

# Capacity Building and Resource Mobilisation for Sustainable Land Management in Bangladesh : Terminal Evaluation



Prepared by:

Hemayet Hossain, international consultant  
Mahbubur Rahman, national consultant



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## **Abbreviations**

AEZ	Agro Ecological Zone
BARC	Bangladesh Agricultural Research Council
BMDA	Bangladesh Multipurpose Development Authority
BRDB	Bangladesh Rural Development Board
BWDB	Bangladesh Water Development Board
CEGIS	Centre for Environment and Geographic Information Services
DAE	Department of Agricultural Extension
DoE	Department of Environment
DLRS	Department of Land Records and Surveys
DLS	Department of Livestock
ECA	Ecologically Critical Area
EIA	Environmental Impact Assessment
FCD	Flood control and drainage
FD	Forest department
GEF	Global Environment Facility
GIS	Geographic Information System
GoB	Government of Bangladesh
GSB	Geological Survey of Bangladesh
LGED	Local Government Engineering Department
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
MoL	Ministry of Land
MTE	Mid Term Evaluation
NAP	National Action Plan
NAPA	National Adaptation Program of Action (for UNFCCC)
PM	Project Manager
PMU	Project Management Unit
SEA	Strategic environment assessment
SEMP	Sustainable Environmental Management Program
SLMP	Sustainable Land Management Program
SoB	Sustainable Land Management
SRDI	Soil Research Development Institute
UNDP	United Nations Development Programme
WARPO	Water Resources Planning Organisation

## **Executive Summary**

In order to establish a sustainable land management system in Bangladesh following five outcomes were targeted.

The main executing role was played by the MoEF with help from MoA and MoL and the operation was guided by a steering committee drawing members from relevant ministries related to planning and management of land and water in Bangladesh. The PMU was managed by the MoEF. The project completed in February 2012 following a four year duration spending \$1.1 million. There were nine main implementers involved in this project.

### **OUTCOME 1 : Mainstreaming SLM through policies, institutions and legislation**

Decision-making high officials from relevant ministries were enlightened on SLM through meetings, workshops and overseas study tours to Australia and Sri Lanka. Discussions were held to identify ways to implement SLM into Government machineries. However, no effective institutional adaptation has been achieved. Quite a few outputs have not been assigned.

Excellent national media campaigns were carried out to enlighten farmers, community leaders, and general public on SLM. Also awareness raising workshops were held for professionals and senior officials, NGOs and women on the use of economic instruments to achieve SLM.

As one of the main targeted outputs, a Land Zoning Law and a Village Improvement Act was drafted with help from the MoL in order to implement the National Land Use policy to arrest conversion agricultural land to other usage. However, this was modified to a agricultural land protection law which is still awaiting approval of the National Parliament.

### **OUTCOME 2 : Strengthening institutions and capacity development**

Several studies were done successfully in a variety rural landscapes and economic conditions to identify rural land use patterns and their changing trend and their impact on land degradation. Similar studies were also done in the fast-changing peri-urban areas to monitor land use and it's changing trend specifically focusing on the conversion of land to urban usage and to formulate a land use classification system and land zoning model.

Unfortunately no significant institutional arrangement in the ministries was achieved in terms of the implementation of the National Land Use Policy.

### OUTCOME 3 : Enhancing SLM knowledge management system and R&D

A study was done on the loss of wetland around Dhaka city and the alarming scenario showed that the permanent wetland came down to only 4% from 14% in 1967. Unfortunately, the study did not address other wetlands in the country.

Studies and workshops were also done to identify land degradation and best SLM practices in the agriculture but no significant best practices were noted. Two national workshops were held to generate awareness amongst the stakeholders on SLM through soil and crop management and fertiliser use.

Inventory of database management, assessment of information capacity needs and development of a pilot information network within the ministries were discussed but nothing significant materialized. A website was developed by PMU to share information on SLM.

### OUTCOME 4 : Human Capacity development at the local level

To enhance capacity of local level decision-makers several successful training programs were carried out. A successful diploma course on SLM knowledge and tools was held at the Department of Geography, University of Dhaka and trained officials from relevant officers from Government and other organisations. BIDS held training workshops on EIA and NRA to train relevant officials from Government and other organizations. DAE developed training materials and held workshops to train trainers on SLM knowledge and tools to address land degradation.

Attractive campaign materials were developed and disseminated through publications, community workshops, field demonstration and radio and TV to enlighten farmers, community leaders and general public.

Excellent ownership was demonstrated at the implementation level by BMDA through their pilot projects on SLM. The projects demonstrated the field level applications through the use of irrigation, rain water harvesting, composting, crop diversification, sapling and tissue culture in the Barind tract. This project also demonstrated the effective integration of the previous SEMP project with SLMP.

Another very significant demonstration was done by SRDI. They demonstrated through their pilots in selected farm fields around the country that SLM-based agricultural practices can produce 15% more production than traditional practices by the farmers. They also demonstrated that Geo-textile can help improve the soil health in the Hill Tarcts area.

## OUTCOME 5 : Resource mobilization for implementation of SLM

Original outputs in the Project document were replaced by several deliverables. PMU arranged a high-level sensitization meeting and developed a Website for information on SLM. Unfortunately, no other significant achievements have been reported.

### Lessons

- Policy changes relating land is difficult due to socio-political implications.
- Institutional reform is difficult and time-consuming
- Project may have better sustainability if ownership can be achieved at the implementation levels of the Government
- SLM can be economically viable option for the farmer
- Incentives and other economic instruments may help suitable crop rotation, efficient tenure and other SLM measures
- Project should rigorously validate risk mitigation measures

### Recommendations

- Future projects must also include demonstration of economic sustainability along with the environmental sustainability
- Policy changes are less effective in developing countries. More emphasis should be given to projects that implement changes on the ground bringing direct benefits to the farmers
- Ownership may be targeted at two levels: (a) at the top decision-making level for appreciation and policy formulation and (b) at the field level for effective implementation
- Sustainable use of agricultural land can be achieved through Agricultural extension Service of the MoA.
- Develop marketing facilities to assist poor farmers
- The main threat to land is the overuse of it due to population pressure. Project needs to look at ways to reduce pressure by more efficient use of land for settlement.
- A systematic scientific study needed to identify vulnerable (hot spot) areas, develop SLM models for crops and effect of climate change on land use.

## **1.0 Introduction**

### **1.1 Purpose of the Evaluation**

The project titled 'Capacity Building And Resource Mobilisation for Sustainable Land Management (Eco-System Management) in Bangladesh' is a GEF and GoB financed project to address the land degradation problems in Bangladesh. The project has been completed recently and this Terminal Evaluation (TE) is being conducted to assess the performance of the project.

This evaluation is also to help UNDP/GEF identify any problem in project design, implementation, achievements and take into account and take in to account the lessons learnt and recommendations for future programming purposes.

Specifically the objectives of this evaluation are:

- To ensure accountability for the achievement of the GEF objective
- To enhance organizational and developmental learning
- To enable informed decision-making
- To identify future scopes for replication of SLM interventions
- To identify potential resource opportunities in favour of SLM initiatives in Bangladesh

The TE will review the activities of the project between 10 August 2008 to 29 February 2012 and will focus on

- The context of the SLMP implementation
- Extent of realizing outcomes of the project
- Asses the soundness of the methodologies developed for 'Land Zoning'
- Asses the relevance of the Land Zoning Law and Village Improvement Act
- Appropriateness of the GIS database format
- Mainstreaming SLM
- Ways to improve agricultural land protection using Land Zoning Law and Village Improvement Act
- Activities of the project contributing to capacity development for SLM
- Recommendations for the future

### **1.2 Key issues**

In order to establish a sustainable land management system to achieve long-term viability of land and water, the project wants to improve the capacity and resource mobilization for sustainable land management in Bangladesh. To achieve this objective, five key issues were targeted focusing on mainstreaming SLM at the decision-making level, strengthening capacity



at the institution level, enhancing SLM knowledge base, enabling the implementing professionals and mobilizing resources for the implementation.

More specifically:

- Mainstreaming of SLM in related policies, institutions and legislation
- Strengthening of institutions and capacity development for implementation of the National Land Use Policy
- Enhancement of SLM knowledge management system and R&D for knowledge
- Development of human capacity for local level institutional coordination and advocacy on SLM
- Mobilisation of resources for implementation of the National Land Use Policy, and policies, plans, programs and projects on SLM

If these issues are not addressed urgently, there may be a serious crisis affecting food security, livelihoods, economic growth and long-term eco-system health. The SLM project is seen as a response to address these issues combating the land degradation challenges through enhancing institutional and human capacity, mainstreaming SLM principles in the development planning and implementation processes, facilitating coordinated implementation of policies, and raising awareness and advocacy for sustainable land management.

### **1.3 Evaluation methodology**

As specified in the ToR, the TE will assess achievement of the project and rate them.

The **project results** (outputs and outcomes) will be assessed by three criteria – their relevance, effectiveness, and efficiency and to be rated as follows:

- Relevance : Were the project's outcomes consistent with the focal areas/operational program strategies and country priorities? Possible ratings are Satisfactory (S), Moderately Satisfactory (MS), Moderately Unsatisfactory (MU), Unsatisfactory (U), Highly Unsatisfactory (HU).
- Effectiveness : Are the actual project outcomes commensurate with the original or modified project objectives/ If the original or modified expected results are merely outputs/inputs, the evaluators should assess if there were any real outcomes of the project and, if there were, determine whether these are commensurate with realistic expectations from such projects. Again, above ratings for Relevance will be used.
- Efficiency : Was the project cost effective? Was the project the least cost option? Was the project implementation delayed and if it was, then did that affect the cost-effectiveness? Wherever possible, the evaluator should also compare the cost-time vs. outcomes relationship of the project with that of other similar projects. Again, above ratings for Relevance will be used.
- Overall rating : The overall rating can not be higher than the lowest rating on relevance and effectiveness.

Assessment of **sustainability** of project outcomes will be done following the GEF Monitoring and Evaluation Policy, 2006 which addresses four dimensions of sustainability: (a) Financial resources; (b) Sociopolitical; (c) Institutional framework and governance; and (d) Environmental. Possible ratings are Likely (L), Moderately Likely (ML), Moderately Unlikely (MU) and Unlikely (U). Since all the risk dimensions of sustainability are critical, overall rating for sustainability will not be higher than the dimension with lowest rating.

**Note that there seems to be a design problem in this suggested assessment of sustainability. Direction of the sustainability and the rating order do not match. The title says assessment of sustainability but the explanation talks about the risk to sustainability. So, sustainability will be renamed as 'Sustainability Risk'.**

**Catalytic** Role evaluation, if any, will be descriptive requiring no rating.

Assessment of **Monitoring & Evaluation Systems** will be rated between highly satisfactory (HS) and highly unsatisfactory (HU)

Assessment of **Processes affecting attainment of Project Results** will address necessary Preparation, Ownership, Stakeholders participation, financial planning, Implementing agency's support, co-financing issues. No rated evaluation is necessary but considers these issues while assessing the performance of the project.

**Lessons and Recommendations will be** on aspects related to helped or hindered project objectives, sustainability, innovation, catalytic effect and M&E.

The evaluation will be done as follows:

- Review relevant documents and build overall perspectives of the project
- Visit stakeholders (partners, Government agencies, NGOs) and discuss project related issues – successes, failures, prospects and problems
- Analyse project expectations and observed outcomes
- Forward looking recommendations

## **2.0 Project Depiction**

### **2.1 Project Basics**

This project has been developed by the joint collaboration between GoB and GEF to establish a sustainable land management system in Bangladesh. The project is titled as 'Capacity Development and Resource Mobilisation for Sustainable Management (Eco-System Management) in Bangladesh (SLMP) (BGD/05/G04)' and is a component of the approved UNDP-GEF funded Global Umbrella Project "Targetted Portfolio Approach for Capacity Development and Mainstreaming of Sustainable Land Management".

This project is jointly funded by the Global Environmental Facility (GEF) and the Government of Bangladesh. Total allocated budget was US\$ 1.559 million with GEF contribution of US\$ 637,000 (41%) and GoB contribution in kind of US\$ 695,000 (59%). Total expenditure till February, 2012 was US\$1.1 million???

The project was initiated in 2005 but the actual operation started on August 10, 2008. The project was extended twice, the first extension was for 1 year and the 2<sup>nd</sup> extension was for 9 month. The project finally completed in March 2012.

## **2.2 Development issues and objectives**

Pressure of an ever-increasing huge population on a small land (147,560 sq km) has remained as the main threat to land and water resources in Bangladesh. By the year 2051, the population may increase to around 240 million leaving only 0.07 acres of agricultural land available per person. Around 1% of agricultural land is being lost every year to other uses.

In order to feed the present 142 million (2005) mouths, present agricultural prescription is following a high dose of HYV + Fertiliser + Irrigation inputs which may not be SLM friendly. Various studies put the land degradation in Bangladesh to a critical level and impacts are visible. Many reasons have been identified – Increasing population, intensification of agriculture, weak governance, inappropriate agricultural practices such as over-irrigation and inappropriate cropping pattern, accumulation of pollutants in the land and water systems, unplanned industrial and infrastructural growth and urbanization, upstream water withdrawal, climate change, sand deposition, insecure tenancy and over exploitation of resources.

The project identified the barriers to prevent land degradation and to this end the project aimed to address the following problems:

(i) There is poor information on the causes and extent of the problem. Preliminary assessments reveal that the quality of land has deteriorated, and the impacts are serious. For example, over the last decade, net return from crop yield has declined due to deterioration of physical and chemical properties of the soil and the requirement of increased agro-inputs. At the same time, a comprehensive, nation-wide study on land degradation covering social, economic, and physical conditions is lacking. To effectively address land degradation, it is necessary to conduct such a comprehensive survey. On this basis, a baseline can be created against which progress can be monitored and assessed.

(ii) There is a lack of harmonized policies, poor implementation of policies, and lack of effective institutional coordination at all levels, including in the field. In particular, conservation aspects for sustainability are not sufficiently mainstreamed and are not comprehensively addressed in important policy documents of the Government. The reasons for the lack of implementation of policies related to land degradation are more difficult to summarize and will be the subject of a thorough review which this project proposes to undertake.

(iii) Lack of adequate knowledge base about SLM is one of the principal barriers. This has also resulted in a limited research budget for SLM.

(iv) Land policies in Bangladesh are mostly concerned with food production. Even in this pursuit, the IPM has not made much progress. There is no credible best practice example or lessons learnt on SLM, which has been properly recorded or analyzed in Bangladesh.

(v) Extension work in the agriculture sector ignores land degradation potential as a result of unsustainable agricultural practices. Long-term impacts and research results that would support SLM objectives are not widely disseminated. Officials are not sufficiently trained on these areas.

(vi) There is overall lack of trained experts and field level workers to implement projects on SLM and carry out meaningful monitoring.

### The principal constraints in preventing land degradation in Bangladesh

- Absence of baseline information on land use pattern;
- Absence of a shared and credible administrative base map of the country in digital format – essential and mandatory for integrated development planning;
- Lack of appropriate and harmonized policies, poor implementation of policies, and lack of effective institutional coordination at all levels;
- Absence of information technology (IT) in the monitoring the implementation of government policies;
- Lack of adequate knowledge base about SLM;
- Spreading of commercial agriculture based on unscientific and unsustainable agricultural practices;
- Lack of awareness on the importance of SLM; and
- Overall lack of trained experts and field level workers to implement SLM practices and carry out meaningful monitoring.

### Objectives of the project are:

- To mainstream SLM in related policies, institutions and legislation
- To strengthen institutions and capacity development for implementation of the National Land Use Policy
- To enhance SLM knowledge management system and R&D for knowledge
- To develop human capacity for local level institutional coordination and advocacy on SLM
- To mobilise resources for implementation of the National Land Use Policy , and policies, plans, programs and projects on SLM

### 2.3 Main stakeholders and partners

The main implementing agency is the Ministry of Environment and Forest (MoEF) along with Ministry of Land (MoL) and Ministry of Agriculture (MoA). UNDP was the implementing agency for GEF. Other implementing partners include Barind Multipurpose Development

Authority (BMDA), Soil Research Development Institute (SRDI), Bangladesh Agriculture Research Council (BARC), Water Resources Planning Organisation (WARPO), Department of Agriculture Extension (DAE), Department of Environment (DoE), Bangladesh Institute of Development Studies (BIDS), University of Dhaka (DU) and Centre for Urban Studies (CUS).

