

Climate Change Adaptation Research

Report on

Research Need Identification and Validation



May 2012

Comprehensive Disaster Management Programme (CDMP-II)

Climate Change Adaptation Research: Report of the Research Need Identification and Validation

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PREFACE

Bangladesh is extremely vulnerable to natural hazards and due to its geographical location, its topography and dense population the hazards often result in disasters with a high loss of life and economic damage. Disaster risk reduction in a changing climate involves identification and delineation of climate change and hazard risks over time and space. Disaster risk reduction (DRR) and climate change adaptation (CCA) options suitable to any context and acceptable to the communities are necessary to address such risks. To reduce the risks and continue sustainable development, planned adaptation is necessary. In planned adaptation, it is necessary to have risk reduction and climate change adaptation options. The options are not readily available for many of the cases. Generation of new knowledge and options to treat such risks are essential. The impacts of disaster and climate change are sector, location and community specific and as such generation of knowledge and options shall be pursued through research accordingly so that those meet the requirements.

Commission scientific research on climate change on livelihood options is one of the activities outlined under outcome 6 (outcome 5 as per original project document) where the major focus is to mainstream the DRR and CCA across the targeted ministries. The research activities are proposed to be conducted by the designated and relevant national research organizations/institutions and managed by the Disaster Management Bureau (DMB). Identification and prioritization of research needs and priorities stand as primary step in the whole range of activities to be carried out to commission scientific research on Climate Change on Livelihood Options. Major purpose of the identification of research needs was to produce a comprehensive list of sector specific needs of research activities/projects. The research needs and priorities identified are expected to lead to commission research activities/projects to the selected national agencies/institutes/organizations.

Once the research activities are commissioned through an open bidding process and the results are gathered, it is planned that the results will be translated into technologies and options readily implementable at the community level. The results are also expected to provide valuable inputs and recommendations for policy level consideration and inclusion.

ACKNOWLEDGEMENT

The entire CCA research need identification work has been successful with the valuable guidance, tireless efforts and timely facilitation of all concerned.

The effort started with the development of the conceptual basis where National Project Director provided his insights, aspiration with regard to the ultimate use of the research results. CDMP and UNDP colleagues reviewed the concept, process and provided their inputs and suggestions for improvement.

Participation and contribution from the partner departments and other agencies in the regional workshops and the sectoral workshops has been highly valuable to draw the real problems and identify the research needs. National workshop, where scientists, experts and policy makers participated, yielded the final list of CCA research agendas.

And finally direction from the Secretary and Honourable Minister of the Ministry of Food and Disaster Management enriched the needs and aspiration of the CCA research CDMP would look forward to commission and promote the results for risk reduction and adaptation.

ACRONYMS

ACD	Assistant Country Director
ARCAB	Action Research for Community Adaptation in Bangladesh
BARI	Bangladesh Agriculture Research Institute
BCAS	Bangladesh Centre for Advanced Studies
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BEMP	Bangladesh Environmental Management Project
BFRI	Bangladesh Fisheries Research Institute
BIDS	Bangladesh Institute of Development Studies
BLRI	Bangladesh Livestock Research Institute
BRRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
CDMP	Comprehensive Disaster Management Programme
CCA	Climate Change Adaptation
CC	Climate Change
DED	Deputy Executive Director
DESM	Department of Environmental Science and Management
DG	Director General
DMB	Disaster Management Bureau
DMRD	Disaster Management and Relief Division
FFWC	Flood Forecasting and Warning Centre
GoB	Government of Bangladesh
GBM	Ganges, Brahmaputra and Meghna
ICDDR,B	International Center Diarrhoeal Disease Research, Bangladesh
ICZMP	Integrated Coastal Zone Management Program
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
LACC	Livelihood Adaptation to Climate Change
MDG	Millennium Development Goal
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
MP	Member of Parliament
NAPA	National Adaptation Programme of Action

NCAP	Netherlands Country Assistance Programme
NEMAP	National Environment Management Action Plan
NGO	Non-Governmental Organization
NIPSOM	National Institute of Preventive and Social Medicine
NPD	National Project Director
NPDM	National Plan for Disaster Management
NSU	North South University
PRSP	Poverty Reduction Strategy Paper
RRAP	Risk Reduction Action Plan
SEMP	Sustainable Environment Management Program

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1. Introduction

Bangladesh is extremely vulnerable to natural disasters. About a third of its population or some 57 million people live in chronic poverty. This fact, combined with the country's geographical location, topography and dense population cause disasters with high losses of human lives and economic damage. Historically, deaths from single extreme weather event such as cyclones reached into the hundreds of thousands in Bangladesh. At the same time, Bangladesh is one of the countries, most at risk from the adverse impacts of climate change and variability. Climate change will exacerbate many of the natural hazards the country already faces and bring about a significant challenge for future development. Livelihood of the community is already under intense pressure due to the socio-economic insecurity. Climate induced hazards threaten our development gains and question the survival and future of the majority of our country's vulnerable population.



Global warming at accelerated levels will lead to an onrush of water through Bangladesh during monsoon, increasing the riverbank erosion. *Photo Source: National Geographic, 2009.*

Human induced global warming is accelerating rapidly, and may be at the tipping point of the threshold for our ecosystems and coping capacity of the communities. Evidence from the ground reveals that households as well as communities are engaging in autonomous adaptation in response to the change. Planned adaptation is necessary to reduce the potential risks and continue sustainable development, anticipating the future risk due to climate change and finding more sustainable solutions. In most cases the available options are very limited. Needs based and demand driven research is essential to identify and generate new knowledge and technologies to address future risks.

The Comprehensive Disaster Management Programme (CDMP) aims to support identification and generation of new knowledge and technologies on climate change adaptation through research and study for different sectors, regions and stakeholders. Ultimate goal of the entire undertaking is to reduce unacceptable risks due to climate change and disaster and improve resilience of the community. The research results are expected to contribute to the overall goals of the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), National Plan for Disaster Management (NPDM), Millennium Development Goals (MDG) achievements and more effective and sustained poverty reduction.

2. Policy Relevance

Climate change has substantial bearing on the national and international policy guidance and drivers like Millennium Development Goals (MDG), the objectives of the PRSP, NPDM, BCCSAP, as well as on the objectives of many national development initiatives, such as the CDMP. Adaptation to climate change is a cross-cutting sectoral concern and need to be embedded in the overall development processes.

2.1 Bangladesh Climate Change Strategy and Action Plan (BCCSAP 2009)

The Bangladesh Climate Change Strategy and Action Plan prepared by GoB (MoEF) provides due importance to ‘research and knowledge management’ in its fourth pillar (thematic area). BCCSAP proposes empirical and social research to estimate the likely scale and timing of climate change impacts on different sectors of the economy, to inform planning of future investment strategies. It recommends study and research on the impacts of climate change on the macro-economy of Bangladesh and key sectors (e.g. livelihoods and food security) and the linkage between (a) climate change, poverty and vulnerability and (b) climate change, poverty and health (disease incidence, nutrition, water, sanitation) in order to identify possible interventions to increase the resilience of poor and vulnerable households to climate change, etc.

2.2 National Plan for Disaster Management (NPDM 2010-2015)

The National Plan for Disaster Management recognizes climate change and disaster linkages and refers to UNFCCC in bringing in climate change issues into the domain of disaster management. NPDM states that disaster risk reduction offers opportunities for “bottom-up” strategies for adaptation to current climate variability and climate extremes. In this respect disaster risk reduction can promote early adaptation to climate risks and impacts.

2.3 Millennium Development Goals (MDG)

Bangladesh is committed to the concept of Sustainable Development (SD) - represented through the Commission for Sustainable Development (CSD) process - as well as achievement of the MDG. As an international driver having national relevance, MDG stands as the principal guidance in all national development efforts. Inclusion of ‘ensuring environmental sustainability’ as one of the goals among the eight goals reflects the importance of management of environment in the changing climate. Climate change impacts have the potential to disrupt both processes, the process to achieve sustainable development and towards achievement of the MDGs.

2.4 Poverty Reduction Strategy Paper (PRSP)

The National Strategy for Accelerating Poverty Reduction is another process that sets a framework for development for Bangladesh in close coordination with the MDG process. Poverty reduction clearly is one of the highest priorities of the Government of Bangladesh. Climate change impacts may directly affect at least two of priority areas of PRSP: nutrition – in the sense of food security and the provision of sanitation and safe water. It is safe to say that some important economic sectors including agriculture, fisheries, forestry, and livestock will be affected by climate change and will affect employment, one of the priority areas of the PRSP.

2.5 Other mandate, initiative

There are numerous plans, projects and programmes in Bangladesh at national, sub-regional and local levels which have strong linkage/relevance with climate change, such as National Environment Management Action Plan (NEMAP), Sustainable Environment Management Program (SEMP), Bangladesh Environmental Management Project (BEMP), Integrated Coastal Zone Management Program (ICZMP), Livelihood Adaptation to Climate Change (LACC) Project, Community Based Adaptation to Climate Change through Coastal Afforestation Project, etc. These initiatives, projects and programmes have generated some useful knowledge, information and policy directions on adaptation to climate change and livelihood options.

3. Institutional setting

Formal and public institutions conduct research and studies mainly in pursuit of new knowledge and technology. However, there are other facilities who conduct informal study, assessment and evaluation. National research institutes like Bangladesh Rice Research Institute (BRRI) has so far released more than 57 rice varieties in order to meet the ever increasing demand for food in response to ecological changes. Other institutes like Bangladesh Agriculture Research Institute (BARI), Bangladesh Fisheries Research Institute (BFRI), and Bangladesh Livestock Research Institute (BLRI) are notable national institutes responsible for research in the respective sectors. Bangladesh Institute of Development Studies (BIDS), International Diarrhoeal Disease Research, Bangladesh (ICDDR,B), National Institute of Preventive and Social Medicine (NIPSOM), and others are engaged in various socio-economic, water and health research and studies relating to climate change and its impact.

