
Conference Paper

Sustainable Development of Water and Environment: An Effort in Reality

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Abstract: Substantial parts of land mass of Bangladesh is built up gradually over ages by the process of deposition of silts carried by waters of three mighty river systems flowing to the sea. The process itself, i.e. deposition of silt, is likely to fill out the formed canals and rivers one day in the long future if it is not intervened. Ecology, however, livelihood including that of human, and environment have developed depending on waters and the river systems which existed so far. There has not been any human intervention, such as, by dredging but in recent decades Farakka has been erected. In up country, India, waters are being drawn out of flowing feeding rivers resulting in nearly no flow of water in the dry season. Thus Bangladesh may have only dried out rivers. The ecology and environment are thus threatened. Both the government and the people are concerned of the crisis and keen to find a solution for their existence. The present Prime Minister utters a slogan “save the rivers, save the country”. The envisaged solution is dredging and excavating rivers to increase their water holding and water flowing capacity. Two organizations which are entrusted by the government with responsibilities of water management have been given required budget and these organizations have been reasonably discharging their responsibilities. The paper outlines the concept of formation of land mass of Bangladesh, the gradually growing threat and cites undertaken steps and actions in reality towards achieving the solution. Restoration of river systems will improve, among others, environment, ecology, help recharging ground water, agriculture, fisheries, navigation and outflow of up country waters during heavy monsoon and floods. The paper may encourage others for development of waters and environment and attract international community to the efforts being made by Bangladesh.

Keywords: Gigantic and Challenging, Withdrawal from up River System, Manmade Irrigation Canals, Save River Save Country, Entrusted Organizations, Dredging Fleet in Bangladesh, Dried out Rivers

1. Introduction

This is a specific case of sustainable development of water and environment being carried out and accomplished in Bangladesh and presented here because it may stand as an example for others to follow. The undertaken work is gigantic and challenging, especially in a developing country like Bangladesh which with her constrained resources presently to meet a few many facets of demands of fast increasing large population. It may encourage policy makers and agencies to take up such water development efforts as well as it may demonstrate

the need and benefit of sustainable development of water. It's impact, expected and already demonstrated, on preservation and upgrading of the environment, influence on the ecology, human life and living standard is praiseworthy. Moreover, the extra ordinary efforts which, a government is making with its limited resources and inadequate logistic infrastructure, may attract attention of international community towards extending cooperation and support to Bangladesh evaluating the value of these endeavors to the world & international community on account of planned improvement of environment.

2. Delta Built Up by Deposition of Silts

Bangladesh is a delta built up over ages by the deposit of washes of the mighty river system of the Ganges, the

Brahmaputra and the Meghna [1-2]. The catchment of this mighty river system is 1.72 million sq. km. It is shown in Table 1 [3].

BASIN MAP OF THE GANGES, THE BRAHMAPUTRA AND THE MEGHNA RIVER



Figure 1. The Source of river systems of the Ganges the Brahmaputra and the Meghna.

Table 1. The Catchment Areas of Major Rivers.

Rivers	Total Catchment Area (Sq. Km.)	Catchment Area (Sq. Km.)				
		India	Nepal	Bhutan	China	Bangladesh
Brahmaputra	552000	195000		47000	270900	39100
Ganges	1087300	860000	147480		33520	46300
Meghna	82000	47000				35000
	1721300 (100%)	1102000 (64.02%)	147480 (8.5%)	47000 (2.73%)	304420 (17.69%)	120400 (7%)

The river Teesta 315 km long had risen in the TSO Lhamo lake [4]. It flows to the sea through Indian states and Bangladesh. It also enormously contributed in this formation. Bangladesh had been a swamp of fall of these flows before they had reached the Bay of Bengal. These huge volumes of water carried silts and dropped sediments in this swamp. Gradually overtime lands built up. The very natural way of building up lands by deposit of silts initiated forming canals and subsequently rivers. A huge nesting of canals, creeks, tributaries along with major rivers with lands in between them shaped the country. The formed river system had a mesh of uncountable canals, creeks, tributaries and major rivers in Bangladesh as it is seen in Figure 2 [5].

The environment, ecology, life, livelihood and living of the people in these areas have evolved on the morphology of this huge river system. Over a very long time a distinct river system took shapes. The system was surveyed after disastrous floods in 1954, 55 and 56 and the length of the network was determined as 24,124 km [6]. These rivers are meandering in nature in the eluvial soft soil. These rivers and tributaries etc are all natural and therefore are effected by river morphology and hydraulics [7]. A study (ISPAN 1993) showed that in 158 years since 1835, waterways shifted on an average 50 meters per year [8]. The river system has been to a great extend unstable.

