, coal and improved oven.
10. Health clinic may be introduced for health facilities.
11. Rehabilitated families will get benefits from all sorts of strip plantations of the project area.
12. Deep tube well will be installed in the project area.
13. There will be a provision for rain water harvesting for drinking purpose.
14. A deed will be formulated among the three parties (District administration, Forest Department & rehabilitated family).
15. The rehabilitated group will maintain and protect the existing mangrove plantation near by and enjoy the benefits on sharing basis.
16. Private/Public enterprise will be encouraged here for shrimp culture, tourism. small scale industry etc. and they will be allotted forest land for a period. Out of allotted land at last 35% should be reserved for afforestation. Without prior permission from FD no trees will be felled/harvested.

Land Zoning of Bangladesh

Md. Kabel Hossain Dewan, Principal Scientific Officer, Soil Resource Development Institute (SRDI)

Introduction

It is necessary to delineate different land zones for particular use of land resources for a defined objective. Productive land is gradually decreasing due to non-agricultural use of land resources. So the utilization of defined land according to its qualities and environment are the main objectives of land use zoning.

Bangladesh possesses a number of diverse ecosystems due to variations of physiographical, hydrological and climatological factors. Dividing a country into small uniform zones is a time old idea for better understanding and management of its biophysical resources. It has been subdivided into smaller units for better resource management in the last fifty years or so. Moreover, the soil as a whole is a complex material and it is always heterogeneous and non-isotropic, because of which profile of soil will be entirely different from place to place.

Previously the zonal classes were mainly based on the nature of the parent materials and age of deposition as, 7 tract of soil (Islam & Islam, 1956) and Brammer's land capability classification (1980). With continued efforts for improvement in agriculture production, agro-ecological zones (FAO-UNDP, 1988) have been developed considering unique combination of landforms, soils, inundation regimes and agro-climatic behavior.

Land Zoning Required in Bangladesh

Bangladesh is a poor country and economically based on agriculture. Among the natural resources, land and soil is the key resources for agriculture. We have to ensure its maximum proper utilization for demanded food security without decreasing its extent.

It is assumed that each year about 10 thousands ha agricultural land is going under non-agricultural purposes. As on agriculture-based country, there is no chance to reduce or improper use of the land. Bangladesh is considered as one of the most densely populated country in the context of land-man ratio. Human needs along with natural resources have substantially increased the cropping area giving on importance about the quality of land, capability of the land etc. Moreover, large areas of cultivable lands as well as forest land is being used for the purpose of urbanization, industrialization, settlement, shrimp culture, roads and highways resulting reducing the total agricultural land of Bangladesh. On the contrary, only 3% area of the land remains as fallow land, indicating that land in this country is not allowed sufficiently to rest long period for regaining the natural bio-physical properties required for the maintenance's of soil health. Improper and unplanned utilization of soil and water resources requisitely demanding proper land zone classes in Bangladesh by maintaining the soil health and rational use of land, soil and water. Now per capita arable land in about 0.06 ha which is the lowest in the world.

Definition of land zoning

"Land zoning is the zoning of land resources for its optimum use according to its quality".

The land zoning should permit the following parameters-

- to sustain land quality
- appropriate cropping pattern
- environmentally balanced
- scientifically sustainable

- economically viable and
- socially acceptable etc.

Zoning involves determining the best suitable uses for all different parcels of land in a given area (Miller, 1985).

This land zone is primarily concerned with preservation of long term development of an area.

Objectives of land zoning

The main objectives of land zoning are:

- To ensure planning of proper utilization of land and soil potentials of particular area in order to maximum economic return.
- To maintain bio-diversity in the area.
- To grow awareness amongst planners, users, policy, makers and decision makers for rational utilization of land resources.

Land is one of the major resources of development aspect. It has been utilized in many different ways for maintaining human livelihood, such as agriculture, forestry, industry, urbanization etc. So, a proper land utilization plan is a pre-requisite or urgently demands for the development of a country, especially for a developing country like Bangladesh. For this land utilization plan, land resource of an area should be classified into different zones based on its potential in producing products and benefits.

Benefits of Land Zoning

By land zoning -

- awareness will grow amongst the land users to utilize the land resources rationally.
- the policy makers will find a guide to formulate the land use policy correctly and decision makers will be able to take decision rightly.
- it will help to develop a planned infrastructure in the country.
- land zoning maps and reports will help not to abuse agricultural land to non-agricultural use.
- it will help to prevail sound environment and ecosystem condition in an area.
- land zoning will create aesthetic environment in an area.
- it will help to set up land utilization type in an area.
- guide line of soil management according to land zoning will be developed.
- finally socio-economic condition of the country will improve.

Land zones and "Land and soil resource utilization Guides"

Lately, soil Resource Development Institute (SRDI), have been developed "Nirdeshika" or "land and soil resource utilization Guide" at Upazila level and "soil and land form map" (1:50,000) is a part of this Guide which consists of several zones, focusing only for better crop management, present land use, soil fertility and production practices. This Nirdeshika guides carry-out the basic informations on land, soil and water resources. It also contains informations on crops, cropping patterns, pattern based fertilizer and proper packages of management practices. These informations will serve the purpose of data-base for micro-level planning. The soil group/groups have been recognized as mapping units in the map. Soil developed from same kind of parent materials having more or less identical morphological, chemical and land use potentials and responding equally to different management packages are grouped into a soil group. One group may contain one or more soil families by incorporating mineralogical data on them. So, in summary, the individual mapping units represents the bio-physical parameters on the map, that has been proposed to be treated as development unit or resource management domain.

But a country's development as a whole, could not ever be possible to serve the ultimate goal only by crop production development. Other development parameters may also be considered such as urbanization, forest development, industrialization, fish culture etc. In Bangladesh cope with the increasing population, zoning should have to be in such a way that should focus the maximum potential land utilization in terms of economical return.

In this study, work has been done, to explore our land zones, based on its potential in producing different products and benefits.

Materials and methods:

Study area: Kaliganj Upazila was selected for this study (Fig.1). Important information of this area is listed in Table-2. It is situated in the south-eastern part of Gazipur district. It is located between $23^0$50' and $24^0$03'N latitude and $90^0$28' and $90^0$40'E longitude. The upazila covers an area of 21,316 ha with more than 2,33,230 inhabitants. The area is rural with majority of the population depending on various agro-based activities. It is near the capital, Dhaka. The transportation system is quite good.

Materials:

The GIS land zonal layer is based mainly on SRDI's database for Kaliganj Upazila, (published in 2000), of Gazipur district. This database consists of a number of bio-physical are chemical properties Table-2. It will serve the purpose of database for micro level planning and can be used as an important day to day working tool by the extension workers as derived from as systematic approach of semi-detailed soil survey (1:50,000) as conducted by SRDI in 1995. Data were compiled on the basis of 'dominant land type and soil group in individual soil unit of the 'Soil and Landform' map. It contains detailed information on crops and cropping patterns, method of predicting required doses of crop specific and cropping pattern based fertilizers and proper packages of management practices. The DLR map of Kaliganj upazila, published by Department of Land Records (DLR) (1 : 4 mile) was also used in this study for defining the boundary upto mouza level.

Methodology:

Data themes were obtained from the Soil Resource Development Institute (SRDI), Department of Land Record (DLR). These sources provided a comprehensive collection of spatial information pertinent to Kaliganj land zone issues. All coverages were developed in ARC/Info and exported into shapefile formats compatible with ArcView 3.2. All themes were found to be projected in the LCC They all were at a scale of 1:50,000. SRDI also provided the current landuse data that would be used to identify how the land is currently used.

Visual data use collected by field survey as a means for familiarization of the current land uses. The tour also provided an opportunity to develop a working understanding of the topography and the landscape characteristics.

Data manipulation : The study was designed to show generalized land Zone classes that occur at Kaliganj upazila level. The purpose of spatial visualization is to incorporate all current coverages for informed decisions based on spatial perceptions. It is important to note, that data in the scale are being used to provide general information for planning purposes.

Data manipulation : The first work is to identity the area under flood risk hazard. Using soil and landform map Table-2, it was possible to create coverage with flood risk as an attribute field. To obtain the area, the theme was queried, selecting out all areas without flood risk. The analysis showed about 5871 ha area. From the Land type coverage, again the query was done for low and very low lands. To find this information, the intersect command was used within X Tools in ArcView. This new theme covered about 5871 ha. The visual tabular output will be used in the decision process for creating a new zone as **Aquatic Zone**.

For exploring the **Agriculture Zone**, 6 major crops i.e., T.Aman, Boro, Potato, Mustard, Wheat, Sugarcane crop's suitability should be rated against the land/soil qualities. According to the table-3. Suited and moderately suitable land will be rated as agriculture land zone. Using Model Builder, extension of ArcView is used on the basis of Table-3. The analysis was left with just over 5247 ha of land that was not affected by flood hazard.

The rest of the land extracted from Agriculture and Aquaculture Land Zone has been identified by Forest zone, about 8760 ha. area showing suitable for trees, bushes and upland crops having characterized by highland and well drained soils.

The existing urban area comprises about 806.5 ha. to obtain the proposed urban / small industry zone, the highland area was extracted from the land type database. Then buffering was accomplished within 1 km. distance along the metal road. Spacial Analyst X -Tool command was used for this new theme. This new theme occurs that about 715 ha.

From the query and analysis at Kaligonj Upazila the following land zones have been developed, i.e. agriculture zone, forest zone, aquaculture zone and urban zone (Fig.-1).

Buffering was accomplished to obtain the urban/industry zone. The buffer zone was analyzed within the metal road taking into account 1km. both side of the road (Fig.-3).

By compiling the upazila land zone map a district land zone map can be obtained (Fig.-4). In an upazila or a district 6 land zone categories may not occur. It will differ from place to place. For example at Chakaria Upazila in Cox's Bazar district. Agriculture zone, Forest zone and Urban zone have been identified together with shrimp culture, salt bed and clay belt sub zones (Fig.-5).

Table 1: The criteria were fixed up for different zonal classes

	Agriculture	Forest	Aquaculture	Urban
Land type	High - lowland	Highland	low and very lowland	highland
Drainage	well - poor	well - moderate	poor - v. poor	well
Surface Water	early – late	very early	very late	very early recession
Relief	level	level-undulating	not applicable	level
Flood risk	no	no	flood risk	no

Table 2: General information of the soil map

Mapping units	Total area (ha)	Dominant Soil group	Land type	Flood risk	Relief	Drainage	Recession
1	6,107	Tejgaon	Highland	no	slight undulated	well	*n/a
2	649	Payatte	M.highland	no slight undulated		poor	early
3	2,035	Gerua	Highland	no	undulated	well	*n/a
4	348	Khilgaon	M.lowland	no	level	poor	normal
5	2,258	Karail	lowland	yes	level	very poor	very late
6	615	Gerua	highland	no	level	Mod.well	*n/a
7	2,258	Karail	V. lowland	yes	level	very poor	very late
8	378	Silmondi	M.highland	no	level	poor	early
9	3171	Sonatala	Mhighland	no	level	poor	early
10	515	Naraibag	M.highland	no	level	poor	early
11	186	Shidhirganj	M.lowland	no	level	poor	normal
12	1045	Naraibag	lowland	yes	level	poor	late
13	407	Shidhirganj	lowland	yes	level	poor	late

* n/a=Not applicable.

Crop suitability rating for Agriculture zone:

For Agricultural zone, specific crops should be rated against a soil qualities (Fig-1). Suitable and moderate suitable land for specific crops will be rated as agricultural land and if one mapping unit is not suited as agricultural land, it will be considered for other suitable land zoning. Land zoning will be considered on the basis of land evaluation.

"The principal objectives of land evaluation is to set optimum land use in a defined land unit, taking into consideration for both physical and socio-economical conditions and conservation of environmental resources for future uses" (FAO, Bull. 52/1984).

For each mapping unit 6 major crops i.e. (1) Mustard (2) Wheat (3) Potato (4) Boro (5) Transplanted Aman and (6) Sugarcane with irrigation will be rated for suitability of Agriculture zone (Table-3). Finally the land zoning classes will be determined by field checking.

Table 3: Method of crops suitability ratings based on land and soil characteristics

Land and soil characteristics				T.Aman (irri)			Boro (irri)			Wheat (irri)			Mustard (irri)			Potato (irri)			Sugarcane (irri)		
				Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability
1.	Land type	a)	Highland	√			√			√			√			√			√		
		b)	Medium highland	√			√			√			√			√				√	
		c)	Medium lowland			√	√			√			√			√					√
		d)	Lowland			√		√			√			√			√				√
		e)	Very lowland						√			√			√			√			√
2.	Relief	a)	Level	√			√			√			√			√			√		
		b)	Undulating		√				√		√				√			√		√	
		c)	Sloping		√				√		√				√			√			√
3.	Recession of surface water	a)	Very early	√			√			√			√			√			√		
		b)	Early	√			√			√			√			√			√		
		c)	Normal	√			√				√			√			√			√	
		d)	Late		√		√					√			√			√		√	
		e)	Very late			√	√					√			√			√		√	
4.	Drainage	a)	Well			√			√	√			√			√			√		
		b)	Moderately well			√			√	√			√			√			√		
		c)	Some what poor	√			√			√			√			√			√		
		d)	Poor	√			√			√				√		√				√	
		e)	Very poor	√			√				√				√			√			√
5.	Soil texture	a)	Sandy			√			√			√			√			√			√
		b)	Sandy loam			√			√		√			√		√				√	
		c)	Loam		√			√		√			√			√			√		
		d)	Clay loam	√			√			√			√			√			√		
		e)	Clay	√			√			√					√		√			√	
6.	Topsoil consistence (moist)	a)	Loose			√			√			√			√			√			√
		b)	Friable		√			√			√		√			√			√		
		c)	Firm	√			√				√				√		√			√	
7.	Available soil moisture	a)	Low																		
		b)	Medium																		
		c)	High																		
		d)	Very high																		
8.	Reaction (topsoil)	a)	Very strongly acid			√			√			√			√			√			√
		b)	Strongly acid		√			√			√			√			√			√	
		c)	Slightly acid	√			√			√			√			√			√		
		d)	Neutral	√			√			√			√			√			√		
		e)	Slightly alkaline	√			√			√			√			√			√		

Land and soil characteristics				T.Aman (irri)			Boro (irri)			Wheat (irri)			Mustard (irri)			Potato (irri)			Sugarcane (irri)		
				Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability	Suitable	Moderately suitable	Non-suitability
		f)	Strongly alkaline		√			√			√			√			√			√	
		g)	Very strongly alkaline			√			√			√			√			√			√
9.	Salinity (topsoil)	a)	Non saline	√			√			√			√			√			√		
		b)	Very slightly		√			√			√				√			√		√	
		c)	Slightly saline			√			√			√			√			√			√
		d)	Moderately saline			√			√			√			√			√			√
		e)	Strong saline			√			√			√			√			√			√
		f)	Very strongly saline			√			√			√			√			√			√

Suitability of Broad cast aman in high land is not tested
This sign indicates suitability
B. Available soil moisture is not considered for identification of suitability in Kharif and irrigated crops.

Result and Discussion:

The ultimate output of this study was a map (Fig.-2, showing the distributions of the variable land zones. The Kaliganj Upazila comprises 21,316 ha. of land surface. Agriculture zone, forest zone and aquaculture zone accounts for 5,247 ha., 8,760 ha. and 5,871 ha. respectively of the upazila's land surface.

Approximately 858 ha. area are in commercial and Residentials and 583 ha in water bodies including rivers.

The proposed urban zone accounts for 715 ha. The agriculture zone was further analyzed for suitability test for major field crops. This can also be defined as a good agriculture land having highest cropping intensity. It is out of flood hazard zone, and prevail almost good nutrient status.

The Aquaculture land zone has been defined as a flood hazard zone. Under irrigation facility, in rabi growing season only the Boro rice have been practiced. This mono cropping pattern in the long run results the production potentiality lower. Moreover for lowland rice culture more inputs and time have to spend comparing to agriculture land zone rice culture. In that case, aquaculture or fish cultivation may account good economic return. There need to be further cost-benefit analysis after getting the financial database.

The Forest land zone comprises the upland crops, orchards and also the reserve forests. The nutrient status differs from that of agriculture land zone. This zone can be considered as a good zone for perennial trees, such as fruit trees and agro forestry and also for kharif and rabi vegetables.

For markets, agro-based industrialization, easy accessible roads and highways is needed thus farmers can avoid preservation problems and transport cost. At present the small industries (cold storages, poultry farms, dairy farms) are situated in an unplanned way. The highlands, besides the highways together with maximum amenity facilities, should be utilized for future urbanization and industrialization, without disturbing the agriculture landzone. The aquaculture zone should also be kept undisturbed because they deals with the surface runoff of the landscape. In this study, the proposed buffer zone might serve the best location for business activities and also for residential area.

In this study, a land suitability analysis has been accomplished for 6 major field crops are wheat, boro, potato, mustard, t.aman, and sugarcane. These field crops have been analyzed presuming that

these crops together supply the major nutrients of daily human diet. This suitable land has been defined as agriculture land zone.

The forest land zone have been identified mainly by its land type and drainage parameter as highland and well drained criteria respectively. Land suitability analyses have shown that fruits, vegetables, Spices, forestry etc. are suitable in this zone. In this land zone afforestration and agro forestry practices would be the best practice and also at same time will improve the environmental balance of the ecosystem. At present Bangladesh contains only about 10% forest area, which indicates imbalance in natural ecosystem.

The aquaculture land zone have been identified with a low/very low land and risk of seasonal flood hazard. This land zone was exploited to grow more fish for the population to supply protein as well to alleviate poverty, as fish plays a vital role in the daily life, economy and aquatic environment in Bangladesh. These lowland floodplains could be the major source of inland close water fish culture. In this study, we have shown the prospective area of rice fish culture in a particular location. Usually seasonally flooded rice field areas are suitable for rice-fish culture. At present HYV Boro rice is cultivated during rabi growing period with irrigation. The rest of the year the land remain fallow. Moreover continuous rice mono culture might cause nutrient imbalance, misuse of fertilizers and continuous irrigation supply results very minimum economic return, together with high risk of flood hazard. Considering all these facts, it is anticipated that fish culture in low / and very lowland might be more income generating than rice mono culture by implementing minimum initial infrastructure plan within these areas.