The Bangladesh Centre for Advanced Studies (BCAS), a NGO has a good track record of research, documentation and knowledge sharing on climate change adaptation and allied fields. It is the Secretariat for the ongoing Action Research for Community Adaptation in Bangladesh (ARCAB) project which is implemented with the International Institute for Environment and Development (IIED, UK). The International Union for Conservation of Nature (IUCN), Bangladesh works in some ecologically critical areas of the country while implementing projects and conducts various studies on climate change adaptation especially in the context of nature conservation. IUCN has hosted the National Capacity Self-Assessment for Implementation of UN Climate Change Convention, Convention for Biological Diversity and Commission to Combat Desertification, for the MoEF. IUCN also completed research and study activities with the Netherlands Country Assistance Programme (NCAP). Other organizations like CARE Bangladesh, ActionAid, BRAC, Concern Worldwide, Practical Action Bangladesh, Oxfam GB, Christian Aid, ProdiPan, etc to name a few have undertaken and supported a number of projects and initiatives on climate change adaptation. With the growing concern of climate change implications for people and communities, academic institutes (universities, training institutions) are also engaged in the field of research on climate change in line with their theoretical courses and also based on the academic and professional interest of their students and fellows.

4. Climate Change Adaptation Research: CDMP Initiatives

Commission scientific research on climate change and livelihood options is one of the activities outlined under outcome 5 (Output 5.1) of CDMP II, as described in the project document¹. Commissioning research on climate change adaptation and livelihood options involves need identification by the stakeholders, geographical areas and various agencies. In order to comply with the national guidance, research agendas need to be established in accordance to the research priority and areas identified in the NAPA and BCCSAP programmes. Engaging research institutes and organizations to carry out research, study and support to the local communities for implementation of adaptation options are outlined in the project implementation strategies.

4.1 Goal

The major purpose is to identify, test and generate new adaptation knowledge and technologies. New knowledge and technologies generated through research and studies are expected to be adopted in risk reduction action plans (RRAP) prepared at the community level, and demonstrated accordingly. The research results and lessons are also to be shared and advocated at the policy levels in order to be included in the national and sector-specific research agendas and development processes. In line with the overall objective of CDMP ultimate goal of the entire undertaking is to reduce unacceptable risks due to climate change and disaster and improve resilience of the community.

4.2 Objective

The research on climate change adaptation and livelihoods is aimed at identifying, testing and generating new knowledge and technologies. The new knowledge and technologies are expected to be applicable at farmers' fields and community environment.

4.3 Scope of the research

Ideally research is a systematic activity to explore and generate new knowledge and technologies to address specific needs aiming to solve a problem. Research proposed under CDMP II covers both adaptation research as well as socio-economic studies on climate change and livelihoods; the primary focus remaining on community based adaptation to climate change.

The research scope is flexible and ranges from formal to adaptive research of certain technology (to test the suitability of drought, salinity tolerant crop varieties) and study to find out the empirical relationship (climate change and health problems) etc. The research and study activities are expected to be conducted with direct consultation and participation of the local communities. The scope and opportunity again depend on the problems, needs and formulation of the research proposals.

Once the identification of research agendas are done, the next step is to commission and engage suitable institutes, organizations to conduct the research and study activities in the area of climate change adaptation and livelihoods.

4.4 Research Context

Changing climate has impacts over time and space across the regions and sectors in Bangladesh. Although the changes are felt in each and every corner of the country, the frequency and severity varies from place to place. Based on the current climate change vulnerability, extent of damage, existing capacity, risk profile and scenario, etc, four (4) regions were considered for the research

¹ CDMP II Prodoc.

need identification: 1) *Central region: Flood prone area*; 2) *South-west region: Coastal Saline area*; 3) *North-west region: Drought prone area*; and 4) *North-east region: Flash flood prone area*.

4.4.1 Central region: Flood prone area

- Bangladesh is highly vulnerable to floods due to its geographical location at the deltas of the Ganges, Brahmaputra and Meghna (GBM) rivers. About 92.5 percent of the area of three basins lies outside the boundaries of the country. More than 80 percent of the annual precipitation of Bangladesh occurs in the monsoon period between June and September.
- The hydro-meteorological processes in the Himalayas are not the main causes for floods in Bangladesh. The combination of simultaneous discharge peaks of the big rivers, high runoff from the Meghalaya Hills, heavy rainfall in Bangladesh, high groundwater tables and spring tides leads to large-scale flooding. Lateral river embankments and the disappearance of natural water storage areas in the lowlands seem to have a significant impact on the flooding processes.
- There is no statistical evidence that the frequency of flooding in Bangladesh has increased during the 20th century. There is indication however, that the inter-annual variation of floods and the areal extent of big events have increased since 1950. The historical analysis of climate in Bangladesh evidently shows that floods are more frequent in recent years.
- During severe floods the affected area may exceed 75% of the country, as was seen in 1998. This volume is 95% of the total annual inflow. By comparison only about 187,000 million m³, of stream flow is generated by rainfall inside the country during the same period. The floods have caused devastation in Bangladesh throughout history, especially during the years 1966, 1987, 1998 and 1988. The 2007 South Asian floods also affected a large portion of Bangladesh.

4.4.2 South-west region: Coastal Saline area

- Coastal region currently has extreme vulnerability to cyclones due to low capacity of its society and institutions to cope with such extreme events. Heavy rains accompanying cyclones, and the tidal waves due to storm surges, cause most of the damages. An average of 1-3 severe to moderate cyclonic storms hit this region each year, with associated storm surges as much as 13 meters, which can reach as far as 200 km inland. These effects are likely to be exacerbated by climate change as peak intensity of cyclones is projected to increase by 5% to 10% and precipitation rates may increase by 20% to 30%².
- A potential implication would be that future storm surges might be even higher than those observed currently. About 1.2 million hectares of arable land are affected by varying degree of soil salinity, tidal flooding during wet season, direct inundation by saline water and upward and lateral movement of saline ground water during dry season.
- Inundation of brackish water for shrimp farming is key causes for secondary salinisation of coastal lands. The severity of salinity problem has increased over the years and expected in increase in future due to sea level rise. IPCC third assessment report gives a global average range of 9 to 88 cm by 2100.
- Many anticipatory adverse impacts of climate change including sea level rise, higher temperature, enhanced monsoon precipitation and run-off, potentially reduced dry season precipitation, and an increase in cyclone intensity would in fact reinforce many of existing baseline stresses that already pose a series impediment to the economic development of Bangladesh³.

² IPCC (2001). Inter-Governmental Panel on Climate Change, Third Assessment Report.

³ Agrawala et al. (2003). Development and Climate Change in Bangladesh: Focus on coastal flooding and the Sundarbans, OECD report

4.4.3 North-west region: Drought prone area

- Climate change has already started triggering the dryness process in the north-western (*Barind*) area and the drought condition will instigate organic matter depletion with other associated risks like depletion of groundwater due to excessive irrigation, drinking water scarcity etc.
- Average rainfall 1400-1500 mm/year (80% during monsoon i.e. June to September) in the Drought-prone area with frequent severe droughts are causing substantial reduction in food production, 1 million tons of food grain (mainly *T. Aman*) lost in 1997, entailing a loss of around US\$ 500 million.
- Due to the decreasing trend of surface and underground water agriculture in the northern belt will continue to suffer. In the north-western area droughts are associated with the late arrival or an early withdrawal of monsoon rains and also due to intermittent dry spells coinciding with critical stages of rain-fed crops.
- Increased droughts associated with high temperature continue to dry up the water bodies and affect fishery activities and reduce fish production drastically and making food and nutrition unavailable to the poor community people.

4.4.4 North-east region: Flash flood prone area

- Flash floods, unique to the north-east region, caused due to sudden onrush of rainwater from adjacent Indian hills poses a high risk of damage to the standing winter rice crop just 2-3 weeks before the harvesting.
- Flash floods remain as a major climate risks to thousands of rice farmers in the region over years. Data reveals that rainfalls in Meghalaya, India have been increased in March-April and intensify the severity of flash floods over the period.
- Due to climate variability and change, increased precipitation early in the season, flash floods are becoming more unpredictable and damaging. Generally occurs during March-April that corresponds to peak rice harvesting time, the timing of flash floods, in recent years, is changing, visiting earlier than usual, making the farmers more exposed to the impacts of extreme weather events that affect livelihoods and food security.
- There have been damages to crops almost every year causing huge livelihood threats to the local farming communities. In 2003 over 80% of rice amounting to 0.6 million tons was completely damaged due to flash floods.

5. CCA Research Need Identification: The process

5.1 Review of contemporary research activities

CDMP in its Phase-I prepared an “Annotated Bibliography”⁴ on climate change research, which was updated and re-printed in 2009. To initiate the process of identification of Climate Change Adaptation (CCA) research needs in CDMP phase II, the bibliography was reviewed to establish a background reference. An inventory of research on CCA and livelihoods was undertaken by collecting research findings and study reports from various research, academic institutes and organizations. Based on the responses received from the organizations a compilation of the reference of the research activities related to CCA (in addition to the existing Climate Change Bibliography) has been prepared (Annex – A). While research and studies have been conducted in various ecological settings and for almost all hazards, the major efforts have taken place concerning agriculture, natural resources and livelihoods aspects of vulnerable communities.

5.2 Identification of regional research needs

In order to identify climate change challenges and adaptation research needs, workshop and brainstorming sessions with the local/regional level stakeholders were conducted at regional level. Specific objective of the regional workshop was to produce a list of research areas that encompass the local CC problems and priorities.

Considering the existing hazard profile, current vulnerabilities and future risks, four (4) regional workshops were organized in four districts, representing four different climate change impact areas e.g. Chapai Nawabganj for drought, Faridpur for flood, Satkhira for coastal salinity area and Sunamganj for flash flood. A large number of experts and practitioners from various development sectors participated and contributed in these workshops. Among the participants there were district and upazila level officers of GoB agencies, experts and scientists from the research institutes, representatives from NGO, media and public representatives.



Participants engaged in a group exercise in a Regional Workshop, 2011

Participants of the regional workshops were involved in identification of risk associated with climate change and need for research/study to generate adaptation options. Research needs articulated in the workshops were documented and compiled (Annex-B).

⁴ CCC-DoE and BDRC

5.3 Sectoral validation of the research needs

Considering the fact that research agenda need to be established in accordance with the sectoral priorities, sectoral workshops were convened to review the problems and needs identified in the regional workshops, validate them through agreed criteria and further identify possible research idea/agenda.

