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Sustaining the In-stream Flow of Rivers: Comparative Case Study of Germany and Bangladesh

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Abstract: Life of the river sustains on its flow. River systems provide many beneficial values and services, including flood mitigation, groundwater recharge, navigation, water supplies, pollution attenuation, nutrient transport and recycling, biological productivity, aesthetic values, and recreational opportunities such as fishing, boating, swimming and wildlife viewing. In-stream flow is necessary to sustain these and other utilitarian and intrinsic values. For Bangladesh being located downstream of many rivers, it is very important to care about the quantity and chemical as well as ecological quality of its river water. Germany's river Elbe originates in Czech Republic, thus the situation is comparable to the transboundary water problems Bangladesh faces. The comparative analysis of water framework directives and policy, plan of Germany and Bangladesh on maintaining the in-stream flow of rivers (Surma and Teesta rivers of Bangladesh and Elbe river of Germany) is the main focus of this paper. The study puts forward key information and recommendations to maintain the in-stream flow of river.

Key words: In-stream flow, transboundary, legal instruments, management.

Introduction

Natural flow regimes of many rivers are increasingly being modified through impoundments such as dams and weirs, abstractions for agriculture and urban supply and structures for flood control. These interventions have had significant impacts, reducing the total flow of many rivers and affecting both the seasonality of flows and the magnitude and frequency of floods. In many cases, these modifications have adversely affected the ecological and hydrological services provided by water ecosystems, which in turn has increased the vulnerability of people especially the poor who are the subsistent users of river resources. The flows needed to maintain these services are termed 'in-stream flows'. Minimum in-stream flow requirement of a river lies in understanding of a fundamental contradiction that arises due to demand on river water for economic uses on the one hand and performance of river system on the other hand. Due to scarcity of water against demand and lack of proper management of the water resources, maintenance of the in-stream flow of the river needs more emphasis.

The principal aim of this research is to understand the issue of in-stream flow requirements of selected rivers in terms of their functions and problems and to compare with respect to their origin, flow diversity and ecosystem management. The study is carried out with emphasis on the impact of policies, plans and legislations. The main objectives of this study are to review institutional as well as technical approaches for the maintenance of in-stream flows of rivers and also in the use of the hydrologic and ecological approaches to maintain minimum in-stream

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flow for selected rivers in Bangladesh and Germany of different topography.

In-stream Flow of River and River Basin Management

Bangladesh Perspective

Basin planning provides the most rational basis of development of water resources under the influence of one or more major rivers. International river basins, however, such as the Ganges basin, the Brahmaputra basin, and the Meghna basin present special problems. Due to its location as the lower-most riparian, Bangladesh has no control over the rivers entering through its borders. The adverse effects of this are the floods and water scarcity, which occur frequently. Although the 1996 Treaty on Sharing of the Ganges Waters with India has brought some relief to the drought-prone area of the southwest, the water shortage problem during the dry season is likely to aggravate in the Ganges and other basins with rising demands of the increasing population. It is, however, encouraging to note that the relevant provision of the treaty will provide the basis in the future for discussion on sharing of waters of the common rivers (National Water Management Plan, 2001).

It may take considerable effort and time for Bangladesh to work out joint plans for different river basins with other co-riparian countries. As a long-term measure, the policy of the government is to undertake essential steps for realising basin-wide planning for development of the resources of the rivers entering its borders.

German Perspective

The Act on the Regulation of Matters Relating to Water (Federal Water Act—WHG), as a framework law of the Federal Government, lays down basic provisions relating to water resources management (management of water quantity and quality). It states that water bodies, as a component of the ecosystem and as a habitat for fauna and flora, must be protected and managed in such a way so as to serve the general public interest and, in harmony with this, must benefit the individual, in a manner which refrains from any avoidable impairments to its ecological function (precautionary principle). A high level of protection for the environment as a whole must be ensured (integrated environmental protection).

As a general principle, water bodies (overground inland water bodies, coastal waters and ground water) are subject to government control. All uses of water (e.g. discharge of substances or abstraction of water) are, in principle, subject to official authorisation, apart from a few significant exceptions. This is intended to prevent impairments to the water regime and enforce a precautionary approach to water protection. Following the 7th amendment of 2002, the provisions of the EC Water Framework Directive have been transposed into national law.