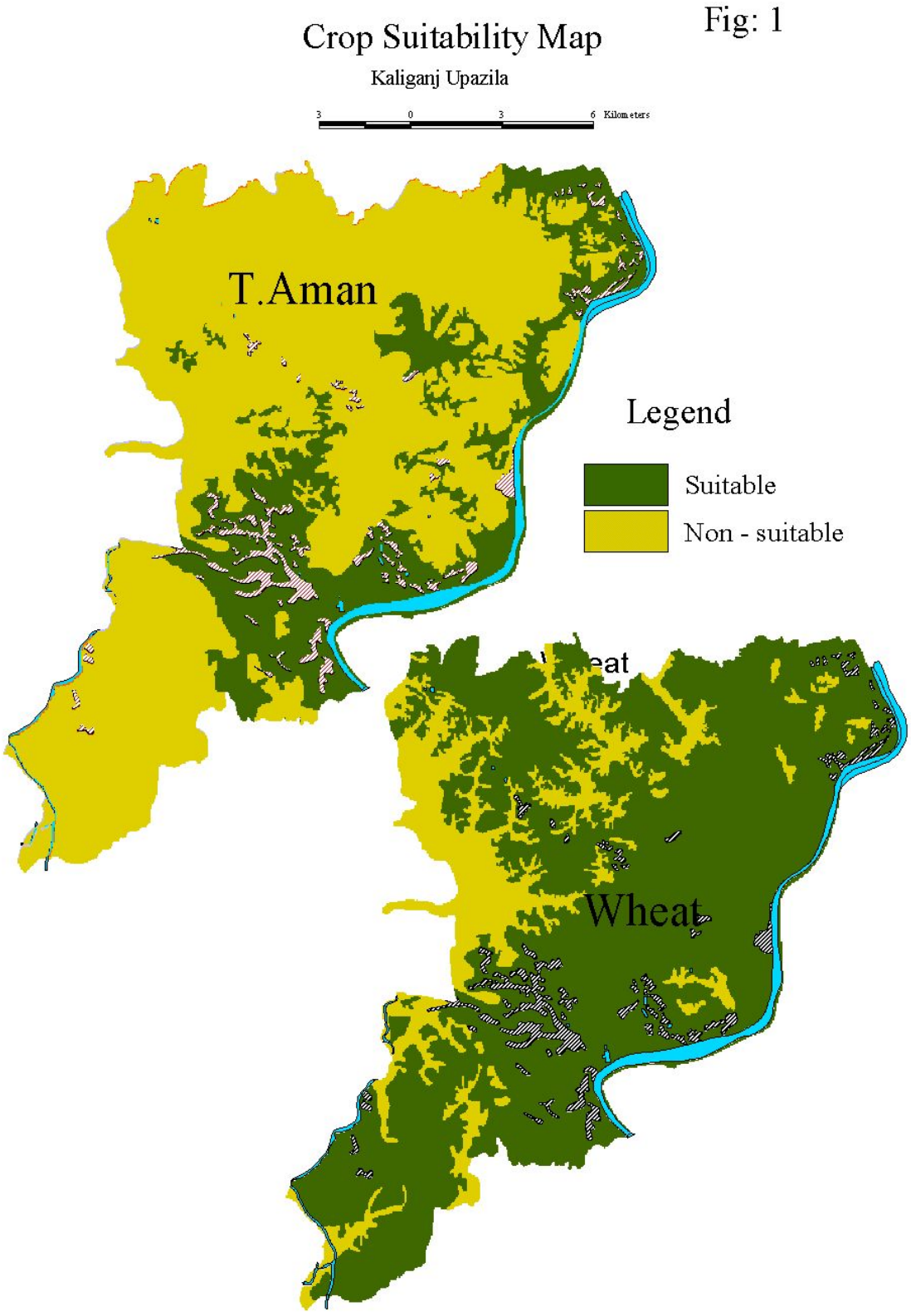
All this agriculture and aquaculture productions demands a good market facility in terms of economic return. That is why, the urban/industry land zone should be located where highest basic amenity facilities prevail. Here highlands and metal highways have been considered for urban land zone. Buffering with 1km area both side of road network have been delineated over highlands presuming the most suitable area of easy accessibility.

Recommendation :

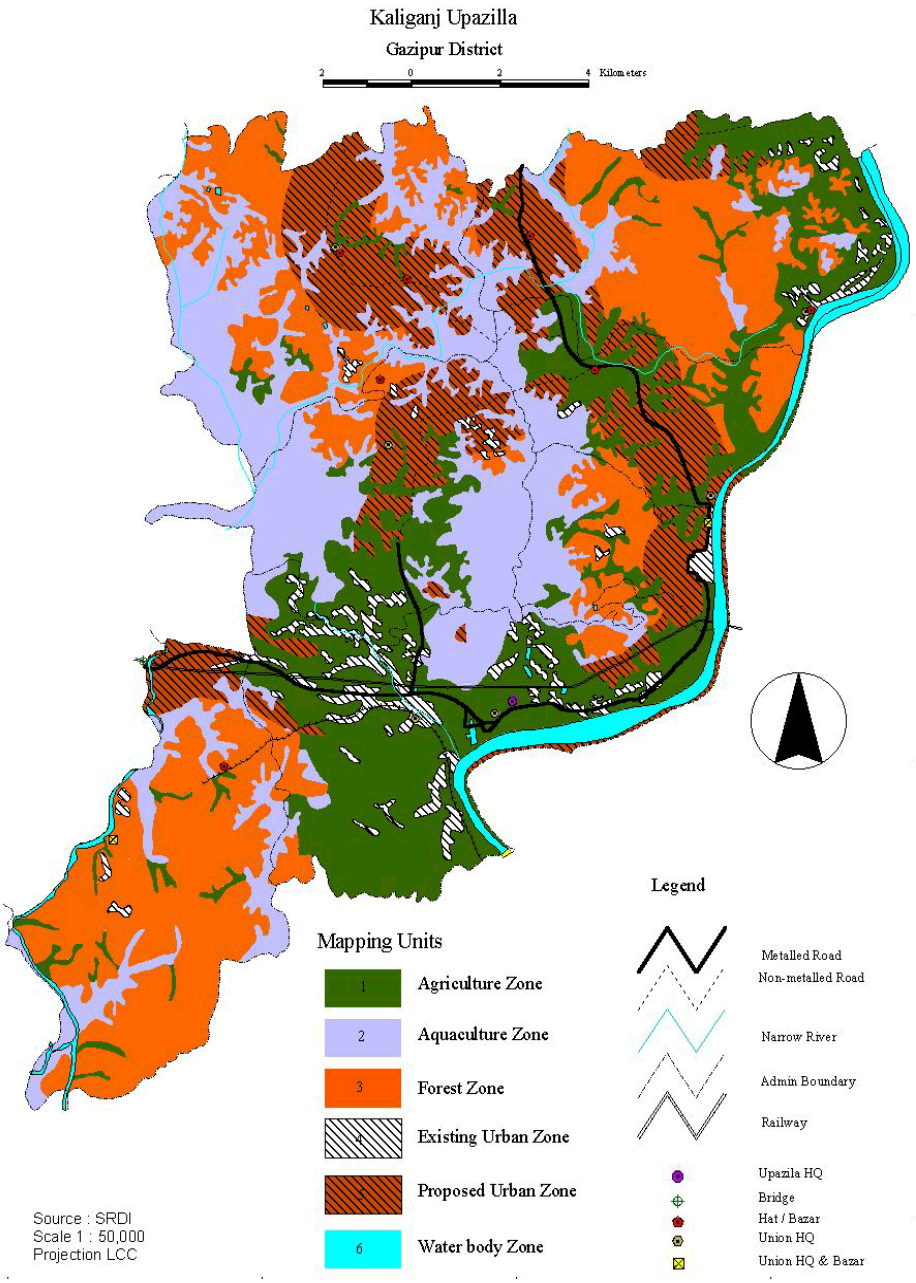
Land zoning is an important task for our country, land zoning in problem soil i.e. Saline area, coastal area, Peat soil etc. should be done with special attempt. To accomplish these task-

i. Local consultants who have the experience in land type, soils and environment may be suited to do the jobs.
ii. The land zone map and reports should be available to the reach of the policy makers and Government bodies for good and appropriate planning programs of the country.
iii. Existing laws about environmental issues should be followed and to be executed properly.
iv. Laws and regulation may be imposed upon big farmers in the coastal zone areas, hill areas and in environmentally sensible areas of the country.
v. Environmentally 8 Reserved areas should be protected carefully.
vi. Land use policy should be formulated and it should be implemented strictly.
vii. Posters, mass media programs, slogans should be undertaken by the Government/NGO'S to grow awareness among the people about the environmental Impact.
viii. Environmental issues to be included in the curricula of education.
ix. Adverse effect of unplanned utilization of land should be advocated in the mass media and it should be included in the relevant training programs.

Fig: 1

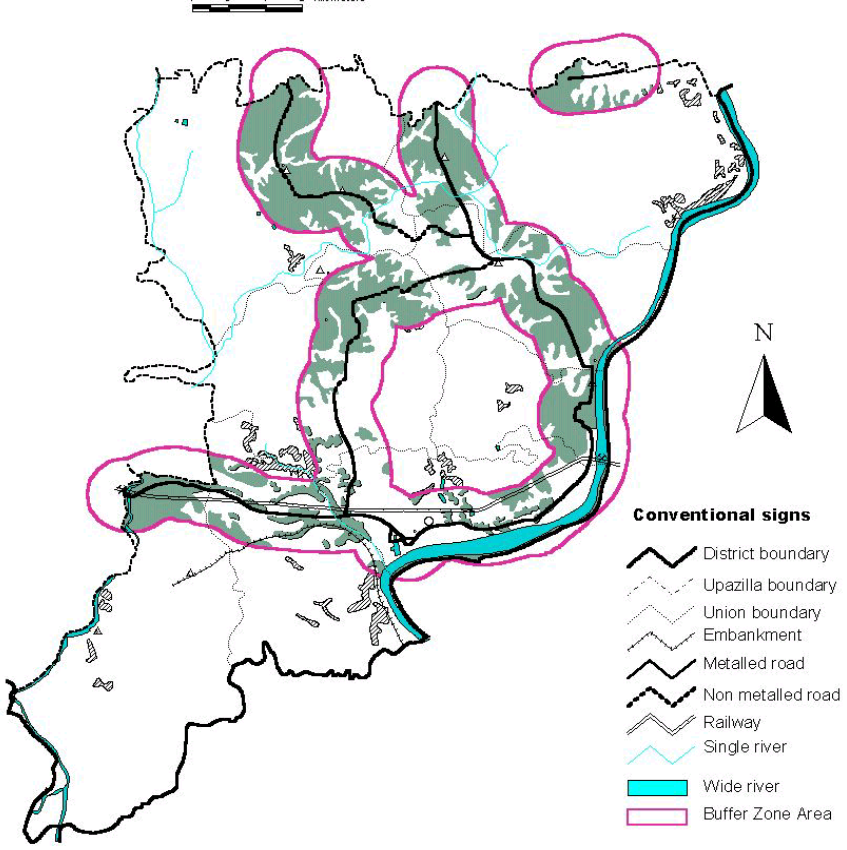

Crop Suitability Map
Kaliganj Upazila
3 0 3 6 Kilometers
T.Aman
Legend
Suitable
Non - suitable
Wheat

Land Zone Map Fig : 2



BUFFER ZONE
For Proposed Urban/ Industry
Kaliganj Upazilla
Gazipur District
Soil Resource Development Institute

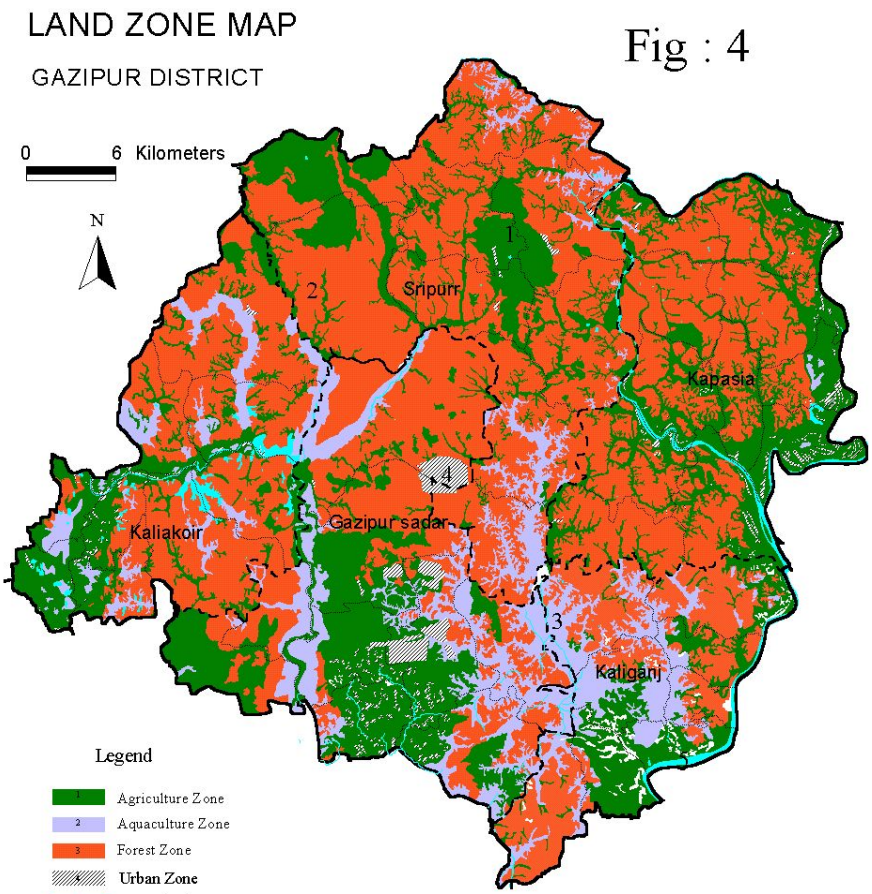
FIG : 3



Legend

Proposed Urban Zone
(within the Buffer Area)

Existing Uraban Zone



Factors considering for Land Zoning

Agriculture Zone -

1. Landtype : Highland to Lowland
2. Surface Runoff : Early - Late
3. Drainage : Well - Poor
4. Texture : Sandy Loam - Clay
   Suitable for major field crops

Forset Zone -

1. Landtype - Highland
2. Surface runoff - Very early
3. Drainage - Well drain , Moderately well drain
4. Out of Flood Hazard
   Suitable for trees,bushes,veg. crops

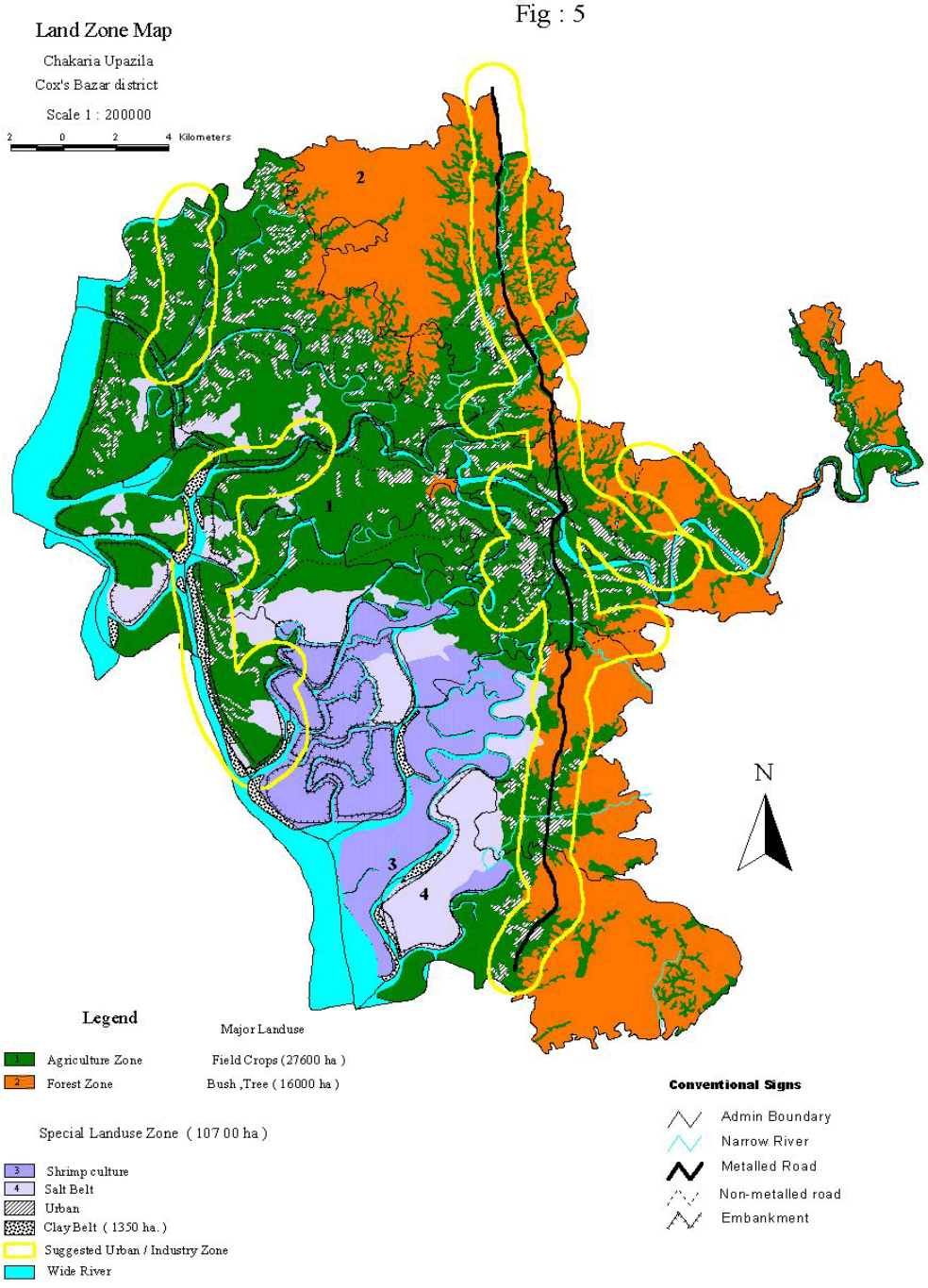
Aquaculture Zone -

1. Landtype - Lowland, Very lowland
2. Surface Runoff - Late, Very late
3. Flood risk Hazard
4. Drainage - Very poor
   Suitable for fish culture

Urban / Indrustry Zone -

1. Landtype : Highland
2. Surface runoff : Early - Very early
3. Drainage : Well - Moderately well drain
   With existing urban area

Fig : 5


Land Zone Map
Chakaria Upazila
Cox's Bazar district
Scale 1 : 200000
2 0 2 4 Kilometers
1
2
3
4
N
Legend
Major Landuse
Agriculture Zone
Field Crops (27600 ha)
Forest Zone
Bush ,Tree (16000 ha)
Special Landuse Zone (107 00 ha)
Shrimp culture
Salt Belt
Urban
Clay Belt (1350 ha.)
Suggested Urban / Industry Zone
Wide River
Conventional Signs
Admin Boundary
Narrow River
Metalled Road
Non-metalled road
Embankment

Presentation for Shrimp Cultivation

Giasuddin Khan, District Fisheries Officer, Dept. of Fisheries (DoF) and Md. Nuruzzaman Fourth Fisheries Project (FFP)

Coastal Land use Zoning

Context of Fisheries

Brackishwater Aquaculture
Coastal Shrimp Farming
Mariculture

Giasuddin Khan &
Md. Nuruzzaman
DoF

1

Thematic Zoning

Presently, no zoning systems followed

Ecosystem Based Land use Zoning

Why?