Based on the findings from the regional workshop and considering the extent of impacts of climate change on various sectors, seven sectoral workshops were organized to review, validate and identify potential research agenda. The organizations were identified based on their expertise and experiences in the field of climate change and most importantly the relevance to the relevant development sector. Various public agencies and departments representing agriculture, fisheries, livestock, water, health, infrastructure, disaster management, livelihoods, women, early warning etc participated in the first five (5) workshops. In the last two (2) workshops NGOs and academic, training institutes took part and provided their inputs based on their working arena regardless of sector.

During the technical sessions of the sectoral workshop, the participants discussed and agreed on the criteria and process of reviewing the research needs gathered from the regions. Then through group exercise, the participants reviewed respective sectoral problems and needs identified from the regional workshops and prioritized them against the set criteria using a scale of 1-4 respective of their own sectoral need. Once the review and prioritization completed, the participants were engaged to recommend few research idea/agenda for the prioritized problem and needs. A good number of research agendas were generated from the sectoral workshops (Annex-C).



Reflecting on the identified adaptation research agendas from Group Exercise in a Sectoral Workshop, 2011

Table - 5.1: Distribution of CCA Research Agendas generated from sectoral workshops

Broad Sector / Region	Crops, Fisheries, Livestock	Environment, Health, Women, Livelihood	Disaster Management, Water, Infrastructure, Early Warning	Total
Salinity prone area	14	14	5	33
Flood prone area	4	5	2	11
Drought prone area	7	3	1	11
Flash Flood prone area	8	5	7	20
Total	33	27	15	75

6. National validation workshop on climate change adaptation research

6.1 Objective of the National Workshop

The objective of the national workshop was to endorse the final list of climate change adaptation research agenda recommended from the sectoral workshops. Specific objective of the national workshops were to:

- Revise and finalize the research agendas; and
- Prioritize the research agendas.

6.2 Preparing for the national workshop

The process of reviewing and finalizing the research agenda was not limited within the workshop. A draft report on the sectoral workshop was prepared which include the outcomes (including the reviewed research needs and identified research agendas) of the sectoral workshops. The report was sent to a 15 member panel of experts, nominated from the participants of the sectoral workshops. The outcomes were revised incorporating the contributions from the member of the expert panel.

6.3 National workshop proceedings

The National Validation Workshop was organized on 4 August 2011, Thursday at CIRDAP Auditorium. The workshop was divided in three sessions, inaugural session and two technical sessions.

6.3.1 Inaugural session

The inaugural session started with recitation from the Holy Quran.

In the welcome speech, Mr Ahsan Jakir, DG, DMB pointed out that climate change increased the disaster risk and creating pain and sufferings in the life and livelihood of million of people in Bangladesh. So there are needs for program/research regarding climate change adaptation and those should be designed based on the practical need of the community people.

Then Mr Sanjib Kumar Saha, Response/Adaptation Management Analyst, CDMP provided an over view of the initiative including background and purpose of the workshop. He mentioned that CDMP had started the implementation of climate change adaptation research from the 1st phase and in the second phase the scope has been elaborated. He however made it clear that CDMP is intended to extend its support to research institutes for conducting research but CDMP itself would not conduct any research.

In his complementary speech, Mr Aminul Islam, ACD, UNDP, emphasized on action rather than discussion regarding climate change adaptation. He also pointed out to some gap in the research topics listed through regional workshop and then flagged up the following topics to bring under consideration:

- Find the productivity regaining process through Agro-eco-system management of saline water inundated land after the tidal surge
- Study the potential for small scale marine based economy development
- Study on the drought-geological dynamics
- Find long term sustainable solutions especially on embankment and siltation of the sea-shore
- Research on the cyclone track changing trends
- Study on reducing the relief and rehabilitation cost
- Research as how to increase common property to reduce disaster risk

He also suggested to work for bridging gap between the research institutes priority and community need/demands.

Guest of Honour, Mr. Wais Kabir, Executive Vice Chairman, Bangladesh Agriculture Research Council mentioned the research initiative as a mile stone on climate change adaptation in Bangladesh. He gave importance on making the research institute more capable and active. He also suggested that the researchers and research institutes can also think of collaboration and regional cooperation by themselves through government.



Inaugural session, National Validation Workshop, attended by Honourable Minister, MoFDM, GoB

Addressing to the participants, Dr. M. Aslam Alam, Secretary, DMRD, MoFDM mentioned that regional feedbacks are not adequate to address all aspect of climate change issues and suggested for thinking out of the box aiming at the national progress. He advised for taking initiative from the research institutes to make regional cooperation rather waiting for Governments plan.

Dr. Muhammad Abdur Razzaque MP, Honorable Minister, MoFDM in his speech highlighted the adverse impact of climate change in Bangladesh. He suggested for conducting target specific adaptation research, useful replication and advised to avoid duplication of activities. He expressed his expectation that through this initiative, he would see the real victims of climate change get support through addressing the problems related to livelihood, water crisis, housing, cyclone effect, embankment collapse etc.

In his concluding remarks, Chair of the workshop, Mohammad Abdul Qayyum, NPD, CDMP informed the participants that CDMP is working on a wider canvass along with 12 ministries. He mentioned that as our knowledge on climate change adaptation is not adequate; to acquire adequate knowledge and innovate technologies the research on climate change adaptation is very important. He affirmed that the expectation of CDMP is to make the appropriate translation of climate change adaptation issue through research and go to the affected people with suitable solution. He concluded the session inviting the participants to contribute in finalizing the research agenda and reconfirm CDMP's position to work with other agency to implement action

programmes on climate Change adaptation to address the problems of affected people by Climate change.

6.3.2 Technical session one

Technical session I of the workshop was consisted of presentations and discussion on the research needs and agendas accumulated through regional workshop and reviewed in the sectoral workshops. Dr. M. Asaduzzaman, Research Director, BIDS acted as chair of the session.

There were three presentations (Annex-D), presented by the sectoral experts in the first part of the technical session one:

- Dr. Jiban Krishna Biswas, Chief Scientific Officer, BRRI on Crop, fisheries and livestock;
- Dr Sirajul Islam, Head, Environmental Microbiology, ICDDR,B on Environment, health, women and livelihood;
- Mr. Amirul Hossain, Executive Engineer, FFWC-BWDB on Water, infrastructure, disaster and early warning.



Presentation from the sectoral expert on environment, health, women and livelihood

In the second part of the session, three designated discussant, selected based on their expertise on the relevant sectors provided their thoughtful and valuable insight on the research needs and agendas presented by sectoral experts.

- *Dr. Md. Zainul Abedin, Country Representative, IRRI on Crop, fisheries and livestock:*
 - In designing CC adaptation research topics consideration should have given to the climatic situation and cropping pattern of 20 years
 - Research agendas should be structured in a way as what should do now and what will be in future
 - Homestead gardening for increased and multiple use of homestead might be considered for its food security potential
 - Research or study topics and research process should be farmer's knowledge based

- Coordinated approach among the research institutes and organizations for extension is very important
 - Allocate resources separately for short term and long term research activities
 - Establishment of a center for climate change adaptation research under the leadership of CDMP
- *Dr. Mizan R Khan, Professor, DESM, NSU on Environment, health, Women and livelihood*
- Action research is less recognized and evaluated by scientists. Their participation in the process may enlighten them
 - Prioritize the research agenda/topics into short term and long-term research by using a matrix
 - Study is needed on finding the appropriate social protection programme for the area in need
 - Study on how to involve private sector in CC adaptation practice
 - Study on why the community peoples are not shifting to cyclone shelter
 - Emphasis should be given on dissemination of research findings
 - Involving community as well as the govt. official in research programme
- *Abu Saleh Khan, DED, IWM on Water, Infrastructure and Early warning*
- There is a critical need to prepare hazard specific map that will be easier for all
 - Finding the way to ensuring potable water in the affected areas
 - Study the future trend to ground water salinity especially in the south-west coastal zone
 - Study on water logging and siltation of river and find the appropriate solution measures
 - Arsenic still a severe problem need to study on it
 - Developing drainage system for flood water
 - Work with neighbouring countries and find the way of early flood forecasting



Review, evaluation and prioritization of the research agendas by the participants

6.3.3 Technical session two

Technical session II was planned to finalize and prioritize the research agendas with contributions from the participants. The session was chaired by Mohammad Abdul Wazed, Joint Secretary, DMRD, MoFDM. The participants were provided with a list of the reviewed and revised list of research agendas, and asked to prioritize them based on their importance (i.e. High/Medium/Low). The participants were also requested to categorize the research agendas based on the length of the research duration (i.e. Short term/Long term). Open discussion took place after completion of the group exercise.



Question and answer session on research agendas during the open discussion

6.4 Development of the prioritized list:

Based on the outputs provided by the participants the research agendas were analysed to prepare a prioritized list. For that purpose, points are assigned against the value given by the participants to mark the importance of each research agenda. Following table shows the points assigned against each value.

Table – 6.1: Calculation process for prioritizing the research agendas

Value of Importance	High	Medium	Low
Point against Value	3	2	1

Points against each research agenda of individual participants are then summed up to get the total points of each research agenda.

Full list of the prioritized research agendas are attached in Annex-E; while Annex-F and Annex-G shows the region-wise and sector-wise prioritized list of research agendas respectively.

A separate list of research agendas based on the duration of the research is also prepared and attached as Annex-H.

7. Conclusion and way forward

The entire process of climate change adaptation research need identification is concluded with finalization and prioritization of the research agendas at the national validation workshop. Regional research need identification workshops provided background knowledge on the local climate change problems and yielded some ideas about the potential research needs. The sectoral workshops, with the participation and contribution of experts and scientists from across the development sectors, reviewed the regional needs and validated according to their sectoral priorities.

Finally the national validation workshop provided a forum and govt. officers, scientists, experts and policy makers evaluated and finalized the list of research agendas.

As part of the overall process, the next step is set to commission and engage suitable institutes, organizations to conduct the research and study activities in the area of climate change adaptation and livelihood options.

Once the research and study results are available, appropriate dissemination and advocacy initiatives are expected to be undertaken.

Annex-A: Review of contemporary research activities

Ali, M.Y., M.B. Islam, M.A. Ali, Sk.M. Zaman, M.S. Islam, M.F. Hossain, M.S. Hossain and P.K. Sarder (2009). *Livelihood Adaptation to Climate Change in Coastal Area of Khulna and Drought Prone High Barind Tract Area of Bangladesh.* On Farm Research Division (OFRD)- Bangladesh Agriculture Research Institute (BARI). Gazipur, Month 2009.

