Water is of paramount importance to sustain life, development and the environment. Its governance has profound implications on the society, economy and environment. Traditionally, the focus of water management projects has been on optimizing economic benefits overlooking the distribution of benefits and costs among different socio-economic groups. Theories of social justice and equity underscore the need for ensuring social justice in water resource management. Using Bangladesh as a case study, this paper examines how and to what extent the concept of social equity has been integrated in water resource management. Analysis revealed that the governance of water resources in Bangladesh is biased towards structural solutions of flood control and irrigation through a centralized approach that ignores the other uses of water such as drinking and sanitation, fisheries, navigation, and ecology, and ignores the costs borne by the rural poor. Often, the access to water resources and the costs and benefits of water resources project is distributed unequally. While the rich get more access to water resources, the poor bear the cost. Recommendations are made to promote equity in water resource governance.

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1. INTRODUCTION

Water is of paramount importance to sustain life, development and the environment and its governance has profound implications. Availability of water is the key determinant of economic growth and social prosperity. Water, however, is a finite resource and its use for one purpose reduces its availability for other purposes. Competing water needs have triggered conflicts between disparate water users such as commercial and subsistence, rich and the poor. Rural poor, who depend heavily on public water bodies such as rivers, streams, khals (natural channels of water), beels (permanent backwater lakes in the floodplain), for sustaining and well-being, often been marginalized and even deprived in access to public water bodies in the process of water resource development such as construction of dam, irrigation canal, flood control structures (Tiwary and Phansalkar, 2007; Phansalkar, 2007). It has also been the bone of contention between different sectors and different regions such as domestic and agriculture, agriculture and industry, agriculture and fisheries, upstream and downstream, rural and urban areas, and fisheries and flood control. Increased demand for water stemming from population growth, increased economic activities and ecosystem services on the one hand and the problem of water management in flood control situations on the other have posed a significant challenge for the planning and allocation of its uses among competing demands and call for attention to the distribution of benefits and costs among different stakeholders of the society (Syme et al. 1999; Meijer, 2007).
Water resource development and management is critically important for Bangladesh due to its geographical location, low-lying topography and socio-economic condition. Water resource management in Bangladesh can be traced back to pre-colonial Bengal. Water management has been institutionalized since 1959, when the then East Pakistan Water and Power Development Board Authority (EPWAPDA) was established and assigned the responsibility for water resources development (Alexander et al., 1996). EPWAPDA and subsequently, the Bangladesh Water Development Board (BWDB) undertook many projects to control floods and build drainage for irrigation. By June 1990, BWDB had constructed 7,555 km of embankments and 7,907 hydraulic structures under 437 projects (Thompson and Sultana 1996:1).

All these projects were developed and implemented under the auspices of the central planning authority. The focus of water sector activities has been on flood control, drainage and irrigation to support the agriculture sector. Despite increasing emphasis on incorporating social justice, there has been no systematic study on how social and environmental aspects are being incorporated in water management projects in Bangladesh (Thompson and Sultana, 1996; Ahmad, 2003).

Water management activities, however, generally involve converting natural environment to built environment through construction dam, polders, irrigation canals, dyke, embankment and other water control structure to create favorable hydraulic conditions (Few, 2003). Such structures alter the water regime and helps to bring increased control for irrigation, flood control and other purposes, they also modifies the natural environment of floodplain ecosystems, which provides various goods and services for local people (IUCN, 2000; MEA, 2005). Regulation of river flow through engineering structures also sometimes changes the property right, which impose restriction on access to water and related ecosystem services, on which the poorest people depend for sustenance and well-being.

Altering floodplain ecosystems therefore has serious implications on different socio-economic groups as benefits and costs of water resource development project often distribute unequally to different sections of society. Poor people often disproportionate bear the cost of floodplain modification, which has raised serious equity and fairness questions (Shiva, 2002; Chowdhury et al., 1997; McLean, 2007; Phansalkar, 2007; Venot and Clement, 2010). Unequal distribution of benefits and costs not only affects livelihoods of poor people but often enhance inequities and disparities among different socio-economic groups, and accelerate social conflict (Mokorosi and Zaag, 2007). It is, therefore, necessary to assess the impacts of water resource development projects on different socio-economic groups.

