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Water/Flood Management and Institutional Issues in Bangladesh

Engineer Sheikh Mohammad Nurul Islam

ABSTRACT

Bangladesh is a low-lying deltaic country with a complex active delta; it has numerous rivers, canals and coast creeks with extensive flood plains through which surface water of about 1.7 million sq-km drains annually. Floods are everyday monsoon phenomena in the deltaic plains of Bangladesh. However present study has conducted to find out the institutional issues of the water resource management project of Bangladesh. The study has conducted at urban and rural area of in Bangladesh. The present study is survey type. Data were collected from primary and secondary sources. Total 500 people from the stake holders in selected areas were selected for the study. Questionnaires, Focus group discussion, Participatory Rural Appraisal (PRA) were used for primary data collection. Computer Program Statistical Package for the Social Sciences (SPSS), Microsoft Excel was used for data analysis. From the result it was found that although the livelihood of the people in Bangladesh is well adapted to normal monsoon floods, the damages due to inundation, riverbank erosion or breach of the embankment, etc., still occur in various regions in almost every monsoon. They often have disastrous consequences: significant damage to infrastructure, great loss of property, crops, cattle, poultry etc., human suffering and impoverishment of the poor. With every major flood in Bangladesh, food security and poverty are adversely affected. The characteristic of rivers varies from region to region. FFWC and BWDB monitored the flood situation during and beyond the monsoon if the situation was in demand. The FFWC has issued daily flood bulletin from May to October with a forecast lead-time of 24hrs, 48hrs and 72hrs, 96 hrs., and 120 hrs. (upto 5 days) along with warning messages and flood inundation maps. Mobile-based IVR systems improved dissemination significantly. Also, 16 new flood forecasting points have been added to the system. These are the new efforts to make a more localized flood forecast. In addition to deterministic flood forecasts up-to 5-days lead time, FFWC issued medium range up to 10-days lead-time probabilistic forecasts at 38 locations. FFWC has attempted to use satellite-based (Jason-2 Satellite Altimeter Data under SERVIR program of NASA) information of the upper catchment with a free download facility for extending the flood forecast lead time up to eight days. This study was done to analyze flood forecasting and management. Climate change and extreme climatic impacts are increased in recent years. Flood in Bangladesh is common, but the secondary data are shown that flood forecasting is well developed, but the problems are information dissemination and communication. The community doesn't involve the dissection-making and warning system of the flood. The community-based early warning system has been developed.

Key words: *Flood, Water, Management, River, Canal, Embankment, Forecasting and Warning, Infrastructure, People participation, Stakeholder, Irrigation, Drainage.*

INTRODUCTION

Extreme weather-triggered flood events have caused more severe damage across the globe. A global dataset from the Centre for Research on the Epidemiology of Disasters and the United Nations Office for Disaster Risk Reduction confirms that floods accounted for 43.4% of all catastrophic events in 2018. In South Asia, Bangladesh has experienced severe floods periodically due to nonlinear geomorphological and hydro-meteorological trends, unplanned land-use practices including urban sprawl, deforestation and, significant population growth. Frequent large floods, thus, make Bangladesh one of the most flood-prone countries in the world. Bangladesh is an agrarian country and transforming from agriculture to industrial country. Rural population (% of total population) in Bangladesh was reported at 61.05% in 2021, according to the World Bank collection of development indicators, compiled from officially recognized sources. According to a report of The Daily Stars on Saturday, May 27, 2023, in Bangladesh, agriculture continues to be the chief source of employment in 2022. In 2016-17, the sector accounted for 40.6 percent of employment. In 2022, that ratio increased to 45.33 percent indicating that the country continues to be a largely agrarian society. The share of manufacturing in total employment declined from 20.4 percent in 2016-17 to 17.02 percent raising questions about the nature of economic development in recent years. According to Bangladesh Bureau of Statistics report 2021 the poverty rate of Bangladesh is 15%. According to a report of The Daily Stars on Saturday, May 27, 2023, the poverty rate of Bangladesh is 18%. According to the previous survey done 2016, the poverty rate was 24.3 percent and extreme poverty 12.9 percent. The 2022 Economic Review that the finance ministry placed along with the budget in June last year estimated poverty rate at 18.5 percent in the 2022-23 FY. Improvements in agricultural production were expected to enhance the economic well-being of the population and help in reducing the incidence of rural poverty. Increasing agricultural production mainly depended on improving the country's water resources regime. This required reducing flood and inundation during the monsoon season and providing irrigation water during the drier months of the year.

Climate change is the reality and Bangladesh is the most vulnerable country worldwide. The frequency and intensity of natural hazards are increasing daily, parallel to climate change. This country loses a large part of its GDP every year as an economic loss. Flood is the most frequent disaster in this country, and this disaster faces every year. Climate change and geographic location make more vulnerable to floods, and some socioeconomic settings have increased the level of vulnerability. Due to the vulnerability and the frequent flood, the losses are high.

Naturally, Bangladesh is a low-lying country standing on the foothill of the Himalayan Mountain. Bangladesh lies approximately between 20o30' and 26o40' north latitude and 88o03' and 92o40' east longitude. It is one of the biggest active deltas in the world, with an area of about 1,47,570 sq.-km (BWDB, 2014). The west, north and most of the east are the India border, some south-eastern areas are the Myanmar border, and the Bay of Bengal is in the south. The country is under a sub-tropical monsoon climate. The annual average precipitation is 2,300 mm, varying from 1,200 mm in the northwest to over 5,000 mm in the northeast (BWDB, 2014). It has 405 rivers, including 57 transboundary rivers. Among them, 54 originated from India, including three major rivers, the Ganges, the Brahmaputra and the Meghna other three rivers originated from Myanmar (BWDB, 2011). Monsoon flood inundation of about 20% to 25% of the country is assumed beneficial for crops, ecology and the environment. Inundation of more than that causes direct and indirect damages and considerable inconveniences to the population.

Naturally, Bangladesh is a low-laying, floodplain country with only a few hills in the southeast and the northeast. Generally, the ground slope of this country extends from north to south with an elevation rand 1-60 m above MSL (BWDB, 2014). The country consists of the flood plains of the Ganges, the Brahmaputra and the Meghna rivers and their numerous tributaries and distributaries. The Ganges and the Brahmaputra join at Aricha-Goalundo, known as the Padma River. The river Meghna joining the Padma near Chandpur, flows to the Bay of Bengal as the Meghna River. The Ganges, Brahmaputra and Meghna rivers are generating a basin named GBM, which covers most of this country's area and drains huge runoff through these three river systems. The catchment of this basin is approximately 1721300 sq.-km which only about 7% lies in Bangladesh and the rest 93% (JRCB, 2016) are outside this country also, with around 100900 million m3 (BWDB, 2014)water passing through this river system during the rainy season. Most rivers have sandy bottoms, flat slopes, substantial meandering, and banks susceptible to erosion and channel shifting.