Abstract/Summary:

It is assumed that global warming or climate change has a definite role on adverse climatic situations like cyclone, flood and Drought. Both in coastal and Barind area large number of people depends on agriculture sector. Therefore, adaptation is important to cope with this changing climate. An array of adaptation measures were formulated and experimented in a participatory manner in the farmer's field of coastal/saline area of Laudobe, Dacope Upazila of Khulna and at Nachole and Shapahar Upazila under Drought-prone High Barind Tract (HBT) under LACC-II project. Drought tolerant and water efficient vegetables (Barind model) were selected for HBT area following Barind model. In coastal area several homestead vegetables (Laudobe model) were successfully produced through scientific management like making ridge and furrowing of bed. Through utilization of different niches of homestead farm family succeeded to increase their vegetable consumption three to five folds more from the bench mark. The study recommended that in coastal area homestead vegetable gardening should be up-scaled in participatory community-based approach following Laudobe model. Testing of other field crops would continue with saline tolerant varieties along with appropriate management options for reducing soil Salinity and Drought. Chickpea/ chickpea + barley/ chickpea + linseed should be promoted for large scale production in the High Barind Tract. Home gardening of vegetables should be promoted in community-based approach.

BARI (2009). *Utilization of Fisheries Gher Boundaries through Vegetable Production for Adaptation to Climate Change in Coastal Area.* On Farm Research Division (OFRD)- Bangladesh Agriculture Research Institute (BARI). Gazipur, 2009.

Abstract/Summary: A study to find out suitable vegetable and fruit species for planting in the *bund* around fisheries *gher* at Bagerhat MLT site was conducted during Rabi and Kharif season of year 2008-09. Five vegetable species were designed and tested for the study. Among the tested vegetables, tomato and bottle gourd gave the highest yield while highest BCR was found from cabbage and bottle gourd in Rabi and Kharif seasons, respectively. The yield of tomato was 58.33 t/ha while it was found 50 t/ha for bottle gourd during kharif season. Although yield of cabbage (57.77 t/ha) was less than that of tomato, the BCR of cabbage (1.41) was higher than tomato. The study found that it was due to lower production cost of cabbage (Tk. 163538.00/ha).

BARI (2009). *Screening of Rabi Crops against Salinity.* On Farm Research Division (OFRD)- Bangladesh Agriculture Research Institute (BARI). Gazipur, 2009.

Abstract/Summary: To select and evaluate the yield potentiality of various *rabi* crops against Salinity and adaptability in saline area, a screening trial was conducted with eight selected *rabi* crops at FSRD site of Noakhali during *rabi* season of 2008-09. The crops selected for experiment were Cowpea, Barley, Foxtail Millet, Mungbean, Soybean, Chilli, Groundnut and Sweet Potato. It was found from the study that among the selected crops Cowpea, Barley, Foxtail Millet, Soybean, Chilli and Sweet Potato are tolerant in some extent to the Salinity level below 8 dS/m. Regarding yield of the selected crops, yield of Barley (1.53 t/ha), Foxtail Millet (1.93 t/ha) and Chilli (1.51 t/ha) were reasonable, while yield of Cowpea (0.98 t/ha) satisfactory, whereas, yield of Mungbean (0.78 t/ha), Soybean (1.75 t/ha) and Groundnut (1.62 t/ha) were found to be moderate.

Haque, M.F. (2009). *Tools and Techniques to Ensure Sustainable Crop Production for Extreme Salinity Condition: Study on two Coastal Upazilas of Noakhali District.* International Union for Conservation of Nature (IUCN), Bangladesh. Dhaka, September 2009.

Abstract/Summary: Agriculture is always vulnerable to unfavourable weather events and climatic conditions. Despite technological advances such as improved crop varieties and irrigation systems, weather and climate remain key factors in agricultural productivity. Salinity intrusion as a result of climate change impacts agricultural productivity adversely. Against this backdrop, the study made an assessment of agricultural productivity to be affected by the climate change or variability. The study found that BR-47 is suitable for saline soil. The study suggested some technology which needs to be explored further with other agronomic interventions and close monitoring of the field practices by qualified agronomists.

Haque, S. (2010). *Climate Change Impacts on Livelihood Strategies: A Study of Adaptation, Continuity and Changes in Agricultural Practices in a Village of Bangladesh.* A research submitted in partial fulfilment of the requirements for the degree of Post Graduate Diploma in Disaster Management Centre for Disaster and Vulnerability Studies (CDVS)-University of Dhaka (DU). Dhaka, March 2010.

Abstract/Summary: About 80% people of Bangladesh are still engage in agriculture. Different types of climatic hazard affect the agriculture and food production, and directly or indirectly affect the livelihood strategies. The study documented the climatic hazards that exists in the study area, indigenous predictive indicators, local understanding of climate change and scenario. The study also captured the impact of climate change, immediate and long term; as well as various adaptation and response measures to climate change impact.

Hussain, S.G. (2008). *Impact of Climate Change on Agriculture: Case study on Shudharam and Subarnachar Upazilas of Noakhali District.* International Union for Conservation of Nature (IUCN), Bangladesh. Dhaka, November, 2008.

Abstract/Summary: Uncertainty and uneven distribution of rainfall, prolonged no rainfall condition, floods, cyclones, and Salinity intrusion will impact productivity in agriculture adversely. Owing to climate change use of fertilizers and irrigation would increase. There may be changes in cropping patterns and crop management technology. The main objective of the study was to promote understanding of the impacts of climate change and climate variability, and raise awareness through the dissemination of information. The study documented local level resources, people's perception about cc, identified local level problems; reviewed policy related to climate change and used some models to assess the impact of climate change.

The study recommended for improvement in crop based weather, flood forecasting system; excavating silted up river bed and proper management of polder; construction of more sluice gates. The study also emphasized on revision of different policies and integration of climate change adaptation needs in various national actions with focus on issues related to coastal zone management.

Islam, M.S., M.A.Y. Sharkera, S. Rhemana, S. Hossain, Z.H. Mahmuda, M. S. Islam, A.M.K. Uddin, M. Yunus, M.S. Osman, R. Ernst, I. Rector, C.P. Larson, S.P. Luby, H.P. Endtz, A. Cravioto (2009). *Effects of Local Climate Variability on Transmission Dynamics of Cholera in Matlab, Bangladesh.* International Centre for Diarrhoeal Diseases Research, Bangladesh. Dhaka, 2009. .

Abstract/Summary: In Bangladesh, cholera epidemics occur during summer and winter seasons but it is not known how climate variability influences the seasonality of cholera. Summer and winter seasons in Bangladesh, temperature and sunshine hour compensate each other for larger cholera incidence. The synergistic effect of temperature and sunshine hour provided the highest number of cholera cases. The study found that an increase in temperature and sunshine hour affects positively to the variability of the monthly cholera occurrence. It was also observed that higher temperature and medium sunshine

hour provided favourable condition for cholera outbreaks. These findings suggested that cholera would be an increasing problem if the global climate continues to warm. The Intergovernmental Panel on Climate Change has already predicted that the global climate is going to be warmer (IPCC, 1995). Therefore to substantiate this retrospective study, a prospective study needs to be carried out to investigate the impact of climate change on transmission dynamics of cholera considering the possible changes in the aquatic ecosystems in Bangladesh. The study recommended that it needs to be investigated how adaptation and mitigation options could be formulated and adapted to combat the increased cholera cases mainly during disaster situations like flood, cyclone etc.

IUCN Bangladesh (2010). *Disaster Risk Reduction Study in Community Based Sustainable Management of Tanguar Haor II*. International Union for Conservation of Nature, Bangladesh. Dhaka, 2010.

Abstract/Summary: The study on Disaster Risk Reduction in Community Based Sustainable Management of Tanguar Haor II was conducted from January to February 2010. The study mainly endeavored to identify people's vulnerabilities to climate change induced disasters in the project area and document their current coping strategies, in order to recommend measures that can reduce their risks from disasters. The study collected information on various socio-economic, environmental, and other disaster related issues of the project area to provide snapshot of peoples' vulnerability to disasters, induced shocks, level of impact and adaptation mechanisms. The study recommended to facilitate various coping and adaptation measures to disaster as suggested by stakeholder, which includes, building multipurpose shelters, infrastructure development (such as building roads and submergible *pucca* (concrete) embankments, protection walls, dredging, etc.), alternative cropping pattern and income generating activities.

IUCN (2009). *Policy Reforms to Climate change and Capacity of Local Institutions: Bangladesh Perspective*. International Union for Conservation of Nature (IUCN), Bangladesh. Dhaka, 2009.

Abstract/Summary: After the announcement of United Nations Framework Convention on Climate Change in 1992, 12 policies were formulated in Bangladesh, with emphasis on the issues related to environment, climate change and their sensitivity towards impacts and adaptation. The study reviewed the policy documents against the backdrop of their relevancy in facilitating adaptation in the event of climate change. Based on the analysis, the study recommended for incorporation of climate change issues in the sectoral policies and institutional mandate and awareness raising as well as capacity building for different groups (including senior official at decision making) is necessary to promote rural development and livelihoods of the local community.

IUCN, UNEP, UNU (2009). *Biodiversity Conservation and Response to Climate Variability at Community Level*. International Union for Conservation of Nature, United Nations of Education Programme, United Nations University. Dhaka, 2009.

Abstract/Summary: IUCN, Bangladesh implemented the "Community-based implementation and compliances of MEAs-Biodiversity related issues in linkage to climate variability" project for improving the role of communities of Bangladesh for better understanding and effective implementation of MEAs. For validation of the importance of community involvement in conservation and adaptation, five case studies were conducted on best practices, local traditional knowledge and resources use modality as well as adaptation actions local level. This publication is a compilation of those five case studies, highlighting five different aspects of biodiversity conservation and climate variability adaptation, mainly focusing on agriculture practices and forest resource management. All these case studies compiled in the publication have recommended some useful research and practical actions on the ground for biodiversity conservation and/or climate change and variability adaptation. Traditional knowledge and practices, and community involvement have been found in the centre of all the studies.

