PAPER 1

SAWAS
South Asian Water Studies

DEVELOPMENT OF AN OPERATIONAL IWRM FRAMEWORK IN A SELECTED SMALL SCALE WATER RESOURCES DEVELOPMENT SECTOR PROJECT: In Bangladesh

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Abstract

Considerable progress has been made for flood control, drainage and/or irrigation under the Small Scale Water Resources Development Sector Projects (SSWRDSP) of Local Government Engineering Department (LGED). However, this study conducted in the Mondolbari Drainage (MD) project, Tungipara, Gopalganj during 2008–2010 found that the project objectives (to enhance agriculture and alleviate poverty) have not been fully achieved mostly due to dysfunctional Water Management Cooperative Association (WMCA). LGED's IWRM unit (IWRMU) had the potential to resolve MD's major constraints to water use, which are (i) the existing institutional conflict between Bangladesh Water Development Board (BWDB) and LGED regarding the operation of non-functioning BWDB sluice gate, (ii) conflict between members of WMCA and local farmers with regard to termination of Aman, and (iii) contestation related to discontinue culture fish. Although, in 2008, IWRMU supported the construction of an embankment to ease culture fish, it did not adequately respond to (a) the demand of an additional new gate on an internal channel and (b) coordinate with BWDB for operation of the existing BWDB gate on another internal channel. Proper operation of both the proposed and existing sluice gates is currently a strong demand for both Aman and Boro rice. Firstly, frequency analysis was done during Aman cultivation to identify the decads of May when gate is needed to remain closed. Secondly, an unsteady flow analysis (using HEC-RAS) was performed to identify the decads of the Boro season when tidal tapping (by closing the gate) is necessary. Furthermore, a gate operation rule is developed through analysis of surface water, key informant interviews, resource mapping, institutional mapping and a series of FGDs with the stakeholders. Additionally, this study found that WMCA of MD is politically biased and its WMCA agenda are more inclined towards their economic gain neglecting the social impact they have. Promoting culture fish in the rice field is an example of this. Only a few powerful individuals are directly benefited from this. This power group has also diverted the project objectives in favor of culture fish and has been operating the gate accordingly. In doing so, it has completely ignored (i) the early flooding problem of young Aman seedlings, and (ii) the water requirements for Boro land preparation. In addition to these, genders are also deprived of from being benefited. The study has found that gates should remain closed especially during (i) the third decad of May for Aman, and (ii) the second decad of February and the first decad of March to tap tidal water for Boro. Finally, this study pointed out the gaps in the existing IWRM framework being practiced in MD project. This understanding and subsequent development of IWRM framework can be used as a model for SSWRDSP in general and in preparation of plans for further advancement of the IWRM road map of WARPO.

1.Introduction

Mono directive structural interventions have in general limited the scopes and opportunities for Integrated Water Resource Management (IWRM) in the South West region of Bangladesh (Halcrow and others, 1998). Since the operation and maintenance (O&M) of Bangladesh Water Development Board (BWDB) is generally non-participatory (Choudhury, 2005), to increase the participation level of the stake holders, Local Government Engineering Department (LGED) initiated Small Scale Water Resources Development Sector Projects (SSWRDSP). It aims to support the local government institutions in implementing small scale projects covering 1000 ha or less (LGED, 2000). SSWRDSP is a deviation from the traditional "top down" approach followed in the past investments in the water resources development sector (ADB, 2004). Here the attention is given towards the promotion of local governance and the transfer of water management to user groups is commonly referred to as the Water Management Cooperative Association (WMCA). It is guided by the assumptions that the WMCAs are non-partisan, non-political and homogeneous bodies, and perform the water management tasks as per the original design (Khanal, 2003). But as it seems, WMCA agenda are heavily biased towards their own economic gains neglecting the social impact they have and they are mostly controlled by the power group of the society (Rahman et al., 2007). As a result, additional complexities are created. Continuing culture fish in the floodplain water body system is an example of this. Most of the benefit, if not all, of this culture fish basically goes to the influential and wealthy farmers creating social issues like access and decision making complexities (Lewis, 1997). This results in an outright inequity and rising social and political tensions (Alauddin and Tisdell, 1998) and starts 'contestation' among the stakeholders.

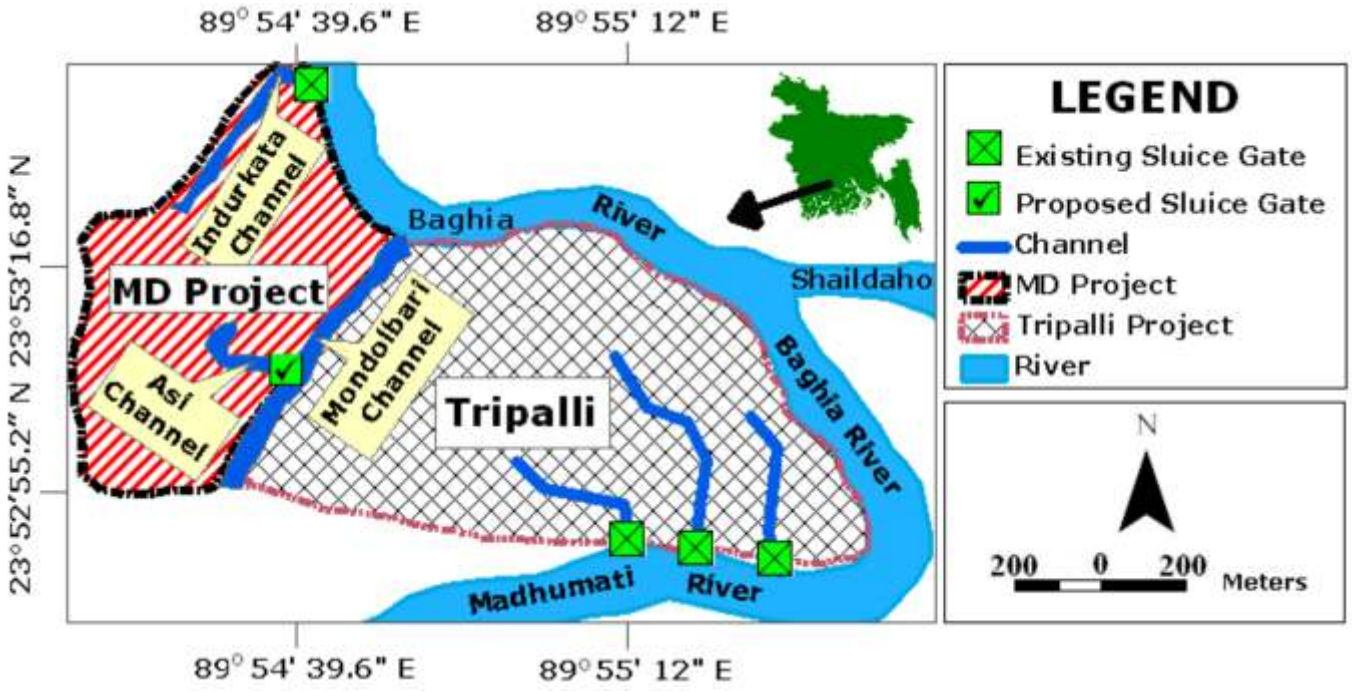


Figure 1: Location of the two project sites under consideration

The arguments and findings in this study are based on a detailed case study of two neighboring projects implemented in 1999, namely the Mondolbari Drainage (MD) and the Kakuibunia-Chinguri (referred to as Tripalli project henceforth) in the South West hydrological region of Bangladesh. Both projects were implemented under the first phase of SSWRDSP. The location of both the projects under consideration is shown in Figure 1.

1. Here, contestation is used to refer to a range of interaction patterns in water management including negotiation and struggle, and also to less explicit and longer term disputations and controversies. The idea is to convey that there tends to be something at stake in water resources management, and that the different individuals or groups involved have different interests (Mollinga, 2008).

The arguments and findings in this study are based on a detailed case study of two neighboring projects implemented in 1999, namely the Mondolbari Drainage (MD) and the Kakuibunia-Chinguri (referred to as Tripalli project henceforth) in the South West hydrological region of Bangladesh. Both projects were implemented under the first phase of SSWRDSP. The location of both the projects under consideration is shown in Figure 1.