Despite growing concern little attention, however, has been paid on equity aspects in water resource development in many South Asian countries. As a result, there is unequal distribution of benefits and cost among different social class and caste that often lead to increase conflict even strong resistance towards water resource development projects (Tiwary, 2006). The Narmada Bachao Andolan (NBA) in India is a glaring example of such resistance, which forced the government to drop implementation of the Sardar Sarovar water resource development project (Phadke and Patankar, 2006). It is therefore important to examine the governance and equity issue in water resource development.

1. Floodplains are wetland ecosystems that are periodically inundated by the lateral overflow of rivers and lakes (Junk, Bayley, and Sparks, 1989). Floodplain ecosystems support diverse aquatic habitats.
2. Three different property rights regimes private, public (state) and common property exists, which defines the rights of access, withdrawal, management, exclusion, and transfer of resources (Schlager and Ostrom, 1992). Most of the floodplain water bodies are common or public property resources, where everybody of the community has access to such ecosystem goods and services. Altering of water regimes through water resource development project often limit or restrict the uses. For example, constructing an irrigation canals may limit the uses of fresh water only for those who are members of irrigation committee or paying fees for irrigation management. And, thereby restrict the use of fisheries or other subsistence uses.
3. The concept of water governance refers to a ‘systems that are in place to develop and manage water resources, and the delivery of water sources, at different levels of society’ (Rogers and Hall 2003). Water governance from local context refers involving different stakeholders in the entire process of management, planning, decision-making, and implementation of water resource management project (Laban, 2007). Also see Franks and Cleaver (2007) for importance and framework of water governance.
Against this backdrop, the present paper examines how and to what extent the concept of social equity has been
integrated in water resource development projects in Bangladesh and how the benefits and costs of water
resource development projects are distributed among the different sections of the society.

This study is based on both primary and secondary information. The secondary information was drawn from
various sources including government reports, books and journal articles. The primary information was collected
through diverse means including field observation, group discussions and key informant interviews. Information
collected from the different sources was triangulated to check their validity. The author's long research
experience in the water sector was also useful. The paper is organized in five sections. While the context of water
management and equity aspects is discussed in this section, the second section provides a conceptual
understanding by reviewing key literature on floodplain ecosystem, human well-being, and different notion of
environmental and social justice. The third section, offers a brief account of the context of water resource
management in Bangladesh and socio-economic condition of people. The fourth section presents the result of
this study and offers some explanations on the findings. The fifth and final section draws a conclusion and
suggests recommendation for promoting social justice and equity in water management.

2. RELATIONSHIP BETWEEN WATER MANAGEMENT INTERVENTION AND HUMAN WELL-BEING: A CONCEPTUAL
UNDERPINING

Understanding the distribution of benefits and costs of water resource development and how it influence the
different socio-economic group is fundamental to aid decision making and enhance social justice in water
resource management (Thompson and Sultana, 1996; Meijer, 2007; Walker, 2010). Growing evidence suggests
that water resource development through structural measures often alters natural environment, hydrological
regime of floodplain wetlands, subsequent changes in the ecosystem health and functions and resulting
availability of ecosystem goods and services (Bayley, 1995; Chowdhury and Salehin, 1997; McCartney, 2009).
Embarkments, dams and other structures obstruct natural corridors for the flows of energy and species thereby
reducing aquatic habitats and hence biological diversity and often obstructing navigation routes (Chowdhury and
Salehin, 1997; Islam, 2001; McCartney, 2009). As a result, the natural functions of floodplain ecosystems are
undermined that affects ecology, environment and human beings (Bayley, 1995; Chowdhury and Salehin, 1997;
Tockner and Stanford, 2002; McCartney, 2009).

Different socio-economic group are likely to experience different effects and may face different levels of benefits
and cost from a particular project. It may affect their initial water access and use rights, entitlements and affect
their well-being differently (Klasen, 2002; Meijer, 2007; Venot and Clement, 2010; Walker, 2010). While an
irrigation project may increase the water availability during the dry season for irrigation, it may reduce water for
fishing or other subsistence uses and affect fishing community (Meijer, 2007).