European Perspective

The Water Framework Directive (Directive 2000/60/EC) entered into force on 22 December 2000. It marked the beginning of a new dimension in European water conservation policy. In future, water bodies are to be managed across national and regional borders, by means of a coordinated approach within the river basin areas.

The central objective of the Water Framework Directive is to achieve a so-called "good status" of all water bodies (watercourses, lakes, coastal waters, ground water) in the community. The basic thinking behind "good status" is that waters may be impaired or changed by human use, but only insofar as the ecological functions of the water body is not significantly impaired. The requirements for good ecological water quality are defined in detail for the various water body types.

National Water Act (Germany)

As stated earlier, the 7th amendment of 2002, the provisions of the EC Water Framework Directive have been transposed into national law (Federal Water Act—WHG) which sets out management objectives for all water bodies to be achieved by 2015 in accordance with the provisions of the Directive. For surface and coastal waters, this means a good chemical and ecological status, while for bodies of ground water the requirement is a good quantitative and chemical status. Mechanisms for achieving this objective include a review, a comprehensive system of monitoring, programmes of measures, and management plans. These need to be prepared by the end of 2009 for every river basin, listing the measures needed in order to realize the management objectives.

Surface waters which are artificial or have been heavily modified may be designated as such, and then need only achieve the less ambitious objective of good ecological potential. Exemptions from objective achievement may be granted subject to a number of stringent requirements. For example, in exceptional cases, the deadlines may be extended, or less stringent objectives standardized.

The same applies in the event of major incidents or disasters, and in the case of new modifications to the water body structure. As the Federal Government only has framework competency for implementing the Water Framework Directive, the WHG contains numerous regulatory mandates to the Federal *Länder*, which have been implemented in the form of regional water acts and ordinances.

Draft National Water Act (Bangladesh)

National water policy and national water management plan address the issue and importance of this sector, but lack of specific Water Act hinders all the development activities. On the other hand, different water management approaches are needed for wet and dry seasons. In the wet months, when flooding is common, water management entails flood protection, proofing, and drainage. The task is complicated by the varied impact of floodwater on different economic activities. For example, agriculture requires flood protection and speedy drainage of water to avoid crop damage, while fisheries and navigation depend on floodwater for support. Such circumstances naturally breed conflict. The upcoming National Water Act will have to consider all the issues that hinder the development due to water related problem. EU Water Framework Directive could be a model in this aspect.

National Water Management Plan

In common with current global concerns over wise use and effective management of water, the Government of Bangladesh is committed to exploring, developing and using its water resources to the benefit of all users.

Government of Bangladesh approved National Water Management Plan (NWMP) in 2004 with the intention of operationalising the directives given by Policy. In reflecting the objective of rationalising and decentralising management of the sector, the Plan is a framework within which line agencies and other organisations are expected to plan and implement their own activities in a coordinated manner. The Plan is presented in three phases: in the short-term (2000-05) it is considered a firm plan of ongoing and new activities; in the medium-term (2006-10) it is an indicative plan; and in the long-term (2011-25) a perspective plan. Implementation of the Plan is to be monitored regularly and it will be updated every five years.

The National Water Management Plan has been prepared to respond to these challenges and paradigms, with three central objectives consistent with Policy aims and national goals. These objectives are:

- Rational management and wise use of Bangladesh's water resources
- People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene
- Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems.

Comparison of Elbe with Teesta and Surma

The Elbe is one of the major rivers of Central Europe. It originates in the northwestern Czech Republic before traversing much of Germany and flowing into the North Sea. Its total length has been given as 1091 kilometres. Elbe has been navigable by commercial vessels since 1842, and provides important trade links as far inland as Prague. The river is linked by canals to the industrial areas of Germany and to Berlin. The Elbe-Lübeck Canal links the Elbe to the Baltic Sea, as does the Kiel Canal, whose western entrance is near the mouth of the Elbe.