In MD project, considerable progress has been made towards the development of its vast water resources for flood control, drainage and/or irrigation by both LGED and BWDB. However, during the study, it is observed that the project objectives have not been fully achieved. It may be noted here that LGED's IWRM unit (IWRMU), though established during SSWRDSP - 2, is providing support to MD project's WMCA, particularly in the Operation & Maintenance stage (O&M). But there is no clear directive on how IWRM will be implemented. Moreover, it is not clear how the existing conflict between BWDB and LGED with regards to the O&M of the presently non-functioning sluice gate on Indurkata channel, would be resolved. As will be clear from the later discussion in this paper, proper operation of this existing gate and the establishment of a new gate, demanded by the local people, are vital for Boro and Aman cultivation.

In addition to the above mentioned complexity, in MD project, the management arrangement of LGED is dysfunctional. Promoting culture fish by WMCA has restricted the local people's access to floodplain fisheries. This has jeopardized household nutrition, public health and general social well-being of communities, in particular, widow, single women and children and benefited only the influential power group which ultimately controls the WMCA. Moreover, as unfortunate as it seems, in reality, the implementing agency, LGED, also favors this power structure. Interestingly this power group by now has been able to divert the project objectives in favor of culture fish, completely ignoring the requirements for the Aman rice despite that the original objective of the project was to enhance agriculture (LGED, 2000). On the contrary, in the neighboring Tripalli project, where social or religious homogeneity (mostly Hindus) exists, culture fish were not continued. This decision was the reflection of the majority people's demand driven by better financial return of jute retting as well as social and religious obligations.

In this research, the contrasting scenarios of the two neighboring projects have been deeply and critically studied with a goal to identify and mitigate the problems and issues related to the current approach of SSWRDSP. Subsequently, this understanding has been used as the basis for developing an operational IWRM framework. Additionally, this paper raises questions on the ongoing approach of one-third women participation in the O&M and calls for a further shift towards more women participation in every stage of the whole process.

The contributions of this paper are as follows:

· Firstly, the potentialities of the water management approach that was or is practiced at the local level before, during and after the implementation of the MD project including the economic gains out of culture fisheries are identified (Section 4).

· Secondly, the constraints to water use that are experienced in the last couple of years are identified and analyzed (Section 5). These constraints include (i) the problems with rice cultivation (ii) the existing institutional conflict between BWDB and LGED regarding the operation of the existing BWDB sluice gate, and (iii) the contestation related to discontinuing culture fish.

· Thirdly, a frequency analysis to identify the vulnerable periods for Aman termination (Section 5.1) was done along with an estimation of the irrigable area for the dry season with the available volume of water measured by the Hydrologic Engineering Centers River Analysis System (HEC-RAS) software (Section 5.2).

2. This project is referred to as the Tripalli project by the local people because it involves three adjacent villages.

· Fourthly, social issues related to the existing contestations with regards to the gate operations are identified and analyzed (Section 5.4).

· Based on the above-mentioned socio-technical analysis, gaps in the existing operational IWRM frame work were identified. In the sequel, a common acceptable gate operation rule for the existing and a propose sluice gates were derived.

· Finally, based on the critical study and analysis of this research work, a number of recommendations for operationalizing IWRM framework have been presented in this paper.

It is believed that these findings on the potentials and constraints of operationalizing IWRM together with suggested recommendations will be the basis for further advancement of IWRM road map of WARPO (2009). Additionally, this study also attempts to find a feasible platform for handling the contestation which is existent in the current projects.

2. STUDY DESIGN AND METHODOLOGY

A comparative and interdisciplinary study has been conducted during the period 2008–2010. For this analysis, both primary and secondary data have been collected. Primary data has been collected mainly through village level Participatory Rural Appraisal (PRA), which includes key informant interviews (primarily) of member families of the WMCAs and the LGED officials and a series of FGDs (Focus Group Discussions) with the farmers, fishermen and women. These helped to understand the social and institutional dimensions related to (i) the existing institutional conflict between BWDB and LGED regarding the operation of the existing BWDB sluice gate, (ii) the conflict between members of WMCA and local farmers with regards to termination of Aman (iii) the contestation related to community decision making to discontinue culture fish, (iv) the deprivation of the poor and the marginalized gender classes, and (iv) the social effects of promoting culture fish by WMCA.

In parallel to the above works, historical tidal characteristics are analyzed for both Aman and Boro seasons from the secondary data, collected and gathered from Bangladesh Inland Water Transport Authority (BIWTA) and LGED. At first, frequency analysis during Aman vegetation helped to identify the decads of May when young seedling of Aman is vulnerable to early floods. Secondly, an unsteady flow analysis (using HEC-RAS) was performed to identify the decads of Boro season when the gate is needed to be closed for tidal tapping. Notably, in this paper, a feasible operation rule for the existing and the proposed sluice gates have been developed based on both hydrological analysis and PRA tools. Finally, through socio-technical analysis, this study pointed out the gaps in the existing operational IWRM framework of the SSWRDSP.

3. PROJECTS OVERVIEW

The original proposal of MD project was for a D (drainage) & WCS (water conservation structure) with the intention (i) to improve drainage by re-excavating internal channels and (ii) to provide irrigation by retaining water in channels by constructing a water control structure at the mouth of Mondolbari channel (LGED, 1999). Later, the project type was fixed to be Drainage; WCS was omitted as, according to LGED, there was no scope for flood control and local people needed the Mondolbari channel open for navigation.

On the other hand, Tripalli is a FCD (Flood Control & Drainage) project. It was developed with an intention to (i) prevent flood from the Baghia River by constructing embankments and regulators to facilitate drainage, (ii) improve drainage by re-excavating three small channels, and (iii) improve navigation by constructing a small boat pass. Now, flood water is controlled at Tripalli by three sluice gates. This Tripalli project passed each of the standard social, environmental and economic viability tests conducted by LGED. All residual adverse environmental impacts of the Tripalli project are expected to be insignificant.

Both of these projects are located within the boundaries of the 21,300 ha BWDB Tarail-Pachuria (TP) Project. This BWDB project was originally financed with a World Bank loan but funding was withdrawn when the project was about 30% complete because local people refused to give up their land for the proposed massive embankments. Currently, no funding for implementation is available.

MD project is dependent on the function of the Indurkata sluice gate (as shown in Figure 1) constructed under the TP project, where as, Tripalli project has no conflict with or dependency on current functions of BWDB. As a result, all three LGED sluice gates of Tripalli are well maintained by its WMCA where as one BWDB sluice gate of MD project is inoperable. The absence of any institutional conflicts (eg. between BWDB and LGED), the presence of religious homogeneity (e.g., mostly Hindus) and discontinuation of culture fish in the rice fields helped Tripalli project to be successful.

4. POTENTIALS OF IWRM PRACTICES IN THE MONDOLBARI DRAINAGE PROJECT

The National Water Policy (NWPo) of Bangladesh is considered as a first step towards the initiation of the IWRM process (Gupta et al., 2005). The goal of NWPo is stated as: 'to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment'. According to the survey of Albert (2001), the principles and concepts of IWRM as presented in GWP[3] (2002) are well-accepted by the majority people of Bangladesh. Respondents are of the strong opinion that the IWRM process could help find the solution to the water problems in the country. This study experienced similar findings. For example, changing of project concept from WCS to Drainage, considering the negative navigational impact it could have, can be considered as a remarkable step of Local Government Engineering Department (LGED) towards IWRM.

4.1 Practice before the project implementation

During interaction, the stakeholders confirmed that the installation of a one vent sluice gate at the mouth of the Indurkata channel was completed by BWDB in the year 1987/88 under TP project. In 1996, people placed a demand before LGED for another sluice gate since the area used to be inundated by both Indurkata channel and Asi channel. Due to this inundation, the study area also had the problem with broadcasting Aman.

4.2 Practice during the project concept development by LGED

During the project concept development through PRA, local inhabitants of Chinguria village strongly opposed the proposal of constructing a dam at the mouth of that Mondolbari channel as it serves as the cheapest way to transport paddy from the field to their houses. They also raised the issue that using the channel water for household cooking, bathing, etc. would not be possible, if that dam were constructed. So the concept of initial proposal was reviewed and revised by 'Techno Consult International Limited' based on an independent PRA, information and data supplied from the field and the results of standard social/technical analysis. Based on the above, it is fair to say that local people of this project are eager to get the most benefit out of its natural resources (e.g. water, land and related resources) and at the same time, LGED has the capability to make IWRM operational. With all these scopes and opportunities, this area is highly potential for practicing IWRM.

3. Global Water Partnership (GWP) defines IWRM as "a process which promotes the coordinated development and management of water, land, and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".