- The whole coast does not fall under a single ecological category
- Different ecological condition support different land use
- Within a single land use type, the technology/model differs greatly
- Presently, all coastal land use within fisheries sector is directed to shrimp farming
- There must be areas suitable for uses e.g. finfish culture, crab fattening, seaweed or even nursery protection or spawning protection

2

Ecological Settings

- ***Classify Ecological Settings***

- Develop different models for different ecological classes
- Identify the ECAs & adopt conservation/ mitigation measures
- Identify ecological areas for environmental protection, commonly important for all uses & adopt measures to maintain ecological integrity
- Restrict some areas for any type of economic activity

3

Compartmentalization

Suitability/Optimum use analysis

- Resource based/Technically sound use
- Environmental Impact Assessment _ EIA
- Economic suitability analysis
- Social/Cultural/Ethnical acceptance _ SIA
- Livelihood enhancement/Poverty reduction

4

Value Addition - Role of ICZMP

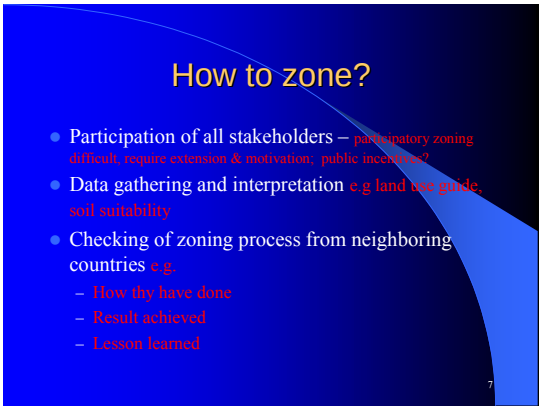
- Ecosystem base management itself takes care of macro conflicts
- Participatory management of land use
- Coordination & Resolution of micro conflicts

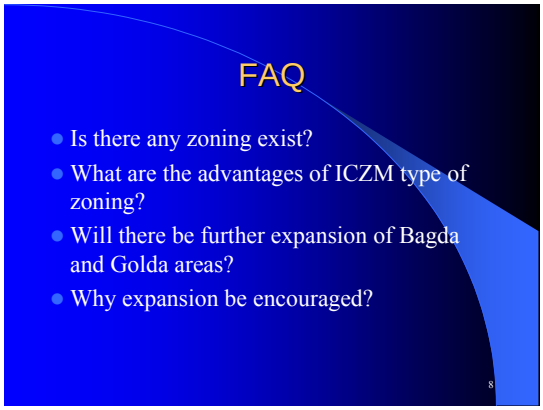
5

Where zoning?

- Zoning in public land e.g. mangrove, charland, wetland – easy but little scope in the SW
- Zoning in private land e.g. inside polders – good scope, should be regulatory (encouraging/discouraging thru incentives)
- Zoning in mixed type land e.g. khas canals/water bodies can be kept lease free for irrigation

6


How to zone?
Participation of all stakeholders – participatory zoning difficult, require extension & motivation; public incentives?
Data gathering and interpretation e.g land use guide, soil suitability
Checking of zoning process from neighboring countries e.g.
How thy have done
Result achieved
Lesson learned
7


FAQ
Is there any zoning exist?
What are the advantages of ICZM type of zoning?
Will there be further expansion of Bagda and Golda areas?
Why expansion be encouraged?
8

Agricultural Productivity Zonation in the Greater Noakhali Region

S.A. Sattar, Sr. Agriculture Advisor, Char Development & Settlement Project-II (CDSP), Noakhali

1. Introduction

Among the different forms of land use crop production is the only one predominant in the coastal region of greater Noakhali region. Single transplanted aman rice was the dominant (80-100%) cropping pattern in the region followed by t.aman-rabi (1.5-18%) or aus-t.aman (below 2%) patterns. Char Development and Settlement Project (CDSP) is trying to improve the economic condition of the char people through strengthening the extension services of the Department of Agricultural Extension (DAE).

Services of DAE in the region are seriously constrained with lack of required manpower, both at the management and at BS levels, logistics and inadequate knowledge and skill of the DAE field workers in handing the specialized coastal ecosystems. Often they fail to identify suitable crops and other technologies appropriate for a particular ecosystem and thus many of the demonstration plots failed having a negative impact on the adoption of improved agricultural technologies in general. As a result, only traditional local varieties of transplanted aman rice occasionally followed by some rabi (mostly greengram, chilli, groundnut, sweet potato and linseed) on a few plots are grown resulting in very low system productivity. We identified five major constraints responsible for improving agricultural production in the char areas and these are: (a) unfavorable moisture situation, (b) soil salinity, (c) lack of knowledge of farmers, (d) poor extension services, and (e) a host of socio-economic vulnerabilities (highly imbalanced land tenure system, lack of marketing etc.). We tried to improve the agricultural production of the chars by strengthening and facilitating extension services by DAE. We helped DAE with two practical tools to improve the extension services such as (a) technology source book, and (b) productivity zone (PDZ) maps. The latter tool appears to be more effective not only for technology targeting but also for their further promotion in the extrapolation domain.

While the technology source book will help DAE identifying crops and crop varieties suitable for a particular char situation, PDZ will indicate the appropriate location for the technologies to be demonstrated. This paper will describe the methods of agricultural productivity zonation in detail together with possible modifications, if any, so as to enable it to be replicated elsewhere.

2. Productivity zone (PDZ)

It can be regarded as a more or less homogeneous block of land having similar agro-ecosystems that supports agricultural productivity at a certain level. However, a zone may be persistent in a stable area in the hinterland while it may be changing in a dynamic situation of char development. This kind of change may take place in decades of time and needs to be addressed accordingly for better farm productivity.

3. Objectives of PDZ mapping

There can be several benefits of using PDZ maps. These are:

- grouping of technologies according to their ecological niche
- targeting a technology by the extension services to PDZ which is more suitable.
- help faster promotion of a technology with less money for its better performance in a more favorable conditions
- saves from the negative impact of the technology.

4. Methods of mapping

4.1 Setting up of criteria

Productivity of a crop is a result of interactions of a number of physical, chemical, biological and management factors. Among these, soil and water conditions are very important. Since coastal chars are formed from fresh deposition of silt, soils are fairly uniform with respect to texture, nutrient status, pH and organic matter content. However, there are considerable differences, even within a short distances, in depth of flooding during peak monsoon period and soil salinity during dry season. DAE must take these two criteria into account while recommending certain technology for a given coastal area. Therefore, these two parameters have been chosen for PDZ mapping. The implications of the criteria chosen for these parameters on crop production are given in Table 1 & 2.

Table 1: Boundaries of flooding depth and their implications on crop production

Flooding depth (cm)	Implication for crop production
0 - 20	Suitable for all crops. Aus in the early and aman in the late stage may suffer from drought. HYVs of aus and aman are possible. Transplanted aus may delay following aman crop
20 - 45	No problem with HYV aus. HYV aman with shorter seedlings may be difficult, particularly after aus. Excess soil moisture at harvest of aman during the wet year may delay sowing of rabi crops.
45 - 100	Only tall varieties of rice (both aus and aman) are suitable. Until taller HYVs of rice are available, local varieties should continue to be grown. Soils do not dry at the beginning of rabi and thus restricts its cropping.
>100	Only tall local varieties of aman rice can be grown successfully. Boro can be grown if surface water is available for irrigation. There is no prospect for rabi cropping

4.2 Data collection

Plot-to-plot survey was done in an area having mouza maps. Where mouza maps were not available, the whole area was divided into 100x100m grid. Information on peak monsoon flooding depth on a particular plot or grid was recorded after discussion with a local farmer hired during the survey. Soil samples were also collected from each intersection of 300x 250m grid and from two depths, 0-0 and 10-30 cm. Soil salinity was measured directly in the 1:1 soil:water suspension in the SRDI Lab. The EC(1:1) values were converted to ECe using a conversion factor 2.37EC(1:1)-0.02EC(1:1)^2 developed by CDSP consultant. However, only topsoil salinity was used for PDZ mapping.

4.3 Mapping of PDZ

Using the GIS software mapping of PDZ was done using the combinations of the features of the two parameters mentioned above (see figure). Based on the sensitivity of the field crops observed (mostly rabi crops) the matrix is chosen such that more or less a favorable ecosystem for a group of crops can be identified. The outcome of mapping is shown in the PDZ map of south Hatiya as an example (see map).

Table 2: Levels of peak soil salinity and their effect on crop production

Topsoil salinity, dS/m		Salinity classes	Suitable technology
ECe	EC(1:1)		
0-8	0-3.48	Non-saline to slightly saline	No effect on growth of most crops
8-16	3.48-7.19	Slightly saline to saline	Growth reduction of highly sensitive crops only
16-30	7.19-14.42	Saline to highly saline	Medium to severe growth reduction of most crops
>30	>14.42	Strongly saline	All available crops fail to germinate and grow

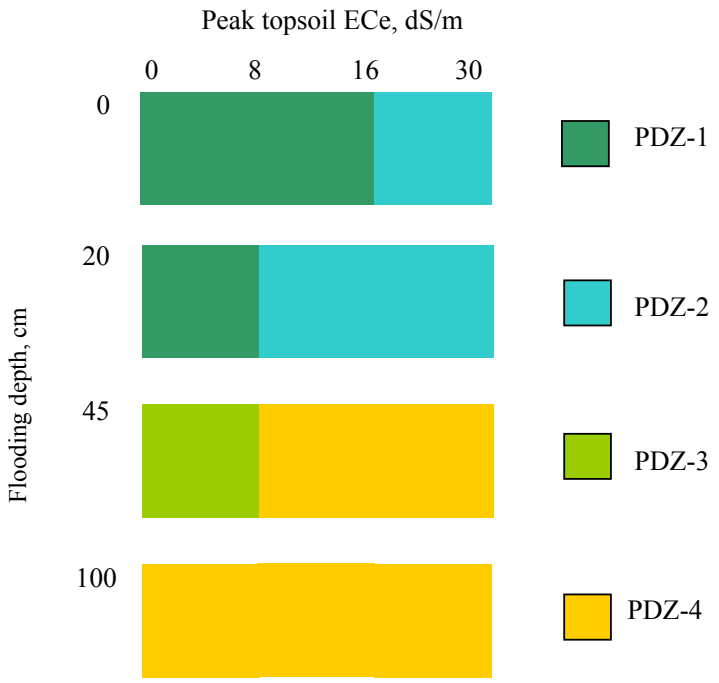


Figure 1. Criteria for mapping PDZ

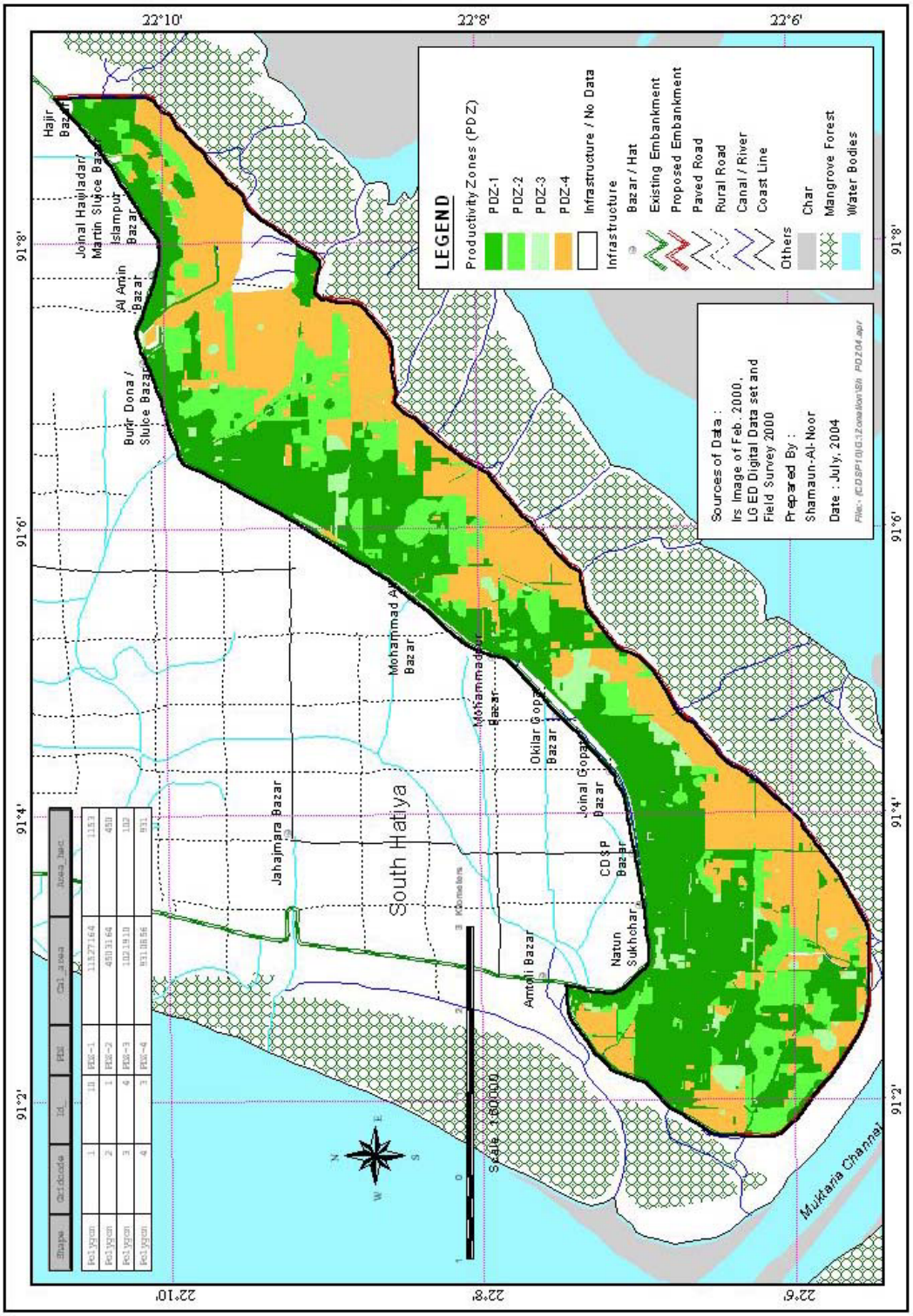
5. The lessons learnt and future modifications

DAE Noakhali started using the PDZ maps since kharif-II of 2003 in sadar and Hatiya upzailas. The field workers of DAE could fully understood the map after a short briefing by the project staff. After working one season they found it useful and are willing to continue further.

The PDZ mapping suggested here is applicable for the coastal ecosystems only. Similar mapping can be done for other areas or even for a block under each Block Supervisor (BS) of DAE. The BS working in the coastal areas should be supplied with a simple portable EC meter and be trained in measuring the soil salinity in 1:1 soil : water suspension. He should also be able to delineate areas according to the flooding depths in his block. Using these information and with some adjustments in the digital copy of the upazila maps organization having GIS facilities would be able to prepare PDZ maps for other coastal areas once each of the blocks are geo-referenced.

Maps for areas other than coastal areas can also be prepared using the same techniques described above. This would require choosing the appropriate criteria for mapping for the concerned area. Selection of criteria may not be an easy job wherever multiple factors become the equally important determinants. While monsoon flooding depth should always be an essential parameter for all areas, other factors limiting crop growth may vary from one place to another. For example, soil salinity is an important factor in the coastal areas only while soil texture may be an important determinant for particular area and deficiency of certain elements (sulfur, zinc, boron etc.) can be highly localized. Likewise climatic variations can also be an important parameter for a region or area.