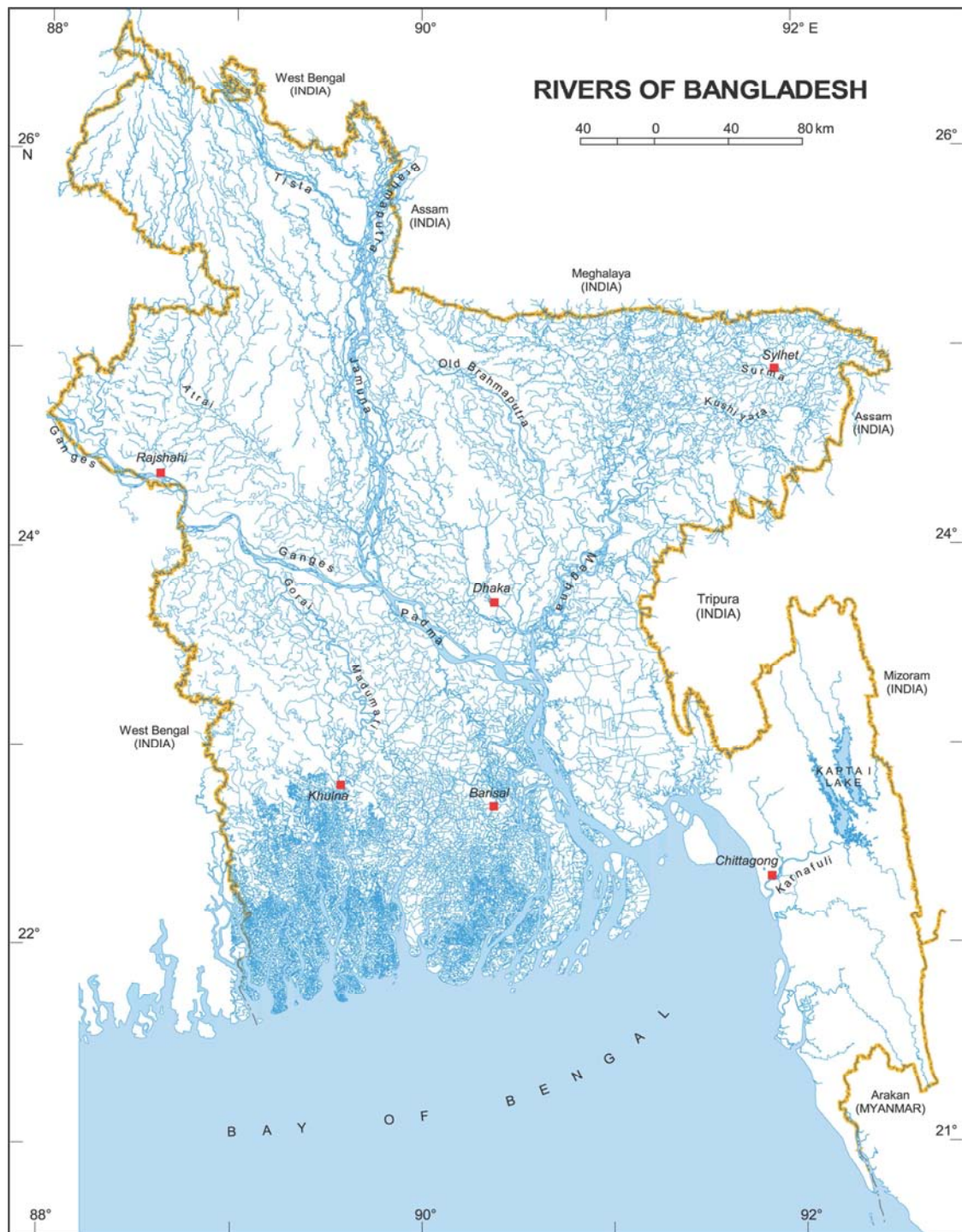


Figure 2. Formed river system in Bangladesh as aerially surveyed.

2.1. Shrinkage of Waterways, a Natural Process

A portion of huge volume of silts flowing mixed with the water deposits and forms the flood plain of Bangladesh, a substantial portion of sediments at the same time deposits on the river bed. A larger part of the silts, however, flows out to the sea and forms land mass there. These formed lands in the mouth of the river in turn reduce the speed of the flowing stream which enhances deposit of silt in the river system. The process continues through centuries silting river and

canal beds. The process itself is likely to fill out the formed canals and rivers one day in the long future, if are not intervened.