This is a question of justice and fairness; how the typical water management projects alter the relationship and
ecosystem functions and services and how it affects different socio-economic groups? Scholars concerned with
distributional and procedural justice attempted to define the notion of social justice. Rawls (1971) established a
moral theory of justice which provides a basis for assessing the distributional and procedural outcome of policy
decisions. From Rawls's perspective social goods and are to be distributed equally unless an unequal distribution
of these goods advantages the least well off. Rawls's notion of justice is consistent with the principles of
environmental justice, which concerns the distribution of environmental benefits enjoys and bears burdens by
the different stakeholders (Baxter, 1999). The proponents of environmental justice insist that the distribution of
costs and benefits from development intervention that impact on environmental resources assets should be
recognized in social theory of justice.
Social theories of justice, equity and fairness underscore the need for ensuring social justice in water resource management and have developed several doctrines that accentuate the need for ensuring equity and social justice in water resource management (Syme et al., 1999; Tisdell, 2003). The equity concept implies that water allocation among the competing users should be based on this overriding criterion of Social justice. It also implies protection of water rights and access to safe drinking water, as it is a basic human need. UN General Assembly recently declared safe and clean drinking water and sanitation as a basic human right (UNGA, 2010). According to Phansalkar (2007) equity in access to and use of water and the distribution of the impact of water resource development intervention can be understood in four connotations: social equity, spatial equity, gender equity, and inter-generational equity. Social equity refers to equity between different groups of people living broadly in the same locale. Spatial equity refers to equity between people living in different regions (Saleth and Dinar 2004). Gender equity refers to equity between genders in regard to share in labour costs, efforts in access to and use of water and share in its beneficial uses and products. Inter-generational equity refers to equity in enjoyment of natural resources, including water, across generations of people (Divan and Rosencranz 2005). The decisions should be fair and free from bias and should ensure social justice in the distribution of social costs and benefits of water management projects. This theoretical framework has provided the basis of analysis for rest of the paper.

3. SOCIO-ECONOMIC FEATURE AND WATER GOVERNANCE IN BANGLADESH

3.1 Geographic and socio-economic features of Bangladesh

Major portion of Bangladesh is formed by deltas of three large rivers the Ganges, the Brahmaputra and the Meghna. The three large rivers meet inside Bangladesh and the combined out-fall discharges to the Bay of Bengal. Approximately 7% of the total area of 1.74 million sq.km. of the three river basins lies in Bangladesh. Numerous tributaries and distributaries of the three large rivers and extensive floodplains is the main physiographic feature of the country.

Unconsolidated floodplain sediments occupy about 80% of Bangladesh while tertiary hill areas in the east occupy about 12% and pleistocene terrace areas in the north-central (NC) and north-west (NW) occupy about 8% (Brammer, 1996). It is mostly a deltaic country characterized by a dense network of rivers (Fig.1), khals (floodplain channels) and wetlands, which provides multitudes of services to the population such as drinking, irrigation, fishing, transporting and other economic, ecological, aesthetic, and social services.

Figure 1: River system and hydrologic regions of Bangladesh
Bangladesh is predominantly a rural and agricultural country. Over three-quarters of its population live in rural areas (Table 1) and agriculture still accommodates almost two-thirds of the country's total labour force, which is about one-quarter of its gross domestic product. It is the most densely populated country in the world (over 150 million in an area of 147,570 km²). About 50% of its people live below the national poverty line and over one-third of its population lives on just below US$ 1 a day. A large section of the rural poor is dependent on natural water bodies in floodplains and in hilly watersheds for their livelihood. Their subsistence is based on food production, fishing, harvesting wetland plants, plying country boats and other activities dependent on water resources. The socio-economic well-being of rural people in Bangladesh is therefore largely interlinked with floodplain ecosystems; thus, underline the significance of ensuring social justice and equity in water allocation and water resource governance.