Matin, M.A. (2008). *Risk Assessment and Evaluation of Probability of Extreme Hydrological Events: Case Study from Noakhali Sadar and Subarnachar Upazilas.* International Union for Conservation of Nature (IUCN), Bangladesh. Dhaka, November, 2008.

Abstract/Summary: The impacts of different hydrological events such as increase in temperature, variable precipitation, extreme weather events, and sea level rise will be felt frequently in Bangladesh and will continue to intensify. These changes are already having major impacts on the economy of Bangladesh. Climate change will also affect the livelihoods and income of common people. The study provided details on changing trends of precipitation, temperature, wind speed, frequencies of cyclonic disturbance, and trends of cyclone along with some predictions regarding some hydrological events. The study observed that out of 20 trends 14 has a positive trend i.e. frequency of disturbance is increasing while 6 trends are decreasing. The lowest category of depression having the highest frequency has the increasing tendency in all the seasons.

The study suggested a set of recommendations on subsequent disaster management of the study areas to make the initiative fruitful which include, improvement of existing canal system, preparing vulnerability map, repair existing embankments, regular monitoring of impact of climate change etc.

Mollah, A.R. (2009). *Climate Change and Fisheries: A Case Study of Noakhali District.* International Union for Conservation of Nature, Bangladesh. Dhaka, April 2009.

Abstract/Summary: The fisher folk, traditionally dependent on coastal fisheries have been identified as one of the most vulnerable groups to be impacted by the projected climate change and climate variability. In Bangladesh, there are long traditions of coping strategies in response to disasters, like floods, storm surges, cyclones, river erosion etc. The inherent coping mechanisms developed within communities and their traditional knowledge base enable them to organize at the community level and manage disasters. The study delineated understanding of the impact of climate change and climate variability on coastal fisheries and livelihood of fishermen, and documented local adaptations strategies developed within the local community in response to changed climatic scenarios. The study recommended for empowerment of coastal fisher community and livelihood improvement, as well as development and implementation of a Coastal Zone Fisheries Management plan.

Neelormi, S. (2009). *Documentation of Local Level Coping Measures: An Experience from Central Coastal Belt, Bangladesh.* International Union for Conservation of Nature (IUCN), Bangladesh. Dhaka, August 2009.

Abstract/Summary: The local ordinary people who have been living in the coastal province for ages have been instrumental in recording and explaining the local level coping practices in response to climate induced events, as well as climate related disasters. Those people have tremendous resilience as well as wisdom, which enable them to respond to any extreme weather condition. The study documented these local level coping strategies and attempted to formulate a meaningful policy and strategy and to identify interventions that really improve the livelihood conditions as well as overall living conditions of the coastal poor.

Qadir, D.A., M.D. Iqbal (2009). *Tropical Cyclones: Impact on Coastal Livelihoods.* International Union for Conservation of Nature, Bangladesh. Dhaka, June 2009.

Abstract/Summary: Climate change is influencing cyclonic behaviors over the coastal zone of Bangladesh, its (cyclone) impacts on the agriculture and fisheries sector as well as livelihood of the people living there. The study observed that the trends of maximum and minimum temperature of the coastal region have accelerated in the recent decades, the annual rainfall over the coastal zone also shows increasing trend for 7 stations, while the monsoon and post-monsoon rainfall shows increasing

trend in some stations and decreasing trend in others. The Sea Surface Temperature (SST) shows an increasing trend (at the rate of 0.094oC/decade). All these changes will result in more damages to the agriculture, fisheries and infrastructures, aggravating the livelihoods of the coastal inhabitants further.

The study point out a number of steps and policy options for coping with the change and sustain livelihood activities using scientific, technological and institutional measures, including peoples' involvement in strengthening community level disaster management; livelihood improvement through social community forestry and fishing; fish processing; tillage equipment on improved crop production; expansion and participatory maintenance of common property resources.

Annex-B: Details of research needs generated from the regional workshops

North-western region: Drought prone area

- Agriculturist felt that increased temperature may intensify pest infestation and lead to crop damage. Special research on the management of insect like *Brown Plant Hopper* (that grows over 38^o C), diseases may be taken up.
- Considering the gradual depletion of ground water retention of water in the pond, conservation of biodiversity and low-cost fish rearing techniques are found important research areas in fishery.
- Comparative adaptation trial of the improved grass varieties developed/released by Bangladesh Livestock Research Institute (BLRI) may be taken up in order to address the persistent loss of grazing fields and lack of green grass in the dry months.
- Ways/methods of rain water harvesting by re-excavation of water bodies like the local and community ponds and also the method of efficient use of surface water for irrigation and others purposes are the most preferred options from the water sector.
- With the gradual loss of ground water and increased temperature some tree species are getting wilted. Felt the need for Drought resistant tree species which could be screened and selected from around the areas.

North-eastern region: Flash Flood prone area

- Flash flood is becoming more uncertain and appropriate prediction has not been possible till now. In most of the year standing crop is lost due to the sudden onrush of water from the upper hills. Trend shows that the flash flood is striking earlier than before and thus, in most cases, the standing winter rice goes under water at mature/harvesting stage. Ways/measures to devise a dependable and long-term prediction model is critical to prepare plan for the local community, farmers in particular.
- In areas where flash flood inundates the crop land, rice varieties like BRRI dhan 51 and BRRI dhan 52 devised for the flood prone areas, can be tested to find out their suitability and hence add new varieties to the crop list of the area. Innovation of few other crop varieties (rice, vegetables) can give a boost to the ongoing effort of addition to the new crops for the submerge condition. Suitable varieties (rice especially) which are 10-15 days shorter than those ones currently grown are extremely needed to combat the situation.
- Since flash flood and submergence has been a persistent problem, introduction of few new (to this area) agricultural technologies is suggested. Adaptation trial on Hydroponics, *Sarjan* to assess their suitability in the flash flood/*haor* areas can be taken up as a way to increase the number of options for adaptation for the affected community people of the area.
- Scarcity of fodder during and after the flash flood is high and farming community is want of alternatives to feed their livestock. Suggestion to find out and introduce new and flood tolerant grass varieties (like *Para, German*) can solve the problem and provide options to the farming community.
- Progressive loss of fish habitat and thus over all biodiversity has been evident over the period due to change in the hydrological pattern and partly due to the over exploitation of the natural resources. Measures like plantation with suitable tree species across the area, preservation of local crop, fish species can be an appropriate measure to restore the ecosystem and biodiversity in the long run. Introduction and breeding new and suitable fish varieties in the *haor* (open water) can be an alternative to cope up with the changing hydrological pattern.
- Recurrence of some vector borne diseases like malaria, filaria, *Kalajor* are causes of concerns for the local community and some study can be undertaken to find out the relation with the changing temperature, rainfall pattern.

- Sexual maturity among the young women has come up as an issue among the health professionals and they suggested studies to find out whether there is/are any correlation with the change of climate of the area.
- Height and slope of the existing road, embankments cannot protect the crops, lands, structures and other resources from the sudden onrush of flash flood. Changing the height, slope of the road, embankments can be an area of investigation for finding out suitable height and slope of the road, embankments to protect the community structures, land, crops and other resources.
- One of the reasons for increased dropout rate from the school is increased uncertainty of flood in the flash flood areas. A careful look into the matter can find and instigate new and real reasons and possible solution measures for further study or action.

Central region: Flood prone area

- Over the period flood has been very frequent in the central area of the country and as a result stagnation of flood water and crop loss are increasing significantly. Agriculture officers and experts proposed the selection and development of crop varieties that can withstand in the flood and stagnant water are required in the areas of frequent flooding and water logging.
- During the flood huge load of silt are flown and deposited on the crop land and adjacent canals, lands that in one hand reduce the area of crop land and fertility of land as well. Technique/technologies need to be generated to solve the problems of silt deposition (sedimentation) to ease the drainage congestion and also retain the fertility of crop lands.
- Loss of biodiversity and fish habitat in the flood prone areas renders fishermen in jeopardy and they are in search of alternative livelihood options and technologies. New aquaculture techniques like case aquaculture can be tested in the area to find out its suitability in terms of local adaptation and socio-economics.
- Due to the recurring river erosion along the *Padma* river a large people of the area remain vulnerable and every year huge people loss their land, houses and assets and leave the place for alternative livelihood opportunities elsewhere. A research on the socio-economic impacts of the migration and livelihood options was identified as an interesting topic by the participants.
- Water management and operation of sluice gates during the flood period especially have always been criticized for their capacity and efficiency. Research to find out alternative techniques and management strategies to ease the drainage congestion may be taken up as a topic of interest as felt by the audience.
- In some areas arsenic contamination has been emerged as a threat to public health, considering the huge interest and importance audience recognized the issue for deeper investigation for appropriate recommendation and measures although the matter does not necessarily belong to climate change.
- Why school is treated as flood/disaster shelter? The people engaged in the education found that schools had to close down and the education activities hampered during the calamities and this caused huge negative impact on the interest and attendance of the students and their guardians. A research need to be conducted to find out appropriate recommendations and directions so that schools/educational buildings are not used as shelter during disaster.

South-west region: Coastal area

- Crop cultivation in the coastal areas is facing increased challenges due to higher rate of salinisation in the coastal water and land. Crop varieties currently grown in the areas are ever more vulnerable to the onslaught saline water. A pertinent need for taking up research on the development of saline tolerant crop varieties came up from the agriculture experts and scientists. As reported, BRRI dhan 47 a saline tolerant rice variety promoted in few last *rabi* (winter) seasons could not perform well, as expected, in terms of tolerance to Salinity and yield. Greater demand for improved and saline tolerant vegetable varieties was also raised.