4.3 Practice after the project implementation

In the MD project, currently the operation of that BWDB sluice gate is controlled by WMCA. With full support of local people, in the year 2007, WMCA first considered the possibility of utilizing seasonally flooded private lands for culture fishery. Economically, it was profitable though the net profit was lowered to 1,40,000 Taka. It is because WMCA had some incidence of fish flee due to the sudden cut of the temporary dam constructed at the mouth of Mondolbari channel by the TNO (Thana Nirbhahi Officer). To avoid this kind of incidence, IWRMU supported WMCA in constructing an embankment (8 feet wide and 16 -19 feet high) along that channel just in time for the spawning of culture fish in the subsequent year. According to the official record, production and profitability increased over the years. In the year 2008, even with a 35% loss of stocked fingerling, each share got a return of 1710 Taka from an investment of 1200 Taka. A total of 1350 kg fingerling were stocked having a value of 1,97,000 Taka and the total return received was 3,84,000 Taka. The local economy therefore has gained from both the direct benefits of the projects (increased production, profits, incomes, etc.) and from the indirect benefits that are transmitted through backward linkages, mainly from the supplier of inputs for the fish production.

There are four clearly identifiable groups of people who have gained directly from the project. These are the shareholder-landowners, the permanent staff of the project, the new fishers who get the opportunity to harvest fish and those involved in earthwork activities. It is claimed by WMCA that the output from agricultural land has increased, whilst input costs have declined. This is because, as the WMCA claims, no pesticides are required, and lower fertilizer doses are enough due to the residual impact of manure and feed used in culture fisheries.

So theoretically, existing water management system is economically successful benefiting an area of 103 ha with little negative impact on its cropping pattern. But social impact towards meeting National Development Goal, such as poverty alleviation, is yet to be explored.

5. CONSTRAINTS TO IWRM PRACTICES IN THE MONDOLBARI PROJECT

Although the majority people of Bangladesh accept the principles and concepts of IWRM, according to the investigation of Albert (2001), these, in reality, are not yet in practice. The National Water Policy (NWPo) itself is not sufficient; NWPo needs to be implemented, monitored continuously, and updated with varying natural and socio-economic condition. The water resources management sector is described as being fragmented (Gupta et al., 2005). Data collection is considered inadequate for planning and decision-making. The interview results reveal that land acquisition is perceived as 'complex, time consuming and cumbersome' in the water resources development process. Though sectoral planning with inter sectoral priorities are described as 'fair', their operation and management are described as 'weak'(Albert , 2001).

In the process of identifying the constraints to practicing IWRM at different stages (planning, design, implementation and O&M) of the MD project, this section points out the problems stakeholders were facing in the last couple of years. The constraints to water use are depicted according to two main seasons (Aman and Boro) of rice in a year in Sections 5.1 and 5.2. Afterwards, analysis on institutional conflict, social issues related to culture fish, elite capture and women involvement are described in Sections 5.3, 5.4, 5.5 and 5.6, respectively.

5.1 Constraints to water use during Aman Season

In both the projects, the main source of problems has been the early flood (LGED, 2007). Since Tripalli can fully operate their three (LGED) sluice gates, it can easily control their early flood whereas in MD project, the flood damages young broadcasted Aman. When Boro harvest is too late, it does not allow timely establishment of the deep water Aman (DW Aman) before the arrival of floods (Catling, 1992). Therefore, managing a DW Aman-Boro rotation becomes impossible. Now, the contestation related to the culture fish during the month of November (see details in Section 5.3) is the leading cause behind the late harvesting of Boro.

This delay early Aman broadcast increasing the possibility for Aman seeds to be inundated by early floods in the 3rd decad of May. The situation is aggravated even more when WMCA keeps the gate open during the 3rd decad of May to facilitate the proper spawning of fingerlings (as it has been doing since 2007). Clearly, whenever it comes to the issue of conflicting interest between WMCA (for culture fish) and common farmers (for Aman), the money wins since the BWDB gate operation has become very costly.

Again, when the culture fish was introduced for the first time in 2007, there was an incidence of severe Carp fish (T. melanopleura) attack on Aman. It has been alleged that Carp fish damaged the young seedlings either by uprooting or by eating rice plants. On one hand, WMCA did not compensate anything at all for such losses. On the other hand, since the complaint was serious among the stakeholders, in 2008, the elite groups or WMCA played a dirty trick: the gate was opened even earlier in May, during the broadcasting of Aman. It basically served two purposes as follows. Firstly, raising water level served better for spawning fish and secondly, entrance of saline water and early flood caused less broadcasting of Aman, which meant less possible complaints from Aman cultivators about any negative effect due to culture fish.

Again, the saline water intrusion in the field due to the early opening of the gate by WMCA is responsible for creating unsuitable soil and/or water conditions for the common farmers. As reported by the local people, saline water in the river becomes noticeable in the mid of January and highest concentration occurs in Mid April-Mid June. As a result, the opening of the gate in early May, results in the highest possible salinity intrusion in the soil. It may be mentioned here that, WMCA closes the gate in Mid June and finally opens the gate again around Mid October for fish harvesting.

Hydrological analysis

As part of this research, a hydrological analysis was performed to identify the period that is most vulnerable for Aman vegetation. The land elevation of the study area varies from 1.4 m PWD to 2.87 m PWD (LGED 1999). At first, to identify the most vulnerable decad for the early flooding, a trend analysis for the month of May was done (as shown in Figure 2) and afterwards, from DEM analysis the percentage of area inundated for different water depths was estimated (as shown in Figure 3).

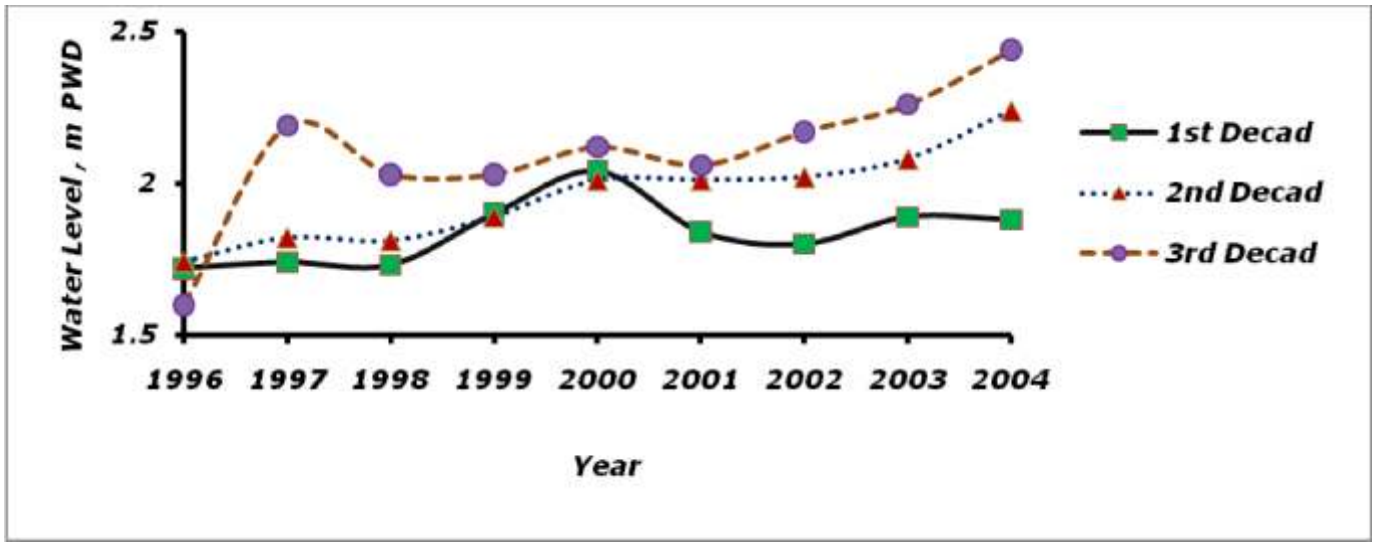
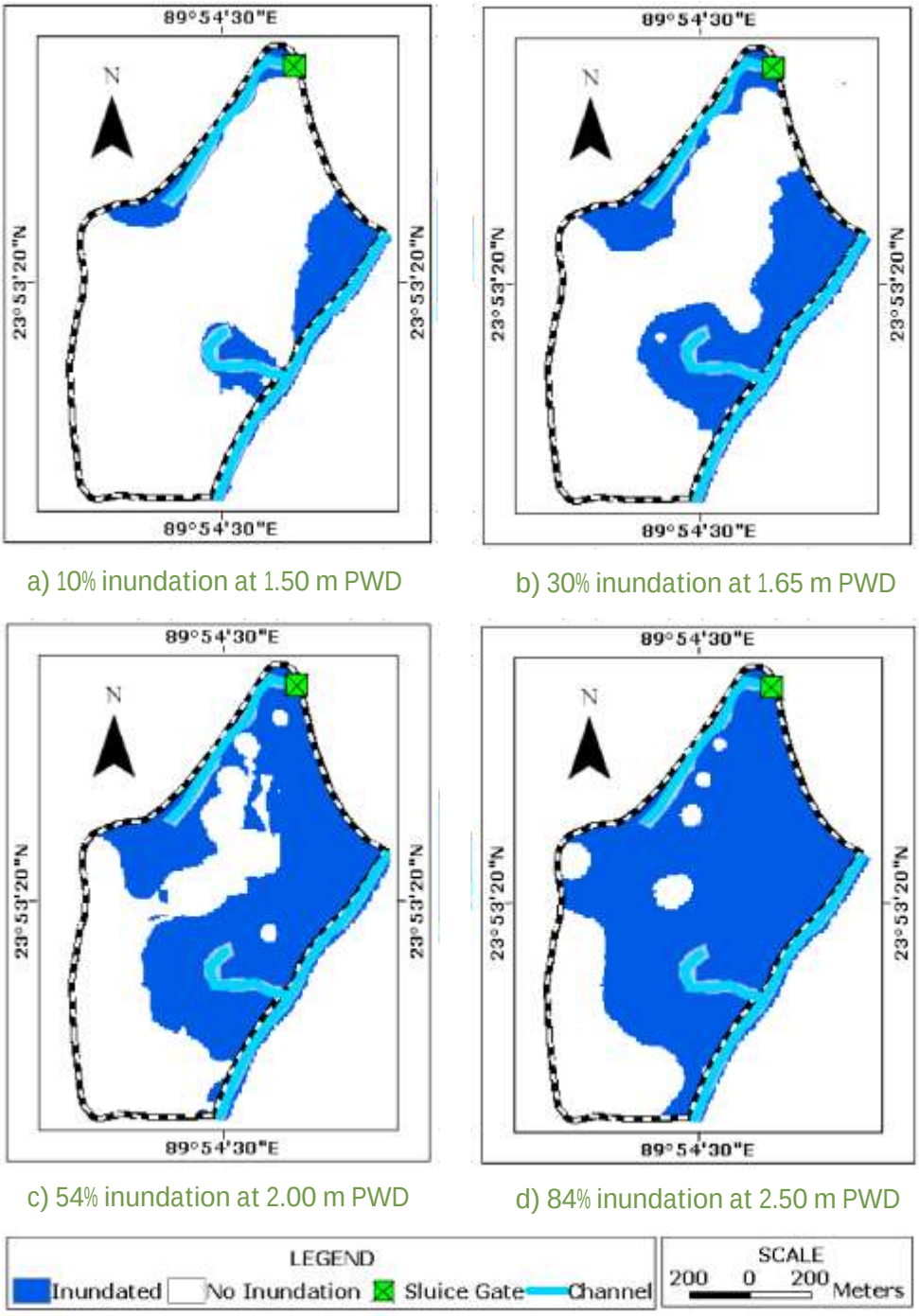