The Gages river is about 2600 km to its confluence with the Brahmaputra-Jamuna at Aricha-Goalundo ad catchment, about 90700 sq.-km (BWDB, 2014). The Brahmaputra is named Jamuna after entrancing Bangladesh at Bahadurabad above Bahadurabad the length of approximately 2900 km (BWDB, 2014) with travel in the complex mountain terrain bordering north-east India and China; it bends through a series of gorges. And the Meghna was an entrance in Bangladesh at Amalshid in Sylhet district, and its meet into the Padma at Chandpur, which came after meeting the Ganges and Brahmaputra at Aricha-Goalundo then named after Chandpur as Meghna and flowed water into the Bay of Bangla. The Flood Forecasting and Warning Center (FFWC) under the Bangladesh Water Development Board (BWDB) mainly take responsibility for flood prediction, early warning, and flood management. The Bangladesh Water Development Board (BWDB) does the flood management work.

This brief study has but generated significant data and information on a number of issues and parameters related to water management, which are expected to provide useful insights. However, not all of them have been discussed here at length for the sake of brevity. Since there is significant interface between activities related to agriculture and water management, these two chapters would have some overlaps for the sake of relevance and emphasis. The benchmark data were not available and, at the same time, we had to overcome recall problems/errors. As such, the control area was selected such that its situation was just similar to project area in pre-project situation, and therefore impact value on any variable should amount to difference of the two values in project and control areas in their post-project situations. As such, we collected data on only current situation of both project villages and control villages. Therefore maximum care was taken to properly choose control areas.

The very SSWRDSP-I model **7** revealed that the success of the subprojects was largely dependent on satisfactory performance of the WMCAs. Hence, this chapter focuses on the issues related to the institutions, engineering and sustainability of the subprojects and their operation and maintenance activities. It also discusses, among others, changes in land and inundation levels, changes in irrigation, water regime and drainage facilities, employment generation and benefits accrued to the farm households. Besides, it sheds some light on constraints of WMCA development, focusing on the lessons learned and makes specific recommendations towards their better performance in the future. Information were obtained from two major sources: household survey and interviews with WMCA officials. Some of the findings of the household survey in this chapter are presented with respect to subprojects so as to highlight differential impacts caused by different types of subprojects.

OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

1. To find out the institutional issues of the water resource management project of Bangladesh.

METHODOLOGY OF THE STUDY

1) Research Methods: This study employed both quantitative and qualitative methods as a combined research approach (also called integrated approach). The study collected data and information from both primary and secondary sources in two phases. First, the study analyzed available literatures and documents to understand the theory and framework and study instruments on sub-projects and beneficiaries of the sub-project. Secondly, a questionnaire survey had been employed to assess the effect of sub-project on the beneficiaries of the sub-projects. In addition, in this study, the following independent variables or factors had been assessed: age, gender, family type, religion, family size, family income, marital status, educational qualification, occupation, farm, crop fields, crops, live stocks, fisheries, soil, soil type, agricultural inputs (fertilizers, seeds, pesticides etc.), irrigation, water, drainage, pump, canal, swilce get, regulator, water reservoir, flashing sluice, culvert, water construction, drainage outlet, equiduct, siphon etc. Filled questionnaires had been back-checked daily for their completeness by the researcher. Data had been collected via face-to-face interview with the respondents of the study area. The study approach had been participatory in nature that ensured meaningful participation of a range of stakeholders in the entire process of the study. It had employed appropriate research techniques and valid tools to ensure the study realistic, viable and reliable leading to ensuring validity of the findings. It has observed seriously cultural, social, economic and political issues to capture the dynamics of study themes.

2) Research Design of the study: The choice of an appropriate research design is essential for a scientific study since it gives a framework of what the researcher do from setting the research question to the operational implications of the data analysis. A research design is 'the arrangements of conditions form collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure' (Selltiz 1965 cited in Aminuzzaman 1991, p.53). The study is focused to evaluate the effect of sub-projects on its beneficiaries in Bangladesh and whether the lack of, maintenances, operations, servicing, monitoring and supervisions barriers for good results. Hence, descriptive and analytical research designs have been chosen. Because descriptive research design helps to describe the current practices and events while analytical research design enables to establish relationship between variables (Aminuzzaman 1991). Here the research design of the present study is survey type. The study design has to be a quasi-experiment one. Data were collected from sub-project/members of sub-project related person (beneficiary and without beneficiary) and compared through cross tables to test study. Some sub-projects/groups has selected by purposive random sampling within sub-project areas of rural and urban area in Bangladesh. To examine the other objectives based on the collected from the representatives of members of the selected sub-projects.

3) Study Area: The study was conducted at urban and rural area of in Bangladesh. In Bangladesh, there are eight divisions. The selected study areas weighted for selection in those areas where the sub-projects are running in Bangladesh. So it was easily access in the field, participate, observation and its interviews from the sample. However, in the field of urban and rural areas, the study has tried to understand in depth of the problems of the sub-projects and the members of the sub-projects

4) Variables: A variable is a property or characteristic whose degree or form varies across a set of objects in a given situation, such as crop yield, irrigation result, drainage effect, flooding effects on crops, level of education, gender, income, age, etc. In research, varability of an event depends on theoretical framework. Same event might be variable in one study but constant in another. Variables are of two types.
a) Independent variable and
b) Dependent variable.

a) Independent variable: Independent variables are those variables which don't depend upon any other variable. In this research, success of sub-project is an independent variable.

b) Dependent variables: Dependent variables are those variables which depend upon any other variable. In this research age, gender, family type, religion, family size, family income, marital status, educational qualification, occupation, farm, crop fields, crops, livestock's, fisheries, soil, soil type, agricultural inputs (fertilizers, seeds, pesticides etc.), irrigation, water, drainage, pump, canal, swilce get, regulator, water reservoir, flashing sluice, culvert, water construction, drainage outlet, equiduct, siphon, crop yield, irrigation result, drainage effect, flooding effects on crops, level of education, etc

5) Sampling Method: Basically, randomly purposive sampling method was used in the study so as to get the best information to achieve the objectives of the study. This method gave flexibility to the researcher to pick up only people who are likely to have the required information and be willing to share it. Moreover, the sampling method helped to ensure representation of different variation of service providers as well as service seekers. In other words, heterogeneity in the composition of sample of service seekers and providers (age, sex, senior-junior officials, education, and profession) was attempted to maintain as possible. Therefore in this study a combination of quantitative and qualitative methods were used. The question might arise why combination of these methods were used. Because as Creswell (1994:177) suggests, that it is advantageous to a researcher to combine methods to better understand a concept being tested or explored. Each approach has its strengths and its weaknesses, and reliance on anyone method is not appropriate. Therefore, in this research quantitative and qualitative research was used to better understanding as well as in depth to know the domain of the study.