**Table 1: Key Socio-Economic Indicators of Bangladesh**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population in 2008 (million)</td>
<td>160</td>
</tr>
<tr>
<td>Rural population as % of total population in 2008</td>
<td>73 %</td>
</tr>
<tr>
<td>Gross national income per capita in 2008 (US $)</td>
<td>520</td>
</tr>
<tr>
<td>Income of top 5% (2005)</td>
<td>26.93 %</td>
</tr>
<tr>
<td>Income of lower 5% (2005)</td>
<td>0.77</td>
</tr>
<tr>
<td>Population below national poverty line (survey year 2005)</td>
<td>National 40.0%, rural 43.8%, urban 28.4%</td>
</tr>
<tr>
<td>Population below US$1.25 a day (survey year 2005)</td>
<td>36.08 %</td>
</tr>
<tr>
<td>Poverty gap index (%)</td>
<td>National 9, rural 9.8, urban 6.5</td>
</tr>
<tr>
<td>Population below the minimum level of dietary energy (2004-2005)</td>
<td>30</td>
</tr>
<tr>
<td>Malnourished children</td>
<td>43 %</td>
</tr>
<tr>
<td>Human development index (HDI) rank in 2007</td>
<td>146</td>
</tr>
<tr>
<td>Human development index value in 2005</td>
<td>0.520</td>
</tr>
<tr>
<td>Population without access to safe water (2002)</td>
<td>75 %</td>
</tr>
<tr>
<td>Population without access to sanitation (1995)</td>
<td>36%</td>
</tr>
<tr>
<td>Life expectancy at birth (yrs) in 2008</td>
<td>66</td>
</tr>
<tr>
<td>Infant mortality rate in 1,000 live birth (2008)</td>
<td>43.0</td>
</tr>
</tbody>
</table>

**Source: World Development Indicator 2010 and SAARC, 2010**

### 3.2 Water resource development in Bangladesh

Before partition of the subcontinent in 1947, there had been little national scale government-led water sector development in the present Bangladesh. Small-scale public investment in water resources development, however, can be traced back to the pre-British period, when small reservoirs were constructed from local infrastructure to reduce the adverse impact of flood and to ensure water for irrigation during dry seasons. The national scale water sector development started in 1959 after the establishment of EPWAPDA following the recommendation of the Krug Mission after a devastating flood in 1954.
The EPWAPDA was responsible for the planning, design, operation and management of all water development schemes. In 1964, it prepared a 20-year Water Master Plan, which designed a strategy of massive flood control and drainage to be followed by irrigation. Emphasis was laid on the construction of embankments and polders over much of the country. Following independence in 1971, the EPWAPDA was restructured and responsibilities concerning planning and management of water resources was handed over to the newly created BWDB. The BWDB became the national focal point of water management and took many initiatives for water sector development. However, the orientation of water sector development has remained almost exclusively aimed at achieving the goal of increased agricultural production to achieve national self-sufficiency and inclined to seek structural engineering solutions. As a result, the focus of water sector activities has been on flood control, drainage and irrigation to support the agricultural sector. The role of water in other sectors, such as domestic water supply and sanitation, fisheries, navigation, industrial use, hydropower, ecology and nature and disaster management, remained mostly neglected (Ahmad, 2003). However, the 1999 National Water Policy (NWP), for the first time, recognized the role of water in poverty alleviation and called for inclusive water management, taking into consideration the national goal of poverty alleviation, along with other goals (Ministry of Water Resources, 1999). The policy was further revised in 2000 and approved by the government. The stated goal of NWP is “to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, a decent standard of living for the people and protection of the natural environment”. To facilitate the implementation of the NWP, the government approved a 25-year National Water Management Plan (NWMP) in 2004. The plan provides guidelines to develop programmes for better management of water resources in the country. The main elements of the NWMP, among others, include the multi-use approach to water (not just flood protection but also irrigation, drinking water and other uses) and an emphasis on ‘soft’ approaches instead of just hard engineering approaches.