Figure 2: Average high tidal water levels in May.

As can be seen from Figure 2, the average high tidal water level always remains above 1.4 m PWD indicating that the possibility of flood always exists during the period (May) of broadcasting Aman. However, as can be identified easily, the worst situation occurs during the third decad coinciding with the period of the broadcasting of Aman (May 15 onwards) and making it the most vulnerable. Therefore, it is of paramount importance that the sluice gate is closed during this vulnerable period to ensure proper broadcasting of Aman. For the calculation of the flooded area at different water levels, annual runoff for the study area was estimated from mean annual monthly rainfall, mean evapotranspiration rate and mean infiltration during the period of 1999 to 2007. Annual runoff depth was found to be 96.66 mm based on the estimated mean infiltration rate of 4.66 mm/day. Figure 3 shows the percentage of area inundated for different water depths.



a) 10% inundation at 1.50 m PWD

b) 30% inundation at 1.65 m PWD

c) 54% inundation at 2.00 m PWD

d) 84% inundation at 2.50 m PWD

Figure 3: Inundated area for different water levels.

5.2 Constraints to water use during Boro Season

In both MD and Tripalli project, lands are irrigated using the surface water. Tripalli project is successfully utilizing their surface water potentials. However, the scenario in MD project is different. Here, for irrigation, the farmers depend on both Indurkata channel and Asi channel. The command area of Indurkata channel is 175 acres, 100 acres of which fall inside the project area. The rest of the project area is dependent on Asi channel. But due to the lack of a sluice gate at the mouth of the Asi channel Boro rice irrigation is facing difficulties (Figure 5). As can be easily noticed from Figure 4, only the spring flood can meet farmer's demand during this dry period. So to overcome this situation, the local people are trying to tap tidal water by constructing a temporary dam at their own cost. Although, WMCA is interested in increasing their command area (as most of the WMCA members are engaged in block managing) it has so far been unsuccessful in convincing LGED to fulfill its demand for a new gate. Nor did it show any interest ever in sharing the expenditures of the farmers for the construction of the temporary dam. The WMCA members, however, are ready to invest more money on culture fish during the wet season.

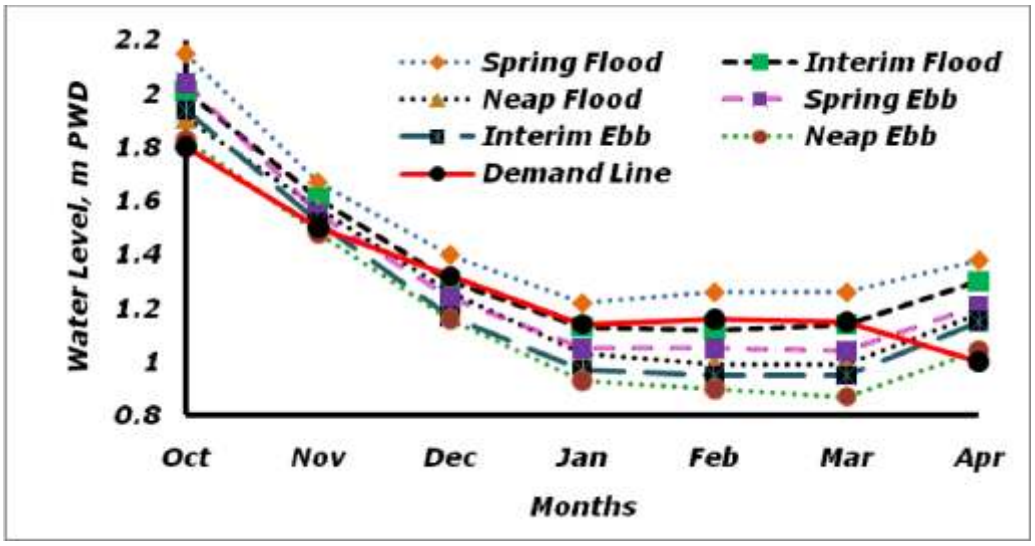


Figure 4: Water availability and demand during the dry period.

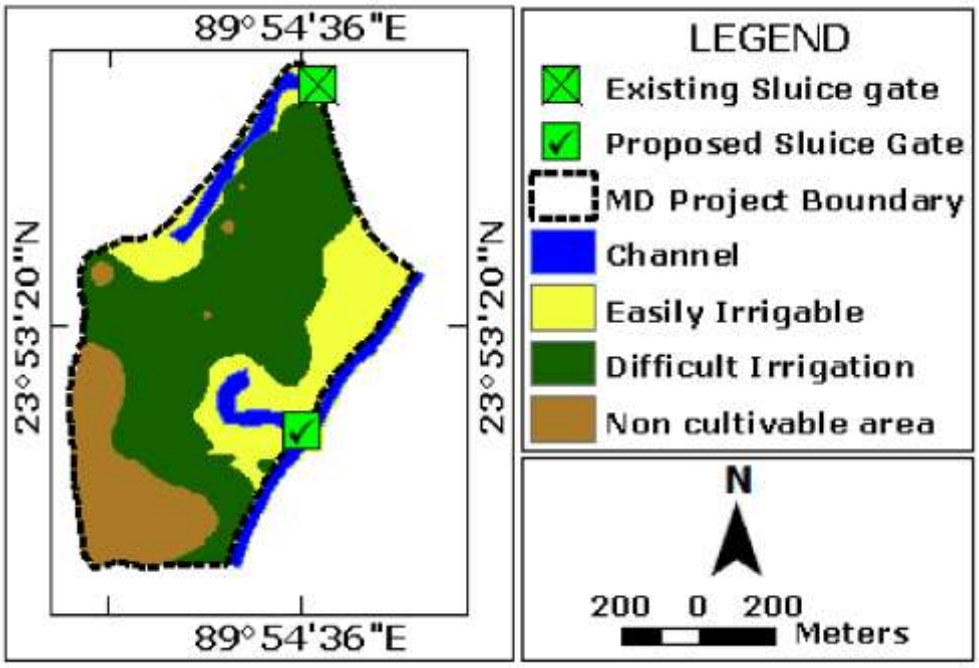


Figure 5: Command area dependant on tidal water tapping.