6) Sampling Technique: Purposive sampling is a sampling technique in which the study relies on judgment when choosing members of population to participate in the study. Purposive sampling is a non-probability sampling method and it occurs when "elements selected for the sample are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money". In this research purposive sampling method was used.

7) Sample Size: Total 500 people from the stake holders in selected areas were selected for the study.

8) Sources of Data: Generally, there are two different sources of collecting data, viz., primary sources and secondary sources. The present study is based on both primary and secondary sources of data. Primary data were collected from the respondents of the study area directly using different data collection techniques. On the other hand, the study has used different relevant publications, dissertations, books, journal articles, reports, and websites etc. as sources of secondary data. The data were collected from secondary sources must be useful to cross validate primary data and also to analyze the relationship among variables. Primary data were collected from the particular areas in urban and rural areas in Bangladesh.

9) Data Collection Method: The study conducted based on both primary and secondary data. Primary data were collected through interviews and Questionnaire survey. Structured questionnaire containing both open and closed ended to be used. A survey through a standardized questionnaire was conducted to collect both quantitative and qualitative information from. Questionnaires were used for collecting primary data such Engineers, Agriculture officers, Livestock officers, Fisheries officers, Public representative, members of somity for interviewed through this survey. The semi-structured interviews have to be used for conducting with the respondents. These provided inputs to see the impact of the policies related subprojects and the quality of the services of the projects. Secondary data and information were collected besides the primary sources side by side secondary data were gathered from journal articles, published books, government documents, different project report, policies, reports of various committees' related to projects, website of LGED, website of ministry of Local government peoples republic of Bangladesh, different reports of LGED etc. At the same time the present study has collected qualitative data through face to face interview by using a check list, Case study and Key Information Interview (KII).

10) Questionnaire Survey: For unique and exploratory research new information must be required. Questionnaire survey is the easiest and most widely use instrument for data collection in this regard. This method allows the researcher to come in direct contact with the respondents, to observe their attitude during answering time and to analyze the issue under study in ordinary setting. The questionnaire precise enough to meet the objectives of the study research questions. Besides, comments and advice from participants defense on the study great support to frame up the questionnaire and other. The purpose and objectives of the study was explained to the respondents as simply as possible allocating sufficient time so that they swallow up the idea and can come back with spontaneous thoughts. Thus questionnaires duly filled up to avoid unwarranted biasness.

11) Tools for Data collection: Questionnaires, Focus group discussion, Participatory Rural Appraisal (PRA) were used for primary data collection.

12) Validation of Data: Validity is the degree to which the allotted instruments convincingly measure, explore or describe the phenomenon in hand (Judd, Smith and Kidder, 1991). In this study data were collected by questionnaire survey and interview method was also followed. The combinations of both the methods give the reliable and valid data. In this study, qualitative and quantitative collecting data were triangulated due to 1998:247). Validity refers to trustworthiness which is done through cross checking the data collect from one source to that of others. If themes are established based on converging several sources of data or perspectives from participants, then this process can be claimed as adding to the validity of the study (Creswell 2009, p.191). In this study data were triangulated during survey and interview and latter justified with secondary data.

13) Data Processing and Analysis: In qualitative study the researcher has the freedom to marshal gathered data to meet the desired objectives of the study (Creswell 2009). Partial data of questionnaire survey was processed using simple statistics. The rest of the data were explained carefully to meet the aim of the study and research question and also attempted to establish relation among the variables. Some important and strong statements were referred in the analysis part to add value to the findings. Endeavor was make firstly to unleash the potential of the relevant officers, members of the somity on the dependent in subproject development and to rationalize its institutionalization; secondly to detect the challenges, prospects and finally to put some light on to overcome the barriers. Computer Program Statistical Package for the Social Sciences (SPSS), Microsoft Excel was used for data analysis. Data were analyzed according to the objectives of the study. Tables, graphs and statistical analysis were done by Computer Program Microsoft Excel.

RESULTS AND DISCUSSION

Water Management

1) The problems and their solution: Perception of beneficiaries

The major reasons for constructing the subprojects, in most cases, have been perceived by local people to be water logging and drainage congestion (33.2%), flooding (29.2%), incidence of crop losses (24.2%) and so on (Table 1). A

few respondents, however, were not agricultural farmers, who did not mention some of the above as major problems. Irrigation has been pointed out as a major issue by comparatively few respondents (13%).

Table 1: Reasons for Constructing the SP in Study Area (as perceived by respondents)

Reasons	Distribution of households WMCA Members	
	No.	%
Flooding due to outflow of river water	146	29.2
Crop loss	121	24.2
Property loss	2	0.4
Water logging and drainage congestion	166	33.2
Lack of irrigation water	65	13.0
Total (Responses =255)	500	100.0

Source: SSWRD-2 Evaluation Study 2014.

In response to the question whether the problems were resolved satisfactorily, only a few respondents (3.9%) mentioned the problems to have been slightly solved or not solved at all, while 17 percent of them mentioned that the problems were only partially solved (Table 2). However, around 80 percent of the respondents thought that the problems have largely been solved or have been solved as expected. All these imply that there were some problems that still remained. Field investigations generally indicate that the formation of WMCAs or the hand-over of the subprojects has been delayed due to, among others, the delay in construction (not shown here). In such cases, the problems are unlikely to be resolved satisfactorily in some places. Two issues can be mentioned here. The performance of the WMCAs was found to be not satisfactory in a number of cases. As would be observed later (second Section – Institutional Issues), in quite a number of cases the subprojects were found to be not maintained properly. The distribution by subproject types on the question of problem solution shows that the respondents to the extent of 85.7 percent termed DR subprojects to have largely been performing well, followed by 84.6 percent in the case of CAD, 80 percent for DR&WC, 75 percent for FMD&WC, and 66.3 percent for FMD subprojects (Table 2). More importantly, there was none in the case of WC subprojects with their problems largely solved.