Key stakeholders of the project included government organizations as service providers responsible for administration and management of land and the land owners. From this perspective the main stakeholders are the Ministry of Planning and Finance – Planning Commission, the Ministry of Environment and Forest – DOE and FD, the Ministry of Land – DLRS, the Ministry of Agriculture – DAE, BARC, SRDI and BMDA, the Ministry of Water Resources – WARPO, BWDB, the Ministry of Fisheries and Livestock – DoF, DLS, Ministry of Local Government and Rural Development – LGED, BRDB, and the Ministry of Defense – GSB, SoB.

The Ministry of Environment and Forest was the main implementing partner for the project. MoEF has a mandate to enhance environmental governance in Bangladesh in partnership with other GoB Ministries and civil societies and other organizations.

The project will have three implementing agencies – the MoEF, Ministry of Land and BMDA of the Ministry of Agriculture. These agencies will contribute in ensuring effective cooperation and involvement of all other relevant Government departments in promoting SLM.

## 2.4 Results targeted

The expected results as described in the project document are:

1. SLM mainstreamed in the related policies, institutions and legislations
2. Institutions strengthened and capacity developed for implementation of the National Land Use policy;
3. Enhanced SLM knowledge management system and R & D for knowledge
4. Human capacity developed for local level institutional coordination and advocacy on SLM
5. Resource mobilized for implementation of the National Land Use Policy and other policies, plans, programs and projects on SLM

These outcomes were translated into following targeted outputs and activities.

<i>Outcome and outputs</i>	<i>Output indicator</i>	<i>Activities</i>
<b>Outcome 1: SLM mainstreamed in related policies, institutions and legislation</b>		
1.1. Integration of SLM principles into national development plans and policies	<ul style="list-style-type: none"> <li>• Sectoral ministries and related departments are mandated</li> </ul>	1. Define working principle of SLM in Bangladesh and review the existing legal structures, policies and institutions under key ministries to assess their positive or negative impacts on SLM and the synergies between those policies; <u>Land Zoning Law and Village Improvement Act drafting</u>

<b>Outcome and outputs</b>	<b>Output indicator</b>	<b>Activities</b>
	to incorporate SLM in their plans and policies.	<p>2. Conduct a guided self-assessment exercise focusing on their roles and responsibilities in relation to land management and their capacity needs to work in relation to SLM through workshop within key ministries and their concerned agencies and regional development board authorities.</p> <p>3. Prepare a consolidated report encompassing assessment from all ministries to identify synergies and inconsistencies between Government policies and the relevance of SLM with PRS/MDGs related actions, and conduct a series of seminars and workshops involving representatives from the abovementioned ministries and institutions to share findings and look at common capacity needs and synergy issues;</p> <p>4. Develop a strategic plan to integrate SLM into policies, legislation and plans within related ministries with suggestions for institutional capacity building.</p>
1.2 Improved capacity in key ministries and institutions on “SLM and the importance of its integration in land related policies, Acts, rules, and development plans”	• Extent of institutional reform and feedback from the network members.	<p>1. Develop an effective institutional arrangement to foster cooperation and coordination among local level institutions of technical departments, civil administration, civil society, and community groups;</p> <p>2. Develop a network for communication with the nomination of a Focal Point from each concerned Ministry to act as communications coordinator on land management issues. Activities will include email circulars, regular meetings and circulation of minutes – to be coordinated by PMU.</p>
1.3. Effective inter-agency coordination and networking mechanisms in place to improve policy making (harmonization) and coordination of SLM initiatives	• Projects affecting land in forestry, agriculture – crop production and irrigation, drainage, watershed management, transport, and energy are to a large extent integrated SLM aspects.	<p>1. Assist to include SLM related activities and the National Land Use Policy in the core implementation activities of the Poverty Reduction Strategy, and the Annual Development Programme to develop synergy with the objectives of poverty reduction and environmental sustainability;</p> <p>2. Identify land degradation related constraints to remove any barriers to the successful implementation of national environmental policies and plans, such as NAPA, NBSAP;</p> <p>3. Develop a screening procedure for inclusion of SLM in the national development planning process</p>
1.4. New policy tools are developed and disseminated for land use decision	• Extent of awareness to be assessed through	<p>1. Develop advocacy and awareness strategy - identify key target stakeholders that will include community leaders, and areas for campaign at different levels with development of campaign materials on existing knowledge and project supported studies;</p>

<b>Outcome and outputs</b>	<b>Output indicator</b>	<b>Activities</b>
making	periodic surveys.	<ol style="list-style-type: none"> <li>2. Organize policy seminars with key policy makers, advisors and Members of Parliaments</li> <li>3. Conduct national level media campaign with women participation.</li> </ol>
1.5 Plans developed and implementation facilitated to deliver obligation under relevant MEAs	<ul style="list-style-type: none"> <li>• The number of tools to be established with SLM objectives that would be promoted for land management and for rehabilitation of degraded.</li> </ul>	<ol style="list-style-type: none"> <li>1. Develop a policy brief on mainstreaming SLM into land use decision-making using economic instruments and integrated land use planning methodologies and other policy tools (including consultation workshops)</li> <li>2. Develop and implement an awareness raising program for senior officials, NGOs, and women groups on the use of economic instruments and other policy tools as management tools for combating land degradation</li> </ol>
<b>Outcome 2: Institutions strengthened and capacity developed for implementation of the National Land Use Policy</b>		
2.1. Institutional arrangements identified and activated to implement National Land Use Policy	<ul style="list-style-type: none"> <li>• SLM concerns are dealt with policy revisions, and establishing guidelines/action programme with provisions of relevant legislation.</li> <li>• Performance of institutional framework established for implementation of land use policy.</li> </ul>	<ol style="list-style-type: none"> <li>1. Review the National Land Use Policy for updating it to meet the current and future demand on land for economic, social, environmental and ecological services and to develop a proposal for legislative support for strengthening its implementation;</li> <li>2. Develop an effective institutional framework with the designation of a coordination body or unit within the Ministry of Land to function as the secretariat of the two committees charged with the review and implementation of the Policy and to ensure cooperation and coordination among the relevant stakeholders;</li> <li>3. Develop an action plan in consultation with the broad spectrum of stakeholders for the National Land Use Policy that will include land zoning, land utilization plan, and investment plan for land development by improving on the drainage, protection from flood, Cyclone, dredging, de-salinization, afforestation, conservation of biodiversity, and improved utilization of cultivable land including Government owned land currently not in use, and also have a pilot focus on the Barind tract;</li> </ol>
2.2 Action plan developed to develop necessary planning and legal instruments such as land	<ul style="list-style-type: none"> <li>• Successful establishment of baseline parameters for National Land Use Policy</li> <li>• Participation</li> </ul>	<ol style="list-style-type: none"> <li>1. Develop an integrated monitoring plan for the National Land Use Policy with appropriate indicators</li> <li>2. Conduct an indicative baseline survey for monitoring the Land Use Policy</li> <li>3. Conduct training of staff from relevant institutions to monitor implementation of National Land Use Policy;</li> </ol>

<b>Outcome and outputs</b>	<b>Output indicator</b>	<b>Activities</b>
zoning principles and land zoning law 2.3 Comprehensive National protected areas systems identified for sustainability	of stakeholders with relevant information.	4. Organize annual workshops of stakeholders to review implementation of the National Land Use Policy.
2.4 Mechanism for Monitoring National Land Use Policy implementation developed		
<b>Outcome 3: Enhanced SLM knowledge management system and R &amp; D for knowledge</b>		
3.1 Capacity development and knowledge management needs assessed for SLM	<ul style="list-style-type: none"> <li>• Acceptance and attribution of ownership of the stakeholders to the report capacity needs for their participation in the proposal for database development.</li> </ul>	<ol style="list-style-type: none"> <li>1. Prepare an inventory of the existing databases in the organizations of the key ministries and the regional development boards; and participatory assessment of the needs for further development:</li> <li>2. Assess the information related capacity needs of technical and research organizations dealing with land, agriculture, forestry, biodiversity, fisheries and livestock, and identify knowledge management gaps, overlaps, and protocol needs;</li> </ol>
3.2 Knowledge management systems on SLM including a GIS based MIS in place	<ul style="list-style-type: none"> <li>• Response from the officials trained for development and maintenance of knowledge management system</li> <li>• Feedback from network members.</li> </ul>	<ol style="list-style-type: none"> <li>1. Prepare a proposal for an information network for the organizations involved in research, studies, and survey related to the problems of land degradation and land use issues with an information sharing protocol and dissemination of information to local level that would assist the decision makers in SLM;</li> <li>2. Develop an active pilot information network for the organizations involved in research, studies, and survey related to the problems of land degradation and land use issues, administered through relevant institution as well as the compatibility of database systems and their management with focus on the Barind Tract.</li> </ol>
3.3. Action research and studies on SLM conducted for policy development and	<ul style="list-style-type: none"> <li>• Study report on poverty and land degradation</li> <li>• Study report on best</li> </ul>	<ol style="list-style-type: none"> <li>1. Assess the extent of land degradation in different bio-ecological zones due to economic, social and natural causes based on existing studies, available field data and an analysis of land use practices. The study should take into consideration the linkages between land degradation and poverty and pay attention to gender issues;</li> </ol>



<b>Outcome and outputs</b>	<b>Output indicator</b>	<b>Activities</b>
awareness raising	practices and traditional knowledge	2. Produce a series of reports drawing on existing knowledge, available best practices, and project-supported studies including sustainable wetland management, forest management and forestation using indigenous species, the role of indigenous knowledge in land management, ecologically sensitive agricultural practices, urban planning, integrated pest management, effective utilization of common property resources.
<b>Outcome 4: Human capacity developed for local level institutional coordination and advocacy on SLM</b>		
4.1 Capacity of local advisory and decision-making institutions enhanced	• Number of officials trained for institutional development	1. Organize training workshops for SLM focal points, responsible officials, and experts for land related issues from relevant institutions on principles and policies for combating land degradation and to apply necessary tools for this purpose.
4.2 Capacity development through training and demonstration of valuation of ecosystem services and use of economic instruments such as tax reform and subsidies, and strengthening EIA process	<ul style="list-style-type: none"> <li>• Number of proposals for introduction of innovative tools such as EIA application for SLM, use of SEA for strategic plans, and economic valuation techniques.</li> <li>• Feedback from the officials of DOE and SLM body for policy implementation on the application of new tools.</li> </ul>	1. Develop a training module on EIA, SEA and valuation of natural resources with organization of training workshops on EIA and SEA for senior technical officials in DoE and other concerned organizations on the issues of SLM
		2. Organize a training workshop on valuation of ecosystem services, natural resources and on the use of economic instruments in decision-making;  3. Illustrate the application of natural resource accounting tools in local land use planning and resource management as follow up to training by selected participants working in one area to implement a pilot project.
4.3 Dissemination of best practices and technologies on sustainable land management	<ul style="list-style-type: none"> <li>• DAE and their extension services have included SLM in their programme.</li> <li>• Percentage of farmers induced to IPM and conservation farming.</li> </ul>	1. Develop training materials and conduct training of trainers program targeting the field staff, community leaders, women groups, and farmers on production of organic manures and conservation of biomass for soil productivity; on soil conservation and mitigation measures including agro-forestry at selected Upazila level, integrated ecosystem management and community based natural resource management.
		2. Disseminate of best practice materials on SLM to farmers and community leaders by organizing media events and

<b>Outcome and outputs</b>	<b>Output indicator</b>	<b>Activities</b>
		community workshops in selected locations, field visits to demonstration sites etc.
4.4. Capacity building for local level coordination between institutions and advocacy on SLM through pilot field demonstration projects	<ul style="list-style-type: none"> <li>Percentage of farmers satisfied with available technical support on SLM, and the local awareness on SLM.</li> </ul>	<ol style="list-style-type: none"> <li>1. Organize pilot demonstration and training on SLM on technology innovation, innovative crop diversification in the Barind Tract with provision of adequate training in institutions of other Asian countries;</li> <li>2. Organize pilot demonstration and training on enhanced soil conservation methods and technology innovation in selected Agro Ecological Zones (AEZ).</li> </ol>
Outcome 5: Resources mobilized for implementation of the National Land Use Policy, and policies, plans, programs and projects on SLM		
5.1 Funding needs identified for the priority areas of targeted capacity development and on the ground investments	<ul style="list-style-type: none"> <li>Needs analysis report</li> </ul>	<ol style="list-style-type: none"> <li>1. Elaborate NAP for promoting SLM policies and programmes;</li> <li>2. Organize workshop of stakeholders to identify further targeted capacity development and on the ground investments for follow-up projects.</li> </ol>
5.2 Project concepts developed for financing by Government, bilateral and multilateral donors, NGOs and private sector	<ul style="list-style-type: none"> <li>Development of mid-term investment projects for SLM.</li> <li>Decision on the responsibility for NAP implementation.</li> </ul>	<ol style="list-style-type: none"> <li>1. Develop a portfolio of projects for SLM drawing on the NAP, Land Use Policy Action Plan and other relevant plans including NAPA and BSAP;</li> <li>2. Prioritization of projects for mid-term investment according to identified criteria.</li> </ol>
5.3 Public Private Partnership developed		
5.4 Resources mobilized	<ul style="list-style-type: none"> <li>Number of project selected for funding from national budget and donor contribution.</li> </ul>	<ol style="list-style-type: none"> <li>1. Organize stakeholders workshop for partnership building and resource mobilization for implementation of the portfolio of mid-term investment projects;</li> <li>2. Donor round table to be organized by Government authorities.</li> </ol>

### **3.0 Project Evaluation**

#### **3.1 Project Formulation**

##### **3.1.1 Relevance of the project design**

The land is under tremendous pressure in Bangladesh being over used due to population pressure. With the ever-increasing population there will be even more pressure on land to provide needed food and housing. So the land needs to be looked after so that it remains healthy enough to support the population.

The SLMP project has been designed to establish a sustainable land management system to achieve long-term viability of land and water. The project is designed to achieve necessary legal, institutional adaptation and capacity development and awareness generation to implement and support sustainable land management in Bangladesh.

##### **3.1.2 Effectiveness of the project strategy**

To implement SLM the main targeted outcomes are:

- mainstreaming the SLM through policies, institutions and legislation
- strengthening institutions and capacity development
- Enhancing SLM knowledge base
- Human capacity development at the local level
- Resource mobilization for implementation of policies

The Outcome 1 intends to integrate SLM principles into national development plans and policies and to do so plans to improve capacity, inter-agency coordination, in the key ministries.

The Outcome 2 intends to strengthen the capacity to implement the Land Use Policy and to do so plans to improve institutional arrangements in the Government ministries and also carry out necessary study on land use.

The Outcome 3 intends to enhance the SLM knowledge and accordingly plans to develop SLM database to serve Government and other organizations involved in land and water resource management, train officials with tools that may assist implementation of SLM.

The Outcome 4 intends to develop human capacity at the local level for the implementation of SLM and therefore plans to train field level officials in SLM tools

The Outcome 5 intends to mobilise resources for the implementation of the national Land Use Policy and to do that the project wants to address funding needs in the priority areas, Public-private partnership and other possible resource organizations.

If a proper review of the similar previous projects was done identifying successes and failures, this may have been noted that policy and law formulation is a lengthy process in a developing country like Bangladesh. And again, policy and legal instruments are not that effective in developing countries. Similarly, Government institutions are very bureaucratic in developing countries and any reform may be more difficult to achieve. And as such, the project could have been strategically designed to implement SLM directly through organisations at the implementing level. For example targeting DAE and BMDA and addressing issues they are facing in implementing SLM. So, emphasizing Outcomes 3 and 4 could have been the strategic option.

### 3.1.3 Validity risks

The project document list the following assumptions for the project :

Assumptions	Risk	Risk mitigation strategy
The concerned ministries and related others would participate in the project and collaborate in the implementation of various components of SLM	The SLM is new approach. Beneficiaries are dispersed. No civil support.	Adequate provision for awareness raising and training on SLM. Dispersed group will be targeted
Policies and capacity will be developed for SLM and National Land Use policy to be incorporated into programs of agricultural sector and urban/rural development	Inadequate awareness	Seminar workshops will be organised
A core team will be put together under the MoL	No provision in the annual development program of GoB	MoL to know the importance of staff deployment
Stakeholders will continue supporting the knowledge base	Inadequate institutional and budgetary provision	M&E and knowledge management to be funded by the Govt
Pilots will be used for capacity development and lessons learn on SLM	Inadequate motivation of the field staff	Training and visits by project management

The risks listed are valid but the mitigation strategies suggested are impractical and never going to work in view of the operational reality in Bangladesh or for that matter in any developing country. Most of the outcomes will not sustain beyond project life unless the ownership has been ascertained in an existing ongoing program.