Hydrological Analysis

A hydrological analysis was performed to identify the period when the gate should be closed for tapping tidal water to facilitate Boro irrigation. Irrigation in the study area is totally dependent on surface water and hence a low lift pump is used for this. According to LGED (1999), the project was supposed to mainly benefit Boro crop production. But the irrigable area depends on the availability of water. To determine water availability during the dry season, at first, dry season water demand was estimated. Estimated water demand was then deducted from the water supply to get the excess amount of water available for use. Figure 6 graphically presents the excess amount of water in different decads as per the calculation. The usable amount of water is the lowest during the neap tide.

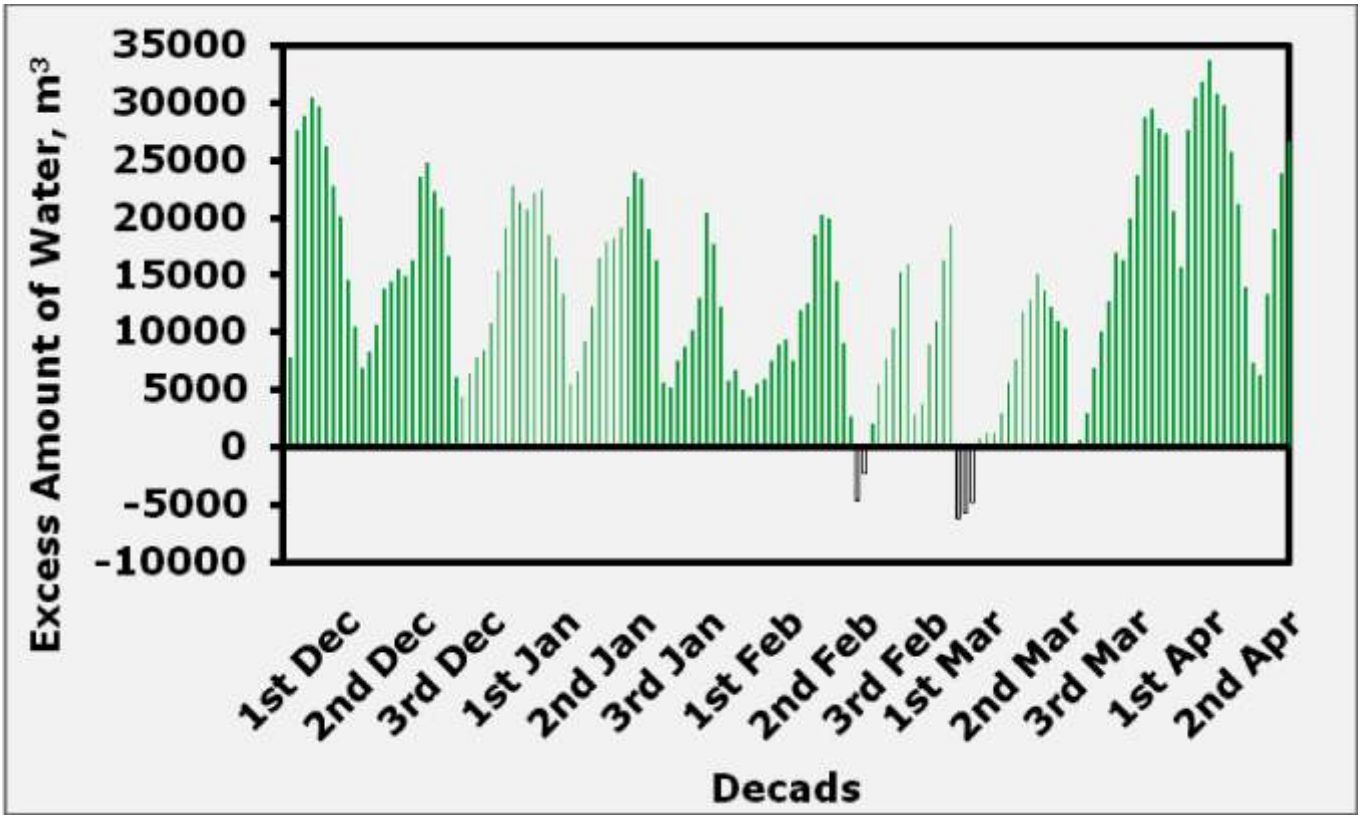


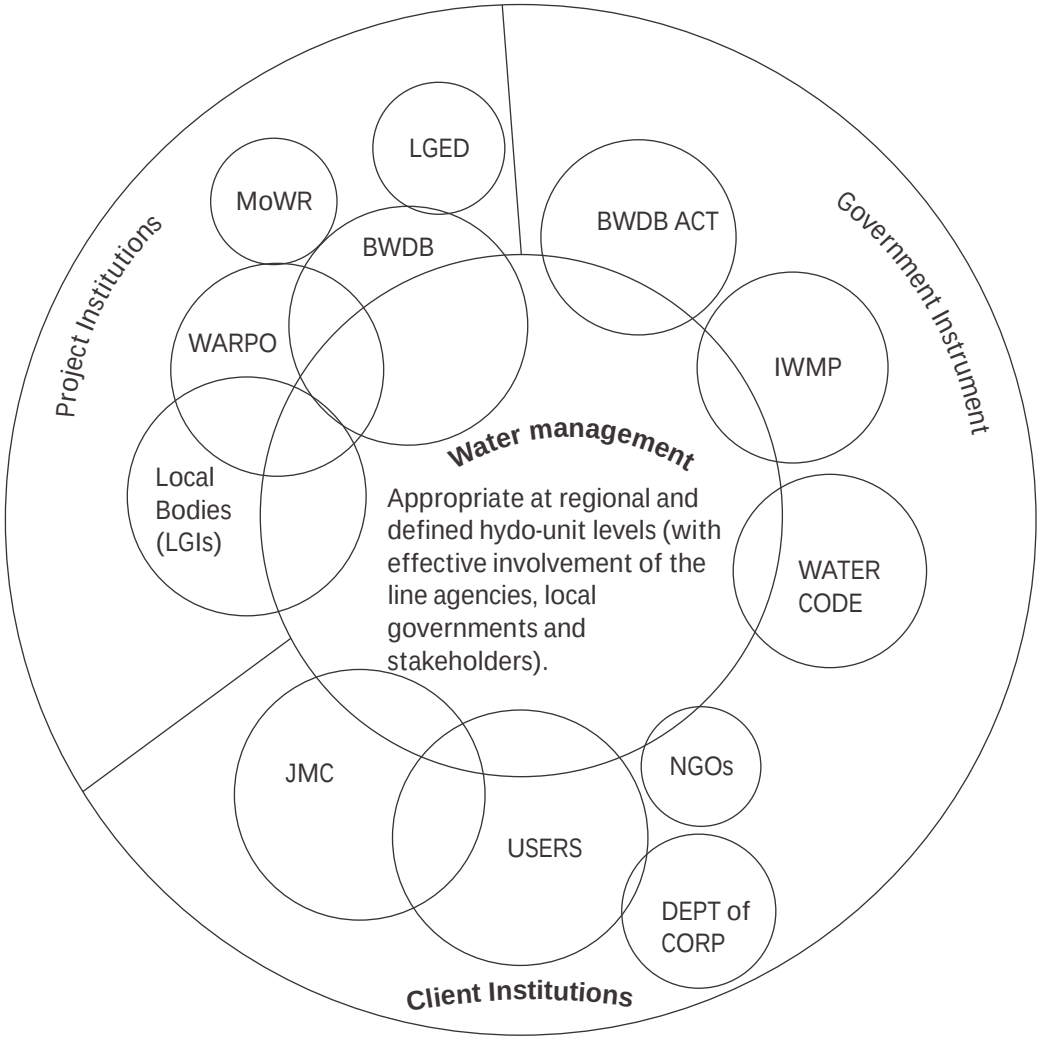
Figure 6: Estimated Excess amount of water during the dry period.