Productivity Zones - South Hatiya 2004



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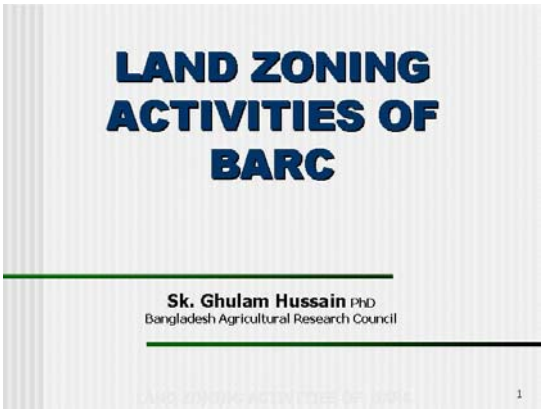
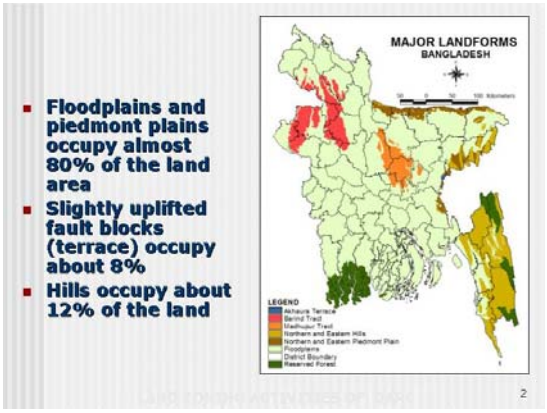
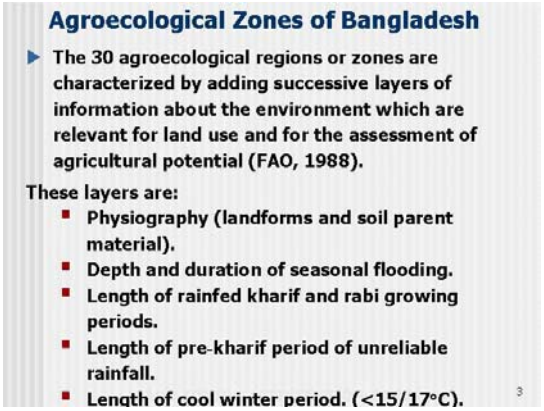
K)	cZ¨¶ LiP		
01	Rwgi jxR gwb (GKi)	14,375/-	14,375/-
02	kwgK gRix (1 Rb)	8,400/-	8,400/-
03	kwg‡Ki ‡LvivKx	4,000/-	4,000/-
04	gv‡Vi miÄvgw`	1,000/-	1,000/-
05	cwjw_b (150 MR) (e¨enwiZ cwjw_‡bi weµq gj¨ ev‡`)	-	2,000/-
06	wcwfwm cvBc (2Ó Wvqv) 10Ô I wdëvi †g‡Uwiqvj	-	250/-
L)	c‡iv¶ LiP		
01	`vjvjx, cwienY, BDwc U¨v· I Ab¨vb¨ e¨q gY cwZ 5/- UvKv nv‡i (cwZ †g:Ub 134/- UvKv)	2,010/-	2,613/-
M)	‡gvU Drcv`b e¨q (K+L)	29,785/-	32,638/-
N)	Drcv`b	* 15 †g:Ub	** 19.50 †g: Ub
O)	weµq gj¨	53,400/- (cwZ †g:Ub 3,560/- nv‡i)	87,750/- (cwZ †g:Ub 4,500/- nv‡i)
	bxU gbvdv (O-M)	23,615/-	55,112/-

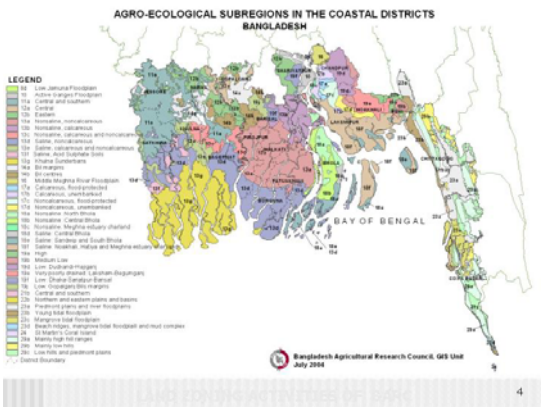
Presentation for Land Zoning Activities of BARC

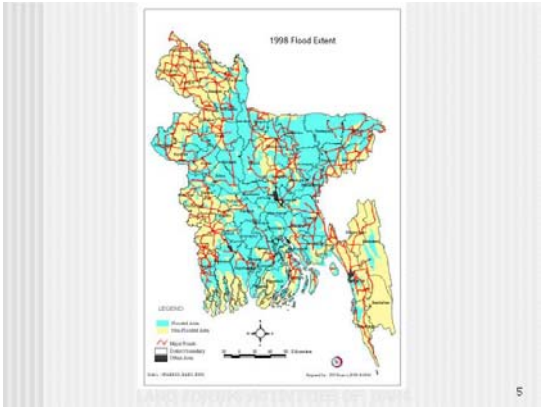
Sk.Ghulam Hussain, Chief Scientific Officer, Bangladesh Agriculture Research Council (BARC)

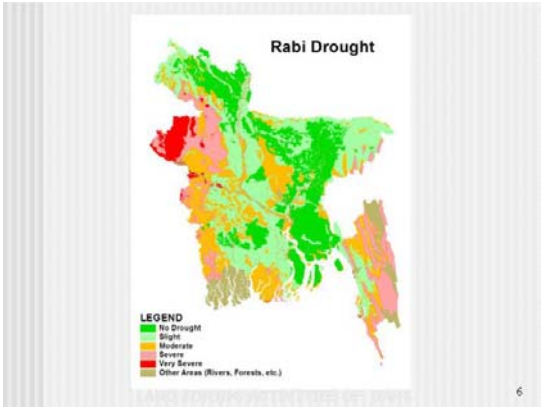


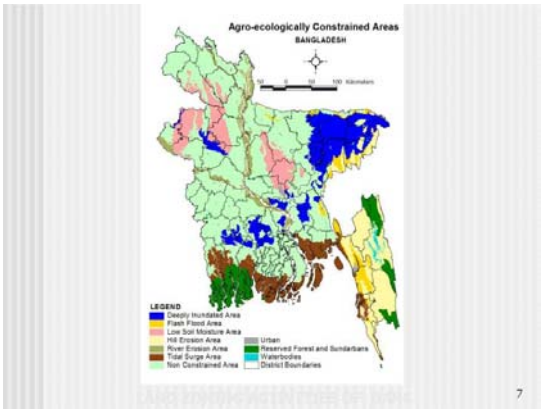




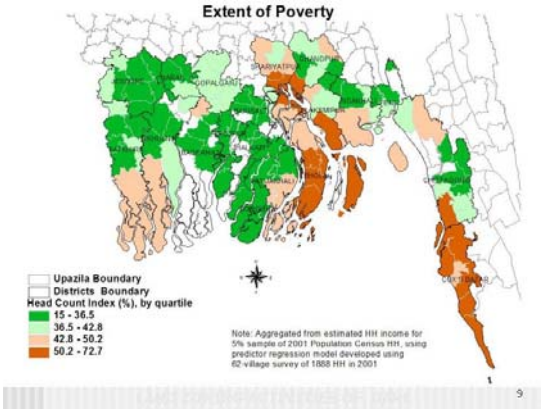


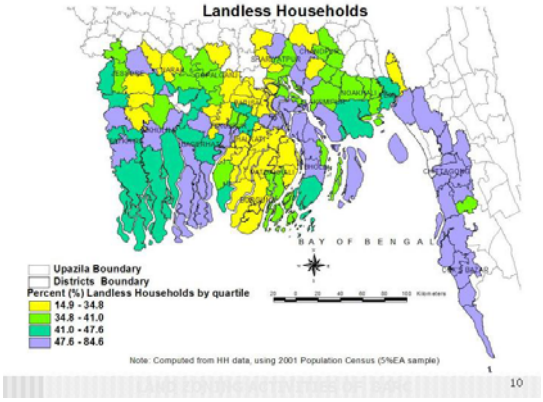


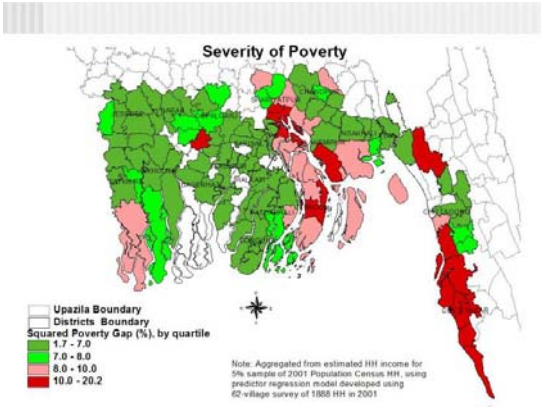


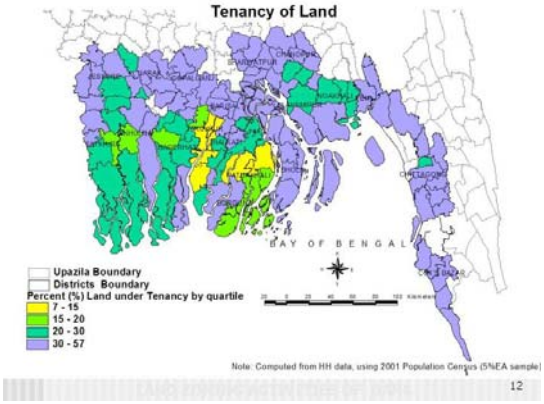

Agro-ecologically Constrained Areas
BANGLADESH
LEGEND
Deeply Inundated Area
Flash Flood Area
Low Soil Moisture Area
Hill Erosion Area
River Erosion Area
Tidal Surge Area
Non Constrained Area
Urban
Reserved Forest and Sundarbans
Waterbodies
District Boundaries
7

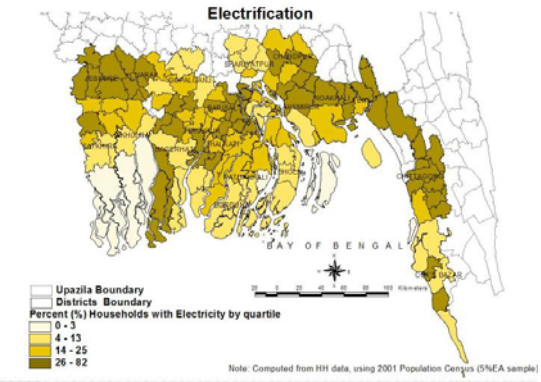

Development of Bangladesh Country Almanac(BCA): A tool for dissemination of information in agricultural decision making
Geographic Distribution of Poverty in Bangladesh: Implications for Policy and Agricultural R&D&E Interventions
8

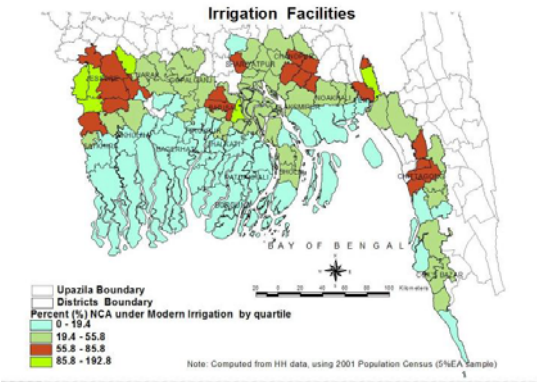

Extent of Poverty
Upazila Boundary
Districts Boundary
Head Count Index (%), by quartile
15 - 36.5
36.5 - 42.8
42.8 - 50.2
50.2 - 72.7
Note: Aggregated from estimated HH income for 5% sample of 2001 Population Census HH, using predictor regression model developed using 62-village survey of 1888 HH in 2001
9

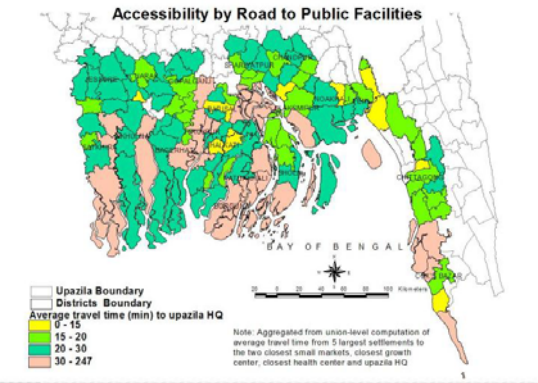

Landless Households
BAY OF BENGAL
Upazila Boundary
Districts Boundary
Percent (%) Landless Households by quartile
14.9 - 34.8
34.8 - 41.0
41.0 - 47.6
47.6 - 84.6
Note: Computed from HH data, using 2001 Population Census (5%EA sample)
10


Severity of Poverty
Upazila Boundary
Districts Boundary
Squared Poverty Gap (%), by quartile
1.7 - 7.0
7.0 - 8.0
8.0 - 10.0
10.0 - 20.2
Note: Aggregated from estimated HH income for 5% sample of 2001 Population Census HH, using predictor regression model developed using 62-village survey of 1888 HH in 2001


Tenancy of Land
BAY OF BENGAL
Upazila Boundary
Districts Boundary
Percent (%) Land under Tenancy by quartile
7 - 15
15 - 20
20 - 30
30 - 57
Note: Computed from HH data, using 2001 Population Census (5%EA sample)
12


Electrification
BAY OF BENGAL
Upazila Boundary
Districts Boundary
Percent (%) Households with Electricity by quartile
0 - 3
4 - 13
14 - 25
26 - 82
Note: Computed from HH data, using 2001 Population Census (5%EA sample)
13


Irrigation Facilities
BAY OF BENGAL
Upazila Boundary
Districts Boundary
Percent (%) NCA under Modern Irrigation by quartile
0 - 19.4
19.4 - 55.8
55.8 - 85.8
85.8 - 192.8
Note: Computed from HH data, using 2001 Population Census (5%EA sample)
14


Accessibility by Road to Public Facilities
BAY OF BENGAL
Upazila Boundary
Districts Boundary
Average travel time (min) to upazila HQ
0 - 15
15 - 20
20 - 30
30 - 247
Note: Aggregated from union-level computation of average travel time from 5 largest settlements to the two closest small markets, closest growth center, closest health center and upazila HQ
15


Thank You.....
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Use of GIS, RS and ALES in Coastal Land use Zoning

Abu Muhammod Ibrahim, Soil & Agriculture Specialist, Centre for Environmental and Geographic Information Services (CEGIS)

1. Introduction

EGIS II, the predecessor of CEGIS was given the responsibility of conducting a study on coastal land use zoning. The study has been included under Sustainable Environmental Management Program (SEMP) of UNDP. This component has been put under the category called 'Policy and Institutions'. The implication would be that the findings of the study are to help in formulating relevant policies and in developing necessary institutions in implementing the policies. The present study component, which is to be carried out in the south-western region of the country, can be viewed as a pilot exercise in the process.

The coastal area of Bangladesh constitutes a unique ecosystem in the country. In the south-western part of the coast, the mangrove forest of the Sundarbans has immense importance in the context of bio-diversity. Certain areas in the coast are important for marine fishing. In many parts, shrimp cultivation has assumed significant proportions. People living in the coastal have also been using the land for crop cultivation by adopting to the soil and water conditions there.

There has been lack of planning in utilizing the resources available in the coastal areas of the country have not resulted in the desirable utilization of the available resources. Issues relating to conflicts of interest and environmental degradation have not been properly addressed, thereby leaving much of the potential of the area unrealized.

2. Study Objectives

- Identifying land use patterns and land cover
- Examining physical suitability of land for different uses
- Examining whether land being used as per physical suitability
- Policy implications

The study would engage in a land use zoning exercise for the region by examining the availability of various resources and their current use as well as the use that would be desirable for sustainable development of the region. It is hoped that the study would help in identifying relevant policies and institutional requirements. Besides, the findings of the study would be useful in future exercises toward land use zoning in other coastal areas of the country.

In the light of the above, the major objectives of the study would be to:

- Provide baseline information on different types of land use in the study area in the form of zones;
- Examine suitability criteria for different types of land use
- Show how zones need to be defined for effective utilization of the resources; and identify some of the policy implication.

3. Study area

The study area includes three administrative districts: Khulna, Bagerhat and Bagerhat. These three districts have fallen under two Agro-ecological regions : High Ganges River Floodplain and Ganges Tidal Floodplain. The former region includes the northern upazilas of three districts. The major areas lying in the southern part of the districts have fallen under the Ganges Tidal Floodplain. The

former region has complex relief of broad and narrow ridges separated by basins, mostly non-saline, while the later region is smooth, flat and saline.

4. Methodology

The following steps are to be followed to complete the work;

- Physical attributes are to be determined that influence the use of lands;
- Collections of secondary data on the attributes;
- Physical attributes needed for land to make it suitable for specific uses are to defined;
- Suitable areas for different uses of land are to be determined
- Results will be made on Land use zoning based on physical suitability
- Delineation will be made on the areas that represents different types of land use
- Suitable land use zoning are to be overlaid over the present land use
- Differences between the suitable and current land use are to be sorted out
- Major reasons of the deviation from the potential suitable area are to be identified for policy implications for the short and long term

Flow chart in Figure 1 has shown the steps of the methodology.

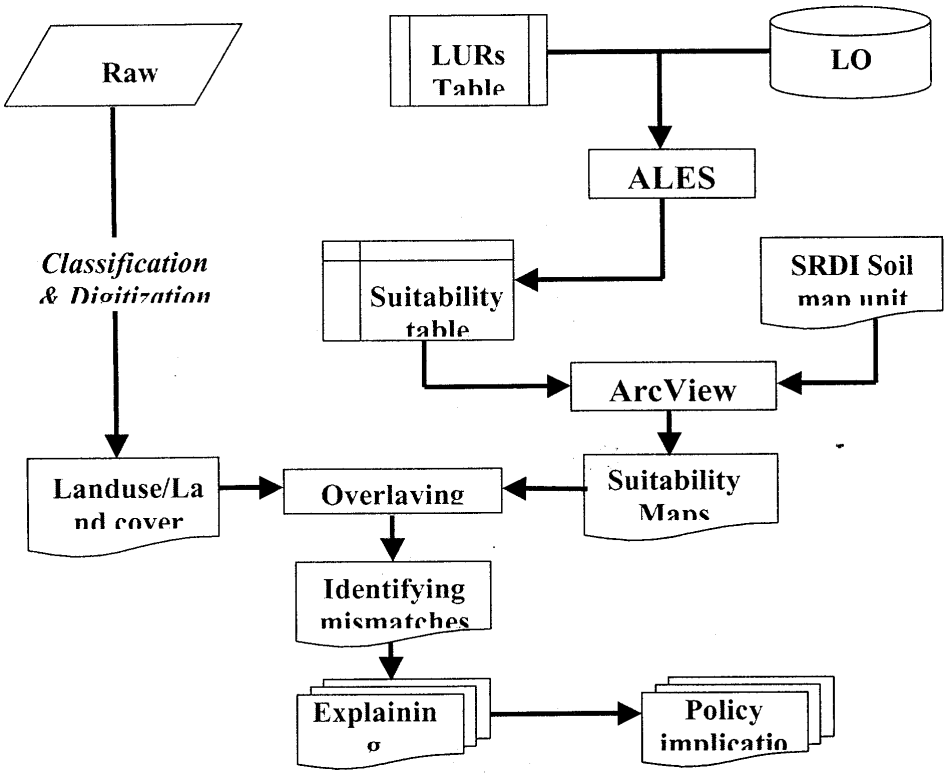


Figure 1: Schematic Diagram of the study methodology

5. Physical attributes for the suitability classification

Two land suitability classifications have been prepared for T.Aman crop (Table 1) and salt water shrimp Bagda (Table 2). In preparing these tables eight land characteristics have been considered for T.Aman and four land characteristics for Bagda shrimp.

