Government of India

Ministry of Water Resources, River Development and Ganga Rejuvenation

National Water Mission

Central Water Commission

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Operational Research to Support Mainstreaming of Integrated Flood Management under Climate Change

Volume 9

Roundtable Consultation Report

Final

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Deltares in association with RMSI and JPS

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Report

Roundtable Consultations on Operational Research to Support Mainstreaming of IFM under Climate Change

August 27, 2015
Hotel *Jaypee Sidharth*, Rajendra Place, New Delhi

Report of the Roundtable Consultations on PATA Project

Introduction

The PATA 'Operational Research to Support Mainstreaming of IFM under Climate Change', supported by ADB and co-financed by DFID is being implemented by Deltares and Risk Management Solutions International (RMSI) in technical collaboration with CWC. The project seeks to evolve approaches to operationalize the concept of Integrated Flood Management in flood prone river basins in general, and the two river basins/ sub-basins in eastern India (Burhi Gandak in Bihar and Brahmani-Baitarani in Odisha), in particular. The operational research involves the entire spectrum from structural measures such as embankments to non-structural measures such as community preparedness and institutional strengthening of various agencies currently involved in flood management in the sub-basins.

Building skills for setting up basin simulation models for flood forecasting, especially inundation mapping, setting up flood forecasting models for the two pilot sub-basins and evolving appropriate institutional arrangements for implementing IFM strategies are key intended outcomes of the project. The project, which was started in February 2014, would be coming to a close on October 31, 2015, and major outputs from the projects are being finalized.

It was thought necessary to present the findings of the operational research with all the key stakeholders of this project, so that the expert suggestions on the flood management strategies for the two states in general and the sub-basins in particular, can be obtained and incorporated in the final report. A roundtable consultation was organized by Deltares, the Netherlands in collaboration with Institute for Resource Analysis and Policy (Hyderabad) with support from the National Water Mission, Ministry of Water Resources, GOI, New Delhi. The roundtable was held on August 27, 2015 at Hotel Jaypee Sidharth, Rajendra Place, New Delhi.

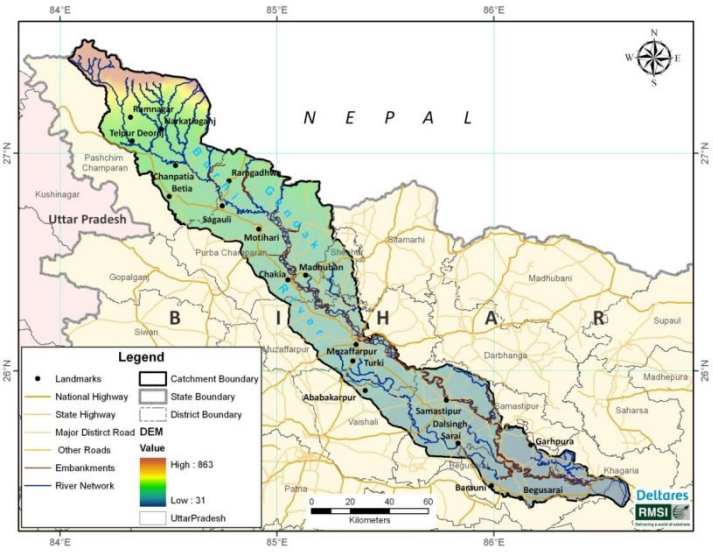
The agenda of the roundtable consultation is given in Annexure 1. Officials from the following agencies were invited to the round table, the invitation for which was sent out by the National Water Mission: National Water Mission-New Delhi, Central Water Commission, New Delhi and two regional offices (in Patna and Bhubaneshwar), the Ganga Flood Control Commission (GFCC)-Patna, the National Disaster Management Authority, the National Disaster Management Institute, Bihar State Disaster Management Authority, Odisha State Disaster Management Authority, the Water Resources Departments of Bihar and Odisha, and the team members from RMSI, JPS and IRAP. The roundtable consultation was attended by senior officials from NWM, CWC, GFCC, officials of Deltares, RMSI, JPS, and their consultants working for the project in the states of Odisha and Bihar. The list of participants of the roundtable is provided in Annexure 2.