Teesta river is a tributary of Brahmaputra which is known as Jamuna river within Bangladesh. Teesta river originates from glaciers in Sikkim at an elevation of 7128 m in the Eastern Himalayas. It is a sandy braided river with steep slope and dynamic in nature. The river is an important source of water in the drought-prone northwest area of Bangladesh. Teesta is the source of water for a large irrigation project called Teesta Barrage Irrigation Project. But amount of inflow of Teesta to Bangladesh is regulated by a barrage in India. The dry season flow is reducing causing siltation as well as harmful effect on river and floodplain. Teesta flows through the northwest region, a very drought prone area, and is the main source of surface water in the area.

The Surma-Kushiyara rivers are formed by bifurcation of the Barak river which is flowing from India and enters into Bangladesh at Amalshid where Barak flow is divided into two branches known as Surma and Kushiyara rivers. The river system is important for maintaining connectivity with an extensive wetland system comprising some 30 haors (tectonic depressions) and supporting navigation and fishery. The rivers exhibit a meandering pattern and the catchment lies in a very high rainfall region.

Length, watershed, average, maximum and minimum discharge of the Elbe, Teesta and Surma rivers are given in Table 1.

Table 1: Basic data of Elbe, Teesta and Surma rivers

Name of the river	*Length (km)*	*Average discharge at mouth (m^3/s)*	*Maximum discharge at mouth (m^3/s)*	*Minimum discharge at mouth (m^3/s)*	*Watersheds (km^2)*
Elbe	1,091	711	1,232	493	148,268
Teesta	315	280	530	203	12,182
Surma	946	1168	3115	613	82,000

Management Aspects

Elbe

As for the effectiveness of the International Commission for the Protection of the Elbe (ICPE), created in 1990, over the past decade, the water quality regime of the Elbe has significantly improved, which partly may be attributed to the interventions by the ICPE itself. The former Eastern Germany after the re-unification contributed significantly to the reduction in pollution loads. About two thirds of the river basin area belongs to Germany and one third to the Czech Republic. Austria and Poland have nearly the same small shares in the catchment. The Elbe catchment covers 27.2% of Germany and 64% of the Czech Republic. About 25 million inhabitants live in the catchment, 76% of which are in Germany and the remaining 24% in the Czech Republic. This amounts to about 58% of the Czech population and 23% of the German population. The most significant cities are Berlin (3.47 million inhabitants), Hamburg (1.71 million), Prague (1.21 million), Leipzig (480,000), Dresden (477,000), Halle (290,000), Chemniz (278,000) and Magdeburg (256,000) (Elbe River Basin: Risk and Options, BMBF, 2007).

A company named Povodi Labs has been appointed as the manager of upper and central Elbe River Basin. The overall task of managing any river basin naturally includes the management and administration of the basin's major watercourses and their tributaries. Besides managing and administering watercourses, they also evaluate the state of surface and ground water within the basin and carry out other tasks that river basin administrators are required to do by Water Act No. 254/2001 of the Register of Laws and Regulations, by River Basins Act No. 305/2000 of the Register of Laws and Regulations and by other related legal provisions. Saxon State Ministry of the Environment and Agriculture, Public Enterprise Saxon Property and Construction Management (SIB), International Commission for the Protection of Elbe River (IKSE), are also responsible for the economic and financial management of the river.

Teesta and Surma

Bangladesh and India expect breakthrough in sharing waters of the river Teesta in the Indo-Bangla Joint Rivers Commission (JRC). Both the upper and lower-riparian countries have had series of meetings on the modalities for Teesta water sharing at three levels—ministerial-level JRC, secretary-level Joint Committee of Experts (JCE), and Joint Technical Group (JTG) level. According to the arrangements, during the lean season both the countries will share 40 percent each of the total water flow while the remaining 20 percent will be kept for the river's own retention. A compromising alternate formula, any of the two sides might wish to sacrifice two percent of their share to make it a 42-38-20 percent deal. For Surma river there is no negotiation yet in progress, though in dry season river goes without water.

Private involvement in these rivers does not exist in the management process. Government implement project as per local needs with the implementing agency Bangladesh Water Development Board. In some cases Local Government Engineering Department (LGED) implement small scale water sector project for agriculture and water management. Water Resources Planning Organization (WARPO) plays key role on overall planning of water sector as apex planning body. Centralization of project financing and lack of private invest in water sector is also the key obstacles for the overall development of the river.