Table 2: Respondents' Perception Whether Major Problems of Project Area were solved by SP

Perception on solution	% of respondents						
	CAD	DR	DR&WC	FMD	FMD&WC	WC	ALL
Solved as expected	15.4	8.6	25.0	18.4	2.9	-	11.5
Largely solved/helpful	84.6	85.7	80.0	66.3	75.0	-	68.1
Partially solved	-	5.7	-	6.1	22.1	100.0	16.9
Slightly solved	-	-	-	9.2	-	-	3.5
Could not solve	0.4	-	-	-	-	-	0.4
Not sure	-	-	-	-	-	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: SSWRD-2 Evaluation Study 2014.

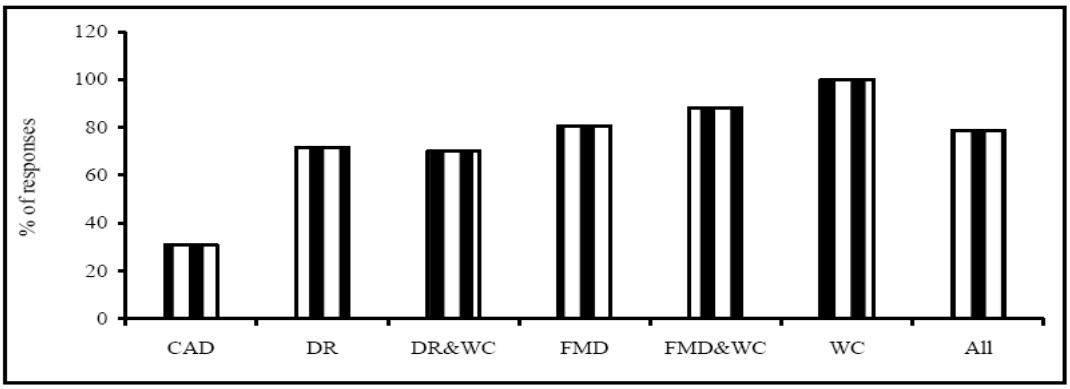
2) Water logging and drainage

The siltation in khals was the most common problem reported to be largely unresolved, which caused drainage problem in their low pockets as mentioned by as high as 78.5 percent of all the respondent households in the six types of subprojects (Table 3) (See also Figure 1). The findings according to subproject types show that the siltation was the only pressing problem in the case of WC, as reported by all the respondents (Figure 1). Non-operation of sluice gates and frequent breach of embankments were among the most pressing problems facing the FMD subprojects. Crop loss or property damage appeared to be no longer a general problem, as only 5.0 percent of the respondents mentioned it to remain still unaddressed.

Table 3: Distribution of Respondents Suggesting Problems Still Unsolved by SP

Existing problems/problems still unsolved	% of responses						
	CAD	DR	DR&WC	FMD	FMD&WC	WC	All
Water logging due to embankment	-	2.9	-	-	1.5	-	0.8
Water logging/drainage congestion	61.5	40-	20.0	8.2	5.9	-	15.4
Frequent break/breach of embankmnt	-	-	-	15.3	2.9	-	6.9
Non-operation of sluice gates	15.4	-	25.0	10.2	19.1	100.0	20.0
Siltation	30.8	71.4	70.0	80.6	88.2	100.0	78.5
Crop loss/damage to property	-	2.9	-	10.2	2.9	-	5.0
Others	15.4	11.4	5.0	34.7	23.5	-	22.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Figure 1: Distribution of households suggesting siltation problems still unsolved by subproject



3) Changes in inundation levels and drainage system

Table 4 presents changes in flood levels of operated lands by subproject type in the pre- and post-project situations. The distribution by broad subproject types in terms of flood intensity, by and large, shows that flood free areas have increased tremendously. In other words, flooded areas have been reduced substantially. For example, in the case of DR subprojects, flood free lands increased to as high as 1523 percent, while increase in the case of other subprojects increased in the range of 86 to 290 percent. Naturally, for DR and FMD subprojects, the extent of improvement was significant.

Table 4: Distribution of Cultivated Land in the Project Areas by Pre-Project and Post-Project Situations

Type of area	Cultivated land (decimal)		% Change in cultivated land
	Before	After	
CAD			
Flood-free area	-	53.7	-
Flooded area	199.93	146.27	-26.8
DR			
Flood-free area	3.9	63.3	1523.1
Flooded area	204.50	145.06	-29.1
DR&WC			
Flood-free area	60.3	112.3	86.2
Flooded area	132.90	80.85	-39.2
FMD			
Flood-free area	51.1	199.5	290.4
Flooded area	193.32	44.95	-76.7
FMD&WC			
Flood-free area	46.8	157.5	236.5
Flooded area	111.41	14.44	-87.0
WC			
Flood-free area	39.3	136.4	247.1
Flooded area	97.10	.00	-100.0

Source: SSWRD-2 Evaluation Study 2014.

The question can be raised whether all these positive changes could be attributed to the subprojects. Nearly 78 percent households perceived major or large influence of the subprojects in effecting the improvement in terms of flood-free areas (having a good drainage), while around 18 percent of the households reported a slight or no influence in effecting the improvement (Table 4.5). Flood protection and drainage subprojects appeared to have improved these conditions on such lands.

Table 5: Influence of the Subprojects in Effecting Changes in Flood/Drainage Characteristics (as Perceived by Respondents)

Influence	Distribution of household's perception about subproject's impact	
	No. of households	% of households
Major influence	99	41.1
Large of influence	90	37.3
Slight influence	39	16.2
Hardly any influence	4	1.7
Not sure	9	3.7
All	241	100.0

Source: SSWRD-2 Evaluation Study 2014.

4) Changes in irrigated areas

The situation with respect to irrigation coverage appears to have improved substantially. In some subprojects, even without irrigation component, surface water provision generally becomes available for irrigation facilities. In the past, per household irrigated land was about 1.21 acres which increased to 2.01 acres after the project intervention (Table 6). This amounts to an increase of 65 percent over time. Across subproject types, the highest increase (257%) was found to have taken place in the WC subprojects (the type of SP aiming to store water for irrigation), followed by FMD&WC (74%), FMD (72%), CAD (60%), DR (35%) and lowest DR& WC subprojects (33%). The overall growth in irrigated land was around 65.4 per 35 cent, demonstrating a growth of approximately 13 percent per annum over

nearly the last five years following the implementation of the subprojects. As can be noted from t values and Z values, the differences in irrigated areas for pre-project and post-projects situations are statistically highly significant, at more than 99 percent level.