4. Social Justice in Water Governance in Bangladesh

4.1 Water management projects and rural livelihoods

There are about 800 implemented small-scale and large-scale water management projects that are dependent on surface water system. Bangladesh Water Development Board and Local Government Engineering Department are implementing agencies for large scale and small scale projects respectively. Most of the projects are intended for creating favorable environment for agricultural growth. Area covered by flood control projects is nearly two-thirds of the country while that by dry season irrigation projects is nearly one-third of the country. As explained earlier, due to the socio-economic and geographic features of Bangladesh, livelihoods and well-being of rural people are heavily linked with the water availability in general and floodplain ecosystem services in particular as floodplain ecosystems provide a variety of goods and services and supports a variety of livelihood activities in rural Bangladesh. Like other South Asia countries (see for example, Shiva, 2002, Tiwary, 2006), water management projects in Bangladesh focused on maximizing economic benefits and are generally biased towards construction of infrastructure to control water for flood control and irrigation (Rogers et al., 1994). Poorly planned infrastructure aimed at flood control and irrigation for agriculture with limited inputs from local people often ignores the other uses of water, particularly those on which the subsistence of poor people are based such as, in fisheries, navigation industries, forestry, domestic water requirements and sanitation, livestock, poultry, horticulture, and other human and environmental services (e.g. Halcrow and Others, 1998; Meijer, 2007; Khan, 2010). Water resource development planners often fail to appreciate the contribution of ecosystem services provided by the floodplains to different socio-economic groups. The loss of these beneficial uses causes economic hardships on the section of society that relies on them for their subsistence. As a result, such projects affect the lives and livelihoods of poor people who live on traditional occupations like farming, fishing, and cattle breeding.
The key implications of mainstream water management projects are:

Impact on subsistence food production: Bangladesh has extensive floodplain wetlands that harbor and support a wide range of aquatic plants and bio-diversity. Some of the products of the floodplain ecosystem utilized by the people living in floodplains were listed by Khan (1997). Wetland plants are harvested by the rural poor as a source of supplementary food. Wetland plants are also harvested for firewood, thatching, mat-making, livestock fodder and medicinal use. Further, these plants provide vital nutrients for open-water fisheries. In Bangladesh, floodplains are largely modified by the water control structures (Sultana and Thompson, 1997; Craig et al., 2004). The construction of irrigation canals and the intensive use of water for irrigation have caused natural water bodies such as rivers, canals and wetlands to dry up, thereby reducing opportunities of subsistence food production to the landless people and small land-holder marginal farmers, who do not afford to pay for water from irrigation schemes. In a 'before' 'after' study on Sonamoral submersible embankment project implemented in Northeastern region in Bangladesh, Khan (2010) found that human development index of poor household such as fisherman, boatman's has declined in 2009 compared to 1991 (before implementing the project) due largely to negative impact of the project on the water where their livelihoods depend heavily. Meijer (2007) reported similar results in a study in Surma and Kushiara rivers floodplain in Bangladesh.

Loss of livelihood of fishermen: The extensive network of rivers, canals and floodplain wetlands in Bangladesh provides a hospitable abode for rich open-water fisheries. Canals link up floodplain wetlands and rivers provide an aquatic habitat suitable for reproduction, migration, breeding and growth of fresh-water fishes. A section of the rural population is dependent on fishing in these natural water bodies for their livelihoods. In the north-west and south-west regions of Bangladesh, small and landless farmers in agricultural communities were found significantly dependent on fisheries while in north-central, north-east and south-west regions, over 60% of all categories of farmers have had some participation in fishing (ODA, 1997). Subsistence fishing is carried out by members of households for domestic consumption as well as for commercial purposes. Open-water fisheries are a major source of protein supply for the rural poor. Open-water fisheries are self-sustaining as long as the habitat is not disrupted by change in water regime. These settings have now been adversely affected by water management projects that include flood control and irrigation activities through reduced aquatic habitat and barriers to the movement of fish between river and floodplain. Water control structures on rivers and canals also cause obstruction to the migration route of open-water fishery (Tsai and Ali, 1997; Mirza and Ericksen, 2005). Due to flood control, drainage projects and irrigation projects, many floodplain wetlands have shrunk and lost hydraulic connectivity with the river and have become seasonal water bodies. Consequently, aquatic habitat is rapidly shrinking and fishermen have lost their livelihoods (WARPO, 2001b, Ministry of Water Resources, 1999). Flood control and water conservation projects benefit the richer section of the society by creating opportunity to culture fisheries, but the less fortunate section of the society suffer from loss because of the adverse effects of these projects on open-water fishery (Sultana and Thompson, 1997). Poor fishermen are unable to make the required investment for culture fishery due to lack of capital. The shrinkage of open-water fisheries also affects the protein insecurity of the rural poor and aquatic bio-diversity (Sultana and Thompson, 1997).