From Figure 6 it is clear that the worst situation happens when neap tide coincides with the highest demand (highlighted with red circle): the highest demand occurs towards the end of March and remains so until the 1st week of April. It is estimated that during the 1st decad of March and 2nd decad of February, respectively 60% and 67.27% of land can be served by the available amount of water and respectively around 6193 m3 and 7844 m3 water is required to irrigate the rest of the area. On the other hand, during the interim period before the neap period, water is available for irrigation and other purposes. In fact, during the same decads, just one day before the neap period there is 19337 m3 and 2582 m3 of excess water in the channel respectively. If the gate is closed during interim period and remain closed during neap period, the excess water can be stored to meet up the deficiencies in irrigation.

From the above analysis, it is clear that water is to be stored during the interim period (spring to neap) to meet up the demand during the dry season. Clearly, the gate operation during February and March at the transition period from spring to neap is very critical, implying that extra care is needed in the management of the gate.

5.3 *Institutional Conflict*

Both of the MD and Tripalli projects are under South-west Area Integrated Water Resources Management Project (SWAIWRMP) of Bangladesh. Figure 7 shows the institutional arrangement theoretically SWAIWRMP has for its IWRM planning, implementation and management.



Source: SWAIWRMP (2004)Figure 7: The institutional arrangement for IWRM planning, implementation and management of SWAIWRMP.

Now, in the MD project, the situation is expected to improve by controlling the water with two sluice gates (one at the mouth of Indurkata channel and the other at the mouth of Asi channel) with the added condition of constructing an embankment along the Mondolbari channel. One sluice gate had already been constructed by BWDB 22 years back under TP Project, which is not fully functional at this moment. BWDB in this case as well emphasized on new construction rather than improvement of services, which led to inequitable service distribution with the poor suffering the most. Another, serious problem regarding this gate is the lack of the proper co-ordination among the two implementing agencies, namely the LGED and the BWDB. Inadequate levels of communication between these two institutional organizations had led to distrust, confusion and conflict. It results in low performance of WMCA as well as the whole physical system. Figure 8 shows the institutional map of the local level institutional arrangement, prepared in consultation with the local stakeholders, which practically exists at MD project (as opposed to the coordination scenario needed between BWDB and LGED in Figure 7). Here, the roles of the informal and formal institutions in management of MD project are shown.

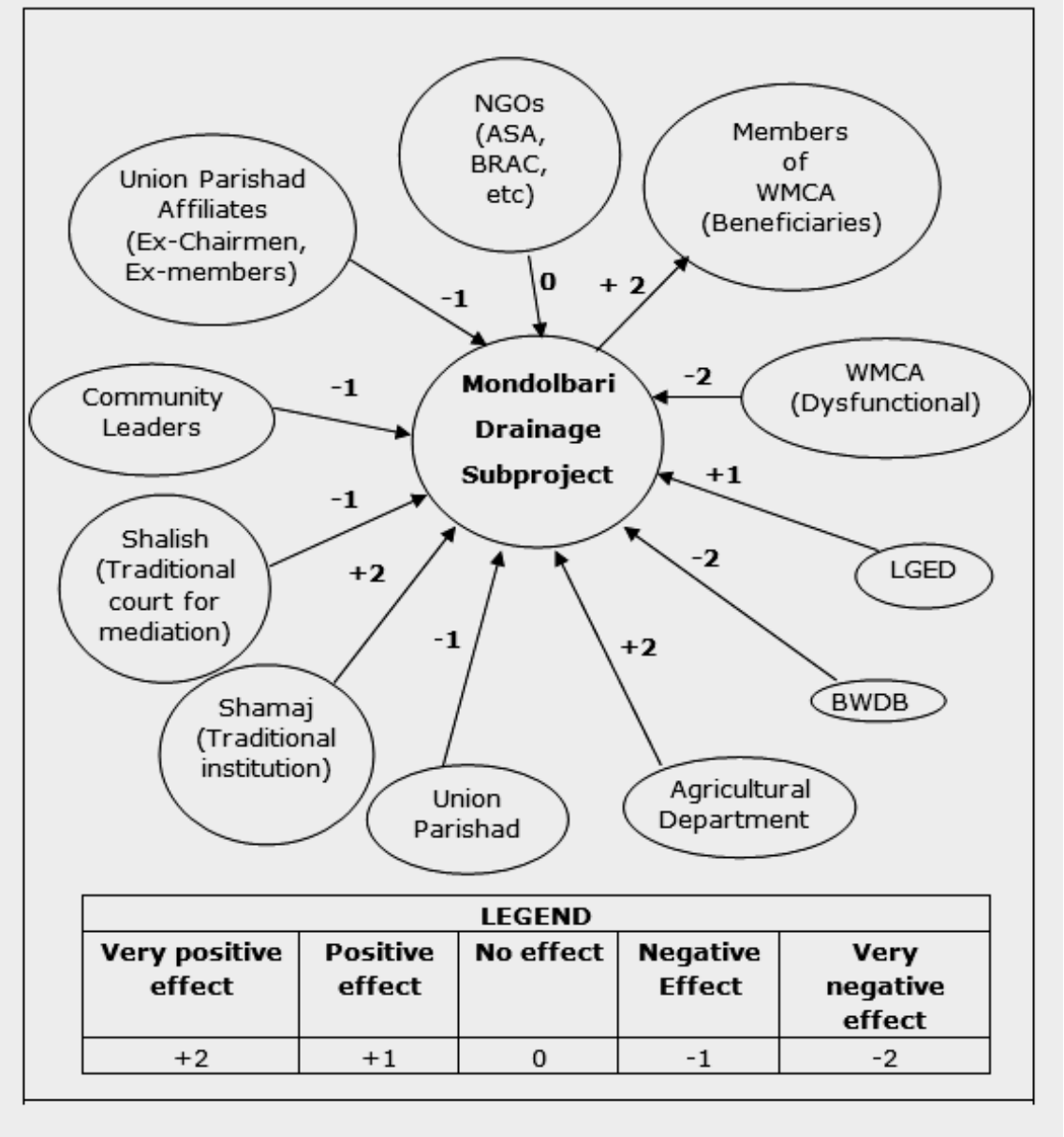


Figure 8: Institutional Mapping of Mondolbari Drainage project

As has been mentioned above, the existing sluice gate needs proper maintenance. However, it is not clear who would do the maintenance and how. Similar to the constraints identified in WARPO (2009), BWDB in this case as well is reluctant to provide stakeholders with financial control over that Indurkata sluice gate. The lack of participation of the local people during the construction of the BWDB sluice gate failed to develop a sense of ownership amongst the users: despite their dependency on the sluice gate, they mostly do not see it as their responsibilities to repair or maintain it. It has been more than 8 years since the key of the sluice gate has been lost! Since then, it has become too difficult as well as costly to operate and maintain the sluice gate. Each attempt of opening or closing of the gate requires a labor charge of 200 Taka and as per WMCA claims, each year during culture fish, it has to spend an extra amount of 5000 Taka just for the opening and closing of the gate. Interestingly enough, although some users including WMCA are willing to pay for the repair and maintenance of the gate, they lack the proper authorization to perform any maintenance work on a BWDB sluice gate. On the other hand, BWDB has no future plan for this kind of maintenance possibly unless and until the structure is on the verge of a complete collapse. And if the infrastructure is not properly maintained, the benefits of the projects will decline over time even after the construction of the proposed (second) sluice gate.

This complex situation is further complicated by the policy of ignoring such conflicts as is clearly manifested by the following declaration of LGED (1999): "There is no interaction with BWDB project". As a result of the above conflicts the major problems of both early flood and water conservation still remain unsolved.

Contrary to the MD project, as already been mentioned, Tripalli has no dependency on BWDB for the operation of their sluice gates. As a result, this Tripalli project is successfully maintaining their three sluice gates without having any major conflicts.

5.4 Issues Related to Culture Fish and Gender

The practice of culture fish has imposed a number of constraints on different dimensions. This section focuses on a number of such issues and makes an effort to depict an accurate picture thereof based on the detailed case study on the involved projects.

5.4.1 Contestation

As has been discussed in the previous sections, the raising of the water levels, during mid May for the culture fish makes broadcasting of Aman very difficult. Even if some Aman is finally produced, the farmers face difficulties during uprooting Aman stubble and also during Boro land preparation as discussed below.
By mid-June, once the water covers the rice fields, natural and culture fish are widely dispersed in the expanse of water. Around mid-October, the water begins to slowly drain off the higher floodplain elevations into the lower lying areas such as channels, marking the start of the drawdown period (mid-October to December). With the water, the fish also move into deeper portions of the channels. The fish thus become concentrated and easier to catch which is highly desirable for WMCA. Aman harvest occurs in 2nd week of Augrahayan (October–November), and preparation for Boro planting begins with seedbed preparation in November. WMCA opens the gate to drain plots and concentrate the fish in the channel to catch, since fishing is very efficient in terms of catch per unit effort during this period (Shankar et al, 2005).