- Considering the gradual reduction of crop and grass land, due to salinisation and water stagnation (in some parts of the region), rearing livestock and other animals has been limiting. Conservation of grazing land for livestock has been an issue. Development of new saline tolerant grass varieties was also noted. Introduction of sheep and buffalo, was also suggested, which are believed to have traits to live in the saline areas.
- In order to exploit the condition created due to water stagnation, huge water of the areas can be used to rear new varieties of fishes. A genuine call for finding out or generation of suitable technique/technologies came from the audience.
- Ways/methods of rain water harvesting to meet the demand for drinking water supply and sanitation has been identified from the health professionals and doctors. A strong need for desalinisation of saline water for drinking purpose was categorically raised. Invention of new vaccine to address the impending risk of water borne diseases in the areas more susceptible to Salinity and water stagnation. Arsenic contamination in the ground water has increasingly been a menace for the area and around.
- Management and use of silt (deposited at the mouth of the river, canal) for the purpose of land filling or agriculture has come as an opportunity. Appropriate technology may be found out carrying out a study or research.
- The issue of climate refugee has been getting a reality since two consecutive storms Cyclone *SIDR* and Cyclone *AILA* hit the coastal areas and as a result thousands of local people have been displaced. A need for study/research has duly been emerged from the workshop to find out the implication of the disaster on the livelihoods of thousands of people and the refugee problem.
- One of the reasons for increased dropout rate from the school is increased frequency and intensity of natural disasters in the coastal areas. A careful look into the matter can find and instigate new and real reasons and possible solution measures for further study or action.

Annex-C: Research agendas reviewed through sectoral workshops**Research agendas proposed from the sectoral workshops****Salinity prone coastal region**

- Study on saline tolerant vegetable variety
- Research on development of saline tolerant rice, vegetable variety
- Promotion of saline tolerant rice, vegetable variety as per cropping season
- Study on water management (water requirement etc) of saline tolerant crop
- Study on adaptation of rice, pulse and vegetable against Salinity
- Improvement of soil health through integrated nutrient management approach and cropping pattern
- Assessment of microbial population in saline prone area
- Development of bio-fertilizer using beneficial microorganisms including Plant Growth Promoting Rhizobacteria (PGPR) for cereals, pulse and oil seeds.
- Selection of land use type for saline area (crop, fish, animal)
- Research on effectiveness of DRR in School
- Identification of dropout causes
- Study to establish the relation between dropout out and occurrence of disaster
- Research on composite aquaculture project
- In depth research on understanding of spawning and hatching practices of various aqua-species in river mouth area.
- Research on rice-fish farming to rear new varieties of fishes
- Identification of indigenous varieties of fishes
- To find the local wisdom to solve the water stagnation by community approach
- Introduce integrated farming system that can withstand in water/inundation for longer period
- Introduction of new saline tolerant grass
- Grass varieties tolerant to Salinity
- Feasibility of sheep and buffalo rearing and their profitability
- Study on land zoning and find out suitable land for producing fodder crop.
- Innovate technique for storing fodder and production of modern fodder for livestock
- Study on increasing the effectiveness of PSF (change in filter, changing the proportion of filter bed materials)
- Study on increasing the effectiveness of RWH
- Impact of using saline water for drinking and cooking
- Impact of intake of saline e tolerant rice variety by women on reproductive system
- Study on potential of groundwater harvesting to meet the demand for drinking water supply and sanitation.
- Identification of need for newer vaccine to treat the Salinity induced health problems
- Research for identification of simpler technique of arsenic removal
- Find out house/building design for harvesting rainwater both at household level and institutional/community level
- Use of electro coagulation and filtration to de-saline coastal area surface water
- Analysis on rehabilitation and compensation

Research agendas proposed from the sectoral workshops

- Trend of CC impact on displacement
- What are their livelihood options after migration to other places
- Creating alternative livelihood especially for adult women and adolescent girls needs to be researched.
- Life cycle assessment of climate migrant and find out possible options for addressing livelihood needs
- Demographic survey of the climate migrants, including health status emphasizing mental health situation
- Area and density of siltation per year and to be used them as agricultural land raising
- Trial of different variety of crops on silt filled land
- Find out alternate use of silt (may be brick or settlement raising)
- Assessment of vulnerability and adaptive capacity of coastal community by occupational group
- Impact of Salinity on fish breeding and fish nursery in mangrove area
- Impact of CC on honey bees and target species in Sunderbans.
- Salinity resilient farming system in coastal area considering variable Salinity gradients.
- Barriers to adaptation in coastal area (social, political, administration and economic)

Drought prone region

- Research on pest control and setting up crop health clinic
- Study the crop-pest relationship with changing climate
- Research on Brown plant hopper as vector and its intensity to transmit diseases
- Development of Short maturing rice varieties
- Development of heat tolerant rice and wheat varieties
- Water and agronomic management
- Pest and diseases tolerant varieties
- Ground water retention capacity
- Water table depletion
- Ways to increase the water retention capacity of bottom surface of water bodies at risk
- Study to find out water recycling options in household level.
- Fish rearing techniques for different species of fishes

Flood prone region

- Research on flood tolerant crop like STR
- Study to identify and promote short time harvested crop variety in near future (10 years)
- Development of submergence tolerant rice varieties
- Agronomic management of crops
- Research on crop variety
- Case aquaculture with local fish variety
- Short duration and high yielding fish species identification for seasonal culture
- Brood stock domestication and stock of prawn and other local fish species
- Lesson learning and documentation (i.e. CLP initiatives)
- Study to design mobile transitional house to cope with frequent river erosion.

Research agendas proposed from the sectoral workshops

- Study on different livelihood options and their impact on health
- Livelihood flow assessment
- Impact of migration on health and environment (due to lack of water and sanitation)
- Impact assessment of climate change on river bank erosion
- Alternative for continued schooling
- Way to efficient use of existing flood/cyclone shelter and existing Govt structure and to recommend options for not using school building.
- Find out the rate of attendance during natural disaster and recommendation can be made for separate shelter.
- Research on suitable height of housing against flood water

Flash flood region

- Obstacle in cross boundary modelling
- Translating the long-term prediction model for flash flood into community use friendly way.
- Time series analysis of meteorological data
- Prediction on Flash Flood early warning
- Crop insurance
- Development of short maturing varieties of rice
- Way to effective and timely response for marginal farmers to cope with flash flood/flood/cyclone related crop damage
- Study on breeding pattern of vectors
- Relationship between existence of vector and carbon emission
- Study on the mental status of the adolescent girl.
- Rainfall variability and flash flood pattern changes under climate change condition
- Identify changing in the trends of time, intensity and duration of flash flood

Common

- Cost-benefit analysis of the pilot project on adaptation
- Source of Climate Change Data in Bangladesh
- Identify suitable adaptation practice due to climate change in Bangladesh
- Ecosystem based adaptation practice in Bangladesh (in each hazard prone area)
- A comprehensive study on household level impact of climate change (all region, impact on agriculture, fishery, forestry, livestock, health, gender)
- Alternative energy
- State and capacity of union and upazila DMC in DRR and CC management

Annex D: Presentations of National Validation workshop

Annex E: Prioritized List of Research Agendas from National Validation workshop

Sl #	Name of research agendas, topics, ideas	Points
1	Identification of flood tolerant rice from the local varieties and the varieties released from the govt.	85
2	Identify submergence tolerant rice from the local varieties and the varieties released from the govt.	85
3	Identification of saline, flood and drought tolerant vegetable varieties through screening of for dry season.	85
4	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	85
5	Identify short duration rice from the local and govt. released varieties for the flash flood prone area.	83
6	Identification of flood tolerant vegetable varieties through screening of local and improved varieties.	82
7	Study the salinity resilient farming system in coastal area in the variable salinity gradients.	81
8	Identification of drought tolerant rice varieties through screening of local and HYV varieties for Boro season.	80
9	Identify flash flood tolerant rice from the local varieties and the varieties released from the govt. agencies.	80
10	Identification of rice and vegetable varieties for different salinity gradients.	80
11	Identify submergence tolerant rice from the local varieties and the varieties released from the govt. agencies.	79
12	Trial on the soil improvement through various bio and microbial fertilizers to combat drought.	78
13	Test of rice and vegetable varieties with less irrigation in saline and drought prone areas.	78
14	Research on integrated rice-fish and/or rice-fish-duck cultivation as an alternative in water logged area.	77
15	Installation and comparative study of different household level rain water harvesting techniques.	76
16	Study the impact of point-of-use water treatment strategy in disinfecting surface water for drinking purpose especially during flood, cyclone etc. as an adaptation option for CC related disasters.	76
17	Comparative study of various water harvesting techniques.	75
18	Test the adaptation of the crops, grasses in the silt deposited area.	75
19	Trial on the soil improvement through various bio and microbial fertilizers to combat salinity.	75
20	Test the cultivation of newly released rice/crop varieties in the water logged area.	74
21	Study the impact of the CC on the existing water management infrastructures (embankment, canals, regulators-drainage or flushing capacity)	74
22	Identify short duration rice from the local varieties for the drought prone area.	73
23	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and emergence of pests for agricultural crops.	73
24	Study the changes in rainfall variability and flash flood pattern under CC condition.	73
25	Study the potential of solar energy based water purification technique identification.	73
26	Study the potential of community managed desalination plant.	73

27	Study the impact of salinity and rise in sea surface temperature on population of coastal area	73
28	Study the effectiveness of household level desalination facilities.	72
29	Comparative study of various irrigation techniques for crop production	71
30	Study the impact of climate change on river bank erosion.	71
31	Introduce and test suitability of sheep and buffalo to the saline areas.	71
32	Possibility of strengthening and expansion of coastal embankment to minimize tidal surge inundation.	71
33	Study the potential of crop insurance for the (likely) affected farmers in the flash flood area.	70
34	Introduction and study on comparative advantages of 2 rice varieties BRRI dhan 51 and BRRI dhan 52.	69
35	Study the change in the trends of time, intensity and duration of flash flood.	69
36	Study the impact of climate change on river bank erosion.	69
37	Study the health impact of saline water especially on the women.	69
38	Impact of CC on the Low Flow during dry season and probable impact on irrigation, water availability etc.	69
39	Study of water retention capacity of local and other (inside/outside country) water reservoir.	68
40	Introduction and suitability of the case aquaculture with local as well as improved fish varieties.	68
41	Study the changes in rainfall variability and flash flood pattern under CC condition.	68
42	Cost-benefit analysis of the adaptation options being used and adopted by the communities.	68
43	Test new fodder storage techniques in the saline area.	68
44	Study the impact of salinity and sea surface temperature on fish breeding and fish nursery in mangrove area.	68
45	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of human diseases.	67
46	Adaptation trial on the newly released grass varieties to test the adaptation/suitability at the saline region.	66
47	Introduction and comparative study on the cultivation of various fish species in the local ponds.	65
48	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and emergence of pests for agricultural crops.	65
49	Study the barriers to adaptation in coastal area (social, political, administration and economic).	65
50	Study relation between occurrence of disaster and student dropout and possible alternative	65
51	Prediction (modelling) of the flash flood in the trans-boundary area.	64
52	Research the socio-economic impact of displacement due to climate change	64
53	Assessment of possible livelihood options for the people displaced due to climate change	64
54	Introduction and suitability of alternative energy equipment/appliance/devises.	63
55	Introduction and study the adaptation potential/suitability of the floating vegetable garden and <i>Sorjan</i> .	63
56	Introduction and suitability test of sheep and buffalo to the drought prone areas.	62