Table 6: Land Irrigated per Household in Pre- and Post-Project Situations by SP

Type of SPs	No. of SPs under study	Per household irrigated land (in decimal)			t values
		Before	After	% changes	
CAD	1	118.00	188.50	+59.7	3.04***
DR	1	150.40	203.49	+35.3	5.69***
DR&WC	2	159.16	211.11	+32.6	3.05***
FMD	7	145.55	249.86	+71.7	6.79***
FMD&WC	3	84.40	146.65	+73.8	6.93***
WC	1	38.25	136.35	+256.5	4.39***
All	15	121.33	200.62	+65.4	Z=7.81***

Note : *** = significant at 99% level

Source: SSWRD-2 Evaluation Study 2014.

Engineering aspects

1) Present condition of infrastructure and its maintenance

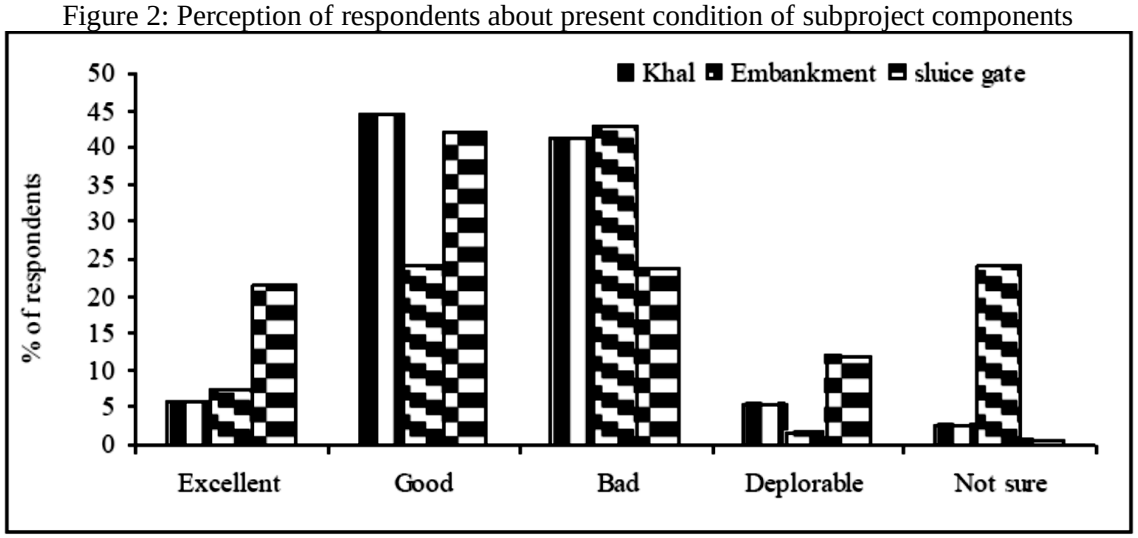
People's opinions were collected about the conditions of the major components of infrastructures: khals and canals, embankments and structures (including sluice gates). So far as the condition of khals and canals is concerned, nearly 47 percent reported to be bad or deplorable while around 50 percent reported to be good or excellent and around 3 percent not sure (Table 4.7 (See also Figure 2). As regards embankments, a large proportion of the respondents (nearly 45%) perceived the condition to be bad/„deplorable, nearly 31 percent reporting as good or excellent and a considerable number of the respondents were not sure about it (24%). Regarding structures or sluice gates, the status was perceived to have been in a relatively better condition, since a large majority of the respondents (64%) mentioned this to be in a good or excellent state.

Table 7: Perception of Respondents about Present Condition of SPs

Present condition of SPs	Condition of SP components					
	Khal/Channel/Irrigation canals/pipe		Embankment		Structures/sluice gate/ culvert	
	No. of respondents	%	No. of respondents	%	No. of respondents	%
Excellent	13	5.9	9	7.4	50	21.6
Good	98	44.5	29	24.0	97	42.0
Bad	91	41.4	52	43.0	55	23.8
Deplorable	12	5.5	2	1.7	27	11.7
Not sure	6	2.7	29	24.0	2	.8
All	220	100.0	121	100.0	231	100.0

Source: SSWRD-2 Evaluation Study 2014.

Figure 2: Perception of respondents about present condition of subproject components



Obviously, operation and maintenance has a large bearing on the condition of the subproject infrastructures. Over half of the respondents (51%) reported that there had been hardly any maintenance while around 41 percent reported of regular maintenance of the subprojects; the remaining 9 percent reported that they were not sure about that (Table 8) (See also Figure 3). There were large variations with regard to maintenance activities across the fifteen subprojects under study. Regular maintenance activities were carried out as mentioned by 63 percent of the respondents for the DR&WC subprojects, followed by 50 percent for the CAD, and lowest 31 percent for the FMD subprojects. Likewise, there were hardly any maintenance as reported by 59 and 60 percent of the respondents in the case of FMD and FMD&WC subprojects, followed by 47 percent in the case of CAD, 41 percent for WC, 36 percent in the case of DR&WC and 20 percent for DR subprojects. Field investigations clearly show that O&M had not developed to its desired level of performance due to many reasons**9**. The reasons in most cases are difficult to explain. In general, lack of motivation of the local beneficiaries and nearly dysfunctional WMCAs (e.g., Civil Hat Padma SP, Pabna, Gobadia Buribari Khal SP, Noakhali, and Singra Khal Subproject, Brahmanbaria) can be considered to be the main cause of its under-performance.

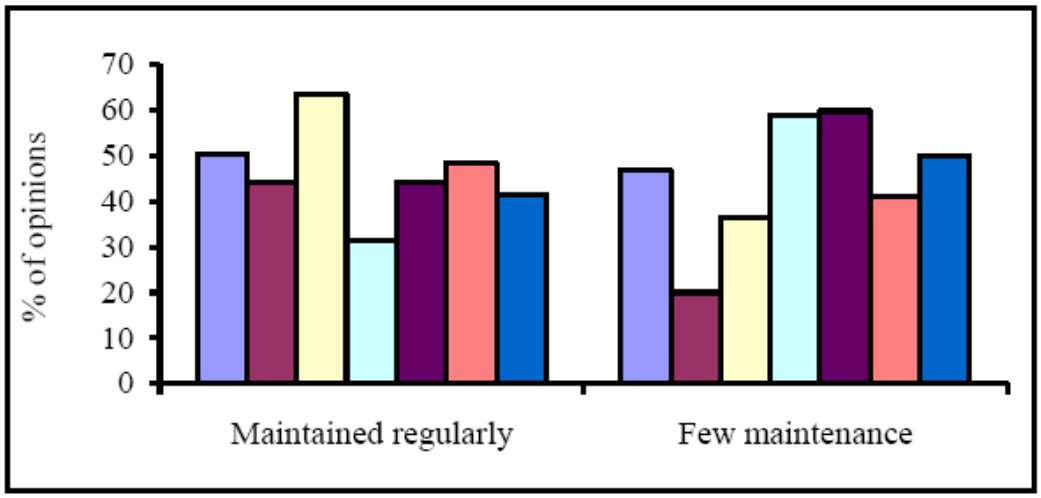
Table 8: Respondents' Options about Maintenance of the Major Components by SPs (Canal/Embankment/Regulators)

Opinion	% of opinions						
	CAD	DR	DR&WC	FMD	FMD&WC	WC	All
Maintained regularly	50.4	44.4	63.6	31.4	44.4	48.4	40.5
Few maintenance	46.9	20.0	36.4	59.1	59.8	41.0	51.0
Don't know/not sure	-	25.6	-	9.5	5.8	10.6	8.5
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: SSWRD-2 Evaluation Study 2014.