### **3.2.0 Project Implementation**

#### **3.2.1 Project organization and management**

The project was guided by a steering committee with members from relevant ministries of the Government and UNDP and was managed by a Project Management Unit (PMU) which was located within the Ministry of Environment and Forestry (MoEF). The PMU had the following officials

- National Project Director (NPD)
- Project Manager (PM)
- Monitoring & Evaluation Specialist

However, the MoEF did not whole-heartedly feel comfortable with the ownership of the project. Although MoL is identified in the Project Document as one of the important collaborator, MoL's participation was insignificant except at the beginning. As a result the achievements of the project have suffered.

Project management has also suffered significantly due to the staffing problem, specifically at the PMU. The project suffered severely due to frequent change and absence in senior management positions. During the four year period of the project, NPD changed 4 times. PM was changed twice and in fact this position was vacant for almost 3 years. During the PM's absence M&E Specialist had to perform this role in addition to his own duties.

Various operational problems affected the progress of the project. The official starting of the project was delayed by 13 months. Availability of equipments was a from the previous SEMP and IPSU projects created problems. The project was also revised twice. The project started in July 2007 and was supposed to be completed by June 2010. The 1<sup>st</sup> revision extended the project for 1 year, up to June 2011. The 2<sup>nd</sup> revision of the project extended it for 9 months, up to March 2012.

#### **Study Tour**

In order to generate appreciation for the project at the decision-making level, the project started with two study tours.

One of them was to participate in a 5-day workshop on "Designing Integrated Financing Strategies for Sustainable Land Management" in Sri Lanka from 20 – 24 April 2009. A five-member Bangladeshi delegate participated in the workshop from different relevant ministries and the project. Objectives of the sub-regional level workshop was to build capacity to create an enabling environment conducive to investment in land management and to develop capacity to elaborate and implement national and multi-country strategies to mobilize financial resources.

The workshop identified following sectors that require immediate attention of the policy makers while formulating an integrated financing strategy for combating desertification:

- In-depth understanding of the decision-making process involved in public planning and resource allocation for activities to combat land degradation and poverty;
- Increased capacity to develop and manage the process of mainstreaming the NAP into strategic frameworks for economic and social development;
- Greater ability to identify the needs of local communities in order to better informed financing strategies;
- Better understanding of the methodologies and strategic approaches of external financial partners;
- Increased capacity to prepare proposals for financing in accordance with the eligibility criteria and procedures of the various bilateral and multilateral financial partners;
- Greater awareness of innovative financing sources such as those relating to climate change, debt-for-nature swaps and decentralized cooperation.

The other visit was made to Australia but no report on that visit was available.

### **Targeted Task Management**

The PMU managed and collaborated with nine implementers who carried the tasks to deliver the outputs targeted under the five outcomes of the SLM project.

However, many of the tasks identified in the Project Document were not assigned to any implementer, some have changed from the original but have not been harmonized and Outcome 5 was almost not implemented. Many of the deliverables from the implementers did not arrive in time even though they have been fully paid. It has been a struggle for the consultants to chase these reports. After lot of persuasion, some have submitted only a draft version or a very scanty report with only a couple of pages.

It is logical for a short TE consultancy to assume that all relevant reports are already available in their final version so that the consultants do not have to spend time to research and look for the reports.

### **3.2.2 Monitoring and evaluation**

The monitoring and evaluation plan was reported to have been prepared but was not executed. There was no mid-term evaluation done. However, two annual progress reports were done and available. The lack of M&E has also affected the progress of this project.

### **3.2.3 Financial management**

The original project allocation was US\$1.5 million and the total expenditures till February, 2012 was US\$1.1 million?????. The project was extended twice and finally completed in March, 2012. There was no complaint about the funding delivery. However, it is to be noted that all contractors/consultants have already been paid in full although the all the deliverables and final reports were not submitted. See annual budget disbursement report in Annex 6.

### **3.3 Project results**

The project has created good awareness for SLM among many of the stakeholders involved in land management and land utilization in general. Other initiatives like demonstrating options for sustainable land management was not sufficient and ultimately not much effective in many cases. Interventions in the policy and legislative areas were very weak to motivate the policy stakeholders on board and bring any change. Preparation of a comprehensive project document for sustainable land management and resource mobilization remained undone.

Some of the activities specified in the prodoc were not assigned to any partner organization or targeted by the PMU.

#### **3.3.1 Outcome 1 : SLM mainstreamed in related policies, institutions and legislation**

This outcome expects that sustainable land management concept will be accepted by the Government machineries and will be reflected policies and legislations. Effective inter-agency coordination and networking mechanism will be in place to improve policy making and coordination of SLM initiatives.

Also, national land use policy will be implemented through the formulation of Land zoning principles and policy tools will be developed for land use decision making.

##### Brief Overview

The project has drafted 'Land Zoning Law' and 'Village Improvement Act' with formal request from the Ministry of Land (MoL), but later those were not taken up by the MoL. Instead they have drafted 'Agricultural Land Protection and Land Use Law'. Again promulgation of which is uncertain. No evidence found on the self-assessment exercise, to establish synergies among the ministries on the issue, no strategic plan observed to integrate SLM into policies.

No evidence or initiative observed to establish institutional arrangement to ensure and foster cooperation among the agencies and organizations.

Some of the activities were not assigned. No evidence of developing screening procedure for inclusion of SLM in the national development planning process. Developing advocacy and awareness strategy activity were not assigned. BIDS did not organize policy seminar, which was in the Project Document but not in their deliverables.

Agricultural Information Services (AIS) arranged excellent media campaign at the national levels with women participation. AIS may be utilized in future in developing campaign materials and campaigning for awareness building.

BIDS prepared policy brief for including SLM into land use decision making using economic instruments, however the cost-benefit for SLM vs economic sustainability not demonstrated. Awareness workshop held targeting senior officials, NGOs, women on the use of economic instruments to combat land degradation.

##### Detail activities

Specifically, five following output targets were identified to achieve this outcome.

#### **3.3.1.1 Integration of SLM principles into national development plans and policies**

The first target was to achieve integration of SLM principles into national development plans and policies. Four different activities were set to achieve this target including review SLM relevance to existing policies, institutions (implementer UNDP/PMU); capacity needs to work in relation to SLM (PMU), identify synergies and inconsistencies between Government ministries and develop strategic plan to integrate SLM into policies (UNDP/PMU), develop legislation and plans within related ministries (UNDP).

There have been a few workshops drawing officials from relevant ministries to discuss SLM and how this can be mainstreamed.

The project has drafted a Land Zoning law and a Village Improvement Act. These laws, if implemented, could promote SLM practices in Bangladesh. However, these laws as formulated, was unacceptable to MoL and were modified before submitting to the national parliament for approval. Inside story as it came out during interviews that these laws may not be approved by the parliament. The Government may be feeling shaky to provide approval because of political reasons.

##### Assessment of this output

- Relevance – S
- Effectiveness – U
- Efficiency – MU
- Overall rating - U

##### Sustainability risk of this output

- Financial – ML
- Sociopolitical – L
- Institutional – ML
- Environmental – U
- Overall rating – L

#### **3.3.1.2 Improved capacity in key ministries and institutions on “SLM and the importance of its integration in land related policies, acts, rules, and development plans”**

Two activities were identified to achieve this output: (a) Development of an effective institutional arrangement to foster cooperation among local level institutions (PMU) and (b) develop a network for communication among concerned ministries (PMU).



There is no evidence of these activities.

Assessment of this output

- Relevance – S
- Effectiveness – U
- Efficiency – U
- Overall rating - U

Sustainability risk of this output

- Financial – ML
- Sociopolitical – L
- Institutional – ML
- Environmental – U
- Overall rating - L

**3.3.1.3 Effective inter-agency coordination and networking mechanism in place to improve policy making (harmonization) and coordination of SLM initiatives**

Three activities were selected to achieve this output target : (a) Include SLM activities in poverty reduction strategy (implementer not assigned); (b) Identify land degradation related constraints to remove any barriers to the implementation of NAPA, NBSAP, etc (implementer not assigned); (c) Develop a screening procedure for inclusion of SLM in the national development planning process (PMU).

The first two activities were not assigned to any implementer and there is no evidence of achievement for the third activity. Therefore no further evaluation is offered for this output.

**3.3.1.4 New policy tools are developed and disseminated for land use decision making**

Three activities were designed to achieve this targeted output (a) Develop advocacy and awareness strategy through key stakeholders (not assigned); (b) organize policy seminars with key policy makers, advisors and members of Parliament (BIDS); (c) Conduct national level media campaign with women participation (AIS).

The first activity was not assigned. Bangladesh Institute of Development Studies (BIDS) has done a few successful seminars drawing various decision and policy makers. Agriculture Information Services (AIS) has done excellent national campaign with women participation through national radio and television. Both of these two activities have increased awareness of SLM amongst decision makers and general public.

#### Assessment of this output

- Relevance – S
- Effectiveness – S
- Efficiency – MS
- Overall rating - S

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – ML
- Environmental – U
- Overall rating - ML

### **3.3.1.5 Plans developed and implementation facilitated to deliver obligation under relevant MEAs**

Two activities were targeted to achieve this output. (a) Develop a policy brief on mainstreaming SLM into land use decision-making using economic instruments and integrated land use planning methodologies (BIDS); (b) Develop and implement awareness raising program for senior officials, NGOs and women groups on the use of economic instruments to combat land degradation (BIDS).

BIDS has effectively implemented these two activities and identified the following policy options for SLM:

- Immediately research and identify the hot spots of land degradation
- DAE may be strengthened to advance SLM practices
- Subsidise farmers to implement SLM
- Encourage suitable crop rotations and agronomic practices to conserve soil fertility
- BARC should be strengthened to advance further research on SLM
- Land zoning to be implemented to restrict unsuitable conversion of land use
- Use economic instruments (subsidy, tax, price, etc) to encourage crop selection, cropping pattern and intensity and use inputs that are SLM friendly.

However, BIDS could have and should have studied and shown that SLM practices are also economically viable for a farmer. To a farmer, specifically for the poor, economic sustainability is the first priority.

#### Assessment of this output

- Relevance – S
- Effectiveness – S

- Efficiency – MS
- Overall rating - S

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - ML

### **3.3.2 Outcome 2 : Institutions strengthened and capacity developed for implementation of the National Land Use policy**

#### Brief Overview

Review of National Land Use Planning for future demand on land and develop necessary legislative support for implementation and the task of developing a framework for a secretariat in MoL to coordinate among the stakeholders has not been assigned. No evidence of an action plan in consultation with stakeholders for the National Land Use Policy for improving various degraded land including the barind tract.

An excellent baseline survey for monitoring land use practice was done through testing in 10 villages representing variety (draught, salinity, haor, hill tracts, average plain, economically better and poor areas). No evidence of organizing annual workshop of the stakeholders to review implementation of the national land use policy. Some of the activities were not assigned, such as developing an integrated monitoring plan for the National Land Use and training of staff from the relevant agencies to monitor implementation of National Land Use Policy.

An excellent study has been done in Palash and Tangail Sadar Upazila, reporting on the trend of land & environmental degradation and conversion of land use using GIS and RS Technologies. The study shows the pattern of land use and their change over time including the rate of conversion of agricultural land to urban use. The study also developed a land use classification system.

#### Detail activities

Four outputs were originally designed and documented to achieve this outcome. However, these were modified later and following were implemented.

#### **3.3.2.1 Institutional arrangements identified and activated to implement National Use Policy**

Three activities were identified to achieve this output: (a) Review the National Land Use Policy for updating it for future demand on land and develop necessary legislative support for implementation (not assigned); (b) Develop a coordination body within MoL to support

stakeholders (not assigned); (c) Develop an action plan in consultation of the stakeholders for the Land Use policy for improving various degraded land including Barind tract (PMU).

The first two activities were not assigned to any implementer and there is no evidence that the third one has been implemented. The actual description of activities has been so verbose that the focus was lost.

Since there was no evidence of activities, no further evaluation was done.

### **3.3.2.2 Action plan to develop necessary planning and legal instruments such as land zoning**

Four activities were chosen to achieve this output : (a) Develop an integrated monitoring plan for the National Land Use Policy with appropriate indicators (not assigned); (b) Conduct an indicative baseline survey for monitoring the Land Use Policy (BIDS); (c) Conduct training of staff from relevant institutions to monitor implementation of National Land Use Policy (not assigned); (d) Organise annual workshop of stakeholders to review implementation of the National Land Use Policy (not assigned).

Except the 2<sup>nd</sup> , no other activities were assigned. BIDS did an excellent baseline survey for monitoring land use practices in 10 villages to represent the variety (drought, salinity, wetland, hill tracts, average plain by economically better and poor). However, the temporal trend inferences were based on questions asked about the past practices and so the results may be questionable.

This is unfortunate here that a good work done for one activities may be lost in the evaluation due to failures of other three activities.

#### Assessment of this output

- Relevance – S
- Effectiveness – MU
- Efficiency – MU
- Overall rating - MU

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - ML

**3.3.2.3 Implementation of Pilot demonstration in selected sites and trend of land and environmental degradation over time in selected bio-ecological zones. Conduct an indicative baseline survey for monitoring the land use policy and designing of SLM plan basing on a urban pilot area.**

This output (assumed as output since there was no updating of the project document) was not identified in the original project document but included later by the project. Two activities/deliverables were performed : (a) Study the prospects of land zoning in Palash Upazila, along with trend analysis of its land and environmental degradation in different bio-ecological zones (CUS); (b) Indicative baseline survey for monitoring the land use policy and design land zoning based SLM plan for Tangail Sadar Upazila, supported by necessary reports and maps (CUS).

CUS performed both activities successfully and reported on the trend of land and environmental degradation using GIS and RS technologies. The study shows the pattern of land use and their change over time including the rate of conversion of agricultural land to urban use. The study also developed a four-tier land use classification system which should be adequate to support a land zoning mechanism. However, it does not include any data that can be related to soil or other environmental degradation.

This report was based on a draft report submitted by CUS and only included generic recommendations about the need for wider land use survey and a national land information system. It did not include a recommended GIS database format and Land Zoning methodology.

Assessment of this output

- Relevance – S
- Effectiveness – MS
- Efficiency – MU
- Overall rating - MS

Sustainability risk of this output

- Financial – ML
- Sociopolitical – MU
- Institutional – MU
- Environmental – U
- Overall rating - ML

### **3.3.3 Outcome 3 : Enhanced SLM knowledge management system and R&D for knowledge**

#### Brief overview

Inventory of existing database in government agencies and regional boards reported but no documents as such received. This is an important area for cooperation and collaboration among the agencies towards a concerted effort for SLM. A workshop was held to assess the information capacity and need of the research and technical organizations and identify gaps – but presented a generic recommendation, not much specifically identified areas for action.

A website has been developed to support information sharing for the relevant research organizations. The website is a good start but needs to be further upgrading and more importantly should be handed over to a relevant technical agency for maintaining. A workshop was held for piloting of an information network to be developed for research organizations relating to degradation of land.

An RS and GIS based study was conducted by WARPO to assess the extent of loss of wetlands in and around Dhaka City, the DAP area. The assessment has given a good estimate for loss or conversion of water areas, but questionable results for other land use type. The deliverable does not directly match with the activities specified in the Prodoc. BIDS, based on a survey on present land use patterns prepared a report on best practices under different ecological and economic settings. This deliverable also does not directly match with the activities specified in the Prodoc.

#### Detail activities

Following three knowledge related outputs were designed for this outcome.

#### **3.3.3.1 Capacity development and knowledge management needs assessed for SLM**

Two activities were selected to be included under this output category: (a) Inventory of existing databases in the key Government ministries and regional development boards and assessment of needs for further development (BIDS); (b) Assess the information related capacity needs of technical and research organizations dealing with agriculture, forestry, fisheries, livestock, etc (BARC)

BIDS arranged a meeting of related officials from relevant organizations and discussed database management needs and recommended the following:

- A coordination body to be formed to manage information related to SLM
- A steering committee with representative from relevant organizations
- The coordination body should formulate other tasks including the needs for creation and management and sharing of the database

BARC held two national workshops focusing on SLM through effective fertilizers use and soil and crop management. A total 23 scientific papers were presented highlighting the problems and land degradation. Soil and Crop management workshop identified issues such as heavy metal contamination, indiscriminate use of pesticide, micronutrient management, forest crop management, wetland management and upland management.