Now the farmers need the land wet for the easier cleaning of Aman roots. Therefore, the opening of the gate by WMCA and the resulting draining of plots (to facilitate fish harvesting) essentially dries up soil too much for uprooting Aman stubble.

On the other hand, the land should be saturated to make it properly prepared for the next crop, namely, Boro. As the start of the drawdown period is mid-October to December, dried up soil makes farmers more dependent on irrigation even for Boro land preparation increasing their cost of production. As always WMCA completely ignores the pleas of these affected farmer's and their demand for compensation. This results in serious contestation between the WMCA and the local farmers.

In the first two years of practicing culture fish, the profits were not equally and fairly distributed (see details in 5.4.3).Not all landowners of the flooded rice field were allowed to be included as members of the WMCA due to a pre-set limit (say, 500) on the number of members (see details in 5.5). As a result non members, majority of which were local poor and marginalized farmers, did not get any profit out of that fish cultivation. But they have a right to get a share of the benefit due to their ownership in that flooded land (see details in 5.4.2). Therefore conflicts did arise among the members of WMCA and the non-members. Additionally, none was allowed to catch or poach fish in their rice field during the flood season. Again, as has been indicated before, Integrated Water Resource Management Unit (IWRMU) of LGED also favors this power structure.

On the contrary, in the neighboring Tripalli project, when culture fish created problem with jute retting and caused less production of Aman rice, majority people who are 'Shudra' (agriculturist or agricultural laborer caste of Hindu) opposed the plan to continue it. This decision was the reflection of the majority people's demand driven by better financial return of jute retting as well as the social and religious obligations/homogeneity.

5.4.2. Limited Access to floodplain

As been discussed, by mid-June, once the water covers the rice fields, the land becomes a common fishing property. During this monsoon period fish catch from common property land, such as seasonally flooded private land, are one form of ecological subsidies to the poor people that keeps the balance between rural poverty and distribution of benefits (Ahmed, 1997). Marginal and landless involved in subsistence activities become subsistence fishermen, in spite of the fact that fishing efficiency (catch per unit effort) is lowest during this period. They catch fish primarily for home consumption and secondarily to supplement cash income (Thompson et al., 2002). The floodplain fish catch is the single most important source of animal protein, Vitamin A, essential fatty acids and calcium for rural people, particularly for nursing mothers, pregnant women and children of ages above two years (Datta, 2000). As a result, the most complex issue of access limitation arises due to the floodplain use for culture fish (Lewis, 1997).

This study has found that culture fish tends to exclude a large number of poor households. This exclusion adversely affects them through the attenuation of their common property rights over the floodplains. The result is fewer and fewer households having access to what previously were common pool fisheries. The consequences are a loss of direct access to animal protein for their household diet and loss of supplementary employment and income (Valbo-Jørgensen and Thompson, 2007). The local people are normally no longer allowed to use the fields for subsistence fishing and this promotion of the culture fish pre-dominantly benefits WMCAs. This means a direct transfer of benefits from the poor and needy to the rich and surplus. As a result, this results in with negative impact on equity and income distribution.

5.4.3. Distributional consequences of shares

Practice of culture fish is biased in all regards. Out of that floodplain, majority common people could have caught fish worth of 5000-6000 Taka in a year; but from culture fish, they got a net profit of 500-600 Taka from WMCA. As a result, although 75% of total revenue is kept recorded as shares for the co-operative in black and white, in reality they only receive 25% of it in cash. Initially majority people were in favor of culture fish. But WMCA has lost their support because of their unequal distribution of benefits. The resulting profit however, is not distributed directly to the commons and is only recorded in paper forms as shares to the cooperative. It increased inequality in the distribution of project benefits which was already positively skewed towards the rich. However, it is found that the primary source of income of dominating members of WMCA is business rather than agriculture and they have diversified livelihoods away from agriculture and have accumulated more financial capital. The non-poor distributional outcome of culture fish development in Bangladesh is also attested by other studies (ADB, 2005; Ahmed and Lorica, 2002; Toufiq and Gregory 2008).

5.4.4 . Social context

The practice of culture fish has affected the local people in a number of ways which include a number of social issues particularly related to gender. This section briefly focuses on these issues.

In the MD project, it was claimed that there were no professional fishers. So WMCA had no strategy for compensating the fishermen. But with the practice of culture fish, the universal access to the floodplain and its fish was restricted. As a result, the interest of the powerless ('lowers'), as categorized by Chambers (1995), was largely ignored and undermined by the powerful ('uppers') (Huq, 2001).

Straw and stubble of Aman plant have significance in the economy of the village (Catling, 1992). People have traditionally used the long rice straw collected from the harvested Aman fields as fuel. Another casualty of culture fish is the loss through the less production of Aman as well as less source of this cheap fuel which was used extensively by the poor.

To protect the flee of culture fish, WMCA, without even having any legal permission, is using bamboo net at the mouth of Asi channel, which is connected with the Mondolbari channel of the Tripalli project. This seems to threaten the livelihood of neighboring people who depend on the fish yield of the Mondolbari channel.

The retting of jute is incompatible with culture fish and as a result is not permitted in the areas brought under culture fish. Farmers who wish to rot jute in the MD project are small in number and they do not have any significant voice. Now for rotting jute farmers must go outside the project area, thereby increasing production costs and adding pressure on wild fish stocks in other areas.

5.5. Elite Capture

As has been reported by Béné and Neiland (2006), elite capture is probably the most frequent pitfall in decentralization reform, and MD project is one among numerous examples of how local elite groups have captured the benefits of decentralized projects for their own use and thus reduce considerable potential positive effects. In this project, LGED first handed over water management to WMCA in 1999. At first only a few people joined as members. Later, the project was captured by elite group who become member of WMCA. They decided to keep its number of members restricted to 500 with the intention of maintaining their influence. It has negatively affected the poor, deprived section due to the lack of adequate consideration of social impacts at the planning stage. Rich members of WMCA usually control the operation of existing sluice gate for flood control and drainage. This is how public good is used as private good by the more powerful (Rahman et. al, 2007). Each year decision making complexities towards opening of the sluice gate increase social and political tension among the stakeholders. In the year 2008, majority people's demand for saving Aman failed against the intention of powerful group for gaining more profit out of culture fish. In WMCA, the leadership lies within the hands of entrepreneurs rather than farmers. And culture fish, which is generally considered to be beneficial to the rural farmers, has been being used by the elite groups of WMCA members for their own benefit. And, this power group by now has been able to even divert the project objectives in favor of culture fish ignoring the slow drainage requirements for Aman rice despite that the original objective of the project was to enhance agriculture. That is how the local elites dominate local governments and maintain commercial and political links with centers of powers (Huq, 2001).

5.6. Involvement of Women

Most water resources development projects do not directly target the poor who constitutes the vast majority of the country's population (Halcrow and others, 1998). ADB (2004) focused more on the formation of labor contracting society (LCS) which is free from socio-political considerations to include only the poor and disadvantaged or destitute women. LGED argues that the landless and women can be benefited directly through including them in earthworks, labor intensive agriculture and fishing activities. Now its focus has shifted more on the formation of LCS groups and water resource development than on monitoring water resources management practiced in their projects. However, the beneficiaries said that women in the project area do not generally participate in field-level agricultural activities due to too much drudgery associated with the traditional agricultural practices and the cultural value system. Rather, they are busy with harvesting and post harvest processing home. So the involvement of women was less.

Key features of the Gender Action Plan include increasing the women's participation in water related governance. It requires one-third female members in operation and maintenance (O&M) Committees, in Project Implementation Committees, and in Water Management Associations representing women farmers, fisher women, landless women and women laborers (LGED, 2003). But in reality, this plan is making the women participation much lesser. Firstly, the limit of one-third women participation has only restricted further gender involvement and is not adequate in many contexts. Secondly, the involvement of women is of paramount importance in other stages of water management as well. In fact, such approach needs to be adaptive with dynamic nature of different water control dimensions so that complex problems of water management can be locally managed. A further shift is necessary at least in these two aspects to initiate and sustain local water management.

6. DEVELOPMENT OF AN IWRM FRAMEWORK

In order to successfully develop a sustainable IWRM framework, identification and prioritization of water resources management issues and challenges must be done through a consensus of the stakeholders. Following the above principle, the suggestions and recommendations of the stakeholders were taken into account and the gaps in the existing IWRM framework being practiced in MD project was identified. These gaps are presented in the table 1.