During dry season these canals, creeks and many tributaries do not get water flow on their gradually raised beds and therefore, die. The river network has reduced to 13, 436 Km Figure 3 [5]. The navigable waterways only also in monsoon is 6373 Km [9]. The navigable network has further shrunk to 3,800 Km Figure 4 [9]. This has affected the environment, ecology, living and livelihood in Bangladesh.

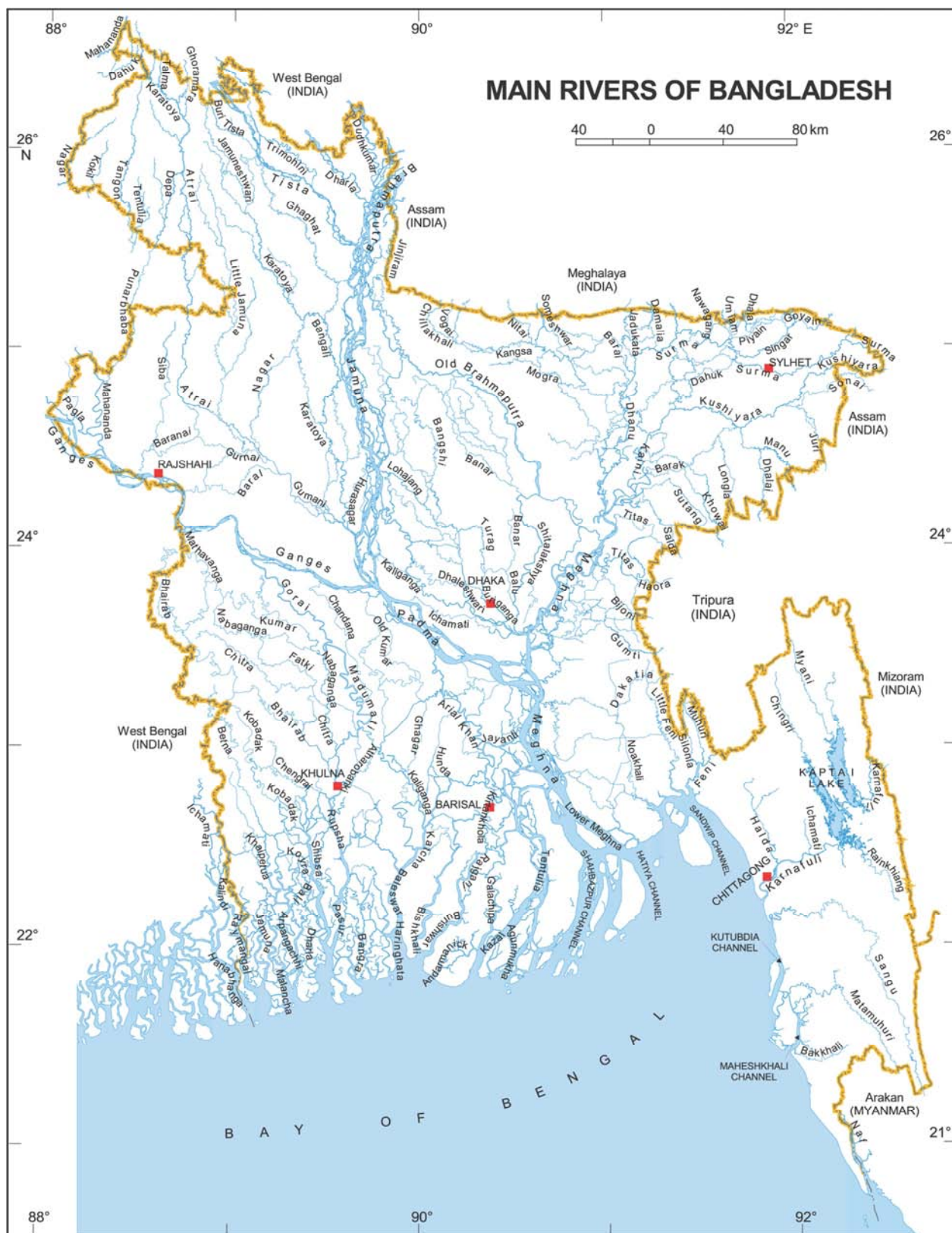


Figure 3. 13,436 km waterway network.



Figure 4. 3,800 km navigable water network.