Background

The PATA Operational Research on Mainstreaming Integrated Flood Management under Climate Change was included in ADB's country operations business plan, 2012-2014 under the 2012 pipeline in December 2011. The ADB fact-finding mission was conducted on 15 February 2012 and 9 March 2012 to consult the Government on the preliminary design of the TA, including expected outputs, outcomes and impacts; the financing modality; cost estimates and implementation schedules and arrangements. Thus the present PATA-8089 IND has emerged. The PATA is co-financed by UK aid (DFID). The Ministry of Water Resources (National Water Mission) is the executing agency.

The PATA was implemented in two phases. The Phase I was from March to August/October 2013 which comprised scoping and planning studies. The present Phase II involves operational research on Integrated Flood management (IFM) in the selected basins in a way that takes into account projected future conditions under the scenario of climate change. The maps of the two basins selected for the research (Burhi-Gandak and Brahmani-Baitarani) are given in Figure 1 and Figure 1, respectively. This phase is being executed between February 19, 2014 and October 31, 2015.

Figure 1: Drainage Map of Burhi-Gandak sub-basin of the Ganga River Basin



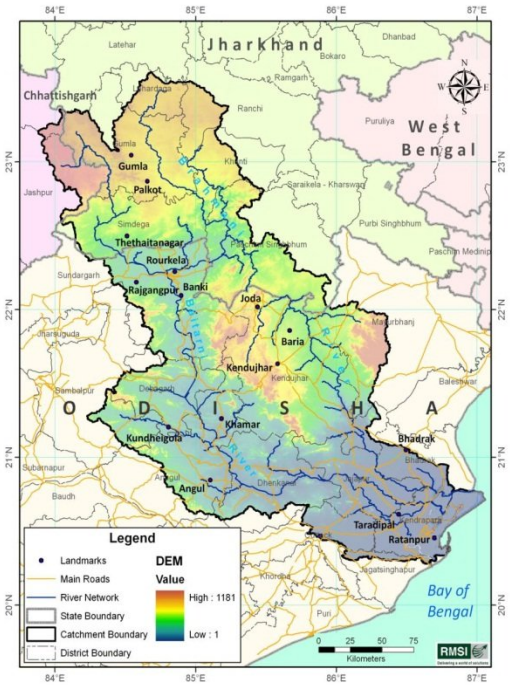
The specific objectives of the study were: to demonstrate that flood risks can be reduced through a broad mix of flood management measures, typical for the Indian context, with specific considerations for Climate Change; to demonstrate to central and state government the benefits of such an integrated flood management and planning process; to provide guidance on such planning process, and to translate results into updated CWC guidelines and regulations relevant for future DPR approval.

The study seeks to explore a combination of structural and non-structural measures for flood control and management as well as ways to increase the resilience of the communities in flood prone areas of the two selected basins (Burhi-Gandak, Bihar and Brahmani-Baitarani, Odisha), so that the selected measures can be replicated or adapted in other basins.

The selection process was such that it would enable evaluation of investment programmes based on scientific reasoning and economic efficiency.

The ultimate outcome of the project is to support risk *informed decision making for flood hazards* in India. We define this as decision making based on estimates of flood risks and the costs and benefits of flood mitigation and management. The approach gives emphasis on two aspects: a] a 'proportionate' response to risk; and b] a process of assessing risk, which is transparent and wherein the results are accessible. The idea is that risk estimates may be used to inform multiple decision makers, including the general public. Risk informed decision making has become a new approach to floods in the past decade and has been incorporated in what we call *integrated flood management* (IFM).

Figure 2: Drainage Map of Brahmani-Baitarani basin



The project is executed by a consortium led by Deltares, the Netherlands, together with RMSI Ltd. (Delhi), JPS Associates (Delhi) and the Institute for Resource Analysis and Policy (Hyderabad) and includes 18 experts from different disciplines. The Central Water Commission is assisting the project.

The research activities include: downscaling Climate Change model results and impact assessment on flood hazards in both basins; development of a 2Dimensional hydrological/hydraulic model for both sub-basins; setting up of a GIS based Integrated Flood Management Information System; analyzing legal, economic and institutional analysis of IFM practices; community needs assessment through Focus Group Discussions and a household survey (approx. 500 HH); review of agricultural, geotechnical, flood control and drainage practices; and, review of environmental aspects of flood mitigation measures.

The Technical Sessions of the Roundtable

The technical session began after formal opening of the roundtable consultation by the senior officials of National Water Mission. The welcome address was made Shri Joginder Singh, Sr. Technical Advisor-NWM. The opening remarks were made by Shri Nikhilesh Jha, Mission Director-NWM. The session was chaired by the Mission Director-NWM.