Table 1: Land suitability classification for T.Aman crop

Land quality	Land Characteristic	Unit	Factor rating			
			S1	S2	S3	N
Retaining water on soil surface	Topsoil texture	Class	Clay	Clay loam	Loam	Silt loam, silt
Retaining water in subsoil	Soil permeability	Class	Slow	Moderate	-	>180
Oxygen availability	Depth of inundation	Inundation depth	1-30	30 - 90	90 - 180	Rapid
Drain ability	Drainage condition	Class	Vpd, Pd	Impd	Mwd	Wd
Excess salts	Soil salinity in wet season	Ds/m	<2	2 - 4	4 - 8	>8
Moisture availability	Moisture holding capacity	Mm/m	>300	200 - 300	100 - 200	<100
Toxicity	Soil reaction	pH	5.6 - 8.4	4.5 - 5.5 & 8.5 - 9.0	<4.5	-
Nutrient retention	CEC	Meq/100g soil	>24	24 - 12	<12	-

Table 2: Land suitability classification for Bagda Shrimp

Land Characteristic	Unit	Factor rating			
		S1	S2	S3	N
Salinity of surface water	Ppt	15 - 25	10 - 15	5 - 10	0 - 5
Distance from river/ creek	M	<250	250 - 500	500 - 1000	>1000
Soil reaction	pH	6.6 - 7.4	5.5 - 6.4 & 7.5 - 8.0	5.0 - 5.4 & 8.0 - 8.5	>5.0 & >8.0
Land type	Class	F2, F1	F1	F1, F3	F0, F4

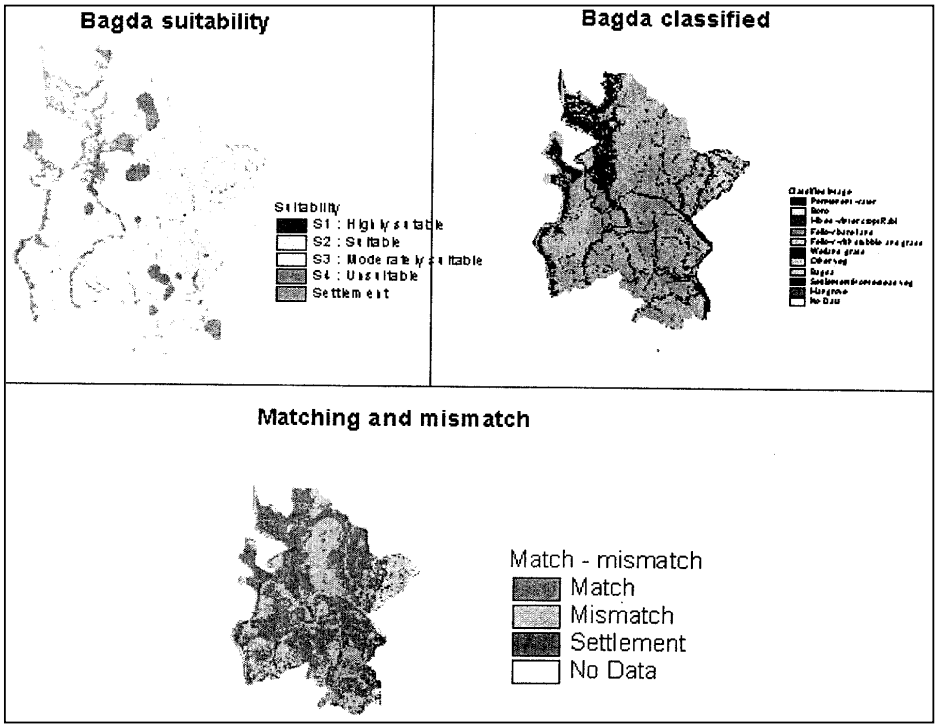
6. Results

Land suitability maps have been prepared both for bagda and T.Aman crop. Present Land use for these two resources has clearly indicated the mis match areas. Policy interventions are needed to remove the conflicts and save the land resources from further degradation.

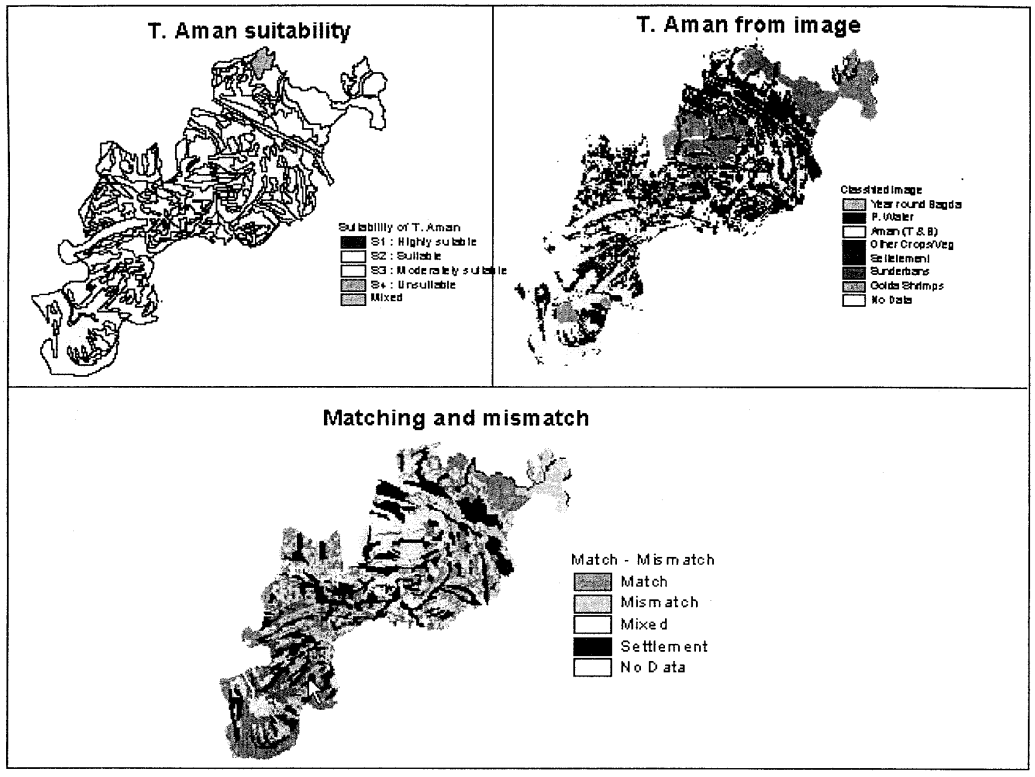
7. Conclusion and policy implications

The land suitability factor for both T.Aman and Bagda are more or less similar, except the soil salinity. High salinity increases the Yield of Bagda, where as it reduces the yield of T.Aman crop. Based on the physical suitability areas, Land use zoning for exclusively Bagda should be clearly delineated. Similarly land zoning for T.Aman and other agricultural crops are to be separated from Bagda practices. Introduction of improved methods of shrimp culture in their respective suitable zone could bring higher net income per unit farmland. The less suitable areas for Bagda must be released for agricultural crops. This must be in accordance with the social acceptance of all category people of the area.

Comparison of suitability of Bagda



Comparison of suitability of T.Aman crop



Coastal Land Use Zoning for Tourism

Ziaul Haque Howlader, Executive Officer (Planning), Bangladesh Parjatan Corporation (BPC)

Overview of Tourism Development in the Coastal Zone

Tourism has become one of the largest and fastest growing commercial activities in recent years. In the last fifty years, tourism has emerged as a force having economic, social and political impact, which crossed borders of the nations. There have been 694.0 million international tourist arrivals in 2003 worldwide.

The tourism industry in Bangladesh recorded increase in tourist arrivals for the 5th consecutive year since 1999-2003. Arrivals in 2003 (244509) surpassed, the earlier peak figure of 207 246 in 2002. In terms of foreign exchange Taka 3 310.00 million was earned during the same period. Maximum of these arrival tourists visited the tourist spots existed in the coastal zone of Bangladesh. The following data will give you a good impression:

Tourist Arrivals at Coastal Zone (BPC Hotels & Motels) (2000-2002)

BPC Unit	2000	2001	2002	2000
Holiday Complex at Cox's Bazar	33856	37884	39859	33856
Motel Shaikat, Chittagong	10537	10946	13850	10537
Holiday Homes, Kuakata	3663	3553	3580	3663
Hotel Ne-Tung, Teknaf	248	1318	1898	248
Hotel Pashur, Mongla	68	1207	1279	68

Source: Bangladesh Parjatan Corporation (BPC)

Here it is very important to note that the potentiality of tourism development in Bangladesh mostly lies in the Coastal area. If we look at the top tourist attracting countries of the world, we shall find there resorts and holiday making facilities are all in their island and coastal belt such as Maldives, Malaysia, Sri Lank, Fiji, and Hawaii etc.

Tourism Prospect in the Coastal Zone

The main tourist attractions of Bangladesh are beaches, varied landscapes and unique bio-diversity. These are also ever-important sports of tourist destination. For Bangladesh most of its known and important tourist spots lie in the coastal zone. The Sundarbans, the largest mangrove forest of the world in one patch is situated on the southern coast. A beautiful sandy beach with forested hills in the background enriches the coastline in the southeast. The beach is about 120 km. long in one stretch and is one of the longest in the world. The famous beach town of Cox's Bazar stands on the northernmost extremity of this beach overlooking the Bay of Bengal. We have Kuakata beach, Inani Beach, Teknaf, Moheskhali Island, St. Martin's island, Sonadia Island and settlement of indigenous people spread over the coastline. Therefore, the coastal zone is very much important for exploiting the tourism potential of Bangladesh.

Tourism industry is one of the first growing sectors of the world and also, in many circumstance, tourism becomes an important alternative profession of the people of the coastal and island area where preservation of bio-diversity has been enforced. It is therefore certain that development of tourism in Bangladesh will greatly benefit from Integrated Coastal Zone Management Program.

Current Activities of Bangladesh Parjatan Corporation (BPC) in the Coastal Zone

The existing establishments of BPC in the coastal zone are:

a) Cox's Bazar- It is the only well developed and most frequented beach town of Bangladesh. The total land area possessed by BPC for tourism development is more than 210 acres. It has both natural and cultural diversity. Almost entire length of the beach, which spreads towards south, has a range of low hills with evergreen vegetation and springs. This scenic beauty is a great attraction to the tourists. It has a sizeable population of Burmese and Rakhyne tribal communities. The pagodas and temples built by them, their particular house types and their exotic life style including their colourful dress are other attractions to any tourist to the place.

Cox's Bazar is well connected with other art of the country by air and road. BPC established there some standard motels for tourists. There are also standard accommodation facilities for tourist in private sector.

b) Teknaf- Here the land area owned by BPC for tourism development is 2 acres. The BPC has recently established a 15-room hotel at Teknaf. Seawater at Teknaf beach is much clear and hills at Teknaf are suitable for trekking.

c) Kuakata- The beach is one of the unique in the world that allows a glimpse of full view of the rising and setting of crimson sun. The beach is not far away from the Sundarbans. It has picturesque coconut grove in the background. It is also a sanctuary of migratory birds. The land area possessed by for tourism development is 5 acres. The existence of Kuakata beach is now in peril owing to the erosion by the sea. Action should be taken immediately to safe this unique beach.

Kuakta has a cultural heritage. The rakhyne community of Mongoloid origin lives here. They have exotic social and cultural traits.

BPC has established a 10-room and one 30-bed dormitory capacity hotel here. Kuakata has a road communication with rest of the country, but journey is uncomfortable and lengthy because of bad road and many ferry interruption. This problem needs immediate attention.

d) Mongla- It is a port town and close to the Sundarban. The area earmarked on behalf of BPC for tourism development is 2 acres. BPC has established a 16-room capacity hotel here. The Hotel will provide accommodation to the tourists who will visit the Sundarban.

Future Activities in the Coastal Area

Cox's Bazar- BPC has taken up a project to establish a hotel-motel zone on Build-Operate-Transfer (BOT) or Build-Operate and Own (BOO) basis along the beach to the south of holiday complex of BPC. Advertisement for Tender has already been published in the daily papers for this purpose. The zone will be developed on 128 acres of land with all urban facilities.

A beach management committee has also already formed with the concern DC as its head for ensuring safety and security in the Cox's beach area.

Parky Beach- BPC will establish tourist facilities at Parky Beach on 10 acres of land. BPC has already asked the concern DC for acquisition of land in favour of BPC and PDB to install electricity at the project.

Kuakata Beach- Another standard Motel will be constructed here. PCP for construction of this motel has already been forwarded to the Ministry of Civil Aviation and Tourism for approval.

Sonar Char: BPC is making a feasibility study to create tourism facilities at Sonar Chaar. If viable, BPC along with the private sector create eco-friendly tourism facilities there.

Patenga beach: A decision was taken in a meeting of Ministry of Civil Aviation and LGRD to demarcation and handing over of land to BPC soon. After getting land, BPC will establish tourist facilities there.

The Sundarban- A committee headed by the Principal Secretary to the Honourable Prime Minister was formed for the Development of Eco-tourism in the Sundarbans. This committee by making various base level visits and meetings with different agencies/departments and private sector has submitted a report to the Secretary. This committee has recommended various short term and long-term programmes. As per the recommendations of the committee various actions are on by different agencies/department. BPC has prepared a PCP for installation of tourism facilities at Monshiganj near the Sundarbans. Work for site selection and land acquisition is going on. BPC has also sent a recommended letter to the Ministry of Finance via its concern Ministry to allocate at least 50 crore Taka for the private sector tour operators for purchasing of tourist vessels to operate in the Sunderaban. Another PCP for promotional activities of the attractions of the Sundarbans is being prepared by BPC.

BPC has also programmes for development of Inani beach, development of Special Tourist Zones at Sonadia Island and Kuakata beach. The Government of Bangladesh has a put a great stress on the extensive promotion of tourism in Bangladesh through public and private partnership. The government of Bangladesh has already declared Cox's Bazar, Kuakata and Sundarbans as Special Tourist Zones. Various sorts of initiatives are under process to develop tourist facilities in those areas. This will keep significant positive impacts on poverty alleviation of those areas and over all Bangladesh.

Issues to be addressed for Sustainable Development of Tourism in the Coastal Zone

A strong synergy among the concerned ministries/agencies and departments is a must for the development of tourist in the coastal area. The tourist resources of the coastal zone and island area have been endangered by ever-growing level of environmental pollution. This is a problem of erosion at some places in the coastline. Therefore an action is needed to contain pollution and erosion.

Apart from theses, looking into aspects like access, land use, energy sources, fresh water resources and waste disposal and above all people's participation are very important for the sustainable development of tourism in coastal and island areas.

4 CONCEPTS AND METHODOLOGY PRESENTATION

Land Use Zoning: Concepts and Methodology

Henk J.W. Mutsaers and Abdul Halim Miah, PDO-ICZMP

1. The zoning concept

Zoning is the demarcation of geographic areas with specific combinations of properties or features. The kind of features which are chosen and the interpretation of their different combinations depend on the purpose of the zoning exercise. Zoning is most often used for research and for planning purposes.

Zoning is a tool, not an aim in itself, and its purpose must therefore be precisely formulated. A lot of zoning is done without a precise objective in mind and the outcome will then be little better than nice-looking computer-generated wall paper. In the present case the broad aim is to elaborate a zoning based on existing information about current and potential land use in support of decentralised planning. More precise objectives will be given later on.

Three broad kinds of zoning can be distinguished:

- ***Descriptive zoning,*** i.e. presenting factual information in a geographic form by mapping the actual situation in respect of some feature or combination of features, like the occurrence of current land use types or population densities
- ***Analytical or predictive zoning***, which defines land classes by combinations of physical parameters, expecting that they will predict or explain an important phenomenon like crop yield or land suitability
- *Zoning for development planning*. Zoning may be broadened into integrated multi-sector zoning by including both physical and socio-economic features. It can be used to demarcate areas according to 'best-bet' options for integrated development and then becomes a tool for planning and management. This kind of zoning, which is proposed for the Coastal Zone, may be termed '*developmental zoning' or 'zoning for development planning'*.

Much factual and geographic information about the current situation in the coastal zone of Bangladesh is available in the form of databases and descriptive maps. A number of broad zoning studies have been or are being carried out, notably the agroecological zoning of Bangladesh and the SRDI land zone mapping. Other information bases are organised on a narrower basis, like SRDI's land suitability assessment for different crops and that of SEMP for paddy and shrimp culture. The latter two studies are 'analytical' but most are essentially descriptive. Section 3 gives an overview of a number of important on-going and completed zoning projects.

Zoning in support of integrated planning, facilitation or regulation of area development has only taken place to a very limited extent. An example is the designation of Export Processing Zones at the country's sea ports and industrial blocks in Chittagong and Khulna. PDO-ICZMP as an inter-sectoral agency wishes to broaden the scope by compiling existing sectoral information and consolidating it through developmental zoning. The ultimate aim would be to formulate integrated development objectives for the coastal areas in accordance with their (dominant) land use and economic activities, as well as their potentials and vulnerability. Hence, the intended outcome is a multi-sector developmental zoning which can be used as a tool for planning and facilitation of development.

Developmental zoning has to be more than just a description of the current situation and must account for major underlying ecological and socio-economic factors and processes which have led

to the current situation and which may be important for future trends and hazards. The approach will therefore take into account the most important ecological and socio-economic factors which are typical for the coastal areas.