2.2. Influence of Farakka, India on the Process of Drying of Rivers in Bangladesh

The process of drying out of the river system, especially of the creeks, canals and tributaries has exorbitantly enhanced due to withdrawal of water at Farakka and withdrawal of water from up river system in India in manmade irrigation canals [10]. These water withdrawals in India have avoided water tablet from gradually falling in India as well kept wet

the lower land mass there. Both together have resulted in reduction of the absorption capacity of the huge land area in India in monsoon. In the monsoon thus a larger volume of water of heavy rainfall, Farraka kept opened and withdrawal in canals stopped, flows to the sea inundating the flood plain of Bangladesh destroying vegetation and living ecology, eroding river banks thereby eating up habitats miles after miles [11].

2.3. *Present State of Affairs*

Siltation has raised beds of rivers, canals, creeks and tributaries. Natural irrigation by pumping water from rivers is nearly nonexistent. Pumping out underground water for irrigation is the norm of the day. The water table has been gradually falling. Ground water reservation has decreased. The surface water reservation capacity in the country has critically reduced. Land and weather of the country are getting drier day by day. Sea saline water is entering in bottom parts of the river system. Ecology, agriculture, fisheries, drinking water supply have been affected. Rural transportation by country boats has been disappearing. Rural economy suffers due to reduced market access. Livelihood has changed which is forcing people to leave homestead to migrate to towns and cities for survival alone.

Bangladesh is, however, aware of its water resources and its importance. Indeed the sweet water and flowing rivers are wealthy blessings to Bangladesh. Bangladesh has always made efforts to assess the quantum of resources, and the maintenance and development of the same. Some the works under taken in these efforts may be seen in references [12-16]. Quite a few many other researches are undertaken mostly by paid consultant, Waters institutions and individuals.

3. The Theme, The Slogan Goes “Save the River, Save the Country”

Indeed Bangladesh has been under the threat of desertification since erection of Farakka. There had been a long march of millions of people then to protest. In the recent past the process of becoming an open dry river land was crossing the limit. Moreover, the discharge of waste water of industries to rivers in this fast developing country with merge resources has been a normal phenomenon. Discharges are damaging the rivers and waters. The people and the government apparently are very concerned and serious about this growing menace. The Honorable Prime Minister, Sheikh Hasina who is fortunately a daughter of the great leader, the Father of the Nation, has a heart always crying for the people and the country. She understands and feels the grave consequences of drying out rivers and contamination of water. She is dedicated to find an answer to the growing problem and she utters the Slogan: “Save the river, save the country.

3.1. *The Concept*

The solution envisaged to this gradually growing siltation problem, which is threatening environment and living, is the development of water holding and flowing out capacity of the river system and this is plausible to attend in Bangladesh by dredging [17]. Bangladesh government under the auspices of the present Prime Minister, Sheikh Hasina, has undertaken a reasonably large scheme of dredging for excavating drying out

canals and rivers of the country. The aim is to develop waters and preserve the environment and thereby to revitalize ecology, living and livelihood of the people of Bangladesh.

Indeed there had been no dredging during the British colonial rules and nearly nil during the period when Pakistan was in power. Father of the nation Bangabandhu Sheikh Mujibur Rahman during his very short span of administration took a project of acquisition of 10 units dredgers for excavating silting rivers. He had been a visionary leader with a soul concerned for the people and the country.

3.2. *Entrusted Organizations for Water Resource Management in Bangladesh*

Bangladesh government discharges its water management responsibilities mainly through two of its organs namely, Bangladesh Inland Water Transport Authority (BIWTA) which has been established propagating an ordinance in 1958 to take care of inland waterway transportation and to maintain navigability of river routes along with providing ports and other facilities [18]. Bangladesh Water Development Board (BWDB) which has been made a distinct entity by President Order in 1972 out of an organization then known as EPWAPDA (East Pakistan Water and Power Development Authority) [19]. EPWAPDA was created in 1958 in persuasion of recommendations of the Krug Mission [6]. The chartered responsibilities of BWDB are to develop water and to ensure its proper use of the same for enhancement of agriculture. Towards that end, BWDB excavates canals for irrigation, arranges drainage of water of early flood caused by early monsoon or excessive raining, syringes out water logging from cultivable lands, provides river bank protection to save land erosion, protects entrances of saline water and develops thus saves land for agriculture. These two organizations have been provided with appropriate budget during the period 2009-2018 under Annual Development Program (ADP) of the government which includes funds for acquisition of dredgers and dredging jobs. These organizations had in the recent past skeleton dredger fleets and they are strengthening dredging capability substantially under these allocated budgets by acquisition of new dredgers and ancillary craft. The theme is to develop sustained dredging capability in the country to ensure sustainable solution to the problem.