Hindrance to waterway transport and loss of livelihood of boatmen: The dense network of rivers and canals in Bangladesh performs an important socio-economic function by providing an opportunity for waterway transport. Inland waterways are a cheap means of transport in Bangladesh. Non-mechanized and partly mechanized country boats provide access to outlying rural areas, which are otherwise unreachable. These boats are the only means of movement during floods in some areas. The country boat is a cheap means of transporting paddy that is harvested at remote agricultural lands. Country boats account for nearly 60% of employment in transport. This is nearly three times more than the employment in all mechanized modes taken together (Jansen et al., 1989). A section of the rural poor earn their livelihood by plying country boats. Water control structures on rivers and canals cause obstruction to boat transport. The plying of country boats is also hindered when the water in many small rivers and canals becomes shallow or dry in the arid season due to irrigation by low-lift pumps. As a result of flood control, drainage and irrigation projects, many boatmen have lost their livelihoods (Halcrow and Others, 1998).
Disruption of rural water supply: Shallow aquifers perform an important public health function in Bangladesh by supplying drinking water through hand tube-wells in rural areas. Access to safe and sufficient water, which is essential for the sustenance of human wellbeing, is recognized as a basic human need (UNGA, 2010). Meeting basic human needs is an equity requirement. The situation analysis report on water supply and sanitation (Ministry of LGRDC, 1994) observes that an increasing number of hand tube-wells for drinking and domestic purposes became inoperative for two to three months a year towards the end of the dry season because of excessive lowering of groundwater level due to expansion of shallow and deep tube-wells for irrigation. The impact of seasonally lowered water table due to groundwater irrigation on rural domestic water supplies is a concern for water management (WARPO, 2001a).

4.2 Distribution of benefits and costs of water resource development

Most of the water management projects do not pay adequate attention to the social impacts of development intervention or consult local people, particularly the poor section. Many projects for agricultural development are biased towards those with agricultural land, by-passing the landless. A majority of the water resources development projects do not target the poor directly. This raises a serious concern about the type of development interventions that do not take into account the interests of the poor, who constitute a vast majority of the country's population (NWMP, 2004). Rich farmers usually control the operation of flood control, drainage and irrigation structures that are simple and relatively small. This is an example where public goods are used as private goods by the more powerful and signifies increased inequality in the distribution of project benefits, which is already positively skewed towards large landowners. As such, certain social groups are negatively affected by the lack of adequate consideration of social impacts at the planning stage.

Table 2: Social costs and benefits of water management projects in Bangladesh

<table>
<thead>
<tr>
<th>Water management activity</th>
<th>Gainer</th>
<th>Loser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land acquisition for flood control embankment</td>
<td>Gainer</td>
<td>Small agricultural landholders who lost their land and households who lost their homestead land are the loser.</td>
</tr>
<tr>
<td>Flood control (FC) project to prevent river flooding</td>
<td>Protected agricultural land holders.</td>
<td>Because of prevention of flooding of large part of floodplain, households in the adjacent unprotected floodplain land are subject to risk transfer (higher flood level).</td>
</tr>
<tr>
<td>FC and drainage project</td>
<td>Large and medium agricultural land owners.</td>
<td>Fisherman, aquatic plant harvester and boatman are the sufferer because of reduction of ecosystem habitat, disruption of fish migration route, reduction of wetland area and obstruction to boat transport.</td>
</tr>
<tr>
<td>FC polder to prevent tidal flooding in the coastal region</td>
<td>Protected agricultural land owners were benefitted for some years after project implementation.</td>
<td>The entire population in the poldered area and adjacent area are subject to severe water logging after some years from project implementation due to river bed rise.</td>
</tr>
<tr>
<td>Water retention in floodplain channel during wet season</td>
<td>Investors of culture fishery.</td>
<td>Rural poor whose livelihoods are dependent on capture fishery and aquatic plant are the loser because of adverse effect on open water fishery and reduction of aquatic plat habitat.</td>
</tr>
</tbody>
</table>
4.3 Water resource development and environment

Two pertinent examples of social inequity in the water resources development are presented below:

Socio-economic hardships due to land acquisition: Flood control projects involve acquisition of substantial land for embankment construction. Land acquisition causes immense economic and social sufferings to the poor households who lose their land. Among the worst sufferers are small agricultural landholders who lose their land, and households who lose their homestead land. Because of the loss of homestead land, which in many cases was their sole property, people become homeless and are compelled to migrate to other places. The economic compensation is a lengthy process that cannot make up for economic loss because of land price inflation. More importantly, the variety of costs borne by the poor are not compensated by the economic compensation, and there is high dissatisfaction among people who are affected by land acquisition. HIFAB and MARC (1992), under the FAP-15 study, assessed the economic and social impacts of land acquisition by selecting six BWDB projects (two in the north-west region and one each in the north-central, north-east, south-west and south-east regions). Household survey in these six projects showed that 38% households lost their land and 4% lost their homestead.