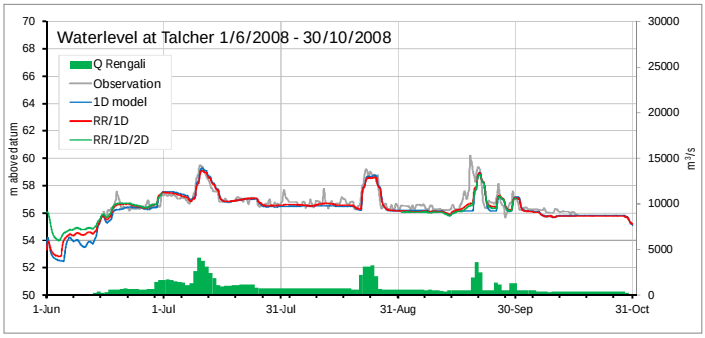
Dr Marcel Marchand, who represented Deltares in the Netherlands as Team Leader of the project, mentioned that IFM is a complex concept; several disciplines are involved; hence there is a problem of integrating the outputs from all of them. Certain aspects are looked at in detail. He mentioned about nine specific outputs expected from the project.

He threw some light on the unique features of SOBEK model, which is composite hydrological and hydraulic model. The rainfall is routed through the rivers after computing the runoff. The model required data on rainfall, elevations, geo-morphology, and river channel section.

Calibration of the model was done for observed flows for certain number of years and thereafter validation was done for subsequent years of flood flow observation. Figure 3 shows the results of Sobek model validation results for Brahmani-Baitarani basin for the period from June 1 to October 30, 2008. Base line simulation of the model was run for two years and 25 years, which showed an increase in extent of flood to the tune of 6961.8 MCM in Odisha (Brahmani-Baitarani). Model simulation was also done for 'climate change scenario' for 2040 and 2080. He mentioned that increased rainfall would lead to increased flooding, with areal extent of flooding increasing from 674.3 sq. km to 713 sq. km in 2040 and 807 sq. km in 2080 in the case of Burhi-Gandak basin.

The model was run with several scenarios of flood management interventions—new dams, barrages and a river link in the case of Burhi Gandak and two irrigation projects, one hydropower project and a barrage for Brahmani-Baitarani in Odisha. Reservoir operation scenario was also incorporated, by suggesting rule curves in the model.

Figure 3: results of Sobek model validation in Brahmani-Baitarani



The models showed significant reductions in flood hazards through control structures (up to 42 per cent as combined effect of all structures and river diversion) in Burhi-Gandak and less in Brahmani-Baitarani. As per the model predictions, the biggest impact would come from construction of embankments. In Baitarani basin, the effect of tides was found to be significant in generating floods in the deltaic region, and therefore controlling inundation caused by floods and tides will require tidal barrages, which are expensive. Complete flood control is not feasible.

In terms of priorities, Marcel argued that community disaster preparedness plans for all the villages in the basin, improving the flood forecasting methods to increase the lead time, embankment improvements, (better supervision during construction, maintenance, provision of drainage and realignment at some places), and optimizing dam operations for better flood control should receive attention.

The presentation was followed by discussions. The following suggestions and comments were made by the Mission Director and Senior Technical Advisor of NWM and the Chairman of Ganga Flood Control Commission for the consideration of the project team for inclusion in the impact analysis: deforestation in the upper catchments and its implications for the flood magnitudes; the impact of soil erosion in the catchment on occurrence of floods; earthquakes/tremors in the Himalayas and its implications for the river course and the consequent impact on future floods; aggradation and degradation of the tributaries of river Ganges on the incidence of flooding. It was pointed out that soil erosion is a main problem in Burhi Gandak basin, due to prevailing terrain conditions in the catchment, which has caused heavy deposition of sediment in the river.