3.3. *Sustainable Dredging Capacity*

Present dredging fleet in Bangladesh is more or less of the size as shown in Table 2. The fleet has developed over the period 2011-2018 i.e., in last 6 years. It is observed that the fleet under the private sector is also of a good size already. Indeed these dredgers are being used in government river excavating projects side by side developing project sites under private schemes. A few Chinese companies are also engaged in dredging.

Table 2. Fleet of Dredgers and Ancillary Craft.

<i>Figures In number</i>					
Sl. No.	Dredgers & Ancillary Crafts	BD Govt. Sector		Private Sector	Total
		BIWTA	BWDB		
1	CSD Dredgers	21	42 *	150+	213
2	Amphibian Dredgers	4			4
3	Ancillary Craft	106	82	112+	300
	Total	131	124	262+	517

* Many of 12" CSD are unworkable.

Under the scheme the government has been ordering construction of dredgers and dredging equipment to Bangladeshi shipyards and manufacturers so that Bangladesh may acquire the technology in this specific field. More than 10 (ten) yards are building dredgers, both for the government and private companies.

4. The Work

The work is to restore the river system of the county to the extent possible. The rivers continuously will remain full of water, fishes and diversified living ecology due to the overall improvement of the environment. Excavating of rivers will allow quick outflow of up country huge waters to the sea. The outstanding culture and hospitality of people of the country, green trees, vast rivers with millions of birds on waters and diversified ecology with singing toads will make Bangladesh the queen of beauty of lands. The Prime Minister is die heart for restoration of rivers for her people and better environment. The work is therefore to make the

rivers deeper, canals and cracks with flowing waters even in the dry season.

4.1. Dredging by BIWTA

The Bangladesh Inland Water Transport Authority (BIWTA) estimates 53 major routes which originates outside Bangladesh of length of 6373 Km need capital dredging to be navigable year round [20]. These routes are seen in Figure-5. The dredging will recover quite a many navigable routes which lose navigability in the dry season. Figure-4 is referred to. Excavation of dried out canals should be added to these programs which will provide more surface water reservation capacity, help agriculture, fishing and especially for the BIWTA, facilitate small boat rural transportation resulting in reduction of cost of inland cargo transportation. Ecology and environment will revitalize in the nook and corner of the country. Other benefits, tangible and intangible will be commendable.

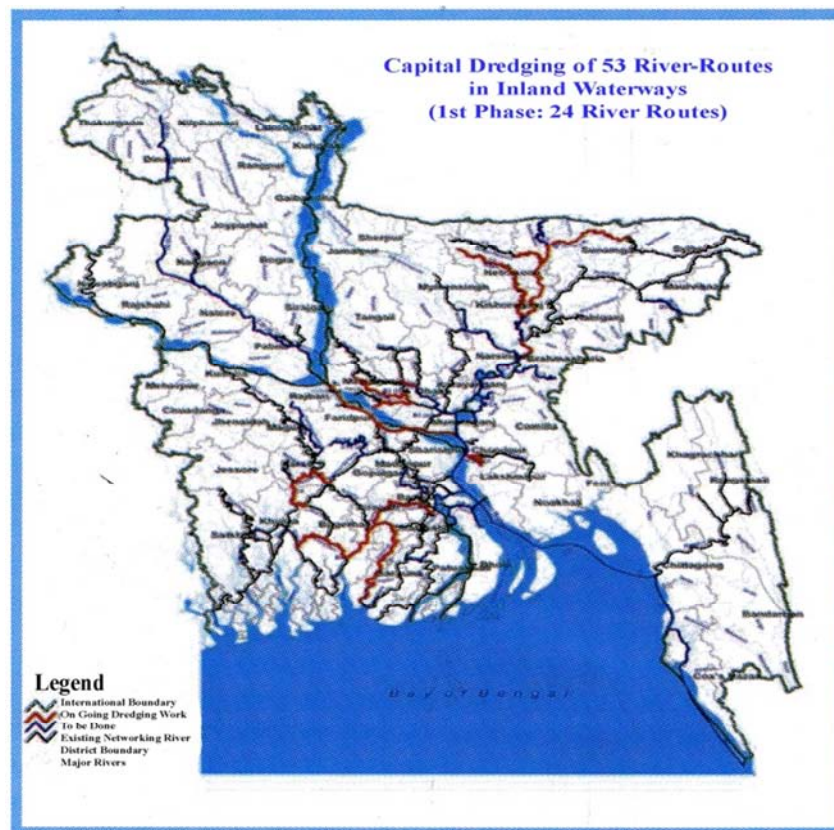


Figure 5. Capital Dredging of 53 River-Routes in Inland Waterways of Bangladesh.