The fertilizer use workshop identified issues on fertilizer use, salinity, toxicity, nutrient management, forest plantation, bamboo groves, fodder crops, livestock, microbial activity, bio-fertiliser, soil organic, upland soil, fish pond, fruit crop and water use to prevent land degradation. Both of these workshops recommended developing crop models suitable for SLM.

BARC has also held a workshop to assess the information related capacity needs of relevant organizations but no report was received on this.

In regard to a national SLM database BARC may be considered as a potential manager. As it seems, the capacity of BARC needs to be strengthened in this regard. Financial support would be crucial for the success of such a database.

#### Assessment of this output

- Relevance – S
- Effectiveness – MU
- Efficiency – MU
- Overall rating - MU

#### Sustainability risk of this output

- Financial – L
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - L

### **3.3.3.2 Knowledge management systems on SLM including GIS based MIS in place**

Two activities were prescribed to achieve this output: (a) A website development for an information network for the organizations involved in research, studies and survey related to SLM and dissemination of information (PMU); (b) Develop a pilot information network for the organizations involved in research, studies and survey related to SLM with a focus on the Barind tract (BARC).

PMU has developed a website to support information sharing for the research organizations related to land degradation and land use issues. The website is a good start but it needs many more improvements and further developments with inclusion of GIS technology.

BARC has held a workshop on the development of a pilot information network to be developed for research organizations relating to degradation of land with a focus on Barind tract. However, there is no official documentation reporting on the workshop and so achievement of this output is questionable.

#### Assessment of this output

- Relevance – S
- Effectiveness – MU
- Efficiency – U
- Overall rating - MU

#### Sustainability risk of this output

- Financial – L
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - L

### **3.3.3.3 Action research and studies on SLM conducted for policy development and awareness raising**

Two activities are assigned to this output. The first output was later modified to only focus on the wetland degradation. (a) Assess the extent of wetland degradation around Dhaka city; (b) Report on existing knowledge, available best practices for SLM under different ecological (and economic) perspectives. Activities identified in the project document do not exactly match with the deliverables for BIDS and this indicates serious problems in relating Outcomes, outputs, activities and deliverables.

WARPO assessed the extent of wetland loss around Dhaka city between 1967 and 2010 change detecting the satellite imageries. The permanent wetland went down from 14% in 1967 to only 4% of the study area in 2010. While wetland was analysed acceptably correctly, other land use type detection and change analysis is questionable.

BIDS reported the present scenarios of agriculture based on a survey of agricultural practices in different ecological and economic areas. It describes the current status land use, degradation, changes in land fertility and causes, fertilizer use and productivity, irrigation related productivity, crop diversification, etc. BIDS however missed to demonstrate the cost-



effectiveness of SLM practices, which is crucial for farmer in accepting SLM. The report also did not identify any acceptable best practices.

#### Assessment of this output

- Relevance – S
- Effectiveness – MS
- Efficiency – MS
- Overall rating - MS

#### Sustainability risk of this output

- Financial – L
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - L

### **3.3.4 Outcome 4 : Human capacity developed for local level institutional coordination and advocacy on SLM**

#### Brief overview

A diploma course on SLM knowledge and tools has been organized and conducted by the Geography Department of University of Dhaka to train relevant government officials to combat land degradation. The department has planned to continue this course and include some of the courses into their M Sc. degree curriculum.

BIDS has developed training modules on Environmental Impact Assessment (EIA) and SEA of natural resource management and the training conducted for government and NGO officials. BIDS did not arrange the workshops for policy makers on the use of economic instrument in decision making for SLM – no evidence found. They have conducted a training on application of Natural Resource Accounting (NRA) in local land use planning. However this activity is not included in the deliverables of BIDS.

Effective training materials have been prepared by Department of Agricultural Extension (DAE) on SLM and conducted ToT for field level staff. Training included production of organic manures to conserve soil productivity among other topics. Quality campaign materials have been developed by Agricultural Information Service (AIS) to enlighten general people and decision makers, community leaders and farmers on SLM. TV and radio talk show, publication of video documentary, workshops etc. have been organized successfully. AIS may be considered as one of the potential partner in future endeavors on SLM, specially on the areas of raising peoples awareness at different levels from policy makers to managers to farmers and other users.

Barind Multipurpose Development Authority (BMDA) effectively demonstrated SLM pilots at the field level through the use of irrigation, rainwater harvesting, composting, crop diversification, plantlets production from tissue culture in the Barind tract. They also

enhanced awareness on SLM through workshops, trainings and focus group discussions. SLMP successfully added on to previous SEMP outcomes. Excellent ownership and sustainability of project outcomes observed. However poor farmers are suffering from lack of marketing and storage facilities and credit support for producing vegetable crops. They also noted that SLM is not much beneficial for sharecropper with less than 3 years tenancy. Soil Resource Development Institute (SRDI) successfully demonstrated SLM advantages over local agricultural practices in 7 areas of the country. It proved that with SLM practice in agriculture they can produce 15% more crop compared to their local practices. But it seems that demonstration in many more areas with intensive effort could give extension worker a confidence to take it to the farmers. SRDI also piloted use of geotextile to stop hill slope erosion and successfully demonstrated in 2 places. This initiative also needs more demonstration before recommending.

#### Detail activities

Four outputs were prescribed to address this outcome. Six different organizations performed activities under these outputs.

#### **3.3.4.1 Capacity of local advisory and decision-making institutions enhanced**

Two activities are assigned for this output but one is not listed in the original project document. (a) Organise training workshop on SLM for relevant officials through a Diploma course(DU); (b) Develop a manual for Sustainable Land Management (PMU).

Geography Department, Dhaka University developed a 15 credit diploma program and training materials and trained 30 relevant officials from Government and other organizations on SLM. However, no report was available.

PMU assigned a consultant from Department of Geography, Dhaka University to develop a Manual for SLM. A draft version was available which requires further restructuring, editing and rewriting.

There are two possibilities of ensuring sustainability of this output. One is to include this as a regular diploma program of the Dhaka University or make the subject available as a 15 credit optional under regular degree/diploma in Geography program of the University.

#### Assessment of this output

- Relevance – S
- Effectiveness – MS
- Efficiency – MS
- Overall rating - MS

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating – ML

#### **3.3.4.2 Capacity development through training and demonstration of valuation of ecosystem services and use of economic instruments and strengthening EIA process**

Three activities were included under this output and all were assigned to one implementer (a) Develop a training modules on EIA, SEA and valuation of natural resources with organization of training workshops for senior technical officials in DoE and others (BIDS); (b) Organise training workshops on valuation of ecosystem services, natural resources and on the use of economic instruments in decision-making (BIDS); (c) Training of participants in a pilot project on the application of NRA in local land use planning and resource management (BIDS).

BIDS developed training modules on EIA for SLM and held workshops for relevant officials with an overall objective of training mid/below-mid level officials from relevant ministries to have a better understanding of cost-effectiveness of SLM.

There was no evidence that BIDS performed second activity – training on the valuation of ecosystem services.

BIDS also trained mid/below-mid level officials from relevant ministries and other organizations to have a better understanding of natural resource accounting (NRA) practices and identify the environmental/economic reasons and/or constraints for adoption of NRA.

Although, these trainings have enhanced knowledge base of officials but the real applications may not happen since SLM needs to be accepted and implemented by the authority and the farmers.

#### Assessment of this output

- Relevance – S
- Effectiveness – MS
- Efficiency – MU
- Overall rating - MS

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – ML

- Institutional – ML
- Environmental – U
- Overall rating – ML

#### **3.3.4.3 Dissemination of best practices and technologies on sustainable land management**

Two activities are listed under this output (1) Develop training materials and conduct training of trainers program targeting the field staff, women groups, farmers etc on production of organic manures, conservation of soil productivity, etc at selected Upazila level for community based natural resource management (DAE); (b) Disseminate best practice materials on SLM to farmers and community leaders by workshops, field visits, etc (AIS).

DAE produced excellent training materials and conducted very successfully a two-day long training of trainers (ToT) targeting field staff. Training included production of organic manures and conservation of soil health. However, it was reported that SLM is not an attractive investment for share croppers with less than 3 years of tenancy.

AIS developed very attractive campaign materials to enlighten farmers, community leaders and general public on SLM through publications, Radio and TV documentary, community workshops, demonstration, WEBSites, SKYPE chatting with farmers, etc.

##### Assessment of this output

- Relevance – S
- Effectiveness – S
- Efficiency – S
- Overall rating - S

##### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating - ML

#### **3.3.4.4 Capacity building for local level coordination between institutions and advocacy on SLM through pilot field demonstration projects**

Two activities were selected to achieve this output: (a) Organise pilot demonstration and training on SLM on technology innovation, innovative crop diversification in the Barind Tract with provision of adequate training in institutions of other Asian countries (BMDA); (b)

Organise pilot demonstration and training on enhanced soil conservation methods and technology innovation in selected Agro-ecological Zones (AEZ).

BMDA effectively demonstrated SLM pilots at the field level through the use of irrigation, rain water harvesting, composting, crop diversification, sapling and tissue culture in the Barind tract. They also enhanced awareness on SLM through workshops, trainings and focus group discussions. SLMP successfully added on to previous SEMP outcomes. Excellent ownership and sustainability of project outcomes. However, poor farmers are suffering from lack of marketing, storage and credit support for producing vegetable type of commodities. They also noted that SLM is not beneficial for share croppers with less than 3 year tenancy.

SRDI demonstrated through pilots the advantage of SLM over traditional agricultural practices by the farmers. They did pilots with farmers with an arrangement that SRDI will use half of the selected agricultural land for SLM friendly cultivation while the other half the farmer will cultivate in the traditional way. The comparative result demonstrated to the farmers in selected plots around Bangladesh that following SLM approach of inputs they can produce 15% more than the traditional practice. SRDI also tried Geo-textile in Hill Tract areas to rehabilitate degraded sloping land. The Geo-textile was helpful in improving the soil condition.

As can be seen, the ownership at the implementation level works better and sustainability of the output is ensured.

#### Assessment of this output

- Relevance – S
- Effectiveness – S
- Efficiency – S
- Overall rating - S

#### Sustainability risk of this output

- Financial – MU
- Sociopolitical – U
- Institutional – U
- Environmental – U
- Overall rating – MU

### **3.3.5 Outcome 5 : Resources mobilized for implementation of the National Land Use Policy, other relevant policies, plans, programs and projects on SLM**

#### Brief overview

Original outputs in the ProDoc were replaced by several deliverables and only a high-level sensitization meeting was held and a website developed.

#### Detail activities

There were four outputs identified for this outcome and six activities represented these outputs in the original project document. However everything was replaced by several deliverables that do not relate to the original outcomes. It seems deliverables have been decided later but was not harmonized with the original document.

Following six deliverables are listed in the “Implementing Agency” document.

- Arrangement of high level sensitisation workshop/round table discussion for policy makers to include SLM in national development planning (PMU)
- Policy recommendation for capacity enhancement and promoting coordination and synergies among relevant institution and agencies. (PMU)
- Multisectoral Action Plan developed for implementation of the National Land Use policy (PMU)
- Website on SLM launched and regularly updated. (PMU)
- Draft proposal on multi-year SLM program submitted for approval (PMU)
- Draft proposal on implementation of Land Zoning Law and capacity development submitted approval (PMU)

PMU arranged a high level sensitization meeting with policy makers to discuss SLM and also developed a website for information on SLM. Except these two there is no evidence of other deliverables/activities.

#### Assessment of this output

- Relevance – MU
- Effectiveness – HU
- Efficiency – HU
- Overall rating - HU

#### Sustainability risk of this output

- Financial – ML
- Sociopolitical – U
- Institutional – L
- Environmental – U
- Overall rating – L

### **3.3.6 Attainment of objectives and their sustainability**

As specified in the Project document the objective of this project is to establish a sustainable land management system to achieve long-term viability of land and water resources in Bangladesh. To achieve this objective, five outcomes were targeted focusing on mainstreaming SLM at the decision-making level, strengthening capacity at the institution level, enhancing SLM knowledge base, enabling the implementing professionals and mobilizing resources for implementation of SLM.

While the targeted outcomes are all relevant but given the socio-political scenario and institutional bureaucracy in Bangladesh the design has to be more strategic. While policy tools are important, they are going to take a long time to get accepted by the Government and the society. And again, policies are less effective in a developing country like Bangladesh. Similarly, institutional reform is also long-time process in a developing country.

Therefore, outcomes 1 and 2 may not achieve much and their sustainability beyond the project duration is highly doubtful and this is a common scenario for many projects in developing countries. SLM knowledge management system and R&D for knowledge may have moderate success and will continue may be on a slow pace depending on the availability of funding. The ownership at the implementation level were good and so Outcome 4 (to develop human capacity for local level institutional coordination and advocacy on SLM) may have the best possible achievement.

Based on the results, the following can be concluded:

- The context of the SLMP implementation is appropriate
- However, realization of the outcomes has not been very successful
- Land Zoning model is yet to be formulated
- While Land Zoning Law and Village Improvement Act have been drafted and they are relevant, they may be socio-politically sensitive and acceptance by the society and the authority is doubtful at this moment
- Detail of the GIS database is yet to be documented
- Mainstreaming of SLM did not have lot of success
- A agricultural land protection law (modified Land Zoning Law) is awaiting parliamentary approval
- Activities of the project has contributed towards capacity development for SLM

### 3.3.7 Meetings with Partners

#### Center for Urban Studies (CUS)

CUS was given the responsibility to prepare a land zoning model and study and reporting on the Land Zoning and Environmental Degradation of Palas and Tangail Sadar Upazilas. Finally they are to conduct a workshop on their findings and come up with recommendations. They have submitted the draft report on the Sustainable Land Management and Land Zoning and Environmental Degradation of Palas and Tangail Sadar Upazilas.

During discussion with Dr. Nazem of CUS, he mentioned that the land use in Bangladesh generally could be divided into 4 categories:

- Human Settlements
- Agriculture
- Forests
- Wetlands

Further sub-classification can be done to specify each of the broad categories. Dr. Nazem mentioned that in Bangladesh most cities/towns specially district and sub-district towns are under bounded; except Dhaka and Chittagong cities. So there is opportunity to bring these cities under proper planning and management if initiative is taken soon. For the over bounded cities planning is difficult.

He mentioned that political commitment remains a challenge for implementation of land use planning and sustainable management. He stressed that a National Planning Act is urgently needed.

CUS submitted a draft report titled 'Sustainable Land Management and Land Use Zoning in Palas and Tangail Sadar Upazilas' has been submitted. The report is focused on land use change of Palash Upazilla, Narsingdi. The report has two objectives. First one is land use survey and development of Land Information System; the second one is Poor's Access to Land. The report describes Palash upazila profile consisting of physical and human environment, land level, flood/inundation level, soil texture, water bodies, climate, and human environment.

The methodology and the steps followed like secondary data collection, Base Map preparation, land use survey using satellite image for 2003 and 2010, spatial overlay process, socio-economic survey, interviews, and data analysis are also detailed in the report. Three Mauzas of Palas Upazila of Narsingdi namely Khanepur, Danga and Majherchar are captured in this study.

Major findings of the Study presented in the report are Mauza based. In Danga Mauza, the changing pattern of land use from Agriculture to Settlement in 2003 to 2010 is dramatic. In 2003, Agriculture was found to be the dominant user of land, which covered 57.72% of total land area (45.33 acres). But in 2010, agricultural land decreased to 25.76% (20.23 acres) to settlement to accommodate the rapidly growing population. In Khanepur Mauza, similar kind of land use change is found that 50% of the agricultural land converted to settlement from 2003 to 2010. In Majherchar mauza, a large portion of agricultural land (about three fourth) altered for residential use. The report also contains the socio-economic information such as demographic, educational, economic activities, migration characteristics of this upazila.



Environmental issues also highlighted slightly in this report and found that flood is the major disaster threat of Palash upzila.

The major categories of land use identified by the study area were agriculture, residential, commercial, industrial, institutional, transport and communication. Besides, there are water bodies, vegetation and fallow land too. These are in fact very common type of land use, can be found in all areas of the country.