It was pointed out that the Himalayan rivers are subject to seismic activities and therefore, the likelihood of these rivers changing course is very high. Particularly, the Burhi Gandak river basin falls under earth quake zone IV. Hence, the structures constructed for flood control in the basin should conform to National Building Code of India, 2005 (SP (7): 2005); criteria for Earthquake Resistant Design of Structures, (IS (1983): 1984); Recommendation for Seismic Instrumentation for River Valley Projects (IS (4927): 1968). The same action was proposed for Brahmani-Baitarani basin of Odisha also. Accordingly, a paragraph on the various codes, their periodic up-grading and the latest CWC guide-lines for earth-quake resistant design and seismic instrumentation will be added in the DFR Volume 1 (Main Report). Also, the present practices followed according to these guidelines for major

river valley projects as well as smaller flood embankments will be included in the Volume 3 of the DFR for Burhi-Gandak basin and in the volume 2 of the DFR for Brahmani-Baitarni basin.-

Further, it was suggested that various flood causing factors, such as: climate variability and change; population rise; deforestation; and economic development, should be identified and ranked in the order of their contribution in affecting floods in the selected basins. Also non-structural measures for flood control need to be analysed.

It was suggested to include the analysis covering the effect of impact of deforestation and soil erosion on flood occurrence in both the river basin as separate chapters in the report. The issue of sediment transport in Burhi Gandak river also needs to be explained / discussed suitably in the report.

It was also pointed out that more than climate change, climate variability is a major concern in the two basins and also choosing a time horizon of 65 years for analyzing the climate change impacts would not be reasonable. Suggestions were also made to provide some examples of flood preparedness and modelling studies in other countries in order to get a better picture of its usefulness in flood management.

While responding to the questions, it was pointed out by the Deputy Team Leader (Sethu Rathinam) that many of the processes happening in the basin are already incorporated in the study, of which modelling is one component. The model was used to analyze the impact of climate change on basin hydrological processes. The discussion was concluded with the observation that some of the published scientific material on the impact of deforestation could be made use of in the report, rather than making refinements in the model.

This was followed by presentation by Murali Krishna, Community Expert working on the project from RMSI. The presentation covered the flood management issues faced by the communities and their perspectives on flood management. He began by saying that though there were common issues related to floods for communities in both the basins, there were also variations across the basin—from upstream to mid steam and downstream. Also, the way communities perceive the impact of flood vary depending on the flood magnitudes. Early floods (before the cropping season) and low floods are preferred; while heavy floods according to them cause devastation.

Some of the problems faced by the communities in reducing the risks associated with floods are: inefficient flood early warning system and improper access to information; waterlogging of agricultural land caused by deposition of silt rendering it unsuitable for cultivation; environmental and health concerns, such as drinking water shortage, poor sanitation, fodder of livestock, etc.; inadequate flood shelters and godowns for storing grains, seeds, and fodders

He highlighted the point that sustaining the livelihoods was an important concern for the communities living in the flood-affected areas. The communities often make settlements in the flood plains, on the river channels and inside the embankments, posing a major threat to the efforts in controlling the impacts of floods through flood control embankments. During floods, people move to the top of embankments for ensuring safety, often posing challenges to those who are engaged in rescue and relief operations. He highlighted the need for developing village level disaster management plans, which take into account community needs and priorities, and enhancing the disaster preparedness of the local communities and carrying out disaster management work at the local level through the involvement of community-based organizations and NGOs. Training of

disaster management task force in rescue and relief operations, including first aid, hygiene and sanitation, safe drinking water, etc., was also proposed.

Suggestions were made about the need to understand certain behavioural patterns among the communities affected by floods, which often pose hindrance to the officials of government agencies carrying out flood relief works. It was pointed out that such an understanding would help devise awareness and capacity building programmes for the communities for promoting IFM. Also, it was pointed out that international best practices concerning community involvement in flood control and management need to be reviewed and presented.

Dr M. Dinesh Kumar, Institutional Expert for the study made a presentation about institutional aspects of flood management. He began the presentation by describing the concept of IFM and defining institutional arrangement, and the approach used for identifying institutional arrangement for IFM for future in the two basins. After describing the existing institutional arrangement for flood management in the two basins—starting from national level institutions to the district level agencies--, he highlighted the institutional issues and challenges involved in IFM, based on the analysis of the capabilities of these institutions--governance, administrative structures, staffing, HR capabilities and finances, and the nature of interactions amongst them, and change needs. He then went on to discuss the institutional design principles for sound IFM and the proposed institutional arrangement for IFM in the two basins. The design principles and roles and responsibilities of River Basin Organization (RBO), as a coordinating body, which would monitor and regulate the activities of various line agencies, were also discussed. He pointed out that increasing the transparency and accountability in the functioning of existing institutions through division of roles and responsibilities, and providing sufficient incentives for the institutions to perform are the fountainheads of the suggested institutional change.