The siltation was the most commonly found problem which needs to be addressed through re-excavation of khals. However, it appeared that the WMCAs were reluctant in this regard presumably because of their understanding that at some later stage, the government or the LGED would take up the job of rehabilitation. In many cases, beneficiaries also showed little interest in assuming responsibility for maintenance.

Figure 3: Opinion of respondents about maintenance of subproject (Canals/Embankments/Regulators)



2) Perceived problems of maintenance

WMCAs were specifically established to conduct routine operation of the structures and necessary maintenance works, with resources generated from among the members. Most subprojects encountered some maintenance problems. Some common problems in relation to the maintenance of the subprojects were identified (Table 9). Nearly one third of the perceived problems (32.9%) were related to either O&M fund inadequacy or O&M group being non-functioning, while over half (54%) were related to lack of dynamism on the part of the WMCA or lack of unity/common interest on the part of the beneficiaries. Some of the problems (7.9%), however, were perceived to be related to subproject design or changed condition.

Table 9: Respondents' Perception about Maintenance Problems with SPs

Perception about maintenance problems	Distribution of responses*	
	No.	%
Inadequacy of O&M fund	64	21.1
O&M group not properly functioning	36	11.8
Flawed design of SP	24	7.9
Defective construction of SP	12	3.9
Lack of unity among beneficiaries	76	25.0
No. common interest	40	13.2
Lack of LGED interest	4	1.3
Lack of dynamism	48	15.8
All responses	304	100.0
No. of respondents mentioning maintenance problem	255	83.6

* Multiple responses

Source: SSWRD-2 Evaluation Study 2014.

As regards maintenance activities undertaken by WMCAs last two years, it is discouraging to note that almost no re-excavation activities were undertaken either in the current year or in the previous year (Table10). Only small-scale repair, siltation removal, cleaning hyacinth and embankment repair and re-sectioning, and small repairs/ coloring/ greasing of sluice gates door were among the minor activities.

Table 10: Canal/Embankment Maintenance Activities of 15 SPs during Last Two Years

Type of maintenance activities	Last two years			
	Current year (1420)		Last year (1419)	
	Yes %	No %	Yes %	No %
Canal re-excavation	-	100.0	1.3	98.7
Small-scale repair/siltation removal	20.8	79.2	32.5	67.5
Cleaning hyacinth/unnecessary bushes	27.5	72.5	27.8	72.2
Embankment repair re-sectioning	4.2	95.8	13.0	87.0
Operation of sluice gates	37.4	62.6	39.0	61.0
Small repairs/coloring/greasing of sluice gates door	8.1	91.9	22.9	77.1
All	87.7	12.3	86.9	13.1

Source: SSWRD-2 Evaluation Study 2014.

Generation of fund on operation and maintenance is treated as a good indicator for the smooth running of the SPs. Trend of operation and maintenance fund of the subprojects over the last five years shows a bleak picture (Table 11). It can be seen that except for DR&WC-SP types (+30%), no other types show a significant positive trends in terms of change in funds in 2013 over 2009; rather quite a few types show negative or zero trends. Overall, percentage change in O&M funds in 2013 over 2009 was only 0.31. This indicates the subprojects under study have not developed good capacity in terms of O&M nor O&M was not given due emphasis.

Table 11: Trend of Operation and Maintenance Fund by Subprojects

Year	Average Amount of O&M Fund (TK)						Average Amount (TK)
	CAD	DR	DR&WC	FMD	FMD&WC	WC	
2009	22330	148889	270000	178507	128603	265000	164788
2010	13760	149778	297000	177592	122663	265000	165620
2011	3140	150667	324000	178705	133080	265000	170400
2012	5580	151556	351000	192015	133243	265000	177733
2013	9420	153333	351000	160236	129007	265000	165304
% Change in 2013 over 2009	-57.81	+2.98	+30.00	-10.24	+0.31	+0.00	+0.31

Note : Data collection from WMCA officials
Source: SSWRD-2 Evaluation Study 2014.

Present situation with water availability and other facilities

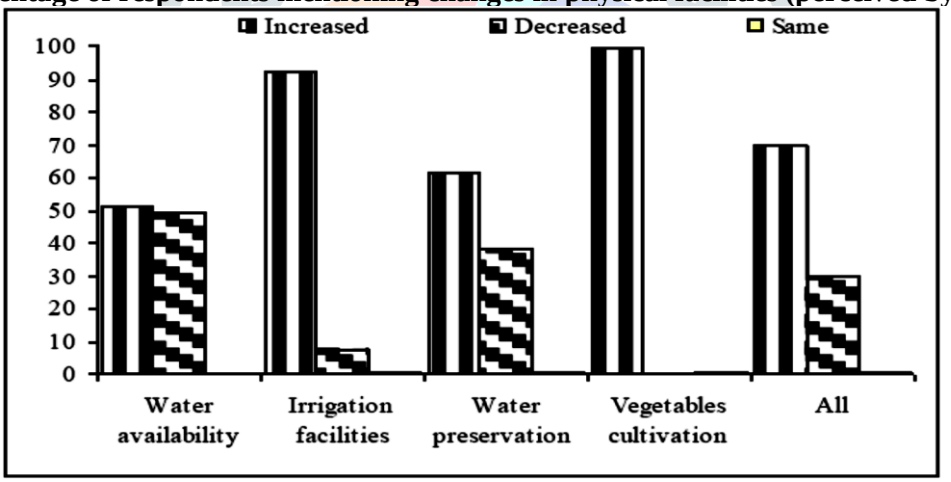
Perception of the respondents on the present situation of water availability and other facilities currently available compared to those in the pre-project situations were obtained from the survey (Table 12, see also Figure 4). Surprisingly though, despite many limitations mentioned above (e.g., malfunction of WMCAs, lack of O&M activities, inadequate funds and participation), an overwhelming proportion of the respondent households mentioned a number of facilities that have increased; these include water availability in canals in dry season (50.7%), irrigation facilities (92%), water conservation capacity (61.3%), and vegetables cultivation (99.6%).