Table 1: Development needed in the operational IWRM framework of Mondolbari Drainage (MD) project.

Stage	Gap in Operationalizing IWRM
Stage	Complex problems of the project were not clearly specified.
	Dependency on BWDB project was ignored. LGED skipped the coordination needed with BWDB.
	Alternate option for water conservation was needed. For that, investigation was needed for the demand of local people for water controlling structures.
	Plan for drainage of channels was not enough.
	Investigation of social, technical and Institutional Issues were required.
Design	Function of all channels did not get their required and sufficient attention. In particular, flood water entrance or drainage through another internal channel (e.g., Asi at MD project) was completely ignored.
	Although water balance was vital, no analysis thereof was performed. In particular, the answers of following questions should have been sought: 1. How much water is drained through internal channels? 2. How much area is affected by the flood water entering through the internal channels?
Implementation	During the formation of WMCA 1. Sufficient time was not given. 2. Appropriate environment was not created.
O&M	Fairness was missing in the annual performance Audit
	Absence of proper monitoring of the O&M facilities and performance of WMCA.
	Problems of IWRMU: 1. Ignored the community demand for new interventions on the internal channel. 2. Adversely affected Aman cultivation by constructing an embankment as per WMCA demand for the ease of culture fish.
	Absence of the investigation of key social, technical and institutional issues.

The proposed IWRM framework also suggests (1) providing technical and institutional support for the new sluice gate, (2) operationalizing the socially acceptable gate schedule, (3) ensuring close coordination and cooperation among LGIs (Local Government Institution), (4) monitoring the maintenance of small scale water resources infrastructures, such as embankment and the existing sluice gate at local level by ensuring proper participation of the community as well as the local government institutions, and (5) taking care of environmental and social issues. But true IWRM can take place only where the necessary platform has been created.

To overcome the constraints mentioned in Section 5, a gate operation rule has been proposed based on detailed analysis of the crop calendar, fish life cycle, tidal cycle and the demand of local people of the study area. This rule is developed in a participatory way and is an attempt to maximize benefits from agriculture and culture fish. The proposed gate operation rule is presented in Table 2.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
CLOSE WITH OPENING AT EACH SPRING FLOOD			OPEN	CLOSE	OPEN	CLOSE WITH OPENING AT EACH 10 DAY INTERVAL					OPEN	CLOSE

Sluice gate will remain closed for the whole month of May and will be opened in the first of June to allow the entry of flood water to raise the water level at channels. After spawning of fingerlings, the gate will be kept closed from mid June to mid November to stock the culture fish with 6-7 times opening with intervals for a day or more depending on the Oxygen requirement of culture fish stocked. By the 2nd week of October, the fish harvesting will have already begun and fish harvesting will end by the 2nd week of November. During the 2nd week of November, depending on the flowering stage of B. Aman, the gate will be opened for Aman harvesting. After the completion of the Aman harvesting, the gate will be closed again to prevent the draining of plots so that the farmers can prepare the fields for Boro. From December to March the gate will remain closed with opening during the spring or highest tide only; this will help in tapping the tidal water. This tapping of spring tides can meet up to 7 days of irrigation demand. After that week the gate will be kept open for next 3-4 days for the entry of natural tides. Again it will be closed to tap next spring/interim flood. And finally the gate will be open during mid April to harvest Boro and remain open until harvesting is completed. This round the year gate operational rule will be same for both existing and proposed gates of the study area.

7. CONCLUSIONS AND RECOMMENDATIONS

In this research, a critical review was made on various issues and problems related to the projects following the SSWRDSP approach. A detailed case study was undertaken on the two neighboring small scale water resources projects implemented in 1999, namely the MD project and the Tripalli projects in the South West hydrological region of Bangladesh. The conclusions and findings arising out of this interdisciplinary research work are summarized below:

1. Local people protested the initial construction plan of a dam as it could create navigational problem for the neighboring villagers. LGED reacted to this protest and changed their initial concept from water conservation to drainage accordingly. It is considered as an important step towards the operationalization of IWRM.

2. IWRM unit (IWRMU) of LGED has made a good progress by clearly pointing out a framework towards operationalizing IWRM.

3. Although IWRMU was established during the second phase of SSWRDSP, it is providing support to its 1st Phase projects like MD project, particularly in O&M.

4. IWRMU supported WMCA with the construction of the embankment needed for culture fish. However, culture fish restricted the access of the commons and caused contestation between WMCA and local farmers. Even the profit, made out of this fish culturing, was not distributed equally.

5. However, WMCA was successful in proving their good governance by showing its economic gain and its political background was a big support to influence LGED.

6. Now, the power group of the society mostly controls WMCA and it works in favor of culturing fish ignoring completely the rightful demand of the commons to discontinue it.

7. Institutional conflict exists between different implementing and controlling government agencies. This is evident from problems and issues in the operation and maintenance of the water structures owned by one institution in the project area of another.

8. B. Aman cultivation is the first priority to local people after Boro. But absence of a sluice gate on another internal channel, a dysfunctional WMCA and the above mentioned constraints are hampering Aman cultivation as well as Boro irrigation.

To utilize and exploit the full potentials and to overcome the above mentioned constraints, in this research work, the gaps in the IWRM framework implemented (particularly at the planning, design and O&M stages) have been identified. To achieve true success, the projects (both ongoing and future) need to do the following:

9. The demand of the local people should be given the highest priority as opposed to the demand of the power group controlling the WMCA (in the case study area, a new sluice gate should be constructed as opposed to a floodplain enclosure)

10. Proper coordination and co-operation is needed between implementing and controlling government agencies (e.g., BWDB and LGED within the study area) with regards to the O&M of the existing water structures.

11. Socially acceptable operation rules must be established for controlling different water structures, which consider the demand of both WMCA and the common people, and is vital for Boro and Aman cultivation.

7.1 Recommendations

In case of about 170 schemes out of the first 280 started in 1999, adequate time could not be given for people's participation and its institutionalization while forming the WMCA (Hossain and Islam, 2001). To avoid such problems, this paper concludes with a number of recommendations as follows:

1. Sufficient time must be given and the appropriate atmosphere must be created to ensure the proper participation of all stakeholders and the WMCA shall not be formed unless the required level of participation is achieved.

2. LGED has to be fair while doing annual performance audit and regular monitoring of (i) O&M of the facilities, (ii) performance of WMCAs.

3. Finally, effort must be made to fully explore the challenges of IWRM in SSWRDSP. Appropriate steps must be taken to implement the policies. IWRMU must monitor the maintenance of the completed projects on key technical issues by walkthroughs with WMCAs as well as local stakeholders. It must also investigate the key social/institutional issues regarding the functioning of the WMCA itself.

4. Implementing agencies must give required attention to the popular demand and carry out detailed analysis to investigate the justification of the demands and act accordingly. For example, the importance of both (the existing and proposed) sluice gates in the project area is clear from this detailed study and analyses that therefore, LGED should consider construction of new interventions (eg. a new sluice gate) and take proper measures to strictly follow the socially acceptable gate operational rules. Though WMCA will be responsible for gate operation, LGED needs to monitor it regularly.

5. After imposing any change to the existing system, an impact study has to be conducted. For example, a study on the impact of the proposed gate operation rule at the study area should be carried out after the installation of the gate control structures. Also, neighboring dwellers fear that the enclosure of floodplains will cause less availability of natural fish at their Channel. So, LGED should also do an impact study on biodiversity, in particular to identify potential negative effects of limiting access to seasonal fisheries.

6. IWRMU of LGED needs to co-ordinate policy-making, planning and implementation in an integrated manner with WARPO, BWDB, Ministry of Water Resources, Department of Cooperatives and other ministries/departments.

7. In case, the popular demand is not fulfilled, a fair compensation scheme must be in place. For example, in the study area, if WMCA keeps promoting culture fish, adequate compensation should be provided to poorer households and local people should be allowed to participate and get benefit from these projects. Again, it should not target maximizing the profit at the cost of terminating any crops practiced locally. Furthermore, an equitable distribution of costs and benefits should also be ensured. LGED must take appropriate steps to ensure this through regular monitoring.

It is well known that providing IWRM framework is not enough, however refined it ever might be; unless the framework is well implemented success will not be achieved. This study has pointed out the gaps in implementing IWRM with the intention of developing or improving the existing framework IWRMU follows. This study is believed to provide a better understanding of the practice of IWRM in future studies and is expected to be useful in implementing the IWRM road map provided by WARPO (2009).

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