On a query about the types of RBOs for each river basin, Dr Kumar mentioned that the basic roles and responsibilities of the RBOs though would remain the same, given the nature of problems and what is feasible to manage them, the regulatory functions to be actually performed by the RBOs and instruments for the same would differ. For instance, in Bihar, increasing groundwater pumping in the plains might have some positive impact on flood cushioning and reducing the flood hazards. On the other hand, in Odisha, changing reservoir operations would significantly impact the magnitude of flood exposure to floods. Accordingly in Bihar, regulating water use by individual farmers will have to be focused and instruments for the same will have to be designed by the RBO. In Odisha, the irrigation department will have to be incentivized to increase the flood cushioning of the major and medium reservoirs in the basin. If there are foregone benefits of releasing water from the reservoir for increasing the flood cushioning, those losses need to be compensated.

Responding to another query related to role of PRI's in flood management, Dr Kumar emphasized that they might not be ideal institutions, given the nature of the work and the technical expertise required to achieve the objectives of flood management. Their role should more in addressing governance issues, and not in management issues.

Uttam Kumar of RMSI made a presentation of the modelling study which analyzed the impact of climate change on the rainfall and flood hazard in the basins under study. He opened his presentation by stating that in the past extreme rainfall over India has resulted in landslides, flash floods, severe river floods and crop damage. He added that given that weather extremes are directly

affected by climate change, it was important to understand the degree to which the adverse impacts of these on flooding intensity and frequency in major river basins, and climate change was expected to further alter the intensity and frequency of extreme rainfalls. He then went on to discuss the methodology employed for the study.

The methodology involved: validation of CMIP5-based three RCP6 climate models (HadGEM2-ES, GFDL-CM3, and MIROC-ESM Model) rainfall projections for the two basins by comparing the CMIP5-based model simulated climatic variables for the period, 1961–1990 with that of APHRODITE-based observed climatic variable; bias correction of daily rainfall time series from the selected three climate models for the baseline and future projections using Delta Change method; assess the projected change in frequency of extreme rainfall events over the two basins using bias corrected three climate models data for short (2040s i.e., 2030–2059) and long-term (2080s i.e., 2060–2099) time horizons.

He mentioned that the predicted variables were the total annual rainfall, the monthly rainfalls and the maximum daily rainfall received during the month, temperature change was the major predictor variable. As per the predictions by multi model ensemble and HadGEM-2, both the basins would receive much higher annual rainfall during 2040 and 2080 as compared to the base year (2015). But, the monthly rainfalls showed slightly different trends by both the models. The maximum rainfall intensity as per the multi model ensemble would be higher than the observed rainfall intensity in the basin, during 2040 and 2080. As per the predictions by both multi-model ensemble and HadGEM 2, the basin in Odisha would receive higher rainfall in 2040 as well as 2080 as compared to the past. But, the monthly rainfall trends predicted by both the models were different. As per the model predictions, the maximum flooding extent and volume for 2040 and 2080 would be higher than that of the base line.

One of the major suggestions by the Chairman, GFCC on the results of modelling study was to link the outputs with the physical reality and ascertain whether the predicted events (increased rainfall) are due to climate change or climate variability.

Roundtable Discussions

After the lunch break, the round table discussions started. Dr M Dinesh Kumar facilitated the discussions. A total of six key questions (with sub-questions) were posed to the delegates, to gain further expert inputs into the issues which emerged from the research, so as to help evolve practical suggestions. The questions and the summary of the responses from the participants against each question are presented below.

1 How to promote community preparedness so that every village has a plan in 2 years?

The group deliberated on the issue and came out with following suggestions:

- Provide a standard format for preparation of village level community based flood preparedness plan.
- Raise community confidence through capacity building.

- Make community preparedness a regular activity for PRIs and provide incentives for the same.
- For making community prepared for a natural hazard like floods, existing institutional structures should be utilized but they may need to be strengthened.

2 Why do people cut embankments? And what can be done about it to prevent this from happening again?

Following observations were made on this issue:

- Often embankments are cut to make passage for flood water as most of the embankments do not have regulators.
- Even when regulators exist, they are in poor and non-working conditions as proper operation and maintenance is not undertaken.
- They are also cut to divert water for irrigating crops during drought years.
- To prevent embankments cutting, ownership of the structure has to be with the community. This can be achieved by involving local level institutions in their construction.
- Further during embankment stabilization programmes, efforts should be made to seek community participation.