Table 12: Present Situation of Physical Facilities Compared to Pre-project Situation (as perceived by respondents)

Quantity/facility level	% of respondent households *		
	Increased	Decreased	Same
Water availability in canal during dry season	50.7	49.3	-
Irrigation facilities through canal water	92.0	7.5	.5
Water preservation capacity/quantity of canal	61.3	38.2	.5
Improvement of vegetables cultivation in SP area	99.6	-	-
All	70.0	29.4	0.5

* Multiple responses.
Source: SSWRD-2 Evaluation Study 2014.

Figure 4: Percentage of respondents mentioning changes in physical facilities (perceived by respondents)



Sustainability and Institutional Issues

While most of the preceding discussion was directly related to the impacts of the subprojects‟ intervention, this section specifically examines sustainability and institutional issues. In other words, it explores how far the institutional procedures have been put into practice, particularly in relation to the subproject identification and implementation process, participation of beneficiaries, operation and maintenance activities, LCS formation and so on. These insights are expected to be useful in the context of highlighting indirect role on impacts, and also in identifying the factors that constrained the performance and gaining lessons towards improvement. The success of the subprojects is largely dependent on the satisfactory performance of the WMCAs but the performance of the WMCAs depends largely on the operation and maintenance activities. Unless the WMCAs are active and well-organized, the impacts of the subprojects are bound to be limited. Hence, this discussion concentrates on the issues related to the institutions and sustainability of the WMCAs vis-à-vis the subprojects, on the basis of findings obtained from the interviews with the households and the WMCA officials.

1) Involvement of beneficiaries in the participatory process

The basic approach of the subprojects was that the initiation, identification, designing, construction and O & M activities should be participatory with the local beneficiaries involved in various capacities (Islam et al 2008a). By and large, the beneficiaries had participated in a moderate way in the activities of the WMCAs, but largely during the identification phase only (observed also in Islam et al 2008a). To some extent, they also participated as wage laborers

during construction and also during the O&M phases. They have contributed to the initial fund for the construction and occasionally to the O&M fund. Opinions were sought on the problems faced during the subproject identification and implementation. Of the total respondents, nearly 45 percent reported conflicts/differences in opinions among villagers while more than 16 percent reported that discussions on identification were made with influential persons only and nearly 12 percent opined that the views of the villagers were largely overlooked. With regard to subproject implementation, nearly 84 percent of the respondents mentioned of lack of supervision or low construction quality and corruption.

Table 13: Problems Faced during SP Identification and Implementation by WMCA Officials

Problems faced	Distribution of responses*	
	Number	%
SP Identification stage		
No adequate discussion with villagers held	58	27.2
Opinion of villagers over looked	25	11.7
Discussion with influential persons only	35	16.4
Conflicts/differences in opinions among villagers	95	44.6
All responses	213	100.0
SP Implementation stage		
Flaws in SP design	4	2.1
Land acquisition	22	11.3
Compensation payments	3	1.5
Lack of supervision	48	24.7
Corruption	55	28.4
Low construction quality	59	30.4
Others	3	1.5
All responses	194	100.0

* Multiple responses.

Source: SSWRD-2 Evaluation Study 2014.

2) Women participation

LCS formation

Earthwork was a major component in many subprojects, carried out through formation of labor contracting societies (LCS). The landless, widows and destitutes were expected to get priority in the formation of the LCS and their employment. As observed in the field and admitted by the WMCA leaders themselves, proper formation of LCS did not happen in most cases. The formation of LCS was somewhat faulty and there were conflicts of interest among the leaders on their formation. In some cases, the WMCA leaders and traditional Sardars formed LCS with their own people, thereby depriving some genuine destitute laborers. It was also a common complaint that the women laborers of LCSs were exploited in respect of wages. In most cases, the formation of LCS was said to be temporary and hardly could they continue (3.1%) (Table 14). LCS operation could continue provided any new work was there (23.8%); and old LCS used to be postponed and new LCS formed for new project (73.1%). Most common problems faced by the women member of LCS related to sanitation problem (46%), followed by low wage rate compared to that of men (26%) and lack of living place (24%) (Table 15).

Table 14: Information Regarding Labor Contracting Society (LCS) in 15 SPs (as per WMCA officials)

Present situation of LCS	No. and % of respondents	
	Number	%
LCS operation still continued as there is work always	8	3.1
LCS operation continued provided any work was there	62	23.8
Old LCS is postponed and new LCS is formed for new project	190	73.1
All	259	100.0

Source: SSWRD-2 Evaluation Study 2014.

Table 15: Problems faced by the Women Member of LCS in 15 SPs

Problems	% of responses*	
	No.	%
Sanitation problem	181	45.8
Lack of living place	94	23.8
Rough behavior of male labors/leaders	3	0.8
Have to look after children	5	1.3
Low wage rate than male	101	25.6
Wage paid to husband/father/male members of family	8	2.0
Others	3	0.8
All	395	100.0

* Multiple responses.

Source: SSWRD-2 Evaluation Study 2014.

Suggestions towards better functioning of WMCAs and the subprojects

The WMCA officials were asked to make suggestions towards better functioning of the WMCAs under study. Table 16 presents the suggestions made. Most suggestions made were related to O & M and WMCA leaders themselves. As the O&M had not yet developed up to its desired level of performance, naturally, most suggestions made (26%) (based on multiple responses) were related to ensuring adequate fund for O& M activities, followed by those making suggestions to mobilize fund from medium and large farmers (19%), making the WMCA officials more dynamic/active (18%), needs for LGED assistance (18%), and introducing some incentive mechanism for the officials (9%) (Figure 8). During the field survey, the respondents were also asked to put forward suggestions towards better functioning of the subprojects under study. Likewise, most suggestions (based on multiple responses) made were related to steps towards regular maintenance of the subprojects, and steps towards making WMCAs more effective, and making WMCA management more responsible and so on.