BIWTA has already undertaken projects of excavating 12 priority routes under this scheme of resurrecting drying 53

rivers which are drying out. Dredging works completed in 2017-18 has been shown in Table 3.

Table 3. Target and Progress of BIWTA's Maintenance & Development Dredging: 2017-18.

Figure in '000' cube meters							
Sl. No	Description	Target			Progress		
		Dredging by BIWTA Dredger	Dredging by Private dredger	Total	Dredging by BIWTA Dredger	Dredging by Private dredger	Total
1	Maintenance Dredging	9,850.00	7,200.00	17,050.00	5,786.00	4,685.00	10,471.00
2	Development Dredging	1,500.00	5,300.00	6,800.00	299.00	2,464.00	2,763.00
3	Capital Dredging	1,400.00	17,200.00	18,600.00	363.00	10,630.00	10,993.00
	Total Dredging			42,450.00			24,227.00

Dredging work of a volume of 24,227.00 thousand cube meters of 42,450.00 thousand cube meters has been completed which is 57% of the target. However this is warm up period and it is very much expected that in coming years

the percentage of achievement will be much higher. BIWTA's outlay of fund up to 2018 is BDT 37,900.00 million [9]. Relative position of the development dredging which has been carried out in 12 priority routes may be seen in Figure 5.

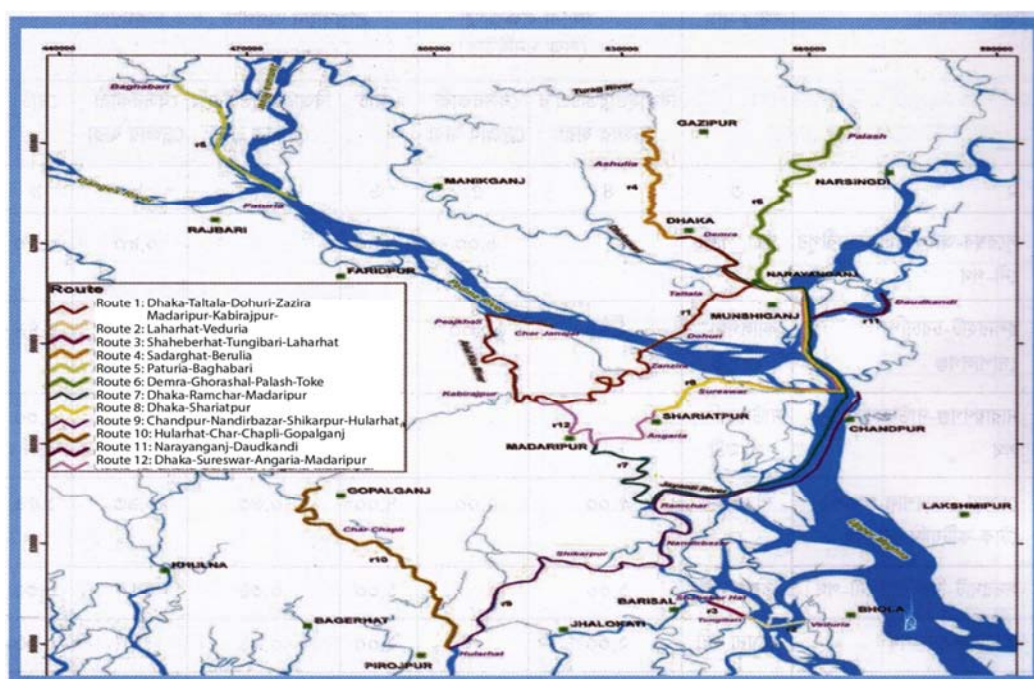


Figure 6. Development Dredging of 12 priority drying out routes.

4.2. BWDB's 25 years' Action Plan

According to specific desires of the present Prime Minister and her international and national commitments, BWDB has framed its action plans for next 25 years which are also in line with the Bangladesh Delta Plan-2100 [21]. In a nut shell these are (a) Protection against disasters

which flood and environmental changes inflict (b) Ensure water security and enhance efficiency of water use (c)

Develop combined management plan of rivers and river mouths (d) Preservation of bio- diversity in marshy land (e) Develop appropriate organizations and legal framework for management of inland and cross country water wealth (f) Ensure combined maximum use of land and water. Under the 25 years action plan, 208 projects have been worked out to be implemented in the plan period [8]. These are noted in Table 4.