57	Feasibility study of alternative energy sources.	62
58	Test the comparative adaptation potential of indigenous and new fish varieties in the water logged area.	62
59	Assessment of vulnerability and adaptive capacity of coastal community by occupational group.	62
60	Potentials for coastal green belt along for defusing tidal/storm surge aggression	62
61	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of diseases.	61
62	Inventory of ecosystem and hazard based adaptation practices in Bangladesh.	60
63	A comprehensive study on household level impact of climate change (all regions, impact on agriculture, fishery, forestry, livestock, health, gender).	60
64	Study to find out the relation between the occurrence of disaster and student drop out. (Include suggestions from the local community and policy makers for possible alternatives).	60
65	Study the local wisdom to solve the recurrent problem water logging.	60
66	Study the breeding potential of newly introduced fish varieties in the <i>haor</i> (open water)	59
67	Study on the impact of CC induced migration/displacement on the livelihoods of displaced people.	57
68	Study on the empirical relation between CC parameters and the emergence of health problems.	56
69	Study peoples' perception on the adaptable height of the rural house.	55
70	Study the barriers that restrict women to adapt to the changing conditions.	53
71	Study the mental health of the women and the adolescent girls displaced due to climate	52
72	Study the mental health of the adolescent girls experiencing changes due to the CC hazards.	51
73	Study the mental health of the women and the adolescent girls displaced due to climate	50
74	Changing the composition of the PHF and test the suitability.	50
75	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	35

Annex F: Prioritized List of Research Agendas from National Validation workshop (Region-wise)

Sl #	Name of research agendas, topics, ideas	Points
Drought Prone Area		
1	Identification of drought tolerant rice varieties through screening of local and HYV varieties for Boro season.	80
2	Trial on the soil improvement through various bio and microbial fertilizers to combat drought.	78
3	Comparative study of various water harvesting techniques.	75
4	Identify short duration rice from the local varieties for the drought prone area.	73
5	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for agricultural crops.	73
6	Comparative study of various irrigation techniques for crop production	71
7	Study of water retention capacity of local and other (inside/outside country) water reservoir.	68
8	Introduction and comparative study on the cultivation of various fish species in the local ponds.	65
9	Introduction and suitability of alternative energy equipment/appliance/devises.	63
10	Introduction and suitability test of sheep and buffalo to the drought prone areas.	62
11	Feasibility study of alternative energy sources.	62
Flash Flood Prone Area		
1	Identify short duration rice from the local and govt. released varieties for the flash flood prone area.	83
2	Identify flash flood tolerant rice from the local varieties and the varieties released from the govt. agencies.	80
3	Identify submergence tolerant rice from the local varieties and the varieties released from the govt. agencies.	79
4	Study the changes in rainfall variability and flash flood pattern under CC condition.	73
5	Study the potential of crop insurance for the (likely) affected farmers in the flash flood area.	70
6	Introduction and study on comparative advantages of 2 rice varieties BRRI dhan 51 and BRRI dhan 52.	69
7	Study the change in the trends of time, intensity and duration of flash flood.	69
8	Introduction and suitability of the case aquaculture with local as well as improved fish varieties.	68
9	Study the changes in rainfall variability and flash flood pattern under CC condition.	68
10	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of human diseases.	67
11	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for agricultural crops.	65
12	Prediction (modeling) of the flash flood in the trans-boundary area.	64
13	Introduction and study the adaptation potential/suitability of the floating vegetable garden and <i>Sorjan</i> .	63

14	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of diseases.	61
15	Study to find out the relation between the occurrence of disaster and student drop out. (Include suggestions from the local community and policy makers for possible alternatives).	60
16	Inventory of ecosystem and hazard based adaptation practices in Bangladesh.	60
17	A comprehensive study on household level impact of climate change (all regions, impact on agriculture, fishery, forestry, livestock, health, gender).	60
18	Study the breeding potential of newly introduced fish varieties in the <i>haor</i> (open water)	59
19	Study on the empirical relation between CC parameters and the emergence of health problems.	56
20	Study the mental health of the adolescent girls experiencing changes due to the CC hazards.	51
Flood Prone Area		
1	Identification of flood tolerant rice from the local varieties and the varieties released from the govt.	85
2	Identify submergence tolerant rice from the local varieties and the varieties released from the govt.	85
3	Identification of flood tolerant vegetable varieties through screening of local and improved varieties.	82
4	Test the adaptation of the crops, grasses in the silt deposited area.	75
5	Study the impact of climate change on river bank erosion.	71
6	Study the impact of climate change on river bank erosion.	69
7	Cost-benefit analysis of the adaptation options being used and adopted by the communities.	68
8	Study on the impact of CC induced migration/displacement on the livelihoods of displaced people.	57
9	Study peoples' perception on the adaptable height of the rural house.	55
10	Study the barriers that restrict women to adapt to the changing conditions.	53
11	Study the mental health of the women and the adolescent girls displaced due to climate	50
Salinity Prone Area		
1	Identification of saline, flood and drought tolerant vegetable varieties through screening of for dry season.	85
2	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	85
3	Study the salinity resilient farming system in coastal area in the variable salinity gradients.	81
4	Identification of rice and vegetable varieties for different salinity gradients.	80
5	Test of rice and vegetable varieties with less irrigation in saline and drought prone areas.	78
6	Research on integrated rice-fish and/or rice-fish-duck cultivation as an alternative in water logged area.	77
7	Installation and comparative study of different household level rain water harvesting techniques.	76

8	Study the impact of point-of-use water treatment strategy in disinfecting surface water for drinking purpose especially during flood, cyclone etc. as an adaptation option for CC related disasters.	76
9	Trial on the soil improvement through various bio and microbial fertilizers to combat salinity.	75
10	Test the cultivation of newly released rice/crop varieties in the water logged area.	74
11	Study the impact of the CC on the existing water management infrastructures (embankment, canals, regulators-drainage or flushing capacity)	74
12	Study the potential of solar energy based water purification technique identification.	73
13	Study the potential of community managed desalination plant.	73
14	Study the impact of salinity and rise in sea surface temperature on population of coastal area	73
15	Study the effectiveness of household level desalination facilities.	72
16	Introduce and test suitability of sheep and buffalo to the saline areas.	71
17	Possibility of strengthening and expansion of coastal embankment to minimize tidal surge inundation.	71
18	Study the health impact of saline water especially on the women.	69
19	Impact of CC on the Low Flow during dry season and probable impact on irrigation, water availability etc.	69
20	Test new fodder storage techniques in the saline area.	68
21	Study the impact of salinity and sea surface temperature on fish breeding and fish nursery in mangrove area.	68
22	Adaptation trial on the newly released grass varieties to test the adaptation/suitability at the saline region.	66
23	Study relation between occurrence of disaster and student dropout and possible alternative	65
24	Study the barriers to adaptation in coastal area (social, political, administration and economic).	65
25	Research the socio-economic impact of displacement due to climate change	64
26	Assessment of possible livelihood options for the people displaced due to climate change	64
27	Test the comparative adaptation potential of indigenous and new fish varieties in the water logged area.	62
28	Assessment of vulnerability and adaptive capacity of coastal community by occupational group.	62
29	Potentials for coastal green belt along for defusing tidal/storm surge aggression	62
30	Study the local wisdom to solve the recurrent problem water logging.	60
31	Study the mental health of the women and the adolescent girls displaced due to climate	52
32	Changing the composition of the PHF and test the suitability.	50
33	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	35

Annex G: Prioritized List of Research Agendas from National Validation workshop (Sector-wise)

Sl #	Name of research agendas, topics, ideas	Points
Crops, Fisheries, Livestock		
1	Identification of flood tolerant rice from the local varieties and the varieties released from the govt.	85
2	Identify submergence tolerant rice from the local varieties and the varieties released from the govt.	85
3	Identification of saline, flood and drought tolerant vegetable varieties through screening of for dry season.	85
4	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	85
5	Identify short duration rice from the local and govt. released varieties for the flash flood prone area.	83
6	Identification of flood tolerant vegetable varieties through screening of local and improved varieties.	82
7	Study the salinity resilient farming system in coastal area in the variable salinity gradients.	81
8	Identify flash flood tolerant rice from the local varieties and the varieties released from the govt. agencies.	80
9	Identification of rice and vegetable varieties for different salinity gradients.	80
10	Identification of drought tolerant rice varieties through screening of local and HYV varieties for Boro season.	80
11	Identify submergence tolerant rice from the local varieties and the varieties released from the govt. agencies.	79
12	Test of rice and vegetable varieties with less irrigation in saline and drought prone areas.	78
13	Trial on the soil improvement through various bio and microbial fertilizers to combat drought.	78
14	Research on integrated rice-fish and/or rice-fish-duck cultivation as an alternative in water logged area.	77
15	Test the adaptation of the crops, grasses in the silt deposited area.	75
16	Trial on the soil improvement through various bio and microbial fertilizers to combat salinity.	75
17	Test the cultivation of newly released rice/crop varieties in the water logged area.	74
18	Identify short duration rice from the local varieties for the drought prone area.	73
19	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for agricultural crops.	73
20	Introduce and test suitability of sheep and buffalo to the saline areas.	71
21	Comparative study of various irrigation techniques for crop production	71
22	Study the potential of crop insurance for the (likely) affected farmers in the flash flood area.	70
23	Introduction and study on comparative advantages of 2 rice varieties BRRI dhan 51 and BRRI dhan 52.	69
24	Test new fodder storage techniques in the saline area.	68
25	Introduction and suitability of the case aquaculture with local as well as improved fish varieties.	68
26	Study the impact of salinity and sea surface temperature on fish breeding and fish nursery in mangrove area.	68