3. How best to get a basin-wide water resource management plan, especially for addressing flood management issues?

The discussions around basin-wide water resource management plan highlighted the following:

i] How best to get the required information—hydrology, meteorology, geo-morphology, land-use and land-cover and socio-economic data, for planning;

- State remote sensing agencies generate such data and information but access may be a problem. India WRIS also has a substantial amount of basin wise hydrological data in public domain for the non-classified basins. However, there is a need to update CWC basin wise data base. Basin-wise data should also be made available at the state level. Though data management is an issue, international experiences and learning on data management can be looked at. It was also realized that the socio-economic data are not available basin-wide and would require substantial amount of effort to deduce them at the basin and sub-basin level.

ii] what kind of skills, required for basin WRM management planning, are absent in the existing institutions?

- Presently, one of the major lacunae in the working of existing institutional set up is that coordinated and integrated basin level water resource management planning is not undertaken.

iii] How to make the planning a two way process—micro (village level) to macro (basin level) and basin to village?

- Presently there is no coordination between State and Centre on the basin or local level planning. However, river basin organisations (RBOs) can handle this proposed two way planning process. Specialized institutions, such as Army corps of engineers established in US, can also be thought of.

4. How best to regulate the land and water use in the flood prone basins in a way that promotes good water resources management and IFM?

   i] How to make land use regulations work for agricultural land? ii] How to incentivise groundwater intensive use in regions with shallow water table for 'flood cushioning' iii] What kind of incentives can be offered to upper catchment communities for protecting watersheds that help improve flood absorption in the catchment?

   The group emphasized that the mechanism for land and water use regulations in the flood prone areas is well documented in various flood control guidelines. However its implementation is an issue. Further, to make such regulations work, various departments handling water and land issues at the State level has to work together. RBOs also can be effective in regulating water use and land use changes in such basins. However, their ability to effectively regulate will depend on its institutional outreach and power conferred to them.

5. How to ensure the flood control structures (embankments) are planned, designed, built and maintained to ensure maximum protection from flood hazards?

   i] What are the inadequacies of Cost – Benefit analysis currently followed for flood control structures? ii] How to ensure that cost benefit analysis for embankments is made more rigorous, taking into account all the direct and indirect benefits, and anticipated damages for floods of different return periods? iii] What kind of changes in the existing funding criteria for flood control structures are needed to produce the best outcomes?; and iv] What kind of institutional mechanisms should be in place for monitoring the performance of embankments?

   In the discussions, it was highlighted that all the projects costing more than 12.5 crore comes to CWC for design approval. A manual also exists for designing the flood control structures. However State government may not follow it.

   As regards the cost benefit analysis, indirect benefits from the flood control structures should also be considered, especially in view of the fact that a lot of development takes place in a locality once it is protected from floods, in addition to the reduction in flood damage. Nevertheless, a committee has already been constituted to analyse the cost-benefits of the proposed flood control structural interventions.

   As regards monitoring the performance of embankments, lack of sufficient tools, equipment and transport vehicles are brought out from time and again as major constraints for the field level officers to perform effectively.

6. What measures should be taken to increase individual and community resilience against floods?

   Group made the following observations on the issue:

   - Economic development and poverty alleviation should be given emphasis in the flood affected areas.
   - Community awareness through education should be provided to better prepare community against floods.

- Agricultural practices (especially choice of crop) should be such that it can acclimatize in flood affected areas.

Conclusions and Ways Forward

Shri Joginder Singh, while thanking the project team for producing the research outputs and organizing the consultation, mentioned that groundwater issues could be given a little more emphasis in the final report. While thanking NWM and CWC officials and other participants of the round table for their valuable inputs and suggestions for improvement, Dr Marcel indicated that there was always a mismatch between what the policy makers and practitioners look for as research outcomes and what the scientists produce. He mentioned that while analyzing problems as complex as climate change and its hydrological impacts there is built in uncertainty, and suggestions could be given with certain degree of confidence, and therefore scientists are still dealing with this issue of making their suggestions practically useful.