Risk transfer by flood control project: Rivers with extensive floodplain are a characteristic landscape feature in Bangladesh. Floodplain landscape performs an important hydrological function by storing floodwater in flat topography, where drainage of floodwater to the sea is a slow process due to land elevation near the coastline. Thus, floodplains moderate the flood flow by acting as detention reservoir. Flood control projects prevent flooding of agricultural land and urban area located in floodplains. As flooding of the floodplain is checked, the storage space for floodwater is reduced causing increased flood level in the adjacent area. Hence, the flood risk is shifted to the adjacent area rather than reducing the overall risk. Pumped drainage of rainfall-runoff from the protected area also increases flood level in the adjacent area. The poorer section of the society is usually the victim of such risk transfer by flood control projects (Table 2). Transfer of flood risk generates social conflicts leading to forced cutting of flood control embankments by the affected people. Such forced cutting was found widespread in the north-west region (Alam and Franks, 1993).

4.3 Water resource development and environment

This section examines how water resource development projects overlook environmental considerations. Neglect of hydro-morphologic features of floodplain: The concept of flood control is aimed at protecting floodplain agricultural lands from river flood so as to reduce damage to Aman (monsoon rice) and encourage agricultural landowners to adopt more productive transplanted variety of rice in place of broadcast.
The benefits of floods are thus overlooked in water management projects. The ecology and traditional settlements around a flood plain adapt themselves naturally to inundation. They depend largely on the annual hydrological cycle. Normal annual flooding provides numerous benefits such as common access to the large natural floodplain fishery, deposition of fertile loam on agricultural fields, and flushing of stagnant water in low-lying areas (Sultana and Thompson, 1997). After a detailed study of the hydrological, morphological, ecological, social and environmental impacts of flood control, drainage and irrigation projects in Bangladesh, Chowdhury et al. (1997) concluded that the goal of water resource development could not be achieved without giving due consideration to the hydro-morphologic features of floodplain and the socio-economic conditions of rural people.

Water logging due to coastal polder: Building embankments and irrigation canals without adequate number of waterways obstructs the natural drainage. Alternate flooding and recession in tidal floodplain performs an important flushing function that is essential for the morphological stability of tidal rivers. Under the coastal embankment project, flood control polders were constructed to prevent tidal flooding of the floodplain. The polders have reduced storage area for tidal water that enters from the sea. A review of the coastal embankment project by Halcrow et al. (1993) considers that the polders have caused a rise in channel bed due to siltation. The rise in the bed of tidal river, in turn, has resulted in serious water logging of the adjacent area and has become a source of major environmental concern in the region. Continued water logging has caused serious damage to agriculture, forestry, fisheries, livestock and physical infrastructures. Many people had to abandon their ancestral homestead and traditional livelihood activities due to the water logging problem, salt water intrusion and this has generated widespread discontent among the people. The development strategy (WARPO, 2001a) of the NWMP considers it to be of foremost importance to rationalize coastal embankment schemes on the basis of environmental audit.

Water is a basic resource for life and production in society and is essential for sustaining a variety of environmental and ecosystem services. Water resource development has been an important thrust area since the 1950s and many projects and programmes have been undertaken for water resource development. Given the growing conflict on allocation of water for competing demands, there is a pressing need for ensuring social justice and equity in water resource development and the resultant benefits and costs. The objective of this paper was to examine how and to what extent social equity has been integrated in water resource development in Bangladesh and how the benefits and costs of water resource development projects are distributed among the different sections of the society.