- To serve the purpose of land administration, land management, landuse planning and environmental protection, etc a Land Use Classification/Zoning system based on four broad classes has been developed.
- This survey on land use was done only on two study areas and as such may have failed to capture the variety of land uses that may exist around Bangladesh. This is important for the development of the conceptual framework for land use zoning.
- A 4-tier landuse classification seems adequate design for the landuse database
- The study demonstrated the conversion from agri to urban by change detection. This is an important finding and is an important issue for land use management. However, the study did not map the sub-categories of agricultural landuse (by cropping intensity, variety, etc) which may be important in implementing the landuse zoning.
- The database should be able to provide information to high-light SLM features in the land (identify the good productive agricultural land, environmentally vulnerable land) so that the problems can be identified and addressed.

### **Geography Department, University of Dhaka**

Under outcome 4 the Geography Department, DU developed training materials and module targeting Government officials with the objective to enhance their capacity on SLM. They have conducted the training for 34 government officials in two batches. The participants highly appreciated the course contents and recommended to continue the course as a diploma program, so that it adds value to their professional qualification. The department is considering to include SLM in their regular Masters Degree curriculum.

A draft SLM manual was also drafted by a consultant from Geography department but it requires further restructuring, editing and rewriting to be useful.

### **Bangladesh Agriculture Research Council (BARC)**

Bangladesh Agriculture Research Council was given the responsibility to assess the information related capacity need of technical and research organizations and develop an active pilot information net work on land degradation and sustainable management issues under outcome 3.

Accordingly they have organized 2 scientific workshops of the researcher, scientists and officials of relevant agencies and published the proceedings. There were 23 scientific papers presented in the workshops on sustainable agricultural practices, which is a key issue to

protect land degradation at the same time enhance crop production. Objectives of the workshop were to share available information, awareness raising of the stakeholders on the importance of sustainable land management at the same time offer them with some tested options. Each of the workshop proceedings have separate section for compiled recommendations, but those are generalized, not much specific.

During discussion with the focal persons they informed that there are researches going on to find out solutions for sustainable land management through agricultural practices, climate change adaptation etc. At the same time they informed that there is no scientific based scenario drawn on Bangladesh by any agency for future situation. So targeting is difficult.

There are heat and saline tolerant rice varieties, different agricultural techniques invented for sustainability and also to adapt with changing climate variables and impacts.

### **Agricultural Information Services (AIS)**

AIS was partnered for advocacy and awareness raising activities at different levels under outcome 4. They have organized 3 workshops, one at Dhaka and others at divisional levels in participation of policy makers, senior government officials, journalists, researchers, extension workers etc. They arranged 2 TV talk shows, where Members of Parliament and senior government officials took part. But AIS did not document the discussions or any decisions made. They also prepared 3 docu-features for awareness raising of the mass.

AIS was found to be a very effective organization specialized in communicate with people for awareness raising and consensus building from national to community levels.

### **Soil Resource Development Institute (SRDI)**

SRDI was partnered to implement activities under outcome 4; specifically demonstrate application of balanced fertilizer for agricultural production based on soil test value in 7 demo plots countrywide, demo on rehabilitation of degraded sloping land by Geo-tex/Jute-tex in 2 demo plots in hill tracts area and conduct 9 focus group discussions with farmers in 9 selected field sites. Through their demonstrations in farmer's plots along with the farmers they have proved that it is possible to enhance 15 – 25% benefit through SLM practices – which is a promising finding to popularize SLM.

They have not submitted any report so far. During discussion with the focal person it was informed that they have conducted balanced fertilizer use demos and the focus group discussions. They also successfully did a demo with the use of Jute-tex to protect degraded sloping in hill tract areas.

### **Bangladesh Institute of Development Studies (BIDS)**

BIDS was the major partner of SLMP. They were contracted to implement activities under outcomes 1, 2, 3 and 4. They have submitted one report on “Sustainable Land Management in Bangladesh: Issues, Constraints and Potentials” and four other small reports. Overall objective of the study is to provide an understanding of cost-effectiveness of SLM practices and identify the main economic reasons and/or constraints for adoption of SLM measures and provide policy recommendations in choosing investment alternatives by the farmers. The report covered assessment of land availability, use pattern, degradation, quality, causes of

degradation, irrigation and fertility. Institutional coordination mechanism also discussed in the report including policy implications and opportunities. One of the important recommendations of the study is to use economic instruments to support SLM.

MoEF may take initiative to convince MoA and MoL to include the policy recommendations into relevant policies.

### **Department of Agricultural Extension (DAE)**

The DAE was given the responsibility to develop a Training of Trainers (ToT) module for field staff and community leaders on production of organic manures, conserve soil biomass for productivity, soil conservation and mitigation measures against degradation of agricultural land.

They have prepared and printed the ToT module in Bangla and conducted the ToTs. The contents of the module will be very useful for the DAE officials to support the farmers to conserve and improve the quality of their agricultural land.

During discussion with the focal person at DAE informed that some of the issues of present agriculture are anti SLM. Such as due to absentee landowner, the sharecropper or land leaseholder does not pay attention to maintain soil quality for long-term sustainability of agricultural production. He tries to extract from the land as much as possible within one year or within his contract period without investing. Contract with sharecropper may be for longer period so that he also takes care of the land. He suggested the owner also should have some responsibility to maintain soil health of his land. He also mentioned that conversion of agricultural land to other use should be strictly dealt with.

### **Barind Multipurpose Development Authority (BMDA)**

Visited BMDA activities at Rajshahi and Chapainobabganj during 23 – 24 May 2012. BMDA was found to be very promising organization to popularize SLM in the barind areas where it is very important. They have implemented all the activities as was planned except introducing date-palm propagated through tissue culture as finally the protocol for this was not possible to collect by them from UAE. The irrigation facilities for vegetable cultivation and supply of drinking water were visited at Zhilim Union, Chapainobabganj. During discussion with farmers and few water users it was found that the facilities created are useful for them. The tissue culture lab established with support from SLMP was in operation to propagate potato plantlets; they are distributing these potato plantlets in a lower price to the farmers.

BMDA also implemented a component for irrigation facilities from the River Padma under SEMP, which they have enhanced and is well maintained.

The comparative cost of agricultural production of barind area may be studied to determine whether barind area is good for agricultural production area or the area may be used for other purposes, may be for industries.

### **Water Resources Planning Organization (WARPO)**

It was not possible to meet with focal person of WARPO due to his absence during the TE mission. But the draft report based on their study submitted by WARPO titled “Assessment of

the Extent of Degradation of Water, Wetland Ecosystem and Identification of Possible Remedies of Wetland Degradation” was reviewed.

The study focused on two major objectives: status of wetland degradation, causes and possible remedial measures. The study area was considered the DAP area of Dhaka city.

The assessment has done based on inventory of wetlands analyzing satellite imageries and validation through field visits. The analysis includes time series to identify wetlands with satellite images between 1967 and 2010. The analysis identified historical and present status of wetlands, causes of wetland degradation and find out possible remedial measures.

The situation of wetlands in the report reveals that the permanent wetlands in 1967 was 14.4% whereas in 1999 it was decreased to 4.4% and in 2010 it was 3.8%. Similarly, seasonal wetlands in 1996 were 28.7%, which decreased to 21.7% in 2009.

The report highlights two major reasons for wetland degradation. The first one is increase of land value over last few decades with the increase of population that resulted in rapid filling up of wetlands. Secondly, loss of connectivity of flood plains within the DAP area due to the construction of flood protection embankments.

The report suggests few remedial measures for the restoration of wetlands. One is the establishment of connectivity between the land and the floodplain. Another is appropriate and adequate design of water management structures. Appropriate zoning and appropriate legislation also suggested as remedial measures for wetland protection in this report.

### **Coastal Land Zoning Project (MOL, GOB)**

Although not a officially contracted for any task, the TE Team also met with Mr. Abdul Halim Mia, Team Leader and Chief Technical Expert, Coastal Land Zoning Project (1<sup>st</sup> phase), Ministry of Land. He mentioned that for sustainable land management land zoning is very important, at the same time he raised some crucial issues those are also very important to address to get any success in land resource management. These are:

1. Population control
2. Political commitment
3. Planned urbanization
4. Policy, incentives and motivation for centralized rural township/centers

Implementation/enforcement of any plan, policy or law is not possible without firm political commitment. This project of the MoL has supported SLMP by assisting the formulation of the Land Zoning Law and Village Improvement Act and pursuing the Government to provide protection to good agricultural land.

SLMP ProDoc identified MoL and DLRS as potential stakeholders but there were no formal collaboration of the project established with the Ministry of Land (MoL), DLRS or with the Coastal Land Zoning Project of the MoL. SLMP was requested by the MoL to draft Land Zoning Law and Village Improvement Act, but after drafting those were not taken into account by MoL.

On the other hand it was within the mandate of the Coastal Land Zoning Project to draft Land Zoning Law and Village Improvement Act, and they drafted both. During discussion with the Coastal Land Zoning Project it was informed that the fate of the law and act is uncertain.

The Coastal Land Zoning Project also prepared Upazila wise digital land zoning maps compiling Union wise land use maps. This seems to be a duplication of work as SLMP is also working on land zoning. And there are similarities in the objectives of both the projects.

#### **4.0 Conclusions**

Sustainable Land Management, as explained by FAO, is a complex and challenging concept and needs to be addressed scientifically.

The SLM needs to be analysed in terms of the realities in Bangladesh and come out with the priority needs translated into an operational definitions rather prescribing generic solutions. The first and foremost is to identify the causes of major threats to land and set priorities. Next step is to device methodologies and establish necessary database to measure the extent of land degradation and identify the most vulnerable areas (hot spots) systematically and scientifically. And then develop methodologies addressing the problems specific to those vulnerable areas. Project needs to be realistic in terms of what is achievable and be strategic in setting short-term and long-term targets.

The project did not have a very successful outcome except generating good awareness amongst decision-makers, professionals and the general public. However there are good feedback and lessons that may help guide future directions towards achieving a sustainable land management system in Bangladesh. Given the challenge of supporting a huge population in a small land, that objective is of paramount importance.

#### **4.1 Strengths, weaknesses and lessons**

Following are some of the notable strengths, weaknesses, and lessons:

##### **STRENGTH**

- A Land Zoning Law and a Village Improvement Act have been drafted though a consultative process amongst stakeholders to support SLM
- A replicable Land Use classification system has been developed
- A Natural Resource Accounting tool was developed to support SLM based agriculture using economic instruments to influence input options

- Excellent awareness has been achieved for SLM amongst decision makers, professionals and general public through meetings, workshops, field-trainings, and national media presentations.
- Critical loss of wetlands around Dhaka city have been identified through scientific research and remedies suggested
- A diploma course on SLM has been established at the Dhaka university to train relevant officials.
- Successful pilot demonstration of SLM has been carried out in the Barind tract by BMDA Targeting landless and marginalized population. These pilots have addressed crop diversification, irrigation, social forestation, conservation of soil health and SLM based agriculture. This project has effectively linked the previous UNDP/SEMP outcomes and achieved sustainability requiring no further financial support.
- Successful demonstration of SLM-based agriculture producing more than the traditional practices and thus ensuring economic viability of SLM approach.
- Effective ownership achievable at the field-level departments of the Government.
- SRDI (MoA) Website providing on-line support to farmers on fertiliser use to achieve SLM

### Weakness

- Administrative support has suffered due to continuing staffing problem specifically in the PMU.
- Project monitoring and evaluation plan was not implemented and this may have affected the achievements of this project
- Validity of the risks measures were flawed.
- Ownership in the Government has been very weak and MoEF did not feel comfortable in performing as the main executing authority. MoL did not participate except in the beginning.
- No evidence of collaboration amongst projects noted in the project document
- Project has severely suffered from minimum time given and guidance from NPD
- Inadequate credit support from banking services has affected poor farmers

- Inadequate marketing facilities has restricted economic viability of poor farmers
- Inadequate storage facilities for vegetable type commodities has discouraged agricultural diversification
- Project document is too verbose and not adequately focused and does not link well the goals/objectives, outcomes, outputs, activities and deliverables. This has also affected the outputs.
- Completion of activities and timely delivery of reports by different partners has been a serious problem. A few have submitted a scanty report and some have not submitted at all though they have been paid in full.

### Lessons

- Policy formulation relating to land is a difficult and time consuming task. Because of socio-political implications, Government becomes hesitant to accept changes to existing law relating to land. So, there is lack of political commitment to establish Land Zoning Law and Village Improve Act to ensure protection of agricultural Land.
- Institutional reform in developing countries is difficult and time-consuming.
- Project has better chance of sustainability if ownership can be achieved at the implementation levels of the Government.
- SLM is not an attractive investment for share croppers with less than 3 years of tenancy
- If administered appropriately, SLM approach can be a economically viable option for the farmer.
- Dispute on land ownership and forgery may constraint reaching the target people in the rural area
- Incentives may help suitable crop rotation and other SLM measures. Use of inputs may be influenced by economic instruments (subsidies, taxes, price stabilising, etc) . This may also be used to promote efficient tenure system.
- Agricultural productivity varies significantly depending on the use of inputs.
- Need to know optimal mix of inputs for production of different crops in different agro-ecological zones

- NRA is difficult to calculate because data on the price of land according its usage are not available
- Online fertiliser recommendation system developed by SRDI (MoA) is very useful and cost-effective
- Finally, except a few cases, the sustainability of the project outcomes beyond the project duration is doubtful.

## **4.2 Recommendations**

The project could have taken note of the threats to land and take a strategic approach in terms of what is effectively achievable considering socio-political implications relating to land in Bangladesh.

The SLMP can be concluded as a successful awareness raising project. In order to further the drive for sustainable land management in Bangladesh, a future follow-up project may consider the following:

### Broad Issues

- An environmentalist has a long-term view and environmental sustainability is the first priority. But to a farmer, the first priority is the immediate economic sustainability. Same is true for the political Government in a poor country. So, there is a need to have a balance between the economic and environmental sustainability in order for the SLM to be acceptable. Project MUST demonstrate that the farmer can remain economically viable using SLM.
- Also note that Bangladesh has a huge population to feed and house and so the major cause of human-made land degradation is the population pressure. What would be the scenario in 2050 when the population will be around 240 million? How much land remains available for agriculture (0.07 acre/person by one estimate) and how much food can be produced with that available land? Should the priority be on managing the population size compatible with the carrying capacity of the land?

### Project related issues

- Project document MUST review the relevant previous projects to avoid duplications and also to IDENTIFY successes and failures so that same mistakes are not repeated. If there are more than one agencies working in related areas, rather than competing and working in parallel, it may be better to form a basket fund and administered through a consortium to address the problem in a more holistic and integrated way. Many international agencies work in isolation creating further confusion in the already disorganized government administration in a developing country.



- Validity of the risk factors, specifically relating to policy formulation and institutional reforms must be properly evaluated.
- While policy formulation is an important tool, it is less effective in developing countries and usually they live in book shelves like a 'poetry book for the poor'. Many of these books are in fact a literary exercise to create something out of nothing. The priority should rather be given for strategic projects that will implement changes on the ground to improve the livelihood for the poor.
- A systematic scientific study of land degradation in Bangladesh may be carried out to identify hot spot areas of vulnerability. As a prerequisite, a national mouza-wise database may be created with soil characteristics adequate for advanced crop modeling systems incorporating the SLM. Also, climate data needed at the union level to support this modeling exercise.

The project could have approached the land degradation in a more logical way and vulnerability may have been classified into human-made and nature-made.

#### Human-made threats

- Human-made threats in Bangladesh is mostly due to population pressure (conversion of agricultural land to Urban/rural settlements, overuse, loss of wetland/forestland) and can be reduced by increasing the housing density in the urban and rural areas. Rural Settlement centres may be provided with schools, health centres, etc to encourage people to live. So, project should put efforts to target this outcome. Conversion of land to settlements can also be controlled by urban and rural local governments using the Land Zoning/ agriculture protection law and Village Improvement act or just using the town planning act.
- Sustainable use of agricultural land can be encouraged and administered effectively through strengthening of the Agricultural Extension Service centres of the MoA. A training institute may be established to train the extension service officers in SLM.
- Protection and management of Wetlands and Forestland may be managed establishing special regional management authorities within respective ministries.

#### Natural threats

- Threats due to climate change and other natural calamities needs to be addressed separately considering its scale and implications. A systematic scientific study should

be done to study the effect of climate change on agriculture coupling IPCC model (downscaled for Bangladesh) and advanced crop modeling system.