2. Zoning as a tool in Coastal Zone development

2.1 Perceptions of line agencies about developmental zoning

The need for zoning as a planning tool has been recognised in many policy documents and one of the first tasks was to examine what kind of zoning different line agencies would find useful and for what purpose it could be used. From discussions with many line agencies a general consensus emerges that cross-sectoral development-oriented zoning of the coastal areas is urgently needed. The purpose would be to enable government assess possible land use options for different areas and choose the best options on the basis of potentials and limitations. There is wide-spread concern that the lack of regulatory measures and even of information to base such measures on, is leading to chaotic situations. Different groups want to set aside certain areas for their sector, for example for forest plantation or shrimp culture, which may conflict with the interests of others or with government's stated policies. An objective of integrated management is to find the best compromise on the basis of physical and socio-economic potential and limitations and cross-sector zoning could assist this process by making the options transparent.

Whereas there is broad consensus about the need and purpose of integrated zoning, there is no complete agreement about the methodology. Most agencies think that zoning with the administrative entities (Upazilas or Unions) as basic map elements is most practical, because it can be linked directly with decentralised decision making, planning and management, which is government's policy. The more ecologically-oriented agencies, in particular the Fisheries Department, would prefer more eco-systems based zoning, in order not to loose sight of important spatially distributed land properties. A compromise will therefore be sought, which combines the use of broad physical and ecological factors with a Upazila focus.

2.2 Why developmental zoning and who will use it?

It is PDO's task to co-operate with line agencies in the elaboration of an overall strategy and management framework for integrated coastal zone development. Information about the coastal zone is therefore being compiled, analysed and disseminated and tools and methods are generated for strategy development and planning. Integrated zoning is one of the proposed tools to help government in planning for optimum, sustainable land use.

In spite of important commonalities the coastal region is a very diverse environment in terms of physical and environmental conditions, land use, economic opportunities and risks. In a sense, diversity is the enemy of planning and the identification of structure is therefore a prerequisite. That calls for the demarcation of more or less homogeneous sub-zones or land use classes, which do justice to the existing diversity.

A major strength of zoning is that it helps to assess the potential, limitations and vulnerabilities of different kinds of land in a systematic way and by making them explicit, provides an objective basis to

- assign the land to its best possible use: agriculture, livestock, forestry, shrimp culture, nature reserve, industrial development, etcetera
- prevent (further) land degradation and restore degraded lands
- preserve and protect eco-systems with high ecological and cultural value
- prevent or resolve conflicts of interest between different land users and line agencies

Policy makers, planners and implementers at different levels of government will be the primary target group and zoning must therefore take administrative boundaries into account. Paper nr. 2 of the 'Living in the Coast' series[1] argues that under the government's decentralisation policy the local levels of government will play an increasingly important role and remarks that "budgetary allocation can be gradually linked to area development plans [and] the Upazila should be considered as the lowest unit of development." For zoning that means in practical terms that the Upazila must become the basic map element for zoning and that Upazilas are grouped in 'classes' or 'clusters' which are similar in terms of major agro-ecological and socio-economic factors, including the current economic activities of the population. There is broad support from line agencies for this approach.

The zoning will first and for all be a tool for government in stimulating, facilitating and regulating social, economic and environmental development, taking into account the interests of different groups of stakeholders and socio-economic and environmental potentials and vulnerabilities. It should allow to make informed choices for investment in human and physical resources and impose protective regulations where needed. Since the zoning at this stage would be Upazila-based and result in the identification of groups of Upazilas with similar developmental characteristics it should impact directly on the government's facilitation of the development of each group of Upazilas. It should also stimulate government, non-governmental organisations and the private sector at the local level to rally around common goals and combine their efforts to attain local development goals. In a later stage the zoning 'resolution' may be increased up to the Union or even lower level but at the moment that is not practicable.

Zoning as a tool for area development is an ambitious goal which can only be attained in stages. This document outlines the conceptual basis for the first stage in the process which should eventually result in an effective planning tool. We propose to refer to this first stage as 'Version 1.0' of the coastal land use zoning, in analogy with software engineering, implying that this is the first edition, which itself will still be amenable to improvement.

2.3 Synopsis of the proposed zoning process

At this point we like to give a brief synopsis of the proposed approach which will result in Version 1.0 of the coastal land use zoning. The approach will be worked out in more detail later on.

- A stepwise approach will be adopted with clear intermediate results so that progress can be monitored
- Only existing data will be used and field information will only be collected informally for the purpose of validating the zoning (ground-truthing)
- Consensus among concerned agencies will be sought at different stages of the elaboration process
- Version 1.0 of the zoning should be ready by the end of December 2004.

The expected output will be:

1. A zoning of the coastal area in about 20 land use classes or clusters each with a specific combination of physical, socio-economic and land use conditions
2. Each Upazila will be associated with one and only one of the land use classes
3. A typology will be given for each class explaining its characteristics in some detail
4. Land use classes can later be grouped (aggregated) into broader categories, like "Agricultural Areas", "Shrimp Areas", etcetera.

[1] Mr. Rafiqul Islam and Mohiuddin Ahmad,2004. Living in the Coast.Problems, Opportunities and Challenges. Living in the Coast series 2.

3. What has been done so far?

Integrated zoning of the coastal areas must use the information which is already available in different sectors. The aim is not to add another map to an already large number, but rather to use what is already known to build a more integrated, development-oriented tool. In this section an overview is given of existing zoning, maps and databases which will be useful as material for integrated zoning of the coastal areas.

3.1 Sectoral and inter-sectoral zoning, databases and maps

Many line agencies and organisations which deal with regionally distributed sectors, problem areas or activities have carried out or intend to carry out mapping to improve their understanding and identify leverage points for development. Such maps and other geographically distributed data are the raw material from which PDO-ICZMP will have to base its integrated zoning. Available databases and maps and those under construction are briefly summarised here. Mr. Halim will prepare a more detailed inventory in preparation of the zoning.

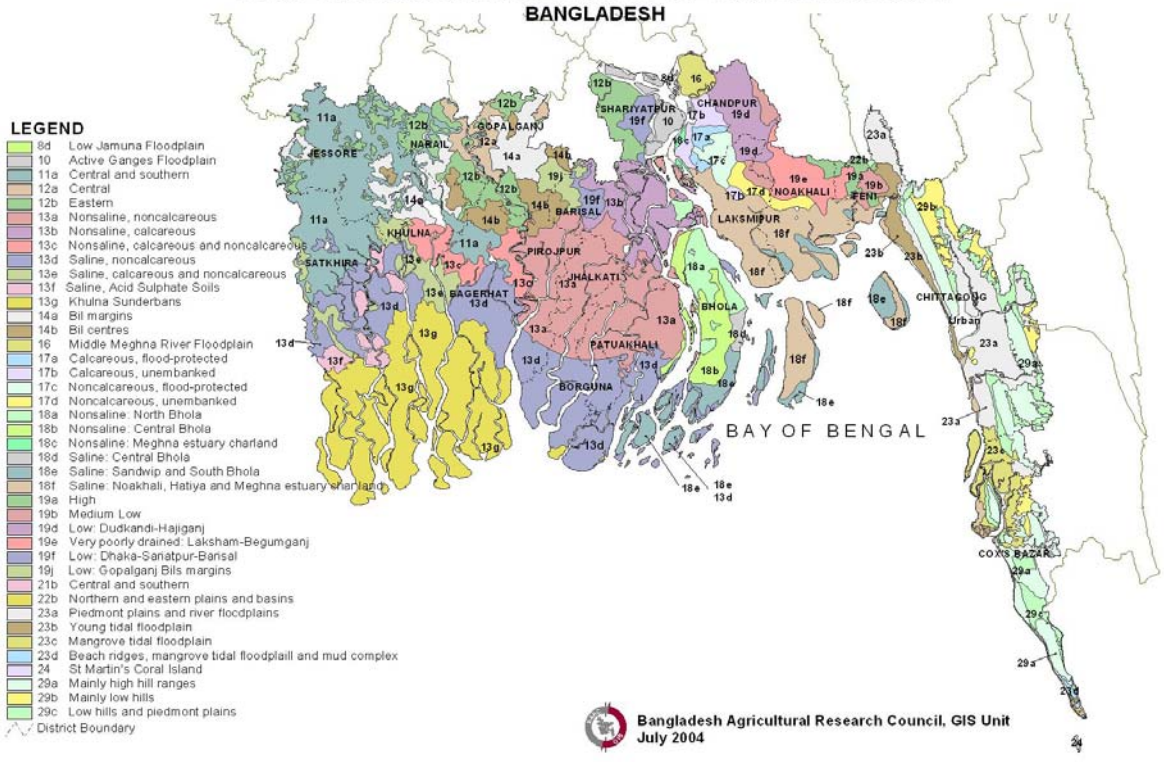
Administrative boundaries, infrastructure

Geo-referenced maps are available for the country's administrative units up to the Union Parishad level. The Upazila map was used earlier for delineating the Coastal Zone. These administrative maps have to be used as base maps for all zoning activities. LGED has detailed information in GIS format about rural infrastructure including rural road networks

The Agro-Ecological Zones map

Probably the best-known thematic map is that for agro-ecological regions produced by FAO in 1988. It distinguishes 31 Agro-Ecological Regions (now called Agro-Ecological Zones, AEZ) and 88 sub-zones. Out of the 31 AEZ, 10 occur in the Coastal Districts, with 41 sub-zones, as shown in Fig. 1. The map has been digitized and georefenced by its custodian organisation, BARC. Apart from the embellishment of publications and office walls its practical use has been limited. We will consider whether the map can be of use for zoning of the Coastal areas.

Fig. 1. AGRO-ECOLOGICAL SUBREGIONS IN THE COASTAL DISTRICTS



Zoning and mapping by SRDI

SRDI has a national mandate for zoning of agricultural land use. It has a long-standing record in producing a variety of maps, including soil maps, a map of problem soils and land use maps, all of the up to date until the late 1990s and 2000. In the last few years Thana Soils and Land Utilisation Guides have been completed for all the Upazilas (Thanas) in the country. They consist of a 1:50,000 soil map and explanatory notes for each Upazila, to be used for extension and land use planning purposes. The institute is now using the same database to prepare Thana and District 'land zone' maps, which distinguish 6 land zones, viz. agricultural land, forestry land, water bodies, aquaculture, urban and industrialised areas. These are actually land suitability maps, except for the water bodies and the urban areas which reflect the real situation. Some ground-truthing is done to compare the assumptions with the actual situation. Furthermore, land suitability maps are being prepared for the major crops.

If requested, SRDI can reproduce any of its maps for the 19 coastal Districts alone, which would be convenient for PDO's zoning activities.

Coastal Land Use Zoning by SEMP/CEGIS

A study is being carried out by CEGIS under the SEMP project (Ministry of the Environment) in three Districts in the southwest (Khulna, Bagerhat and Sathkira) to map current land use and assess land use capability for paddy (Aman and Boro) and shrimp cultivation, mainly based on bio-physical parameters. The project is funded by UNDP. Actual land use maps based on satellite imagery are also available for 1995 and 2001. The land capability maps will be ready by the end of this year.

Databases and zoning by the Department of Fisheries

The Fisheries Department has data on inland fisheries and shrimp culture for all Upazilas, which can be made available to generate simple Upazila-based maps. The department also intends to carry out land zoning to identify areas suitable for shrimp cultivation.

Zoning under the National Land Use Policy 2001

The National Land Use Policy document of 2001 considers land zoning as a key tool for the optimisation of land use, by demarcating areas of different potential and vulnerabilities. The Ministry of Lands has been given the task of co-ordinating land zoning under supervision by the inter-agency National Land Use Committee. So far the zoning work has not started.

Other organisations

Several other line agencies and other organisations have produced thematic maps or possess databases which may be useful for coastal land use zoning. IUCN, for example, has produced a *bio-ecological zone* map and a Upazila-based distribution map of shrimp culture. BARC is in the process of finalising a *rural poverty* map, in collaboration with IRRI.

The Bangladesh Country Almanac

The Almanac is a GIS-based database which can be used as a tool by non-specialists. It is the result of a joint effort by BARC, SRDI, BRRI and CIMMYT and brings together a large amount of scattered information on agriculture, social factors and environment in a (fairly) easily accessible form. Much of it is in the form of maps, produced by different institutions. Some of the maps mentioned earlier are part of the Almanac. That includes the AEZ map, but without the sub-zones.

3.2 Overall characterisation of the Coastal Zone

Delineation of the Coastal Zone

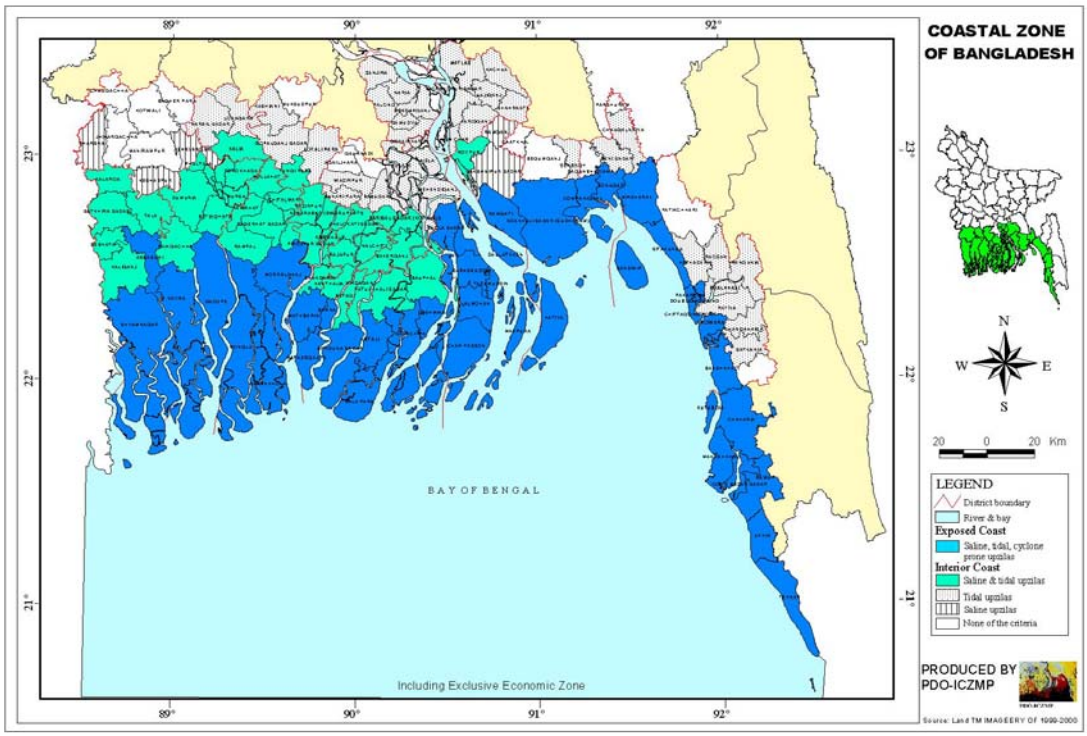
PDO-ICZMP has proposed a quantitative definition of what constitutes the "Coastal Zone"[2], which has been officially approved by the concerned line agencies. The delineation of the coastal zone is linked to administrative boundaries, with the Upazila as the smallest entity, using three physical factors:

- Tidal water movements
- Salinity intrusion
- Risk of cyclones and storm surges

For each of these a threshold value was chosen and a Upazila is considered part of the coastal zone if its average score for at least one of the factors exceeds the threshold. A District with at least one coastal Upazila was labelled as a coastal District. This resulted in 19 Coastal Districts comprising 147 Coastal Upazilas.

Next, the coastal zone was sub-divided in 'exposed coast' and 'interior coast' sub-zones. The 'exposed' sub-zone includes Upazilas with significant risk of cyclones. They all face the Bay of Bengal or the lower estuaries and the thresholds for tidal movement and soil and water salinity were exceeded in all of them. The 'interior' sub-zone is quite heterogeneous and includes Upazilas where the threshold for both or only one of the latter was exceeded. The resulting zonal map is shown in Fig. 2. This zoning was only meant to delineate the overall coastal zone. For strategy development and planning purposes it obviously is too crude, nor was it intended for that.

Fig. 2. Delineation of the Coastal Zone (from Kamal and Koudstaal, 2003)



[2] M. Kamal Uddin and Rob Koudstaal, 2003. Delineation of the Coastal Zone. PDO-ICZMP Working Paper WP005

Profile of the Coastal Zone

A multi-facetted profile of the coastal zone has just been published[3], which gives an up-to-date picture of the physical and socio-economic conditions in the coastal areas, including information about problems, opportunities and vulnerabilities. The information will be useful for the zoning project, in particular for the analytical information which should accompany the zoning map, as will be described later.

4. Concept and methodological outline for coastal land use zoning

4.1 Preamble

Many agencies in Bangladesh recognise the need for integrated zoning in support of planning for 'best possible' economic land use, while preventing land degradation and protecting the environment. So far zoning has mainly been done along sectoral lines which does not provide a basis for choices between often conflicting sectoral objectives. Integrated development is the outcome of such choices and multi-sector zoning should provide a tool to arrive at the best choices for economic land use in an area, on the basis of its needs and potentials. Since the tool will primarily be used by government agencies for stimulating integrated development it is widely accepted that the basic map elements must take administrative boundaries into account.

It is also recognised, however, that there is a contradiction between the geographic nature of important physical, agro-ecological and socio-economic features and the wish to use administrative entities as map elements. Eco-systems, for example, cross-administrative boundaries and an administrative entity may embrace more than one eco-system. The challenge for developmental zoning is to reconcile the two by grouping the Upazilas into 'classes' or 'clusters' which are characterised in terms of combinations of physical and socio-economic features, including present land use. These classes will be referred to as 'land use classes'.

Finally, the ambition of zoning as a genuine development-planning tool cannot be entirely fulfilled at this time. This is considered as just the first stage in a longer term process towards genuine developmental zoning. The first version, which may be called 'version 1.0'[4] will still be more descriptive of the current land use situation than indicative for best possible future land use. Furthermore, the Upazilas will be the basic map elements, in other words the maximum resolution of the zoning map will be up to the Upazila boundaries. The Upazilas, however, are quite heterogeneous, which cannot be accommodated by this zoning. It will, however, be reflected in the descriptions or 'typologies' of the land use classes, which will form part of the zoning. In the future more ambitious versions may be developed, which are based on a genuine assessment of land capability and which have a higher resolution by using the more homogeneous Unions as map elements.