27	Adaptation trial on the newly released grass varieties to test the adaptation/suitability at the saline region.	66
28	Introduction and comparative study on the cultivation of various fish species in the local ponds.	65
29	Introduction and study the adaptation potential/suitability of the floating vegetable garden and <i>Sorjan</i> .	63
30	Test the comparative adaptation potential of indigenous and new fish varieties in the water logged area.	62
31	Introduction and suitability test of sheep and buffalo to the drought prone areas.	62
32	Study the breeding potential of newly introduced fish varieties in the <i>haor</i> (open water)	59
33	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	35
Environment, Health, Women, Livelihood		
1	Installation and comparative study of different household level rain water harvesting techniques.	76
2	Study the impact of point-of-use water treatment strategy in disinfecting surface water for drinking purpose especially during flood, cyclone etc. as an adaptation option for CC related disasters.	76
3	Comparative study of various water harvesting techniques.	75
4	Study the potential of solar energy based water purification technique identification.	73
5	Study the potential of community managed desalination plant.	73
6	Study the impact of salinity and rise in sea surface temperature on population of coastal area	73
7	Study the effectiveness of household level desalination facilities.	72
8	Study the impact of climate change on river bank erosion.	71
9	Study the health impact of saline water especially on the women.	69
10	Cost-benefit analysis of the adaptation options being used and adopted by the communities.	68
11	Study the barriers to adaptation in coastal area (social, political, administration and economic).	65
12	Research the socio-economic impact of displacement due to climate change	64
13	Assessment of possible livelihood options for the people displaced due to climate change	64
14	Introduction and suitability of alternative energy equipment/appliance/devises.	63
15	Assessment of vulnerability and adaptive capacity of coastal community by occupational group.	62
16	Feasibility study of alternative energy sources.	62
17	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of diseases.	61
18	Study the local wisdom to solve the recurrent problem water logging.	60
19	Inventory of ecosystem and hazard based adaptation practices in Bangladesh.	60
20	A comprehensive study on household level impact of climate change (all regions, impact on agriculture, fishery, forestry, livestock, health, gender)	60
21	Study on the impact of CC induced migration/displacement on the livelihoods of displaced people.	57

22	Study on the empirical relation between CC parameters and the emergence of health problems.	56
23	Study the barriers that restrict women to adapt to the changing conditions.	53
24	Study the mental health of the women and the adolescent girls displaced due to climate	52
25	Study the mental health of the adolescent girls experiencing changes due to the CC hazards.	51
26	Changing the composition of the PHF and test the suitability.	50
27	Study the mental health of the women and the adolescent girls displaced due to climate	50
Disaster Management, Water, Infrastructure, Early Warning		
1	Study the impact of the CC on the existing water management infrastructures (embankment, canals, regulators-drainage or flushing capacity)	74
2	Study the changes in rainfall variability and flash flood pattern under CC condition.	73
3	Possibility of strengthening and expansion of coastal embankment to minimize tidal surge inundation.	71
4	Study the change in the trends of time, intensity and duration of flash flood.	69
5	Study the impact of climate change on river bank erosion.	69
6	Impact of CC on the Low Flow during dry season and probable impact on irrigation, water availability etc.	69
7	Study the changes in rainfall variability and flash flood pattern under CC condition.	68
8	Study of water retention capacity of local and other (inside/outside country) water reservoir.	68
9	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of human diseases.	67
10	Study relation between occurrence of disaster and student dropout and possible alternative	65
11	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for agricultural crops.	65
12	Prediction (modelling) of the flash flood in the trans-boundary area.	64
13	Potentials for coastal green belt along for defusing tidal/storm surge aggression	62
14	Study to find out the relation between the occurrence of disaster and student drop out. (Include suggestions from the local community and policy makers for possible alternatives).	60
15	Study peoples' perception on the adaptable height of the rural house.	55

Annex H: Prioritized List of Research Agendas from National Validation workshop (Based on Duration)

SI #	Name of research agendas, topics, ideas	Short-term	Long-term
1	Test the cultivation of newly released rice/crop varieties in the water logged area.	24	8
2	Test new fodder storage techniques in the saline area.	23	9
3	Introduction and suitability of the case aquaculture with local as well as improved fish varieties.	21	10
4	Research on integrated rice-fish and/or rice-fish-duck cultivation as an alternative in water logged area.	21	12
5	Identify flash flood tolerant rice from the local varieties and the varieties released from the govt. agencies.	20	12
6	Study the local wisdom to solve the recurrent problem water logging.	19	8
7	Introduction and study the adaptation potential/suitability of the floating vegetable garden and <i>Sorjan</i> .	19	9
8	Study the potential of solar energy based water purification technique identification.	19	10
9	Study the effectiveness of household level desalination facilities.	19	10
10	Introduction and study on comparative advantages of 2 rice varieties BRR1 dhan 51 and BRR1 dhan 52.	19	11
11	Test the comparative adaptation potential of indigenous and new fish varieties in the water logged area.	19	12
12	Identify short duration rice from the local and govt. released varieties for the flash flood prone area.	19	13
13	Study the health impact of saline water especially on the women.	18	10
14	Study the potential of crop insurance for the (likely) affected farmers in the flash flood area.	18	11
15	Study the potential of community managed desalination plant.	18	12
16	Introduction and comparative study on the cultivation of various fish species in the local ponds.	18	12
17	Identification of flood tolerant vegetable varieties through screening of local and improved varieties.	18	15
18	Identification of rice and vegetable varieties for different salinity gradients.	18	15
19	Changing the composition of the PHF and test the suitability.	17	7
20	Cost-benefit analysis of the adaptation options being used and adopted by the communities.	17	11
21	Study the change in the trends of time, intensity and duration of flash flood.	17	13
22	Introduction and suitability test of sheep and buffalo to the drought prone areas.	17	13
23	Identification of flood tolerant rice from the local varieties and the varieties released from the govt.	17	16
24	Identify submergence tolerant rice from the local varieties and the varieties released from the govt.	17	16
25	Test of rice and vegetable varieties with less irrigation in saline and drought prone areas.	17	18
26	Study the mental health of the women and the adolescent girls displaced due to climate	16	8

27	Introduction and suitability of alternative energy equipment/appliance/devises.	16	11
28	Feasibility study of alternative energy sources.	16	11
29	Assessment of vulnerability and adaptive capacity of coastal community by occupational group.	16	12
30	Adaptation trial on the newly released grass varieties to test the adaptation/suitability at the saline region.	16	14
31	Identification of saline, flood and drought tolerant vegetable varieties through screening of for dry season.	16	16
32	Study the barriers that restrict women to adapt to the changing conditions.	15	10
33	Study to find out the relation between the occurrence of disaster and student drop out. (Include suggestions from the local community and policy makers for possible alternatives).	15	11
34	Study the impact of climate change on river bank erosion.	15	13
35	Study relation between occurrence of disaster and student dropout and possible alternative	15	13
36	Installation and comparative study of different household level rain water harvesting techniques.	15	14
37	Test the adaptation of the crops, grasses in the silt deposited area.	15	17
38	Introduce and test suitability of sheep and buffalo to the saline areas.	15	17
39	Study the mental health of the adolescent girls experiencing changes due to the CC hazards.	14	10
40	Study peoples' perception on the adaptable height of the rural house.	14	12
41	Study the mental health of the women and the adolescent girls displaced due to climate	14	12
42	Comparative study of various water harvesting techniques.	14	13
43	Study the impact of climate change on river bank erosion.	14	13
44	Study the barriers to adaptation in coastal area (social, political, administration and economic).	14	14
45	Study the impact of point-of-use water treatment strategy in disinfecting surface water for drinking purpose especially during flood, cyclone etc. as an adaptation option for CC related disasters.	14	15
46	Comparative study of various irrigation techniques for crop production	14	16
47	Possibility of strengthening and expansion of coastal embankment to minimize tidal surge inundation.	14	16
48	Identify short duration rice from the local varieties for the drought prone area.	14	17
49	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	14	18
50	Study the breeding potential of newly introduced fish varieties in the <i>haor</i> (open water)	13	14
51	Study the impact of the CC on existing water management infrastructures (embankment, canals, regulators-drainage or flushing capacity)	13	15
52	Study the changes in rainfall variability and flash flood pattern under CC condition.	13	16
53	Trial on the soil improvement through various bio and microbial fertilizers to combat salinity.	13	18
54	Identify submergence tolerant rice from the local varieties and the varieties released from the govt. agencies.	13	19

55	Inventory of ecosystem and hazard based adaptation practices in Bangladesh.	12	11
56	Potentials for coastal green belt along for defusing tidal/storm surge aggression	12	15
57	Trial on the soil improvement through various bio and microbial fertilizers to combat drought.	12	19
58	Study on the empirical relation between CC parameters and the emergence of health problems.	11	13
59	Study the impact of salinity and rise in sea surface temperature on population of coastal area	11	17
60	Prediction (modelling) of the flash flood in the trans-boundary area.	11	17
61	Study the changes in rainfall variability and flash flood pattern under CC condition.	11	18
62	Identification of drought tolerant rice varieties through screening of local and HYV varieties for Boro season.	11	22
63	Comprehensive study on household level impact of climate change (all regions, impact on agriculture, fishery, forestry, livestock, health, gender).	10	14
64	Assessment of possible livelihood options for the people displaced due to climate change	10	15
65	Research the socio-economic impact of displacement due to climate change	10	16
66	Impact of CC on the Low Flow during dry season and probable impact on irrigation, water availability etc.	10	18
67	Study the salinity resilient farming system in coastal area in the variable salinity gradients.	10	21
68	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of diseases.	9	15
69	Study on the impact of CC induced migration/displacement on the livelihoods of displaced people.	9	15
70	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for the agricultural crops.	9	18
71	Study of water retention capacity of local and other (inside/outside country) water reservoir.	8	18
72	Study/development of prediction (model) on changes in the climate (temp. in particular) and the emergence of human diseases.	8	19
73	Study the impact of salinity and sea surface temperature on fish breeding and fish nursery in mangrove area.	8	20
74	Study/development of prediction (model) on changes in the climate (temp, humidity in particular) and the emergence of pests for the agricultural crops.	8	24
75	Identification of saline tolerant rice varieties through screening of local and HYV varieties for Boro season.	5	10