Main River Development

Elbe

It is a river basin where the upper riparian (Czech Republic) is relatively weak compared to the lower riparian (Germany) in economy and political influence in international era. The economic ties with Germany are very important for the Czech Republic, as well as becoming EU member (a process which started in 1994 and was concluded in 2005). Sufficient reason to act as a good neighbour! The asymmetry rather promoted than inhibited cooperation. A Decision Support System (DSS)

for the Elbe River Basin is made through a project for the development of the river considering transboundary issue that made the Elbe river developed with integration.

The Elbe estuary is an important federal waterway leading to the port of Hamburg which is the second largest (container) port in Europe. Therefore port development is a major issue safeguarding the economic growth and employment for the metropolitan region of Hamburg and beyond—today and in the future. The effort to maintain the water depths in the port area has increased significantly during the last couple of years. Several reasons have led to this situation such as the so-called tidal-pumping-effect and the upstream transport of sediments placed at the state boundary of Hamburg.

Teesta and Surma

The Teesta River system is one of the most beautiful watersheds of wild river left in the world. It is an unspoiled treasure of surpassing beauty. The government of India is expected to commission 22 power projects by 2012. On the other hand Teesta barrage project by Bangladesh is one of the main river developments since 1990. Recently government started the 2nd phase of the Teesta barrage project.

Amidst mounting protests both at home and in lower riparian Bangladesh, India is going ahead with the plan to construct its largest and most controversial 1500 mW hydroelectric dam project on the river Barak (Surma-Khusiara in Bangladesh) at Tipaimukhin, the Indian state of Manipur on the common borders of three northeastern states of Assam, Manipur and Mizoram. The river Barak has entered into Bangladesh through Zakiganj in Sylhet and is flowing into two directions, Surma and Kushiyara. The Timpaimukh Dam will choke up the Surma and Kushiara rivers during the dry season and leave similar effect on Bangladesh as the Farakka Barrage is doing. A study made by Bangladesh Water Development Board (BWDB) noted that obstruction to the natural flow of the Surma and Kushiyara will seriously hamper hydrology, agriculture etc. in at least seven districts of Sylhet, Moulvibazar, Habiganj, Sunamganj, Brahmanbaria, Kishoreganj and Netrokona in Bangladesh that produce bulk of the country's rice crop.

Agriculture and Water Management

Elbe

The Elbe and its tributaries are mostly used for obtaining drinking water and water for industrial or irrigation purposes. Due to the poor quality of the river water, its use as drinking water and industrial water is only possible after adequate treatment or with corresponding restrictions. Compared with other areas of Europe, water availability per inhabitant (680 m^3) can be considered extremely low. Along the Elbe numerous filtration plants provide water to about 1.8 million people.

In 1998 the International Commission for the Protection of the Elbe River (IKSE) identified the most significant industrial emissions in the Elbe basin as originating from chemical, pharmacological, cellulose and paper, metallurgic, electrical, leather, fur, glass, ceramic and textile industries, as well as from mining. In 1999 in the Elbe basin, 33 industrial sites and 15 waste disposal sites were identified as potentially dangerous. After that integrated approach was taken through implementation of better governance in agriculture water management.

Teesta and Surma

The Teesta River Floodplain (TRF) in Bangladesh accounts for 14% of the total cropped area and 8.5% of the population in the country (BBS, 2001). About 63% of the total cropped area in the TRF is irrigated as compared to the national average of 42% irrigated cropped land. On an average, each unit of this irrigated cropped land supports 1.82 crops per year as compared with national average of 1.75 crops per year. This indicates a direct association between irrigation water availability and land use. About 64% of the total households in the TRF are farms, of which 78% are marginal or small, owning less than 1.0 ha of cultivated land (Census of Agriculture, 1996). The northwestern region, which includes the TRF, is considered to be the most drought-prone area of the country. The region surrounded by Teesta along the left bank of the Ganges River is termed as 'dry zone' (Brammer, 1997). The mean annual rainfall, which ranges from 1250 mm to 2000 mm, in this area is much lower compared with 1600 mm to more than 5000 mm in the other regions of the country. For that reason agriculture production and other economic activity collapsed in the long dry season. More than four million people surrounding the Teesta river mainly use its water for agriculture purpose, their daily use especially drinking water; bathing is also covered through the river water. But low dry season flow destroys the ecological as well as chemical condition of the river flow.