Table 4. BWDB Project Plan for next 25 years.

Type of Project	Total Projects	Priority (Term-wise)			Included in BDP IP
		Short (8yrs)	Medium (15yrs)	Long (25yrs)	
River Management Project (Dredging, Bank Protection, Connectivity with Floodplain)	61	30	30	5	5
Land Reclamation and Development Projects	18	8	8	6	11
Integrated Development Project	35	17	11	8	13

Type of Project	Total Projects	Priority (Term-wise)			Included in BDP IP
		Short (8yrs)	Medium (15yrs)	Long (25yrs)	
Irrigation Project (New & Rehabilitation)	26	23	3	1	5
Climate Change Adaptation and Ecosystem Restoration Project	19	10	8	1	5
Rehabilitation of Coastal Polders	17	14	4	1	-
Haor Rehabilitation Projects	17	9	14	3	5
Others Projects	15	13	1	1	5
Total	208	124	79	26	49

In 2017-18, BWDB have undertaken 52 projects to fulfill the commitments of the Prime Minister of which 28 projects have been completed [22]. 12 are ongoing and 12 are under process. The allocation had been BDT 103,150.00 million. The spending in the year was BDT 57,970.00 million under these projects. These projects are either for dredging & excavating or to reduce or avoid river erosion to protect homestead and cultivation in disaster and flood prone areas.

4.3. BWDB's Massive Activates in 2017-18

Bangladesh Water Development Board (BWDB) has excavated 6.5 million cubic meters of earth from 45km of waterways in 2017-18. BWDB has farther undertaken their usual annual development of water resources in 2017-2018. Also as desired by the Honorable Prime Minister, 52 projects

have been under taking by BWDB under Bangladesh Climate Change Funds [23]. This scheme includes infrastructural works, all related to water development i.e, dyke make and river bank protection works of 101 km of which 90 km has been completed. The scheme also includes dredging of 29 km of rivers and canals of which 22 km has been completed and canal digging of 259.72 km. The budget allocation for these projects was BDT 2000.00 million.

4.4. BWDB Standard of Finished Works

BWDB has experience the disciplined studies, both theoretical and practical, on the environment friendly river bank protection [20]. It has specialized specific experience of canal development [24]. Standard of BWDB's development works are depicted in photographs cited below as an example.



Figure 7. Re-excavation of the River.



Figure 8. Re-excavation of the River.

4.5. BWDB's Outlay in Annual Development Program

BWDB under RADP (Revised Annual Development Program) 2017-18 has implemented various development projects with a outlay of BDT 42450.00 million. These

activities are shown in percentage in the Pie Diagram below. An amount of BDT 46730.00 million was allocated under RADP 2017-18. 91.90% of the allocated funds have been utilized. All these activities are related to development of waters and therefore affecting environment in turn.