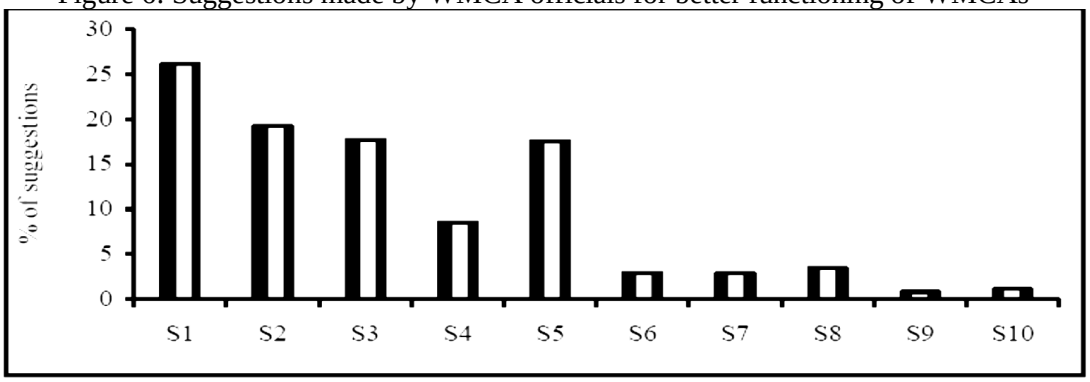
Table 16: Suggestions Made by WMCA Officials for Better Functioning of WMCAs

Suggestions	Distribution of responses over 15 SPs *	
	No.	%
Ensure adequate fund for O&M activities	171	26.1
Mobilize fund raising through more contribution from large & medium farmers	126	19.2
WMCA & its leaders should be more dynamic and active	116	17.7
Introduce some incentive mechanism so that leaders can give more time and efforts	56	8.5
Ensure technical assistance from LGED even after handover of the SPs	115	17.5
Ensure improved monitoring method and facilitation through LGED & other organizations	19	2.9
WMCA officials should be more committed	19	2.9
Increase skilled manpower within WMCA	22	3.4
Make cooperative rules & regulation easy and relaxed	5	0.8
Reduce political pressure	7	1.1
All	656	100.0
Total no. of responses	255	38.9

* Multiple responses.

Source: SSWRD-2 Evaluation Study 2014.

Figure 6: Suggestions made by WMCA officials for better functioning of WMCAs



S1 Ensure adequate fund for O&M
S2 Mobilize fund from large & medium farmers
S3 WMCA leaders should be more dynamic/active
S4 Introduce incentive mechanisms for leaders
S5 Ensure technical assistance from LGED
S6 Ensure improved monitoring method and facilitation through LGED
S7 WMCA officials should be more committed
S8 Increase skilled manpower within WMCA
S9 Make cooperative rules & regulation easy and relaxed
S10 Reduce political pressure

CONCLUSION AND RECOMMENDATIONS

The flood problem in Bangladesh is extremely complex. Engineers of Peoples Republic of Bangladesh are very much dynamic, experienced, expert and effective. The engineers give their best efforts to manage water/flood but due to some unwanted circumstances and activities, their efforts become in vain. The characteristic of rivers varies from region to region. FFWC and BWDB monitored the flood situation during and beyond the monsoon if the situation was in demand. The FFWC has issued daily flood bulletin from May to October with a forecast lead-time of 24hrs, 48hrs and 72hrs, 96 hrs, and 120 hrs. (up to 5 days) along with warning messages and flood inundation maps. Mobile-based IVR systems improved dissemination significantly. Also, 16 new flood forecasting points have been added to the system. These are the new efforts to make a more localized flood forecast. In addition to deterministic flood forecasts up-to 5-days lead time, FFWC issued medium range upto 10-days lead-time probabilistic forecasts at 38 locations. FFWC has attempted to use satellite-based (Jason-2 Satellite Altimeter Data under SERVIR program of NASA) information of the upper catchment with a free download facility for extending the flood forecast lead time up to eight days. This study was done to analyze flood forecasting and management. Climate change and extreme climatic impacts are increased in recent years. Flood in Bangladesh is common, but the secondary data are shown that flood forecasting is well developed, but the problems are information dissemination and communication. The community doesn't involve the dissection-making and warning system of the flood. The community-based early warning system has been developed.

From the study it was found that the development of water and flood-disaster management policies in Bangladesh was a nonlinear and iterative process. Multiple drivers and actors were responsible for both incremental and radical shifts in policies. Among various drivers, major flood-triggered events, policy discourse, and institutional learning played critical roles in such shifts. For instance, the devastating floods in 1974 shifted a large-scale engineering approach to more low-cost solutions. In a similar vein, the floods of 1987 and 1988 influenced policymakers to initiate the FAP in 1989. Findings of our study further demonstrated that although floods were considered catalysts, policy formulation and implementation strategies drew upon other approaches implemented in the USA and the Netherlands. Heavy reliance on such exogenous factors often resulted in detrimental effects on the deltaic and floodplain social-ecological systems of the country.

Flood and water management policy discourses in the last seven decades in Bangladesh oscillated from a top-down approach to a decentralized and participatory decision-making mechanism. Between the 1950s and 1995, the adoption of a flood control approach chiefly using structural interventions was dominant among the donor communities, bureaucratic elites and political interests. During this period, a policy coalition persisted between the bureaucratic and political elites within the policy community. However, policy failures of the command and control model triggered policy debates and concerns about the technical and economic viability of structural solutions. This model could not succeed in ensuring community resilience to disasters and sustainable livelihoods in flood-prone areas of Bangladesh.

A critical turning point in generating a new "punctuation" in the overall policy approach was the inclusion of the voices, opinions, and learning of stakeholders. In the early 1990s, policy debates between the bureaucratic elites and the members of civil society (including social scientists, environmentalists, journalists, practitioners, and civil society organization leaders) were key factors in bringing modifications to flood policies in Bangladesh. The policy transitions and shifts, therefore, were also influenced by concerns about environmental impacts and political pressure

from civil society organizations. To overcome the prevailing policy gaps, the participation of local people and attention to the local contexts of floods were seen to be important elements in the policy formulation processes. Overall, both incremental policy modifications and flood-triggered discourse initiated inclusive coalitions among policymakers, practitioners, and local people.

Recently an inclusive approach, labeled a "people-centered" model is receiving the most attention in formulating flood and water management policies in Bangladesh. The strength of this approach is that it enables the incorporation of a community-based governance approach to flood management at the community level. This broader, integrative approach not only helps to protect communities and resources from floods, but it also buttresses the capacity of the community to prepare for and respond and adapt to uncertainty concerning flood disaster risks. This emerging people-centered, inclusive approach also creates an opportunity for concerned actors to generate and assert new ideas into the policy formulation processes. The study suggest that a harmonious coalition among the relevant actors is needed to generate socio-culturally sensitive and environmentally friendly ideas, which can only emerge from an inclusive process and active participation of stakeholders, in the flood and water management policy process.

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