On the other hand, extreme low flows and seasonal no flows in Surma damage fish stock in the river, but monsoon period overflow the bank and make people homeless. Monsoon floods during July-September damage transplanted Aman, particularly in Zakiganj and

Kanairghat upazilas. Floodwaters enter from Surma breaches in embankments, open kahals and often overtopping roads and embankments. Siltation of Surma-Kushiyara was referred as a serious cause of flooding in the area. Domestic and industrial water use, irrigation, navigation and groundwater recharge are the main socio-economic water demands. In particular in the dry season, large amounts of water are needed and shortages already occur at some locations. An integrated water resources management approach is needed to come to equitable and sustainable use of the natural resources.

Natural Environment and Aquatic Resources

Elbe

The Elbe river landscape has been a designated UNESCO biosphere reserve since 1997. The area has a unique natural and man-made landscape for the visitor to discover. Green tourism is a priority in the biosphere reserve. The Dresden Elbe Valley has been the crossroads in Europe, in culture, science and technology. Its art collections, architecture, gardens, and landscape features have been important references for Central European developments in the 18th and 19th centuries.

Teesta and Surma

It is expected that in the coming years some man-made as well as natural changes will occur that have a great impact on the river basin. The largest change will be due to the construction of the Tipaimukh Hydropower Dam on the Barak River, upstream of the river basin in India (possibly in combination with an irrigation-barrage). The partial regulation of the discharge in the Barak River, which bifurcates at the border of Bangladesh into the Surma and the Kushiyara, will result in less severe or even no flooding in the river basin. This will have consequences for the water supply to the different demands.

Surma River is polluted day by day by human activities, poor structured sewerage and drainage system, discharging industrial and household wastes. The *charas* (natural channels) are responsible for surface runoff conveyance from its urban catchments to the receiving Surma River. Lack of law enforcement to reduce pollution is the main cause for continuous degradation of the river water.

Conclusions

Water resource planning in Bangladesh has to take into account a variety of geographic, economic, and environmental factors. Bangladesh is a lower riparian country. Most of it is located within the flood plains of three great rivers—the Ganges, the Brahmaputra, and the Meghna—and their tributaries and distributaries. The river systems drain a total area of about 1.72 million square kilometres in India, China, Nepal, Bhutan, and Bangladesh. Only eight percent of the catchment area lies within Bangladesh. As a result huge inflows on water over which Bangladesh has no control enter the country. The lack of control is a critical problem because Bangladesh has an agrarian economy dependent on water. At different times (and sometimes unpredictably), it has too much and too little water. The intricate network of alluvial rivers carries a huge annual discharge and sediment load, causing channel shifting and bank erosion. Withdrawals in upstream areas seriously affect socio-economic growth, the environment, and the ecology. The habitat of fish, a major source of protein for the rural poor, is under threat from the increasing conversion of land to agricultural use. Inland navigation is hindered by blockages in the river delta. Meanwhile, the need for pure water is increasing along with the salinization of the coastal belt and the degradation of ecosystems.

Over the last decades, river basin management has become increasingly complex. Rising demands of society regarding ecological and chemical quality of waters, their use and protection, and pollution with many different substances lead to new views and strategies towards (the making of) a policy for river basin management. The European Water Framework Directive consequently calls for a multidisciplinary approach to river basin management. A number of measures can be taken to solve these problems. Allocation of costs on the basis of the polluter-pays principle and full recovery of costs, Relocation of dykes and other measures, Dyke shifting (giving more space to the river), Restriction on new buildings and accumulation of property and other treasuries in the foreland, Illegal river encroachment should be strictly prohibited, Provide information on flood management, Involvement of the general public in the planning process should be ensured for high water management. Reducing point- and non-point-sources of pollution by improving agricultural practices (nutrients, pesticides), Reducing pollution by hazardous substances, improving building waste-water treatment plants is the pre-requisite for improved water quality of the river. Groyne modification, Dredging, Reduction of riverbed erosion, Artificial bed/sand load supply will have to ensure for better navigation facilities. For nature-protection zoning of nature-reserves, development of

nature likes floodplains should get the top priority. Ecological infrastructures and intense diversification will be needed for tourism industry to be developed around nearby rivers.

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