Annexure 1: Agenda for the Roundtable Discussions

Operational Research to Support Mainstreaming of IFM under Climate Change

August 27, 2015

Hotel *Jaypee Sidharth*, Rajendra Place, New Delhi

11.00-11.10 hours	Opening Remarks	Shri M Satyanarayana/ Shri Joginder Singh
11.10-11.15	Participants self-introduction	
11:15-11:25 hours	Introduction to the Project	Dr MP Singh, CWC
11.25-11.45 hours	Session Chair: Shri Nikhilesh Jha, IAS, Mission Director, National Water Mission Key Findings from the two Study Basins, including modelling results	 Dr Marcel Marchand, Deltares
11.45-12.00 hours	Tea/Coffee break	
12.00-12.20 hours	Community Perspectives in Flood Management	Dr. Murali Krishna, RMSI
12.20-12.40 hours	Institutional Arrangements for Integrated Flood Management	Dr M Dinesh Kumar
12.40-13.00 hours	Impact of Climate Change on Flood Risk	Dr. Uttam/ Dr.Marcel Marchand
13.00-14.00 hours	Lunch Break	
14.00-15.40 hours	Roundtable Discussions	Moderator: Dr M Dinesh Kumar
15:40-16:00	Tea/Coffee break	
16.00-17.00 hours	Roundtable Discussions Contd.	Moderator: Dr M Dinesh Kumar
17.00-17.20 hours	Ways Forward	Asian Development Bank/NWM/ CWC/ TA Team Leader
17.20-17.30 hours	Closing Remarks	Sethu Rathinam/Marcel Marchand

List of Participants

Sr. No.	Name	Designation and Institution
A)	National Water Mission, Ministry of Water Resources, RD & GR	
1	Shri Nikhilesh Jha, IAS	Mission Director, National Water Mission, New Delhi
2	Shri M. Satyanarayana, IFS	Advisor-Coordination and Monitoring, National Water Mission, New Delhi
3	Shri Joginder Singh	Advisor-Technical, National Water Mission, New Delhi
4	Shri Ashok Gupta	Director, National Water Mission, New Delhi
5	Dr R.C. Jain	Consultant, National Water Mission, New Delhi
6	Shri Arijit Ganguly	Young Professional, National Water Mission, New Delhi
B)	Ministry of Water Resources, RD & GR	
7	Shri K.M.M. Alimalmigothi	Economic Advisor, National Water Mission
C)	Central Water Commission	
8	Dr M.P. Singh	Chief Engineer-P & D, Central Water Commission, New Delhi
9	Shri Vinay Kumar	Chief Engineer-Hydrological Studies Organization, Central Water Commission, New Delhi
10	Shri Sanjay Kumar Singh	Director-Climate Change, Central Water Commission, New Delhi
11	Shri R.J. Verma	Director- Planning & Development, Central Water Commission, New Delhi
12	Shri Sharad Chandra	Director, Central Water Commission, New Delhi
13	Shri Pranav Shukla	Assistant Director, Office of Central Water Commission, New Delhi
14	Shri Manoj Kumar	Deputy Director, Office of Central Water Commission, New Delhi
15	Shri M. Balan	Assistant Director, National Water Mission, New Delhi
16	Shri G.S. Jha	Chairman, GFCC, Patna
D)	Asian Development Bank	
17	Shri Naduvina Mani	Asian Development Bank , New Delhi
E)	International Consultant	
18	Dr Marcel Marchand	Project Team Leader, Deltares, Netherlands

19	Shri Jayadev Nansey	Environmentalist, Consultant-Deltares, Jamnagar
20	Shri T.G. Ekande	Water Resource Economist, Consultant-Deltares, Pune
F)	National Consultant	
21	Shri Sethu Rathinam	Project Deputy Team Leader, RMSI
22	Dr M.V.R.L. Murthy	Vice President, RMSI
23	Dr Sujana Dhar	Technical Specialist, RMSI
24	Shri Murali Krishnan	Community Expert, RMSI
25	Shri Madan Gopal Kauleshnam	Flood Management Expert, RMSI, Patna
26	Shri Uttam Singh	Technical Expert, RMSI
27	Shri Ujjwal Sur	GIS Advisor, RMSI, Orissa
28	Shri Rupesh Kumar Sinha	GIS Advisor, RMSI, Bihar
29	Dr M. Dinesh Kumar	Project Institutional Specialist, Hyderabad
30	Shri Nitin Bassi	Senior Researcher, Institute for Resource Analysis and Policy, New Delhi

The Roundtable in Pictures