4.2 Principles

Coastal land use zoning should result in the demarcation and mapping of a modest number of land use classes which capture all the important variation in the zone. Three conditions must be satisfied for integrated zoning of the coastal area to be useful:

1. it must take into account the *key factors* which affect the coastal people, their livelihood and their environment

[3] M. Rafiqul Islam (ed.), 2004. Where land meets the sea. [A Profile of the Coastal Zone of Bangladesh]. The University Press, Dhaka, Bangladesh.

[4] The terminology is borrowed from software development, whereby version 3.2 would stand for the third edition and the second update.

2. it must present a truly *integrated picture* by combining agro-ecological and socio-economic factors and reflecting current economic land use
3. it must be *linked with the administrative entities* to provide a direct entry point for integrated planning at the local level; at the present stage the Upazila is therefore chosen as the smallest map element

A further requirement is that it is consistent with and makes use of the information already compiled:

- Databases and maps produced by different agencies
- The nationally approved delineation of the Coastal Zone, based on three physical parameters (tidal water movements, salinity intrusion and risk of cyclones and storm surges)
- The inventory of major problems, opportunities and challenges already made by the PDO.

A limited number of land use classes or clusters (around 20) will be defined and demarcated, which capture the essential variation in the area. Each land use class will embrace several Upazilas with similar land use conditions, while any one Upazila can belong to one land use class only. Analytical descriptions or typologies will be prepared for each class. The implications will become clear from the following outline and the more detailed descriptions of the methodology in section 5.

4.3 Stepwise implementation of coastal land use zoning

Three implementation steps

It is proposed that the zoning is carried out in three steps which are outlined here and will be described in more detail in section 5.

Step 1. The coastal zone is first sub-divided in a small number of sub-zones (preferably not more than 5) on the basis of recognised physical and ecological factors. The resulting broad sub-zones should have clearly definable characteristics in terms of potentials and limitations for development. The sub-zones are mapped and their developmental characteristics are briefly described.

Step 2. For each sub-zone a number of additional features are chosen which are typical for that sub-zone. That is where the existing maps and databases come in. They will be used to choose the combination of features which together capture most of the variability in the sub-zone. All the Upazilas in a sub-zone are scored for these additional features and the scoring table is checked for clusters of Upazilas with similar conditions which will form the classes of the coastal land use zoning. Current land use will be an important consideration for clustering. This is the most critical step in the process. It will result in each Upazila belonging to one and only one 'compound' land use class

Step 3. Once each Upazila has been associated with a particular land use class the zoning map can be prepared. For each land use class a semi-detailed description or typology is made to characterise that class with its typical potentials, limitations and vulnerabilities. Available documentation is used for the typologies.

Why these three steps ?

The first step in the process carries out a first-cut division in broad sub-zones. The demarcation of sub-zones is an intermediate result in a structured process. The reasons why this first step is useful are:

- → it takes care of major physical differences which have implications for land use
- → it simplifies the next step
- → it strengthens 'ownership' by technical line agencies who will recognise some major physical determinants for (economic) land use

Step 2 is the actual zoning into about 20 land use classes. The identification of land use classes is done separately for each sub-zone, whereby some features will be relevant for some sub-zones and not for others. That makes the process more transparent. In the final analysis it is possible that some land use classes in different sub-zones are more or less the same. If that is the case they can yet be merged into one class.

Step 3, the typology of each land use class is essential. Each land use class is defined by a combination of factors and a good description is needed to explain the implications for current and potential land use. It also allows to stress the heterogeneity within the classes and the Upazilas which belong to them.

What are land use classes ?

At this point it will be useful to give some concrete examples of what is meant by 'land use classes' in the context of this zoning. They are necessarily 'compound' or even hybrid classes, embracing several aspects related to land use. A brief description of some (imaginary, but not unrealistic) classes may help to grasp the idea. Descriptions for three imaginary but possible classes are shown in the box. Note that the characterization will usually be a combination of features from step 1 and step 2.

Box. Three *imaginary but plausible* examples of characterization of land use classes

"Agricultural areas with non-saline soils, mainly single cropping because of severe water logging, and important inland fisheries"

"Mainly densely populated urban areas with intensive vegetable production; potential for industrial development"

"Areas with coastal chars at the sea side and impeded drainage in the hinterland, saline soils, Aman paddy and limited rainfed Rabi cropping; major pond fish production".

Once the land use classes have been defined it will be useful to devise descriptive map legends or 'labels' by which they can be easily referred to, in a similar way as was done in the AEZ map. The short descriptions just given as examples could be used as map legends, but perhaps they are too long. It is important that good descriptive names are found once the classes have been defined. The information about a class which is not already reflected in its name should be given in its 'typology'.

Broader land use categories

From the land use classes, broader categories can be formed by aggregation, i.e. combining two or more classes into broader categories. Such broad categories could be:

- "agricultural areas"
- "shrimp areas"
- "urban areas"
- "areas for tourism development"

4.4 Technical support group

For a smooth implementation of the zoning project it is essential to draw on the expertise which is available among line agencies. A small technical group or committee of experienced professionals, preferably not more than 3, should therefore be formed to provide hands-on and back-stopping support to the PDO zoning expert. The support group should contribute proven experience in zoning and computerised methods and be knowledgeable about the conditions in the coastal zone. They would meet several times during the process to review on-going work and help in overcoming technical hurdles. It is also recommended that they participate in the ground-truthing which is proposed as part of the zoning exercise.

4.5 Inter-agency consultation

The zoning will typically be an inter-disciplinary and inter-agency activity. In order that the zoning acquires the status of an accepted planning tool there must be a high level of consensus and ownership among the concerned agencies. The first stage of consensus building took place during the preparation of this document, through consultation with individual agencies followed by a workshop where the concept and proposed methodology were presented. In the course of the next 5 months of elaborating the zoning further consensus has to be sought at key moments about the direction the zoning is taking and the results which are coming out.

5. Methodological details

5.1 Step 1: identification, mapping and description of broad sub-zones

This step has already been initiated. During a technical session involving PDO and SRDI staff it was agreed to base the sub-zones mainly on a combination of two existing maps:

1. the map of agro-ecological sub-regions[5], which is the country's official agro-ecological zoning
2. the 'delineation of the Coastal Zone', prepared by PDO[6] and approved by the concerned agencies

A preliminary sub-division was made in 5 sub-zones, plus some special areas: the Sunderbans and the two major Urban areas (Chittagong and Khulna) which were demarcated for a 'perception' study[7]. The Sunderbans and the Urban areas do not need further sub-division, which leaves 5 sub-zones to be carried into the next step. They may be tentatively characterised as[8]:

1. Ganges tidal floodplain, with strong tidal movement
2. Ganges river floodplain, with weak tidal movement
3. Meghna-dominated non-saline areas
4. Meghna-dominated saline areas with accretion and erosion
5. Chittagong coast

This is just a first attempt which needs to be carefully scrutinised for consistency, validated and if necessary adapted. Once accepted the sub-zones must be precisely delineated. It is strongly recommended not to increase their number, although it will be tempting to do that, and instead compromise to get an acceptable even though imperfect result. Remember that *this is merely an intermediate step* in the process. Next, each Upazila will be assigned to one of the sub-zones. Finally, a short characterisation (typology) of the sub-zones will be prepared, which clearly brings out development-related aspects of each sub-zone. This characterisation is useful, because it forces the authors to think carefully about the implications of some major physical factors on development potential and limitations. Again, it is only an *intermediate output*, which will help in the demarcation of more precise land use classes in Step 2.

The broad sub-zone map and the typologies should be carefully reviewed by the technical support group and modified as needed. It is the starting point for the more detailed developmental zoning in step 2.

[5] FAO, 1988. Agroecological Regions of Bangladesh. UNDP Rome.
[6] M. Kamal Uddin and Rob Koudstaal, 2003. Delineation of the Coastal Zone. PDO-ICZMP Working Paper WP005
[7] Mohiuddin Ahmad, 2002. Perceptions of direct stakeholders on coastal livelihoods. Working Paper WP004. PDO-ICZMP.
[8] They were roughly demarcated by hand during the technical session on the AEZ sub-zone map for the Coastal areas (map is with Mr. Rounak)

5.2 Step 2: demarcation and mapping of land use classes

This is the most challenging part of the zoning process. It consists of a refinement of the sub-zones identified in Step 1 into a number of land use classes which capture the essential variability occurring in the Coastal Zone in respect of actual and potential land use. We must therefore first look at the factors and features which may affect an area's land use potential and constraints.

Table 1 shows a 'long list' of features which are likely to be important. Some available data sources are also mentioned. These features, or rather the data and maps which quantify them, are the raw material for further refinement of the zoning. Quantitative information has to be collected from the line agencies, preferably in the from of digital maps. If maps are not available quantitative data disaggregated to the Upazila level can be used. This would for instance be the case for shrimp culture, for which the data are available at the Fisheries Department.

For some of the features classes have to be established with their value ranges. Examples are 'population density' (e.g. classification in low, medium, high) and 'accessibility' (poor, medium and good).

These features will be used for refinement of the zoning, but not necessarily all of them nor are the same ones relevant for all sub-zones identified in Step 1. These sub-zones will be quite different in terms of current land use, land use potential and constraints. The additional features from the long list will therefore not apply uniformly for all of them. For example, 'salt production' is only a relevant feature in the Chittagong coastal sub-zone and 'bagda shrimp culture' only occurs in the sub-zones where there is intrusion of saline water. For each sub-zone a particular combination of features has to be chosen, on the basis of which it can be further sub-divided.

It will be useful at this stage to use simple GIS techniques, in particular overlaying different map layers to explore clustering of combinations of features and reduce the number of features needed for the further sub-division of the sub-zones, because some of them may be strongly overlapping. For instance the areas with coastal mangrove plantations coincide with areas of active accretion. The features which are retained after this process for each of the sub-zones will re-appear in different combinations in the description of the land use classes. The choice of combinations of features to refine the zoning will be an art rather than a rigorous scientific process. It is therefore essential that this is done collaboratively with the technical support group.

Once the essential features for each sub-zone have been selected, a procedure can be used which was also applied in the 'delineation' study. It consists of recording the values of the features or scoring their simple incidence for all the Upazilas in the sub-zone in a two-way table and grouping those with similar incidences (for details reference is made to the 'Delineation of the Coastal Zone' document; if necessary consult with the authors). The Upazilas with the same or similar incidences constitute a land use class, characterised by a particular combination of features from steps 1 and 2. Examples of what these land use classes could represent were given in the shaded box in section 4. They are not simple classes like soil series or soil associations in a soil map, but rather compound classes which may be combinations of physical conditions, actual land use and probably some social factors. That will be reflected in their 'typology' discussed below.

At this point the art of practical zoning will be two-fold:

- to keep the number of different classes to the minimum, while still capturing most of the essential variation in the area
- to arrive at land use classes which will be recognised by different disciplines as relevant from their perspective, 'ownership' in short.

Table 1: Land features to be considered for coastal land use zoning, with some data sources

Features	Data sources
environmental	
bio-ecological zones?	IUCN?
large water bodies	BWDB
land accretion	MES?
bank erosion	MES?
soil salinity	SRDI, soil salinity map
surface and groundwater salinity	DPHE demarcation of 'tubewell type areas';
water-logging, impeded drainage	BWDB, LGED
availability of groundwater for agriculture	WARPO?
land use	
current agricultural land use	SRDI land use map
bagda shrimp farming	Department of Fisheries database
golda shrimp farming	Department of Fisheries database
other inland fisheries	Department of Fisheries database
salt production	
forests, coastal mangroves	Forestry Department database and maps
infrastructure	
protected, empoldered areas	WARPO-CERP figures
accessibility, road networks	LGED
social conditions	
population, settlement density	
poverty incidence	BARC
land tenure relations, khas land	Ministry of Lands
special features	
conservation areas, nature reserves	
major urban areas	
major industrial areas	
marine fisheries	

In respect of the number of classes, it may be too large initially but can probably be trimmed down by careful inspection and combining classes those within and even between sub-zones which are only different in some details

Ownership can be strengthened by hand-on assistance from the technical committee during this process, whose members would be from different agencies.

5.3 Step 3: typology of the land use classes

Elaboration of the typology for each land use class is an essential part of zoning, as indeed it is of any mapping with compound mapping units[9]. The more complex the units the more explanation is needed, without which the zoning does not come to life. In the key publication on Bangladesh' AEZ a large part of its 570 pages is in fact devoted to the typology of the zones. For the zoning of the coastal areas proposed here the mapping units are the land use classes, each of them comprising several basic map elements, i.e. Upazilas.

[9] When mapping a spatially distributed feature, the 'units' are the different forms a feature can take, like for instance the different soil series occurring in an area. In our case, like in agro-ecological zoning, the units are more complex entities.

Each of the land use classes should be described in some detail, including information on problems, opportunities and vulnerabilities already compiled by PDO in the 'Profile of the Coastal Zone'. Those descriptions will also be invaluable to guide the ground-truthing and can in turn be updated on the basis of the observations made during the ground-truthing. The typologies will form an integral part of the zoning.

5.4 Field observations and ground-truthing

It is recommended to do the ground-truthing only after the first draft of the zoning (version 0) has been completed and discussed in an inter-agency workshop. While working for the draft the authors can rely on their own intimate familiarity with the area, complemented by the available documentation, in particular the 'Profile' and underlying reports.

Once the draft is ready, however, ground-truthing becomes important to validate the assumptions made during the zoning exercise. The typologies of the land use classes will be the key material because they contain descriptions of what the classes represent. It is suggested to carry out the ground-truthing only in those classes, which the team feels least confident about in terms of consistency with the real situation in the field. That should not be more than half the land use classes. A sample of Upazilas in each of those classes is then chosen for field visits, again choosing those Upazilas the team feels least sure about. The total number of Upazilas to visit should not be more than 25. Three weeks of field visits should be adequate, preferably by a few members of the team.

Prior to the field visits checklists will be prepared of issues which need to be verified. They will at least partly be different for the different land use classes, because they should reflect the specific conditions of each class to be visited and the uncertainty the team has about its characteristics. No formal questionnaire would be needed, but consultation with key agencies is crucial.

5.5 Participation and ownership

Genuine participation by the concerned agencies throughout the process is essential to create ownership and ensure that the zoning will eventually be accepted as a key tool for policy making in the coastal areas. There will be three mechanisms by which this can be accomplished:

1. Inter-agency workshops will be held to present and discuss intermediate outputs of the zoning activities. One such workshop was already held on August 2 where this conceptual proposal was presented and accepted as a basis for the zoning. A second workshop will be held in October where the draft zoning and the typologies will be presented. Finally, a national seminar is planned for December 2004 where version 1.0 of the zoning will be presented to a wider audience.
2. The technical support group will play a dual role: it will provide hands-on expert support to PDO's zoning expert and at the same time it will strengthen the involvement of some of the line agencies in the process. It is recommended that the members of the support group will participate in the ground-truthing and that they will be considered as co-authors of the zoning document.
3. During the ground-truthing local agents of some of the concerned agencies will be extensively consulted to obtain factual information and at the same time strengthen the multi-agency nature of the zoning.

6. Activities and time frame

The actual zoning will be carried out in the coming five months, but some preparatory work has already been done to facilitate the process.

The chart at the end of the document shows the different phases in the elaboration of the first version of the zoning, including an October workshop, to discuss the preliminary zoning, and the final seminar in December, where Version 1.0 will be presented. Annex 1 presents a more detailed time frame which indicates a number of 'milestones'. At each of these milestones a concrete output is envisaged. The time frame also indicates the times at which inputs from the technical support group would be needed.

7. Future prospects

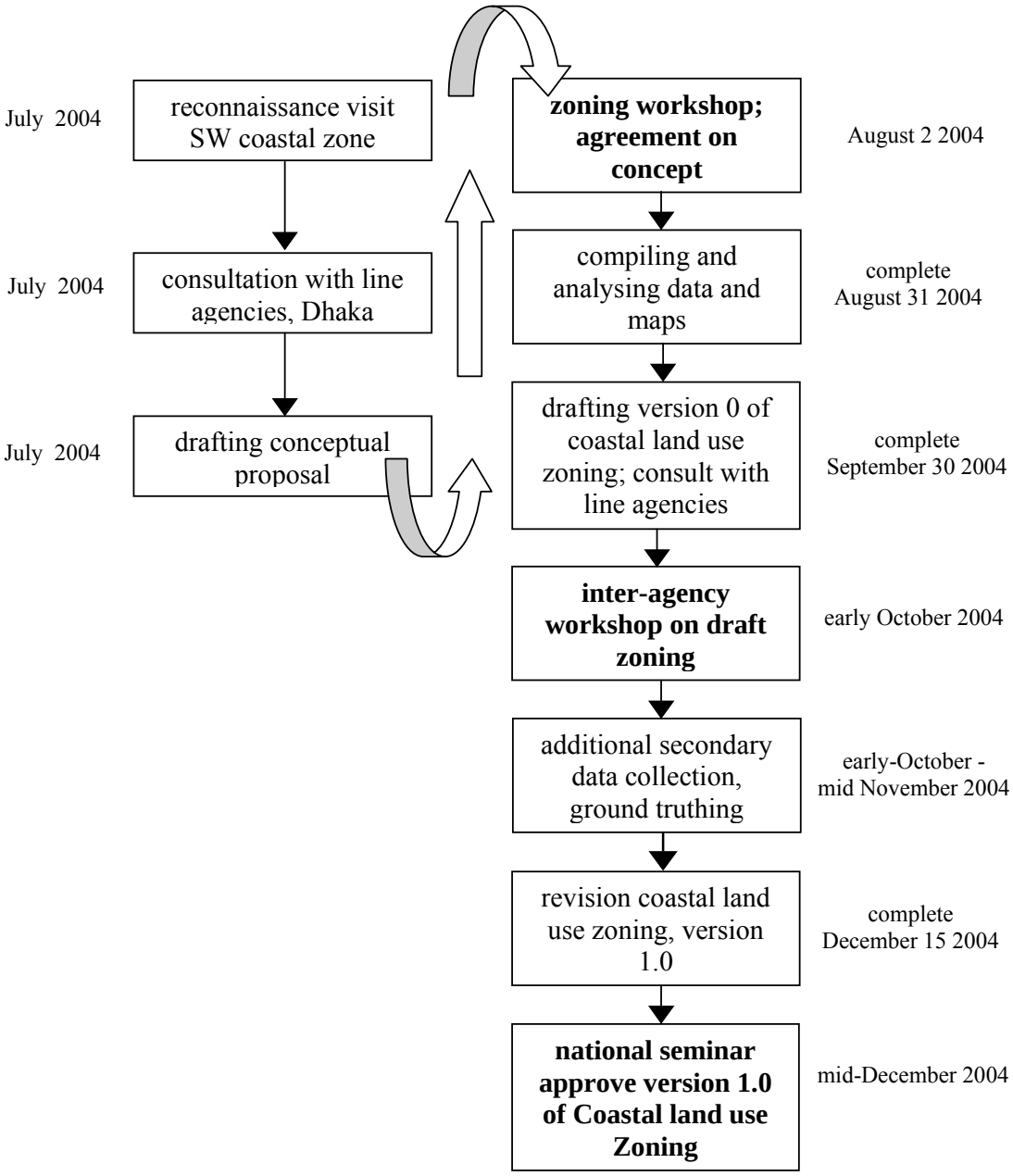
As stated repeatedly, coastal land use zoning will be a continuing process which does not end with Version 1.0. It should be a living document which can accommodate future findings.