Our analysis revealed that focus of water resource development in Bangladesh has been biased towards flood control, drainage and irrigation to support the agricultural sector. The role of water in other sectors, such as domestic water supply and sanitation, fisheries, navigation, industrial use, hydropower, ecology and nature and disaster management, remains mostly neglected. Moreover, water resources management favors structural solutions through a centralized approach by professional engineers. Although construction of embankment, drainage and irrigation infrastructure has facilitated agriculture production in control areas, these structural solutions and engineering approaches often neglect the social aspects and create unintended impacts to the society and the environment.

Although poverty alleviation and social equity have recently become the goal of water resources development (NWP, 2004) and some efforts have been made to involve local people in water resource management (MoWR and MoLGRD&C, 2000) the policy goal has not yet fully been translated into action, particularly at the program and project levels. Top-down centralized approach is still dominant (Chowdhury, 2007). As a result, water resource management projects have not been able to bring the expected benefit to all sections of the society because of inequity in the distribution of social costs and benefits. While the rich people get benefits from this management approach, the poor often suffer and their livelihoods are affected because of changes in the water regime brought about by projects, which are not suitable for their livelihood activities.

5. Conclusions and Recommendations

Water is a basic resource for life and production in society and is essential for sustaining a variety of environmental and ecosystem services. Water resource development has been an important thrust area since the 1950s and many projects and programmes have been undertaken for water resource development. Given the growing conflict on allocation of water for competing demands, there is a pressing need for ensuring social justice and equity in water resource development and the resultant benefits and costs. The objective of this paper was to examine how and to what extent social equity has been integrated in water resource development in Bangladesh and how the benefits and costs of water resource development projects are distributed among the different sections of the society.

Our analysis revealed that focus of water resource development in Bangladesh has been biased towards flood control, drainage and irrigation to support the agricultural sector. The role of water in other sectors, such as domestic water supply and sanitation, fisheries, navigation, industrial use, hydropower, ecology and nature and disaster management, remains mostly neglected. Moreover, water resources management favors structural solutions through a centralized approach by professional engineers. Although construction of embankment, drainage and irrigation infrastructure has facilitated agriculture production in control areas, these structural solutions and engineering approaches often neglect the social aspects and create unintended impacts to the society and the environment.

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It is, therefore, important to institutionalize social equity and environmental justice aspects in designing and implementing water resource projects. Appropriate policy, regulations, standards and guidelines are needed to ensure social justice in the distribution of social costs and benefits of water management projects. As suggested by the World Commission on Dams (WCD, 2000) local people's initial water rights and access should be recognized in water resource development projects and attention should be paid that there rights and interest are not undermined or denied. Following Rawls's principle, discussed earlier, benefit and cost of water resource project should be distributed in such a way that the disadvantaged section of society receive higher benefits and bear less costs in comparison to their initial water access and use rights. Distributional analysis should be part of water resource development projects as traditional impact assessment often overlooks social distributional aspects. If livelihoods of poor and disadvantage group are adversely affected due to water resource project, appropriate compensation or rehabilitation should be made so that adverse impacts are properly compensated.

Successful water resource management involves balancing the needs of a wide range of water-users along with the needs of the environment. A multi-objective and holistic water resources planning approach is required to address the various needs of public health, agriculture, fisheries, ecology, river morphology, salinity intrusion prevention, and navigation, industry and hazard reduction. Water resource management should not be based on economic benefit alone. Social, environmental and ecological aspects should be considered in the process of identification, planning, implementation, operation and maintenance of water management projects. Efforts should thus be made for preservation of water quality, environmental flow and ecosystems. Water management decisions should ensure that no one is deprived of prevailing opportunities for their livelihoods and particular attention is to be given to the water-dependent subsistence activities.

Equity consideration in the decision making process is essential to ensure provision of safe domestic water, improve water-use efficiency, maintain connectivity between wetland and river, maintain support to water-dependent subsistence activities, preserve ecosystem services, maintain prevailing livelihood opportunities and reduce vulnerability to water-related natural hazards. Appropriate provisions need to be made for the poor section of the society who cannot afford to pay for service infrastructures. Appropriate restrictions need to be imposed on these activities in order to prevent adverse impacts on hydrological cycle and water regime.

To promote equity in water management activities, it should be first recognized that access to safe water is a basic human need and essential to public health and livelihood. Efforts should be made to innovate and promote non-structural solutions in flood control so that ecological and social impacts are reduced. Explore better ways to reduce ecological impacts where structural solution is inevitable.
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