- Sea Level Rise (SLR) due to climate change has been studied by CEGIS under SEMP/UNDP showing the effect of SLR and salinity in the coastal zone.
- Another project “Community Based Adaptation to Climate Change through Coastal Afforestation in Bangladesh” by UNDP is also addressing the SLR problem
- MoL, GoB also did a project on Coastal Land Zoning
- All these projects need to be reviewed and considered for developing an integrated approach to address the coastal area problems.

### Project Specific

- OWNERSHIP is an important issue for a project to become successful. Ownership may be targeted at two levels: (a) at the top decision-making level for appreciation and approval of the project and policy formulation and (b) at the field level for project implementation. Note that the sustainability of the project outcomes depend much on achieving effective ownership at the field level through which actual implementation is done.
- SUSTAINABILITY of the project outcomes is a continuing problem for projects in developing countries. In most cases the sustainability ends with the end of the project funding. This is a common problem of the short-sighted project-based programs. So the challenge is to have a long-term view of development and find a proper ownership in a holistic program of the country. Effective ownership may be provided for SLMP by the Agricultural Extension Service centres (MoA) for protection against degradation of agricultural land, Urban Local Government for controlling conversion of land to urban land use, Rural Local Government for controlling conversion of land to rural settlement, Wetland Management authority for Wetlands and Forestland Management authority for forest lands management.
- Lack of marketing facilities has been identified as a major barrier for the poor farmers to improve their profitability. Project needs to address this issue in order to achieve better acceptance of SLM by poor farmers.
- Soil Resources Development Institute needs to be strengthened to be able to develop advanced soil database .
- As demonstrated in SLMP that SLM based fertiliser use can increase agricultural production by up to 15%, pilots may established around the

country to demonstrate and make it a popular option for replication by farmers.

- Large farmers should be encouraged to cultivate land maintaining organic matter around 3% and Government support should be extended to poor farmers in this regard.
- SLM needs to have an operational definition through development of necessary methodologies and supporting bio-physical and socio-economic database. A SLM model for each crop for each AEZ may be developed and made available through SRDI website and the field application administered through DAE. THIS SHOULD BE A PRIORITY TARGET OF A SLM PROJECT.

**In summary, the focus should be to strengthen the following implementing organizations:**

- **AEZ** for administering SLM approach to agriculture
- **BARC** and **SRDI** to research and develop appropriate SLM methodologies for agriculture and supporting database
- **National Wetland and Forestry authorities** for sustainable management of wetlands and forests
- **Urban local government** to help stop conversion of good agricultural land to urban use and also to increase urban housing density
- **Rural local government** to help stop conversion of good agricultural land to settlement and also to develop higher density rural settlement centres.

#### **4.3 A project proposal for furthering SLM in Bangladesh**

The sustainable land management will be further complicated by the climate change and therefore any future project must consider the effects of climate change. There is a need for a systematic scientific study to address the following three important components that are prerequisite to achieve sustainable land management in Bangladesh:

- a) Development of SLM methodologies and supporting bio-physical and socio-economic database
- b) Identification of the vulnerable areas (hot spots) of land degradation
- c) SLM model for each crop in various AEZs in Bangladesh
- d) Effect of climate change on the sustainability of agricultural land use

A concept proposal addressing these issues is given in appendix 7. A detail project proposal with budget requirements may be submitted on a formal request.



## **Terms of Reference (TOR)**

for

**International Consultant** (land degradation and desertification, biodiversity and natural resources management Including Policy and Institutional Aspects) for SLMP Terminal Evaluation

### **1. TERMS OF REFERENCE (TOR):**

#### ***Objectives:***

The objective of the assignment is to conduct the terminal evaluation of Capacity Building and Resource Mobilization For Sustainable Land Management (Eco-System Management) In Bangladesh (SLMP) (BGD/05/G04). This will follow the monitoring and evaluation (M&E) policy at the project level in UNDP (United Nations Development Programme)/GEF (Global Environment Facility). According to the UNDP/GEF M&E policies and procedures, all projects are mandatorily to conduct a terminal evaluation at the end of the project. In addition to providing an independent in-depth review of implementation progress, these types of evaluations are responsible to GEF Council decisions on transparency and better access to information.

The Capacity Building and Resource Mobilization for Sustainable Land Management (Eco-System Management) in Bangladesh (SLMP) (BGD/05/G04) has been implemented by the Ministry of Environment and Forests (MoEF), Bangladesh during August 2008 to March 2012. The project was funded by UNDP-GEF and Bangladesh Government. The goal of the project was - to strengthen the enabling environment and capacity for SLM while ensuring broad-based political and participatory support for the process.

Terminal evaluations are intended to identify potential project design problems, assess progress towards the achievement of objectives, impacts, identify and document lessons learned (including lessons that might improve design and implementation of other/future UNDP/GEF projects). It is expected to serve as a means of validation or filling the gaps in the initial assessment of relevance, effectiveness and efficiency obtained from monitoring. The terminal evaluation provides the opportunity to assess project success or failure and accumulates necessary learning for future projects.

## ***Background:***

**Land is a scarce resource in Bangladesh that has a direct link to country's food security, economic growth and overall national development. The per capita availability of land is diminishing with the increase in population. Unsustainable agricultural practices are causing long-term productivity losses and deterioration of the soil quality and health. Accumulation of pollutants in the terrestrial and aquatic ecosystems, sand deposition, riverbank erosion, biodiversity loss is also causing land and wet land degradation. In addition to unplanned industrial, commercial and infrastructural development, a high rate of urban expansion and encroachment of other settlements into agricultural land, forestland and wetlands, are also reducing the land and water resource pool to meet future needs.**

Land degradation results in diminished land-based livelihood opportunities, above all, farming, Bangladesh's leading economic activity. Furthermore, it induces emigration of rural youth, which exacerbates poverty and undermines economic improvement capacity in rural communities by depriving communities of the energetic youth required for sustainable development of land resources.

Bangladesh's landscape is susceptible to soil erosion, landslides, and seasonal floods partly due to natural factors such as steep terrain, fragile geologic conditions and heavy rainfall. These in combination with anthropogenic factors triggered by population pressure on the limited cultivable and grazing lands cause land degradation problems in Bangladesh. With ever rising population size, addressing land degradation issues is an important priority of the government and that the importance of the Sustainable Land Management (SLM) should not be allowed to be overshadowed by other developmental needs.

Based on the above facts, the Ministry of Environment and Forest has been implementing the project "Capacity Development and Resource Mobilization for Sustainable Land Management (Eco-System Management) in Bangladesh (SLMP)", financed by UNDP/GEF, and co-implemented by Ministry of Land, Ministry of Agriculture and a number of relevant Government departments and agencies. The project offers a unique combination of an array of many dimensional and multi-ministerial activities, including capacity building and knowledge management, so that the agricultural, forest and other terrestrial land uses of Bangladesh are sustainable, with productive systems that maintain eco-system productivity and ecological functions while contributing directly to the environmental, economic and social well being of the country.

The SLM project focuses primarily on capacity development and mainstreaming activities as they relate to the implementation and enforcement of the Government's National Land Use Policy from the eco-system based approach. This project is expected to place considerable emphasis on developing and sharing best practice and integrating them into

the day-to-day management as well as long term planning in land resources management in Bangladesh.

SLMP embodies five (05) main outcomes:

- SLM mainstreamed in related policies, institutions and legislation
- Institutions strengthened and capacity developed for implementation of the National Land Use Policy
- Enhanced SLM knowledge management and R & D systems in place
- SLM demonstrated through pilot projects at the local level
- Resources mobilized for mainstreaming SLM

It should be mentioned that for the period about three years the project has experienced lack of professional human resources and institutional memory. The project also suffered due to delay in approval of project revisions. Number of rotations in the senior level management had lead to the decreasing of overall efficiency of the project implementation and had influenced severely the achievement of the projects results.

### ***Scope of work and expected outputs/deliverables:***

The main output of the assignment will be a terminal evaluation report with recommendations presented. The evaluation must provide a comprehensive and systematic analysis of the performances of the project by assessing its design, process of implementation, achievements and impacts vis-à-vis project objectives.

The terminal evaluation will take stock of SLMP project achievements over the period from inception on 10 August 2008 to 31 March 2012. It will review activities and analyze the extent to which their outcomes are fulfilling planned targets. The TE findings will serve as a basis for improving project performance and impacts. The evaluation will:

1. Portray the context of the SLMP implementation
2. The extent of realizing outcomes to reach set objectives of the project
3. Ascertain the soundness of the methodologies developed for 'land zoning', SLM best practices, relevance of draft 'Land Zoning Law' and 'Village Improvement Act', assess the understanding of SLM issues at the policy level and integration of SLM principles into national development plans and policies, recommend ways to enrich the agriculture land protection act using elements from the legal tools drafted by SLMP.
4. Determine the contribution of activities towards capacity development on SLM, integration of SLM activities into future development program

The Evaluation Mission will make recommendations for the future course of the project, including any adjustments or re-orientations required. Detailed proposal will be made for:

The future plan, including recommendations regarding replication and exit strategies;

The need and potential for expanding project activities and a set of criteria for selecting the areas for future expansion that may be supported by government and/or by other development partners; as GEF resources can not be used for replication; and

Additional support to the project, if any.

Focus should be on relevance, effectiveness, and efficiency of the project results; sustainability of project outcomes; adequacy of monitoring and evaluation system while recording measures or implementation strategies that are “good lessons”, or “bad lessons” so that the later is addressed in future initiatives. In such case, the Mission should also provide remedial measures/recommendations. They should provide a broader basis of generic steps if any.

#### **Deliverables:**

Three main deliverables are expected from the Evaluation Team for which the International Consultant will mainly be responsible. These are:

1. To prepare a presentation to key stakeholders on preliminary findings at the end of the stakeholders’ consultations and field-based evaluation period;
2. To prepare a comprehensive Terminal Evaluation Report conclusions clearly substantiated by evidence; and
3. To prepare a comprehensive road map to include the next phase of SLM in the upcoming UNDP intervention that will cover the land degradation and desertification activities under the programme.

#### **Duration of Assignment and Duty Station:**

##### **Duration:**

International Consultant (2 weeks)

**One Week** for plan presentation, finalization, discussion with stakeholders and field visit;

**One Week** for report preparation and findings presentation.

During the evaluation process the consultant will be stationed at UNDP CO or SLMP Office at DoE, Dhaka besides field visits.

#### **Supervision and Performance Evaluation**

The consultant will work closely with the UNDP, CO, Bangladesh, specifically with the Environment Cluster, GEF Regional Office and Ministry of Environment and Forests. The main contact person in the UNDP CO will be the ACD, Environment, Climate Change Mitigation and Energy. The ACD will review the progress and deliverables and undertake actions to ensure quality and timely implementation of the tasks.

**Timeframe and deadlines:**

Activity	Time
a. Evaluation plan presentation, finalization, discussion with stakeholders and field visit;	7 days
b. Draft report preparation and findings presentation to the stakeholders	4 days
c. Report finalization along with recommendations and submission	3 days
<b>Total</b>	<b>14 days</b>

**2. REQUIREMENTS FOR EXPERIENCE AND QUALIFICATIONS****I. Academic Qualifications:**

The candidate should have Masters (preferably PhD) in Environmental Sciences/ Geography / Urban Planning / Ecological Sciences / Natural Resource Management / Environmental Economics or closely related fields.

**II. Years of Experience:**

The incumbent should be sufficiently competent as an evaluator with at least 10 years prior experience in managing, implementing or evaluating land degradation, desertification, land management related projects. Preferably he/she has experience in assessing the ratings for overall project outputs, outcomes and development impacts. Experience in socioeconomic analysis of the various project components and of the project as a whole is essential. Experience in Bangladesh context and familiarity with UNDP/GEF programmes would be an added advantage. Excellent proficiency in English is a must.

**III. Competencies:**

- Fluency in English
- Strong interpersonal skills with ability to work under pressure and to establish and maintain effective work relationships with people of different backgrounds;
- Ability to take initiative and to work independently, as well as part of a team;
- Proven capacity to organize and conduct terminal evaluation of similar projects;
- Excellent oral and written communication skills, reporting with ability to express ideas clearly, concisely and effectively, both orally and in writing;

**3. DOCUMENTS TO BE INCLUDED WHEN SUBMITTING THE PROPOSALS**

Interested individual consultants must submit the following documents/information to demonstrate their qualifications:



### 1. Proposal:

- (i) Explaining why you are the most suitable for the work
- (ii) Provide a brief methodology on how you will approach and conduct the work (if applicable)

### 2. Financial proposal (including fee, travel cost, DSA, and other relevant expenses)

### 3. Personal P-11 form, including past experience in similar projects and at least 3 references

## 4. FINANCIAL PROPOSAL

### **Lump sum Contracts**

The financial proposal shall specify a total lump sum amount, and payment terms around specific and measurable (qualitative and quantitative) deliverables (i.e. whether payments fall in installments or upon completion of the entire contract). Payments are based upon output, i.e. upon delivery of the services specified in the TOR. In order to assist the requesting unit in the comparison of financial proposals, the financial proposal will include a breakdown of this lump sum amount (including travel, per diems, and number of anticipated working days).

### Travel:

All envisaged travel costs must be included in the financial proposal. This includes all travel to join duty station/repatriation travel.

## 5. EVALUATION

Individual consultants will be evaluated based on the weighted scoring method, the award of the contract will be made to the individual consultant whose offer has been evaluated and determined as:

- a) responsive/compliant/acceptable, and
- b) Having received the highest score out of a pre-determined set of weighted technical and financial criteria specific to the solicitation.

Only candidates obtaining a minimum of 70% would be considered for the Financial Evaluation

Criteria	Weight	Max. Point
<u>Technical</u>	70%	70
<ul style="list-style-type: none"><li>Experience in managing, implementing or evaluating land degradation, desertification, land management</li></ul>	25%	25

related projects		
<ul style="list-style-type: none"> <li>• Experience in assessing the ratings for overall project outputs, outcomes and development impacts</li> </ul>	20%	20
<ul style="list-style-type: none"> <li>• Experience in socioeconomic analysis of the various project components and of the project</li> </ul>	15%	15
<ul style="list-style-type: none"> <li>• Experience in Bangladesh context and familiarity with UNDP/GEF programmes</li> </ul>	10%	10
<b><u>Financial</u></b>	<b>30%</b>	<b>30</b>

## **Appendix 2**

Terminal Evaluation Mission  
Capacity Building and Resource Mobilization for Sustainable Land Management  
(Ecosystem Management) in Bangladesh  
*17 May to 02 June, 2012*

### **Schedule**

Date	Agenda	Place/Remarks
17 May 2012	Meeting with UNDP Environment Team and UNDP Senior Management	UNDP
20 May 2012	Introductory meeting with National Project Director. Meeting of the TE Team	UNDP/DOE
21 May 2012	Meeting with SLMP Partner Organizations at Dhaka	Dhaka
22 May 2012	Meeting with SLMP Partner Organizations at Dhaka	Dhaka
23 – 24 May 2012	Field Visit to BMDA at Rajshahi	Rajshahi
25 May 2012	Compilation and analysis of the findings	Home
26 May 2012	Meeting with SLMP Partner Organizations at Dhaka	Dhaka
27 – 28 May 2012	Other Stakeholders: Meeting with Ministry of Land, UDD, LGED, DLRS, UPPR etc.	Dhaka
29 – 30 May	Compilation and analysis of the findings	UNDP
31 May 2012	Debriefing on findings of the Terminal Evaluation to the NPD, UNDP and Secretary, Ministry of Environment and Forests	UNDP and MOEF
1 – 2 June 2012	Compilation and analysis of the findings	UNDP

### **Appendix 3**

#### **List of persons participated in meetings**

<b>Name and designation</b>	<b>Organization</b>
1. Professor Mahbub	Geography Department, University of Dhaka
2. Professor Nazem	Geography Department, University of Dhaka
3. A F M Kamaluddin, Climate Change Expert	UNDP Bangladesh
4. Dr. Mohammad Shahjahan, Chief Scientific Officer	Bangladesh Agriculture Research Council, Dhaka
5. Dr. S M Khorshed Alam, Principle Scientific Officer	Bangladesh Agriculture Research Council, Dhaka
6. Md. Nazrul Islam, Director	Agriculture Information Service, Dhaka
7. Dr. Md. Zahangir Alam, Farm Broadcasting Officer	Agriculture Information Service, Dhaka
8. Mohammad Zakir Hasnat, Information Officer	Agriculture Information Service, Dhaka
9. Mohammad Maroof Masum, Information and Communication Specialist	Agriculture Information Service, Dhaka
10. Md. Moqbul Hossain, Principle Scientific Officer	Soil Resource Development Institute, Dhaka
11. Dr. S M Zulfiqar Ali, Senior Research Fellow	Bangladesh Institute of Development Studies
12. Dr. Abdul Mannan	Department of Agricultural Extension
13. Md. Abdul Latif, Executive Engineer	Barind Multipurpose Development Authority, Rajshahi
14. Rafiqul Islam, In-Charge, Tissue Culture Lab	Barind Multipurpose Development Authority, Rajshahi
15. Amena Begum, Supervisor, Tissue Culture Lab	Barind Multipurpose Development Authority, Rajshahi
16. Mahfuzur Rahman, Publication Officer	Barind Multipurpose Development Authority, Rajshahi
17. Atiqur Rahman, Asst. Engineer	Barind Multipurpose Development Authority, Chapainobabganj
18. Motor Chandra Shaha, Sub. Asst. Engineer	Barind Multipurpose Development Authority, Chapainobabganj
19. Md. Enamul Hoque, Executive Director	Barind Multipurpose Development Authority, Rajshahi
20. Abdul Halim Mia, Team Leader and Chief Technical Expert	Coastal Land Zoning Project (1 <sup>st</sup> phase), Ministry of Land
21. Dr. Nasiruddin, National Project Director and Joint Secretary	Ministry of Environment and Forests
22. Stefan Priesner, Country Director	UNDP Bangladesh
23. Framers and ... Farm Labor, local people	Barind Area, Rajshahi and Chapainobabganj

#### **Appendix 4**

##### **Terminal Evaluation Mission of SLM Project Field Visit Report**

23 – 24 May 2012, Rajshahi

Visited the activities of Barind Multipurpose Development Authority (BMDA) under SLMP at Rajshahi and Chapainobabganj during 23 – 24 May 2012.