The kind of zoning to be undertaken by PDO comes very close to that proposed in the National Land Use Policy of 2001, to be carried under responsibility of the Ministry of Lands. The Ministry has expressed its support for the PDO initiative, but close co-ordination with the Ministry will be very important.

A next major revision of the zoning could involve an increase in resolution up to the Union level. According to the National Land Use Policy, however, zoning within the Upazilas is the responsibility of the Union Parishad, under the co-ordination by the Ministry of Lands. Higher resolution zoning will therefore require close co-ordination with that Ministry and with the authorities at the Upazila level. A formal agreement for such zoning would probably be needed.

The National Land Use Policy also requires the establishment of an inter-agency 'Zoning Task Force' for the Coastal areas. The technical group, proposed here to provide technical support to the zoning activities, could in the future formally assume the role of 'Zoning Task Force'. That would ensure continuity, durability and institutional ownership of the efforts which are about to be undertaken and their expected results.

Activity flow chart



ANNEX 1 : Time schedule for the implementation of zoning of the coastal areas

Activity	August				September				October				November				December			
	1-15		16-31		1-15		16-30		1-15		16-31		1-15		16-30		1-15		16-31	
Step 1: demarcating broad sub-zones																				
finalise demarcation/mapping of sub-zones																				
assign all Upazilas to sub-zones																				
brief 'developmental characterisation' of sub-zones																				
***input by technical support group*:**																				
assess sub-zones and characterisations																				
finalise sub-zones and characterisations																				
MILESTONE 1, 31 August 2004: sub-zone map and characterisations ready																				
Step 2: refine zoning into 20 land use classes																				
select features from long list for each sub-zone																				
collect quantitative data and digital maps																				
establish value ranges for features if appropriate																				
examine co-incidence/overlap of features using map overlays (ArcView)																				
reduce number of features if possible, finalise																				
***input by technical support group*:**																				
assess final choice of features for zoning																				
MILESTONE 2, 25 September 2004: selected features with value ranges ready for use in detailed mapping																				
record values or incidence of selected features in each Upazila of each sub-zone																				
group Upazilas with similar incidence into preliminary land use classes																				
reduce number of classes if necessary by combining within/across sub-zones, finalise																				
map Upazilas according to land use classes																				
***input by technical support group*:**																				
assess land use classes, preliminary zoning ma ; help improve																				
Step 3: typology of the land use classes																				
prepare semi-detailed typologies of the classes																				
MILESTONE 3, 15 October 2004: preliminary version of Coastal zoning ready for inter-agency workshop																				
Inter-agency workshop on draft zoning																				
choose Upazilas for ground-truthing, prepare checklists																				
ground truthing, additional data collection																				
revision coastal zoning, typologies																				
***input by technical support group*:**																				
participate in ground-truthing																				
assess revised zoning, help improve																				
prepare zoning document to present to national seminar																				
MILESTONE 4, 10 December 2004: semi-final version 1.0 of Coastal Zoning ready for presentation at National Seminar																				
National seminar on version 1.0, Coastal zoning																				
finalise version 1.0 of Coastal zoning																				
***input by technical support group*:**																				
help improve version 1.0																				

5 OPEN DISCUSSION

During the open discussion, participants gave their valuable opinions, suggestion and remarks. These are summarized below:

Dr. Md. Giasuddin Khan, DFO, Dept. of Fisheries

He mentioned that they have thematic zoning, which does not exactly follow zoning system for planning. If possible zoning should be based on ecological settings and compartmentalization process. In case of zoning proposed by ICZMP, participation of all stakeholders is needed.

He also mentioned besides SRDI, information and data from IWTA are also needed. Duplication of activity needs to be avoided.

Dr. Gias mentioned again that Mr. Henk's paper is appreciable which has covered important issues of land zoning.

He made a suggestive direction that targeted administrative boundary of the land use zoning should be at union level; even blocks could be considered if high resolution information are available; because at upazila level hardly any plan is possible to adopt as it is so heterogeneous. For the present exercise with limited time and resource upazila boundaries could be the lowest tier.

Dr. S. A Sattar, Senior Agriculture Advisor, CDSP-II, BWDB

He explained the salinity level criteria used by CDSP and trend of seasonal variation of the soil salinity. The salinity classification is not different from the standard classification system of SRDI. He raised his concern that method of topsoil collection often misleads the data.

Dr. Sattar mentioned that, CDSP considered the farmers' opinion on the flooding depth while doing the agricultural productivity zoning in the CDSP project area, as CDSP has done the zoning exercise at the micro level. That is why, only land and water were taken under consideration. Methodology of determining the delineation of the flood-inundated area was also discussed.

Mr. Jalal Uddin Md. Abdul Hye, Deputy Executive Director, IWM

Accreted land should be considered in zoning activity. Malaysia has good guidelines on land zoning which could be considered as a helping book.

He also mentioned that parallel data collection is needed as because we don't have much up to date data in our hands. He requested to consider drainage, physical and infrastructural features and other risk factors in land zoning. Not only the past trends of the factors but also the interactions among interventions should be considered.

Mr Jalal emphasized that physical process of a particular ecological setting like coastal zone needs to be considered before any sort of intervention.

Mr. Zahirul Haque, IWM, Senior Specialist Coast, Port & Estuary Management Division

He wanted to know the criteria for site selection for the mangrove plantation and also about flooding depth considered for agriculture productivity zoning.

Mr. Md. Nuruzzaman, Fourth Fisheries Project

He said "no new data collection is needed" as mentioned by Dr. Henk is not acceptable. In response, Dr. Henk agreed but not at this stage of activity.

He also said the salinity range used in the Paper "Coastal Land Zoning: Present Status" strongly differs to their reference. Because in the paper 60-70% of the cultivable land in Barisal and Khulna region has been defined as the saline area, whereas DoF data shows that only 14% of land falls under severe salinity. He raised the question that why shrimp farming is singled out for intensifying of soil salinity range and as CDSP has done the agricultural productivity zoning, so do they have the cumulative data on the variation of the soil salinity.

Reply: In the paper it was mentioned that 60-70% of the cultivable land is affected by different degrees of salinity which reduces yield level of the crops and not defined the land as saline areas. Changes in cropping pattern with the increase of shrimp cultivation has been shown in the graph as an example.

Dr. S.G Hussain, BARC

He mentioned that they have flood maps, drought maps, Almanac tool, Map showing extent of poverty, landless HH maps, irrigation and infrastructural development maps and a good database, which could be used by the PDO-ICZMP for zoning purpose.

Dr. Khurshid Alam, Dhaka University

In the department they have ecosystem-based assessment document which could be helpful for this activity.

He has a book on Coastal Land Zoning. Dr. Alam gave importance on historical assessment of resources for zoning purpose. He emphasized on the background preparation i.e., literature and record review before intervene the zoning system as it remains as a difficult exercise.

Mr. Ashit Ranjan Paul, Forest Department

Mr. Ashit Ranjan Paul raised his concern on land use under forest zoning. He explained that there are two types of plantation in the coastal area – one is for mangrove and another is for non-mangrove forest. Mangrove species are planted in the newly accreted land where Kewra is the main species used for this purpose. He emphasized that, special areas like Nijhum Dwip of Noakhali district must be incorporated in the land use zoning of Bangladesh Parjatan Corporation for the prospective expansion of tourism in the coastal zone.

Mr. Kabel Hossain Dewan, PSO, SRDI

Clarification of 20 land classes is needed.

Mr. Abu Md. Ibrahim, Soil & Agriculture Specialist, CEGIS

He remarked on Henk's paper and suggested that poverty levels of farmers, fisheries etc. could be considered in his paper. Henk replied if it is done at this stage thing would become complicated. He said that emphasis should be given on to the socio-economic factors along with the physical factors.

Mr. Md. Nurul Islam/ Representative, LGED

In the Land Use Policy it has been mentioned that zoning will be done by local governments. But in the present exercise of PDO there is no representation of Local Government and it is not clear how they will be incorporated? In absence of zoning laws, the legal status of the zoning exercise is not also clear.

Mr. Ziaul Haque Howlader, Executive Officer, Dept. of Tourism

He mentioned that they have tourism map which will be helpful for this activity. Government declaration on special areas like - Cox's bazar, Kuakata, Sundarbans is needed.

Dr. Mahmudul Karim, Executive Director, Shrimp Foundation

He pointed out to the presentation of Mr. Ibrahim of CEGIS and wanted to know what are the criteria they have considered for land capability classification. Mr. Ibrahim mentioned salinity is the main criteria for shrimp cultivation and also considered other relevant factors (land type, inundation) needed.

Dr. Karim appreciated the idea of using existing data to construct present situation but he raised his concern over the implementation status of Land Use Policy (2001).

Mr. Abu M. Kamal, Sr. National Consultant, PDO-ICZMP

He wanted to know whether environment and social factors are considered for zoning activity in Henk's paper.

Commenting on Mr. Ibrahim's paper he mentioned whether he could include environmental and soci-economic concerns in the matrix. On Dr. Sattar's paper he said that SRDI has some standard salinity classification. Whether his classification matches with this?

6 CONCLUDING REMARKS & RECOMMENDATIONS

Mr. Md. Badiul Alam, Deputy Secretary (Development), Ministry of Land gave the following concluding remarks on the initiative.

The PDO-ICZMP has taken today a good attempt on coastal land zoning, specially in its attempt to have consensus of all the stakeholders. Multi-agency and multi-stakeholder's support is necessary for this initiative. This is evident from participation from many agencies. Land zoning will help to address undesirable conflicts of interest.

This present zoning exercise is rightly considered as an initial first step. It is also good to know that the land use policy, as already mentioned by PDO-ICZMP, has been taken as the key guiding document; Ministry of Land will play a facilitating and guiding role.

The Ministry of Land has the mandate for land zoning activity. He said, zoning law under the Land Use Policy (2001) has not yet been formulated. According to the policy, zoning at local level should be done by local administration like Upazila Parishad, Zila Parishad, etc. In the coastal zone, MoL favours practices like shrimp, tourism and salt production zones etc. According to policy guidelines, there are central committees at national level to take decision on these issues, who are backed up by district and divisional level committees comprised of stakeholders, government representatives and different strata of society. In the coastal zone, pressure on land is high. Khas land in char areas are managed by the MoL where landless people take shelter before anybody went there for other interventions. So the present initiative is a very timely one. The MoL supports this initiative.

Recommendation

- ◊ Zoning exercise, initiated by the PDO-ICZMP, is a timely & praiseworthy effort. This should be continued beyond its initial planned period of six months.
- ◊ Land Use Policy (2001) should be used as a guiding document for coastal land zoning.
- ◊ Participation of all relevant agencies should be continued with the aim to produce the first version by December 2004.
- ◊ This effort should eventually be mainstreamed with the initiatives of the Ministry of Land. This present exercise has been rightly considered as the first step towards 'coastal land zoning, as described in the Land Use Policy. Even, at this stage, the Ministry of Land, should be involved with the process.
- ◊ To assist land zoning, the physical process of a particular area needs to be considered with collection of all relevant information; emphasis should also be given on to the socio-economic factors. Such initiatives in other countries, like, Malaysia could be consulted.
- ◊ Land use zoning should be demarcated using administrative boundary. Target should be at union level; even blocks could be considered if detailed information are available. However, for the present exercise, upazila boundaries will be the lowest tier, though it was acknowledged that upazila is a very heterogeneous entity;
- ◊ A working group comprising DoF, FD, BARC, SRDI, IWM, LGED, CEGIS will be formed to provide technical and supportive input to this exercise. This working group can be considered as precursor to task force as mentioned in the Land Use Policy.

ANNEX-A: PROGRAMME

09:00AM Registration

09:30AM Welcome address by Mr. Hasan Parvez, Principal Scientific Officer (Engg.), WARPO

09:40AM Coastal Land Zoning: Present Status - Mr. Abdul Halim Mia, PDO-ICZMP

09:50AM Land use under Forestry & Zoning - Mr. Ashit Ranjan Paul, Forest Department

10:00AM Land zoning activities under SRDI - Mr. Kabel Hossain Dewan, Soil Resource Development Institute (SRDI)

10:10AM Land use Zoning for shrimp cultivation - Mr. Md. Nuruzzaman, FFP, Dept. of Fisheries

10:20AM PDZ Concept Developed by CDSP- Dr. S A. Sattar, Char Development & Settlement Project (CDSP)

10:30AM evsjv‡`‡ki jeb Pv‡li µgweKvk I fwg e¨envi - Mr. Nizam Uddin, Salt Project, BSCIC

10:40AM Land zoning activities of BARC - Dr. S.G. Hossain, BARC

10:50AM Coastal Land Zoning in the Southwest - Mr. Abu Md. Ibrahim, Centre for Environmental and Geographic Information Services (CEGIS)

11:00AM Land Use Zoning for tourism - Mr. Ziaul Haque Howlader, Bangladesh Parjatan Corporation

11:10AM Conceptual proposal on land Zoning of the Coastal Areas - Dr. Henk Mutsaers, ICZMP

11:40AM: Open Discussion

13:25PM: Closing Remarks

13:30PM: LUNCH

ANNEX-B: LIST OF PARTICIPANTS

Name	Position	Address
Ministry of Land (MoL)		
Mr. Md. Badiul Alam	Deputy Secretary (Dev.)	Bangladesh Secretariat Dhaka
Water Resources Planning Organization (WARPO)		
Mr. Hasan Parvez	PSO (Engg.)	House 103, Road 1, Banani, Dhaka
Mr. Md. Abdul Matin	PSO (Agril.)	
Mr. Md. Ekram Ullah	SSO	
Bangladesh Water Development Board (BWDB)		
Mr. Md. Shafiqul Alam	Chief Water Management	Ansar Chamber (10th Floor) 149, Motijheel C/A Dhaka-1000
Local Government Engineering Department (LGED)		
Md. Nurul Islam/ Representative	Superintending Engineer, IWRM	LGED Bhaban, Agargaon, Shere Bangla Nagar, Dhaka-1207
Department of Fisheries (DoF)		
Dr. Md. Giasuddin Khan	District Fisheries Officer	Matshya Bhaban (10th Floor) Ramna, Dhaka
Mr. Md. Nuruzzaman	Fourth Fisheries Project	
Forest Department (FD)		
Mr. Md. Osman Gani	Deputy Chief Conservator of Forests Social Forestry Wing	Ban Bhaban, Mohakhali, Dhaka
Mr. Ashit Ranjan Paul	Divisional Forest Officer Coastal Forest Circle	Noakhali
Directorate of Land Records & Surveys (DLRS)		
Mr. Khondaker Ahmed Ali	Deputy Director (Survey)	28, Shahid Tajuddin Ahmed Sharani, Tejgaon, Dhaka-1208
Bangladesh University of Engineering & Technology (BUET)		
Dr. Rezaur Rahman/ Representative	IWFM	Dhaka-1000
Bangladesh Parjatan Corporation (BPC)		
Mr. Ziaul Haque Howlader	Executive Officer (Planning)	233, Airport Road Tejgaon, Dhaka-1215
Dhaka University		
Prof. Dr. Khurshid Alam	Head Dept. of Soil, Water & Environment	
Institute of Water Management (IWM)		
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Mr. Zahirul Haque Khan	Senior Specialist Coast, Port & Estuary Management Division	House 476, Road 32, New DOHS, Mohakhali, Dhaka

Name	Position	Address
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Dr. Mahmudul Karim	Executive Director	House-47, Road No-23, Block-B, Banani, Dhaka - 1213
Bangladesh Agricultural Research Council (BARC)		
Dr. S.G. Hossain	Principal Scientific Officer	BARC Complex Farm Gate, Dhaka
Char Development & Settlement Project-II (CDSP-II)		
Dr. S. A. Sattar	Senior Agriculture Advisor	BWDB Compound Sonapur, Noakhali
Soil Resource Development Institute (SRDI)		
Mr. Kabel Hossain Dewan	PSO (Land use Planning Section)	Khamarbari Road Farmgate, Dhaka
Center for Environmental and Geographic Information Service (CEGIS)		
Mr. Abu Mohammad Ibrahim	Soil & Agriculture Specialist	Road-23/C, House-6, Gulshan-1, Dhaka
Bangladesh Small & Cottage Industries Corporation (BSCIC)		
Mr. Nizam Uddin	Extension Officer Salt Project	Motel Road, Cox's Bazar – 4700
Program Development Office for Integrated Coastal Zone Management Plan (PDO-ICZMP)		
Dr. Rafiqul Islam	Team Leader	Road No. 22, House No. 4/A, Saimon Center, Gulshan-1, Dhaka
Dr. Henk Mutsaers	Land Zoning Expert	
Mr. Abdul Halim Mia	Land Zoning Specialist	
Mr. Abu M Kamal Uddin	Knowledge Management Expert	
Ms. Afsana Yasmeen	Research Officer	
Mr. Sayed Iftekhar	Research Officer	