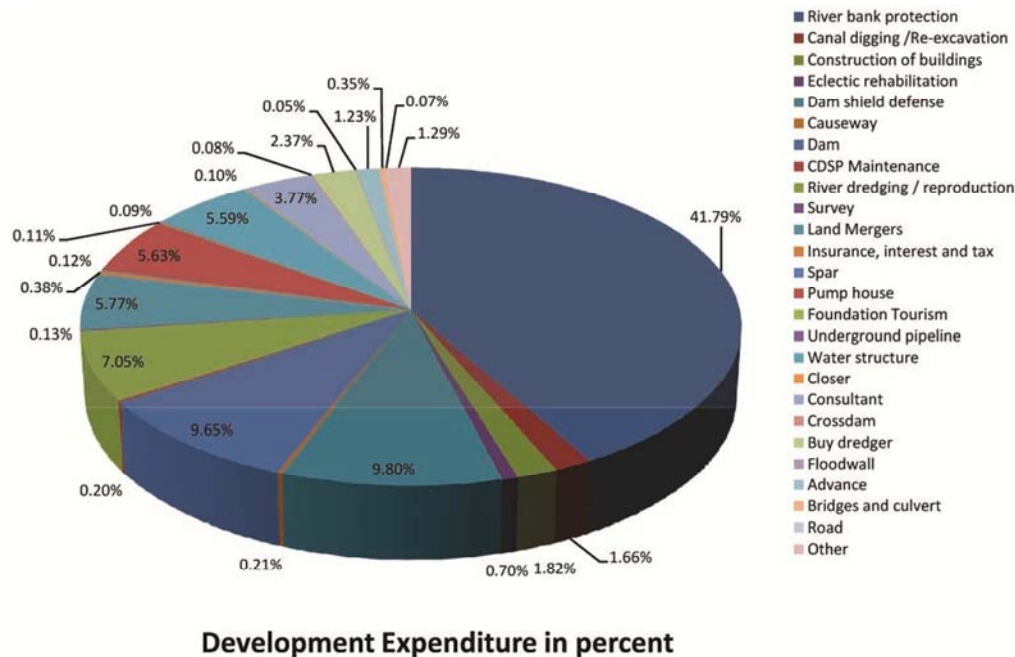


Figure 9. Development Expenditure in Percent.

Table 5. Details Revised Annual Development Program.

Details	Allocation	Expenditure (Tk in crore)	Progress
Local	3724.24	3494.64	93%
Project help	948.94	799.84	84%
Total	4673.18	4294.48	91.90%

In 2004 it was estimated that an amount BDT 900.00 billion is required for planned capital dredging in Bangladesh [17]. The comparative value of BDT to hard currencies has decreased, price structure since then has improved positively, purchasing power has increased nearly 3 times and per capita income also by 4 times [25]. Inflation, however, has gone down to -5.78% [26]. A reasonable estimate for similar volume of works may stand at BDT 3,000.00 billion now equivalent to USD 35.90 billion (USD=BDT 83.56). It is possible to accomplish the work in 15 years with a dredging fleet of capacity of 3 times of that of today. The maintenance dredging, however, over the navigable network as well as for canal system will also be unavoidably necessary and could be phased on alternative years.

5. Impacts of Undertaken and Planned Dredging Activities

The nature of these plans itself demonstrates its sustainability and expected impact that it may have on the overall river system of the country and therefore on the environment.

Bangladesh had devastating floods in 1987 and 1988. Crops and vegetation went washed off, trees fell, cattle heads and poultry floated away, reserved grains for the year got soaked, loss of human lives got fatal, roads suffered irreparable damages, mosque, school and many age old buildings and establishments vanished, sands covered fertile agricultural

lands, irrigation canals got filled up and leveled, drinking water became scarce and furthermore, diseases broke out.

Excavated canals and rivers will bring back and restore the river system partially which will help up country water flowing through Bangladesh faster, work as water reservoirs and avoid swap floods. Waters in rivers will recharge ground water and thus retard the water tablet from falling, revitalize transportation, supply irrigation waters, create fisheries, reduce flooding, bestow cherished ecology and improve environment. Therefore, it is undoubtedly a successful sustainable water and environment development effort.

Other Benefits

One of the indirect impacts of the scheme is the transfer of technology of manufacturing dredges and dredging equipment in Bangladesh. The silt flowing to the sea through rivers in Bangladesh could turn to a valuable asset to the nation [17]. Over the period of last 30 years salvaged slits have been utilized to develop many housing estates in and around the city as well as many industrial sites and estates. The work has been accomplished by using indigenous dredge pump system. The author designed this indigenous system and introduced the system first in the country in 1985 for land filling of his shipyard site. The system has been popular in Bangladesh since then and the registered fleet of the system is comprised of 3450 units. Indeed dredging is an economically viable outlay of resources in a country like Bangladesh though the benefits are long drawn, dispersed and mostly intangible. The matter of disposal of dredge spoils is being considered as a critical problem. Instead the deposit of dredge spoils should be planned and programmed in the long term development strategy of the country which is a flood plain.

6. Conclusions

Bangladesh has been a role model of development but her efforts and achievements in the field of sustainable development of water and environment are for survival and better living of any living being including her people, i.e. it is to support the people enjoying benefits of material achievements better. By stressing her boundary of resources, Bangladesh endeavors to protect and nourish the environment. This will help the country and the nation to perform better in all respect. Accomplished works will be durable with usual maintenance like that for any capital asset. Environment is for all. International community may appreciate and encourage these activities by extending their support, in terms of providing visionary technology and funding.

There had been virtually no dredging in silting river system in Bangladesh after separation from British India, If no such appropriate attention, rather, an investment of scarce resources were not made on the rivers and waters in Bangladesh, the country could be with only shallow rivers of filthy waters, not suitable for any living being, nor for irrigation or navigation and her sea front could be full of Junk. From that point of view, present concentration in dredging has been a safety key for survival of the country for at least next 100 years.

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