BMDA was found to be very promising organization to popularize SLM in the barind areas where it is very important. They have implemented the activities as was planned except introducing date-palm propagated through tissue culture as finally the protocol for this was not possible to collect from UAE. The irrigation facilities for vegetable cultivation and supply of drinking water were visited at Zhilim Union, Chapainobabganj. During discussion with farmers and few water users it was found that the facilities created are useful for them. The tissue culture lab established with support from SLMP was in operation to propagate potato plantlets; they are distributing these potato plantlets in a lower price to the farmers.

BMDA also implemented a component for irrigation facilities from the River Padma under SEMP, which they have enhanced afterwards and is well maintained.

## **Appendix 5**

### **List of documents consulted**

1. Project Document on Capacity Building and Resource Mobilisation for Sustainable Land Management in Bangladesh (SLMP) (Received 7 May 2012)
2. Annual Progress Report 2010, SLMP (12 May 2012)
3. Annual Progress Report 2011, SLMP (12 May 2012)
4. Annual budget & disbursement, SLMP (22 May 2012)
5. Sustainable Land Management in Bangladesh : Issues, constraints and potentials, BIDS (10 May 2012)
6. Chittagong Workshop Report, SLMP (14 May 2012)
7. Draft Land Zoning Law (22 May 2012)
8. Final Report of Naren Das on National Land Zoning Act 2010 (6 June 2012)
9. Final Report of Naren Das on Village Improvement Act 2010 (6 June 2012)
10. National Land Use Policy 2001, GoB (16 May 2012)
11. Report on Sri Lanka Visit, SLMP (29 May 2012)
12. Report-wetland-reduction, WARPO (14 May 2012)
13. SLM Manual - Ver 5.0 - Final Draft (26 May 2012)
14. Land Use Study on Polash and Tangal, SLMP draft Report, CUS (10 May 2012)
15. Sustainable Land Management Project Report, SRDI, MoA (30 May 2012)
16. Sustainable Land Management Project report, DAE, MoA (15 May 2012)
17. Policy Brief on Sustainable Land Management in Bangladesh, BIDS (3 June 2012)
18. Recommendation from database management meeting, BIDS (3 June 2012)
19. Summary report on training workshop on EIA, BIDS (3 June 2012)
20. Summary report on training workshop on NRA, BIDS (3 June 2012)
21. Workshop Recommendation, BIDS (3 June 2012)

22. BARC-fertilizer-SLM Report (20 May 2012)
23. BARC-soil-crop-SLM (20 May 2012)
24. Content Review of SLMP (20 May 2012)
25. Matrix for Content Review of SLMP (20 May 2012)
26. Matrix for Content Review of SLMP deliverables (20 May 2012)
27. Policy\_Dialog\_on\_SLM\_in\_Bangladesh1 (20 May 2012)
28. SLM Round Table (20 May 2012)
29. Mid-term Evaluation of Community Based Adaptation to Climate Change through Coastal Afforestation in Bangladesh, UNDP (Downloaded from Website)
30. Coastal Land Zoning Report , MoL ( 28 May 2012)
31. Training Manual for SLM, DAE (22 May 2012)
32. Proceedings of National Workshop on SLM through soil and crop management, BARC (15 May 2012)`
33. Proceedings of National Workshop on SLM though Fertilizer use, BARC (15 May 2012)
34. UNCCD Fourth National Report : Bangladesh, DoE, MoEF (15 May 2012)
35. Climate Change and Agriculture, AIS, MoL (21 May 2012)
36. Media Campaign Video on DVD, AIS, MoL (15 May. 2012)
37. Project Steering Committee Meetings (6 June 2012)
38. A budget report only (BMDA) (May 22, 2012)

## **Appendix 6**

### **Capacity Building and Resource Mobilization for Sustainable Land Management (Eco-system Management) in Bangladesh**

Project no. BGD/05/G04-SLMP

Project ID: 00045948

(in Lac)

<b>Table: Annual Budget, including in-kind Parallel funding</b>						
Donor	Total 2008-2012	Annual Budget (US \$)				
		2008	2009	2010		
GEF Contribution	6.37000	2.250	2.478	1.642		
GOB in-kind Contribution	6.95484	2.318	2.318	2.318		
<b>Total</b>	<b>13.32484</b>	<b>4.568</b>	<b>4.797</b>	<b>3.960</b>	<b>-</b>	<b>-</b>

<b>Table: Annual disbursement, including in-kind Parallel funding</b>						
Donor	Total 2008-2012	Annual disbursement (US \$)				
		2008	2009	2010	2011	2012
GEF Contribution	5.83095	0.354	1.810	2.621	0.720	0.326
GOB in-kind Contribution	3.56820	-	3.099	0.157	0.157	0.157
<b>Total</b>	<b>9.39915</b>	<b>0.354</b>	<b>4.908</b>	<b>2.778</b>	<b>0.877</b>	<b>0.482</b>

#### **Note:**

<b><u>Annual Budget</u></b>		<b><u>2011</u></b>	<b><u>2012</u></b>
Revised GEF Contribution		1.146	0.865
Revised GOB in-kind Contribution		0.157	0.016



## **Appendix 7**

# **ADAPTATION OF AGRICULTURAL SYSTEMS TO SUSTAINABLE LAND MANAGEMENT AND CLIMATE CHANGE IN BANGLADESH (A Concept Proposal)**

## **Project Partners**

**(1) Dr. Hemayet Hossain (BSc, MSc, DED)**

Land-use Modeller

Former Land Specialist (UN-HABITAT), Senior Research Scientist (Department of Primary Industries, Victoria, Australia), Senior Research Fellow (Melbourne University)

Contact email: hemayet.himukala@gmail.com

**(2) Dr. Muhuddin Rajin Anwar (BScAgr, MScAgr, PhD)**

Senior Research Agronomist (Climate Modeller)

Department of Primary Industries, NSW, Australia

**(3) Mr. Victor Sposito (MScCE, MPhPI)**

Principal Research Scientist and Project Director - Department of Primary Industries, Victoria, AUSTRALIA

**(4) Dr. Ifzal Ali**

Former Chief Economist (Asian Development Bank)

**(5) Dr. Robert Faggian,**

Senior Research Scientist, Director, Department of Primary Industries  
Victoria, AUSTRALIA

**Keywords:** climate change adaptation, APSIM-model, Multiple Criteria Analysis, vulnerability, Adaptive Capacity Index(es), production, yield, Sustainable Land Management

## **SUMMARY**

Climate change is a major threat to rural livelihoods including food security in Bangladesh. This change will affect the soil as well and will further complicate the sustainable management of land and agricultural land use. The required transformations in agricultural systems (see definition in National Research Council of the National Academies, 2010) and their management to enable farmers, resource managers and policy-makers to adapt to the climate challenges will not come about in sufficient time unless the best science-based solutions are developed and excellent delivery mechanisms are put in place (see, for instance, Jubb *et al.*, 2010). In this context, the project will develop for Bangladesh a comprehensive *Spatial Analysis Framework* to formulate sustainable adaptation actions that

will enhance the preparedness of farmers, resource managers and policy makers to confront a changing climate. The framework will integrate knowledge of crop physiology, climate and natural resources (including land, soil and hydrology) sciences in a Geographic Information System (GIS) environment. A *Spatial Information System*, based on GIS, will complement the framework. See **Figure 1**, below, p. 4.

## **BACKGROUND, AIMS AND OBJECTIVES**

There is now extensive scientific evidence that the observed rapid warming of the Earth is caused by human-induced climatologically phenomena interacting with natural climate processes. Increased climate variability, as evidenced by a higher global incidence of extreme weather events of greater severity and magnitude, is regarded as both a symptom of, and a precursor to, long-term climate change. The enhanced (anthropogenic) greenhouse effect is the result of modifications to the Earth's atmosphere from gases emitted by industrial, transportation and agricultural activities – termed Greenhouse Gases (GHG) - and variations in the land surface reflectivity caused by deforestation, cropping and irrigation. The impacts are predicted to become more serious over the coming decades as global warming accelerates, with an increasing risk of drastic changes to the coupled natural/human/climate systems (Millennium Ecosystem Assessment, 2005; Intergovernmental Panel on Climate Change – IPCC, 2007a and 2007b).

Reducing the vulnerability of natural and human systems (including human settlements, land and water resources and economic activities) to the impacts of climate change by means of adaptation is critical. Planned adaptation to climate change is the result of a deliberate policy decision to return to, maintain, or achieve a desired state of the system of interest. Adaptation aims at moderating the risks and damage, or capitalizing upon potential benefits from current and likely future conditions. It can encompass national or regional/local strategies, practical steps taken by communities or individuals. Adaptation is a crucial policy response, along with mitigation, to responding to climate change (IPCC, 2007b; United Nations Development Programme, 2004).

The cost of failing to mobilize in the face of this threat may be extremely high, impacting on the economic and social well being of Bangladesh and its rural communities.

Within this context, the project *Adaptation of Agricultural Systems to Climate Change (AASCC) in Bangladesh* (hereafter the 'project') aims to enhance the preparedness of farmers, resource managers and policy makers for a changing climate. The project will underpin increases in the production, productivity, competitiveness, profitability and sustainability of agriculture through the development, application and evaluation of a novel methodology that integrates biophysical models, global climate models, Land Suitability Analysis (LSA), Multiple Criteria Analysis (MCA) and an adaptive capacity method in a GIS environment.

Impacts on Bangladesh agriculture of projected climate change would be spatially and temporally diverse, with many rural regions likely to experience increased risk in agricultural production. In particular, populous low-lying areas exposed to coastal inundation (e.g. storm surge) and flooding from major river systems (e.g. the Ganges and Brahmaputra) are projected to be at risk of adverse outcomes associated with climate change.

The rate and extent of warming, together with modifications in rainfall amounts and distribution, are key determinants of the impacts on agriculture and will affect the success of planned adaptation actions, both strategic and operational. Nevertheless, the likely gradual unfolding of climate change should provide farmers in many regions with sufficient time to utilize, or develop, and implement adaptation actions. Many of the actions are likely to be based on farmers' current responses to climate variability. Investments in research and development (R&D) and innovation will be important ingredients in facilitating adaptation to climate change by farmers and the agricultural agencies supporting them.

Farmers are likely to face additional costs of capital adjustments due to climate change. Investment in long-lived climate-dependent agricultural assets, such as farmland, crop and livestock and agricultural implements, will become more problematic. Investing in ecological assets in rural regions, especially where these assets may become stranded by climate change, will also be increasingly difficult.

The project will provide answers to the following vital questions for Bangladesh:

- What are the major issues for agriculture, rural livelihoods and food security in the context of climate change?
- What (strategic and operational) actions are needed to enhance the resilience of vulnerable farming systems and livelihoods in the face of climate change?
- How to protect livelihoods from adverse climatic extreme events (e.g. through effective safety nets and pro-active coping responses).
- What major challenges does a new collaborative research program need to address?

Therefore, the **aims** of the project are:

1. To develop for Bangladesh a comprehensive *Spatial Analysis Framework* to formulate adaptation actions that will enhance the preparedness of farmers, resource managers and policy makers to confront a changing climate. The framework will integrate knowledge of site-scale crop physiology, climate and natural resources (including land, soil and hydrology) sciences in a Geographic Information System (GIS) environment.
2. To develop a country-wide *Spatial Information System*, based on GIS, that complements the spatial framework.
3. To develop methodology and create necessary biophysical and socio-economic database to support implementation of sustainable land management.

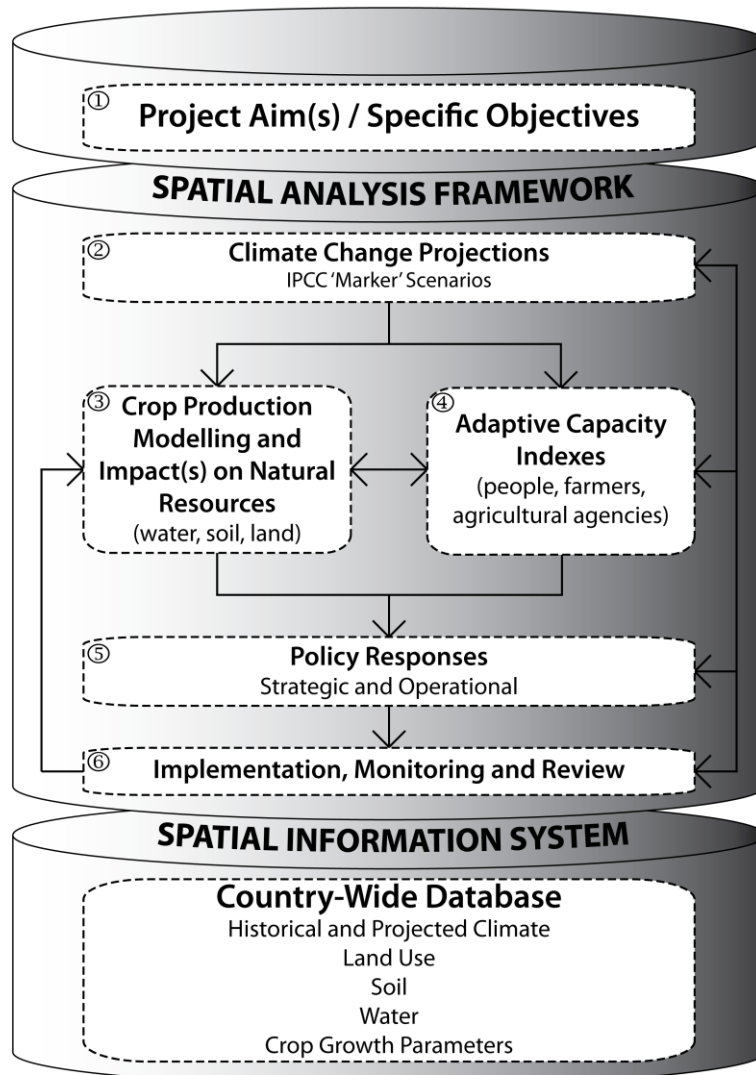
**Specific Objectives** of the project are:

- Identify and prioritize areas and populations, particularly in rural regions, most at risk in the face of climate change.

- Develop an innovative Spatial Analysis Framework to simulate crop production using sustainable land management – rice (or other selected crops) - yield, greenhouse gases (GHG) emissions and water use under a changing climate at farm, local (village), regional (district) and country geographic (or spatial) scales.
- Understand agricultural yield variability in response to climate change in Bangladesh's rice or other crop over the past century.
- Quantify the crop yield, water use and GHG emissions under a changing climate with future CO<sub>2</sub> increase scenarios at farm, local, regional and country scales in Bangladesh.
- Develop Sustainable Land Use (SLM) models for selected crops for various agro-ecological zones in Bangladesh using advanced crop modeling systems such as APSIM.
- Develop Adaptive Capacity Index(es) (ACI) that indicate(s) the farmers' and agricultural agencies' capacity to adapt to climate change following the SLM approach.
- Formulate agricultural adaptation and mitigation actions in the face of climate change as an integral part of sustainable agricultural development and food security policy.
- Improve the understanding of how agricultural adaptation and mitigation options at strategic and operational policy levels affect ecosystems.

## **METHODOLOGY, KEY COMPONENTS AND METHODS**

**Figure 1** shows the simplest version of our proposed methodology for assessing climate change impacts, vulnerability and adaptation. It includes two major components: (i) a *Spatial Analysis Framework*, and (ii) a *Spatial Information System* that complements the framework; that is, the information generated in the framework will be fed into the information system where it will be stored and then retrieved by users as required. Both the framework and the information system will be developed in a GIS environment. An essential feature of the spatial framework is the integration of 'Crop Production Modelling and Impact(s) on Natural Resources', in Phase 3, and the formulation of 'Adaptive Capacity Indexes', in Phase 4. That is, the methodology combines a climate scenario-driven approach with a planning horizon of decades (Phase 3) and a vulnerability-driven approach with a time frame of years (Phase 4). The formulation of 'Policy (adaptation) Responses', in Phase 5, will consider both strategic and operational (or tactical) actions. Similar versions of this methodology have been developed and extensively applied by DPI in Victoria, Australia (see, for instance, Sposito *et al.*, 2009, 2010, and forthcoming). The key methods to be deployed as part of the methodology are mentioned below.



**Figure 1 Methodology for assessing climate change impacts, resilience and adaptation in Bangladesh.**

### ***1. Modelling crop production and greenhouse emissions***

Crop models, such as APSIM (Agricultural Production Systems Simulator) developed by Agricultural Production Systems Research Unit (APSRU) in Australia, are powerful tools for diagnosing crop growth, predicting crop yield and evaluating environmental impacts at multiple spatial (geographic) scales – farm, local (village), regional (district) and country. The management of agriculture resources is of paramount importance because the world has an ever increasing demand for food and fiber, while trying to reduce potential adverse environmental impacts. As a consequence, agricultural scientists have conducted numerous demonstration projects worldwide to maximize crop production and minimize adverse impacts to soil. For example, agricultural system models CERES (Crop Environment Resource Synthesis) from the US, WOFOST (WORLD FOOD STUDIES) from Europe, and Agrosys from China. However, the results or recommendations are at best site-specific and

time-dependent. Furthermore, large difference and uncertainty exist in the future climate due to human activities.

GHG emissions from farmland are also a concern and are closely correlated to climate variables and agricultural practices (Chang *et al.*, 1998; Li *et al.*, 1992; Mosier *et al.*, 1991). Recently, APSIM has been modified to improve the APSIM module of carbon and nitrogen cycles to calculate greenhouse gases (CO<sub>2</sub> and N<sub>2</sub>O) emission from soil.

## **2. Spatial analysis for crop-climate interactions**

The NSW Department of Primary Industry (DPI) has conducted pilot research in developing many short-term and long-term management practices and decision support tools to effectively preserve its natural resources while maintaining high agricultural productivity. At present, several software tools and models are applied in NSW DPI for research, evaluation, and extension purposes, in which a Climate Change Adaptation Strategy Tool (CCAST) can be adopted to make model results useable to producers.

As crop models are designed for site-specific conditions, spatial variations of soil and climate alter crop growth and water use diversely. For example, parameters of soil physics (e.g. field capacity, soil saturation conductivity) determine crop water uptake and soil water balance, then mediate rainfall impact on crop growth. The annual mean temperature and rainfall varied from 14-25°C and 400-800 mm in NSW wheat belt, respectively. Therefore, crop models (such as APSIM) adjusted for site scale can be incorporated into spatial analysis tools (such as CCAST) to predict crop production (yield).

## **3. Adaptive Capacity Indexes**

Increasing evidence indicates that adaptation actions need to generate significant long-term transformative change rather than ad-hoc adjustments (IPCC, 2007b; Stokes and Howden, 2010; Pearman and Härtel, 2010). Nevertheless, past adaptation research has predominantly focused on the biophysical aspects; it is however emerging that socio-cultural and economic factors are comparable to the biophysical aspects (Adger and Barnett, 2009). To address this concern, therefore, DPI developed a methodology for formulating Adaptive Capacity Indexes (ACIs) through a ‘bottom-up’ approach with strong participation of stakeholders and concerned people.

ACIs are based on the application of a Multiple Criteria Analysis Method, the *Analytic Hierarchy Process* – AHP (Saaty, 2000) in a GIS environment (Sposito *et al.*, 2008). For example, in a recent application in an agricultural region in the State of Victoria, Australia, the ACIs consistently focused on educational levels, socio-economic status and demographic changes (e.g. population growth and age of farmers) and community involvement in decision-making. The ACIs can be represented spatially through visualisation techniques (e.g. Pettit *et al.*, 2012). For Bangladesh, it is proposed to develop ACIs for farmers and agricultural agencies supporting them to understand their ability to plan and implement adaptation actions as well as determine the areas that require improvement.

## SIGNIFICANCE AND INNOVATION

Potential future climate change introduces uncertainty in crop production, water use and GHG emissions from farmland. The project will ultimately develop innovative methodology and technology that will simulate crop growth, and water, carbon and nitrogen cycling under climate change.

The **expected outcomes** of this project include:

- An enhanced understanding of the impacts of climate change on agricultural production, productivity, competitiveness and rural sustainability in Bangladesh in the future and over the past century.
- An enhanced understanding of the adaptive capacity of farmers and relevant agricultural agencies to potential climate change and levers for improving their capacity.
- Increased local village capacities to produce and market agricultural products in a carbon-constrained future.
- Improved technical capacity by agricultural agencies to plan, implement and monitor research and development programs, and support farmers' activities.

The expected **deliverables** include:

- (1) A Spatial Analysis Framework for distributed simulation of water use and drought severity, and for the prediction of crop yield and GHG emissions at farm, local (village), regional (district) and country levels.

The information thus generated will be fed into:

- (2) A Spatial Information System with a country-wide database of historical and projected climate, land use, soil, water and crop growth parameters to inform climate change adaptation research in Bangladesh.
- (3) Prediction of crop responses to climate change and land use change, and feedbacks of agricultural management to climate change through greenhouse gas emissions under scenarios of CO<sub>2</sub> concentrations from the present to 2050

Accordingly, the **significance and innovation** of this project are as follows.

### *1) Innovative spatial analysis methods for crop production models*

Modeling is an essential method to predict future consequence of climate change (IPCC 2007a). Scientists in Australia have done pilot research on agricultural adaptation to climate change, including experimental, modeling and software development. Its challenge is to link understanding of physiological mechanisms to predict future responses to climate change. To deal with the issue, this project will be based on a multi-disciplinary research in agronomy, crop modeling, and climate change with assistance of geosciences techniques.

### *2) Analyses of crop production explicitly over farm, local (village), regional (district) and country levels*

Agro-ecosystems have high spatial heterogeneity and temporal variation of productivity, arising from the spatial and temporal variability of climate, soil texture/moisture, and land

use. To accurately quantify crop production, and estimate GHG emissions at farm and regional scales, it is essential to link spatial information of agro-resources and crop models to assess crop growth in response to agricultural management and environmental variation. As mentioned, the project will build a spatial analysis framework that uses GIS software (CCAST) to manage and link spatial data with the crop model APSIM. The outcomes of this project will enhance the capability of farmers and policy makers to adapt and manage farm outcomes in the face of climate change/variability.

The sensitivities of local agricultural and other activities to the projected changes in local climate will be identified and then integrated assessments of the potential impacts will be conducted. This work is novel in modelling spatial extents and resolution and in quantifying the benefits and costs of agricultural landscapes — in terms of food production and GHG emissions in agriculture, which has not been previously done in Bangladesh. This is essential for evidence-based policy development and for avoiding the potentially high social costs of agricultural reform.

### *3) Economic, environmental and social benefits for stakeholders*

Decisions that are made to enhance adaptation to climate change need to be based on current information and a synthetic analysis of data. This spatial analysis platform will provide much-needed information about crop production with an associated probability in each growth stage and before sowing when using precise climate forecast data. The platform can be used to evaluate long-term adaptation (changing farming systems) and short-term agronomic practices (irrigation, fertilizer application, etc.). The product of the monitoring and prediction system will help farmers make decisions of financial investment and agronomic practices. It will also provide information to policy makers for timely evaluation of the impacts of climatic disasters (e.g. drought) on region-specific crop production.

In addition to the impacts of climate on productivity, farmers must also manage on-farm practices to minimize costs and minimize off-site pollution (e.g., fertilizer run-off). Therefore quantifying the impacts of climate change on crop production is essential to allow farmers to adapt to climate variability and change by evaluating agronomic practices and on-site management options.

## **APPROACHES AND TRAINING**

The project will provide answers to challenging questions by combining knowledge of site-scale physiological responses to climate and agricultural managements with Geographic Information System (GIS). It will draw upon research from plant physiology, soil science, GIS and global change sciences. The project will build upon the increased understanding of the impact of future climate change on agricultural production and GHG emissions at farm, village and district scales in Bangladesh.



### ***Approaches***

The **conceptual framework** of this research is to build a platform incorporating the crop model with the spatial analysis tool to manage spatial data of soil, climate and land use. Then fed with climate prediction of GCMs (Global Circulation Models), the platform will be used to calculate the impact of future climate on crop production.

#### *1) Developing a GIS-based platform incorporating spatial data with crop model*

The spatial analysis software (CCAST) from NSW DPI is a type of GIS tool, which will be applied to link with the crop model, APSIM. This will be an innovative spatial analysis approach for driving the crop models. This work involves development of a framework to accommodate crop model and spatial data, input parameters and climate variables. The GIS-based framework can be performed to simulate crop production, soil carbon storage, and CO<sub>2</sub> and N<sub>2</sub>O exchange over farm land and atmosphere.

Land use data are normally in 250 m resolution based on satellite reflectance products (e.g., MODIS). The system will also be able to incorporate 30 m land-use data from Landsat image. Crop rotations change every year in light of weather and economic factors. Land-use data are just a snapshot at a specific time. Therefore, we will model across all the potential arable land referring to history land-use data rather than confine in crop area at a certain year.

Soil physical parameters for the crop model APSIM will also be prepared, which will be derived from the Soil Resources Development Institute (SRDI, MoL, GoB).

The history climate data will be derived from 0.05°continental raster climate data from 1890. The daily time-series climate dataset comprises maximum and minimum temperature, total solar radiation, rainfall and evaporation. Future climate scenarios will be provided by the Climate Change Model (IPCC) downscaled for Bangladesh. This downscaled data are required to match the land use data in calculation of regional crop yield.

In the regional scale, APSIM will adopt spatial-based raster data. The computing task is generally based on the spatial resolution of modelling. A series of innovative techniques will be employed to accelerate computing speed, such as parallel computing processing the raster data with the GDAL (Geospatial Data Abstraction Library) library in a CPU cluster environment.

#### *2) Impact of historic climate change/variability on crop production (yield) in the Bangladesh*

Field experimental data from SRDI will be used to validate APSIM, including data of crop growth of biomass, leaf area index, yield, soil water and GHG emissions. Historical crop yield data at the district level during 1889 to the present years will be used to evaluate the model's validity.

The spatial platform will be used to analyse the impacts of historic climate change/variability on rice/other crop growth and yield, in Bangladesh. In the first step, selected crop yield and water use over the past years will be calculated at several sites using APSIM. These simulations aim to evaluate APSIM to predict the impact of temperature

increase, rainfall variation, CO<sub>2</sub> increase, and fertiliser application. First, several sites in Bangladesh from East-West and North-South will be selected, respectively. Second, soil types, selected crop variables and some parameters responding to soil and crop variables, and managements will be determined. Finally, the historic climate data will be applied to drive APSIM in modeling the crop growth, water use, soil organic carbon, and GHG emissions.

### 3) *Impacts of future climate change on Bangladesh crop production and agricultural greenhouse gas emissions*

Future climate change data sets with GHG emissions scenarios at the site scale will be used to analyse its impact in Bangladesh. The approach adopted in this project will be: (a) to downscale the future climate data under GHG emissions ‘marker’ scenarios (e.g. A2, B1 and AIFI) generated by GCMs (IPCC, 2007a; Nakicenovic and Swart, 2000), and then analyse the future climate changes in Bangladesh under these scenarios; and (b) to predict the response of rice and/or other crop growth, water use and GHG emissions using APSIM. This system will be driven by the downscaled climate data and CO<sub>2</sub> (‘marker’) scenarios from the present to the year 2050 as predicted by GCMs. The spatial analysis platform will be applied to assess the effect of climate change and elevated CO<sub>2</sub> concentration on crop yield and water-use of Bangladesh. The combined CCAST and APSIM will be used to manage these spatial data including climate, land use, and soil and crop parameters. The system will be able to evaluate the impacts of climate change on agriculture and evaluate agricultural GHG (e.g. carbon budget over arable land, N<sub>2</sub>O emission, etc) in response to agricultural management and historic climate change/variability and future climate change scenarios. The system can also simulate severity of water stress and field evapo-transpiration with a high spatial resolution of 250-500 m for crops.

## REFERENCES

- Adger, N., and Barnett, J. 2009. “Commentary: Four Reasons for concern about adaptation to climate change”. *Environment and Planning A*, **9**(41): 28800-2805.
- Intergovernmental Panel on Climate Change – IPCC. 2007a. *Climate Change 2007: The Physical Scientific Basis, Contribution of Working Group I to the Fourth Assessment Report on the Intergovernmental panel on Climate Change*. Edited by Solomon S. *et al.* Cambridge: Cambridge University Press.
- Intergovernmental Panel on Climate Change – IPCC. 2007b. *Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Edited by Parry, M. *et al.* Cambridge: Cambridge University Press.
- Jubb, I., Holper, P. and Cai, W., Eds. 2010 *Managing Climate Change*. Papers from the GREENHOUSE 2009 Conference. Melbourne: CSIRO Publishing.
- Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being*. Washington, D.C.: Island Press.
- Nakicenovic, N. and Swart, R. eds. 2000. *Special Report on Emissions Scenarios (SRES), Special Report for Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press.

- National Research Council of the National Academies. 2010. *Toward Sustainable Agricultural Systems in the 21<sup>st</sup> Century*. Washington DC: National Academies Press.
- Pearman, G. and Härtel, C., 2010. Climate Change Are we up to the challenge? In: Jubb, I., Holper, P., and Cai, W., Eds. *Managing Climate Change – Papers from the GREENHOUSE 2009 Conference*. Melbourne: CSIRO Publishing, 1-15.
- Pettit, C., Bishop, I., Sposito, V. Aurambout, J-P., and Sheth, F. 2012. Developing a multi-scale visualization framework for use in climate change responses. *Landscape Ecology*, DOI10.1007/s109800-012-9716-5.
- Saaty, T.L., 2000. *Fundamentals of Decision Making with the Analytic Hierarchy Process*. Pittsburgh: RWS Publishing.
- Sposito, V., Hossain, Anwar, M., Sietchipping, R. 2008. *Facing the Challenges of Climate Change – Impacts and Adaptation in Regional and Agricultural Systems in Victoria*. Department of Primary Industries, Melbourne.
- Sposito, V., Benke, K., Pelizaro, C. and Wyatt, R. 2010. Adaptation to climate change in Regional Australia: A decision-making framework for modeling policy for rural production. *Geography Compass*, 4/4: 335-354.
- Sposito, V., Faggian, R. and Romeijn, H. (forthcoming) Systemic Regional Development in Planning Practice – Climate Change Impacts and Adaptation in Victoria, Australia. *Informationen zur Raumentwicklung (IzR)* – German specialist journal on spatial planning, policy and information published by the Federal Office for Building and Regional Planning.
- Stokes, C. and Howden, M., Eds., 2010. *Adapting Agriculture to Climate Change – Preparing Australian Agriculture, Forestry and Fisheries for the Future*. Melbourne: CSIRO Publishing.
- United Nations Development Programme – UNDP, 2004. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. Cambridge: Cambridge University Press. [Online: <http://www.undp.org/cc/apf>; accessed on 28 January 2011].