Rural Poverty Alleviation through Large-scale Irrigation Planning: Problem and Prospects of the Dalia Barrage Project, Bangladesh

Yoshiro Higano *
Md. Fakrul Islam **

I Introduction

Bangladesh is predominantly a rural country in nature, and nearly 85% of the population live in villages[1]. No less than 70% of the vast rural population is engaged in agriculture. The rate of literacy is 63%[2]. The agricultural labor force especially in the northern part of the country remains idle for a considerable part of the year.

The majority of the rural population live in poverty with an annual per capita income of only US$340. One of the world's most densely populated nations, Bangladesh, in the 1980s, was caught in the vicious cycle of population expansion and poverty.

Bangladesh is one of the most disaster-prone countries of the world. Frequent natural disasters like flood, coastal cyclones, droughts occur almost every year and cause a huge loss in agriculture and the national economy. At the household level, floods bring misery, suffering, and substantial loss of crops and assets and at the national level, floods not only disrupt economic activity but also significantly reduce future growth potential.

Bangladesh is criss-crossed by about 700 rivers[3], which mark both the physiography of the country and the life of the people. These rivers generally flow to the south—to the Bay of Bengal, which not only cause misery for the people but also every year they bring alluvial sediments and make the land more fertile, help to produce more crops. In spite of an expansion of population and predominant agrarian economy, such land can produce sufficient food to feed the population of Bangladesh, if proper modernization policy and planning can be implemented.

In spite of limited and unused natural resources, natural and man-made disasters and other problems, Bangladesh is continuing her effort for economic development by increasing agricul-

* Professor, Institute of Agricultural & Forest Engineering, University of Tsukuba, Japan.
E-mail: *higano@jsrsai.envr.tsukuba.ac.jp*.
** Ph. D. Student, Doctoral Program in Agricultural Sciences, University of Tsukuba, Japan.
E-mail: *islam@jsrsai.envr.tsukuba.ac.jp*.

1) Bangladesh Bureau of Statistics (BBS), *Yearly Manual*, 1998.
2) Bangladesh Census Report, *National Census*, 2001.
3) Bangladesh its People and Culture; *http:// lynx.dac.neu.edu/j/jiqbal/bangla1.html search on Oct.22,2001*

tural production. As a part of this effort, the government of Bangladesh undertook and completed the Teesta Barrage Project for irrigation purposes to boost agricultural production by bringing more land under cultivation during the dry season. However, the Gazoldoba Barrage built by India at 60 km. upstream of the Teesta River (in Indian Territory) has made the Dalia Barrage project useless. In this regard, a brief history on the use of the Teesta water for economic purposes (e.g. irrigation, navigation, producing electricity etc.) needs to be discussed.

Ⅱ　A Brief Background of Establishing the Teesta Barrage Project

The idea of using the Teesta River for irrigation for the betterment of the people is as old as the British period (1935) (GPRB 1993). Abbas A.T. (1984) has written in brief, the 'history' of the talks between India and Bangladesh on the establishment of barrages and sharing of the Teesta water (1955-83). Most of the area found suitable for gravity irrigation falls in the territory of Bangladesh (Abbas 1984). Due to partition of India (1947), implementation of the project was delayed. However, afterwards, India and East Pakistan (the name of the Bangladesh territory before independence) started to formulate the project within their own parameters.

During the 1950s, the then East Pakistani authorities intimated the Indian authorities regarding the Teesta Project in her territory. India at that time asked for more detailed data. During the 1960s, India intimated Pakistan about her plan for using the Teesta water and the two parties exchanged information in this regard. India protested against Pakistan's plans to build a barrage, assuming negative effects (inundation's etc.) in her territory. However, Pakistan replied that it was possible for India to use other rivers to irrigate the proposed command area.

After the independence of Bangladesh in 1971, talks on the Teesta water sharing continued in the Indo-Bangladesh Joint River Commission. Bangladesh objected to India's design to divert the water of the Teesta to the Mahanada basin area. The talks continued without any result until 1983, when the two parties reached an adhoc allocation agreement, according to which India was to get 39 percent, Bangladesh 36 percent and the remaining 25 percent was to be reserved for reallocation later, after further study. Abbas A.T. argued that as the irrigation command is overwhelmingly within the Bangladesh territory, Bangladesh should get the lion's share of the water. Moreover, the location of the apportionment had not been specified, which was very important from Bangladesh's point of view in getting the due amount of water (Abbas 1984).

However, even this agreement has not been executed and the amount of dry season water on the Bangladesh side has gradually decreased. As a result, Bangladesh ended up in getting only 176 cusecs of water in January 1999 (The Daily Ittefaq 1999). On April 9th and 10th, 1999, the Joint River Commission of India and Bangladesh met after observing the 'real situation' but the meeting ended without any significant solution to the problem (The Daily Ittefaq 1999).

Statement of the Problem

Attempts are being made in this paper to clearly understand the nature of the problem prevailing in the Teesta River area and also to know what kind of situation is prevailing regarding sharing of the Teesta water in the dry season and to suggest some remedial measures.

We also intend to reflect on some major concerns published in various media (newspapers, journals) regarding the stopping of operation of the Dalia barrage in dry season and put some examples of treaties that have been signed before to solve the problem of sharing water of international rivers elsewhere in the world. We wish to conclude by making some recommendations for optimal use of Teesta water, which would be beneficial for both India and Bangladesh.

Ⅲ Some Salient Features of the Projects: Two Barrages on the Teesta River

The Dalia Barrage: The Dalia Barrage is the largest irrigation project in Bangladesh. It stands across the Teesta River at Doani-Dalia point in the Lalmonirhat district of Bangladesh. The total target area of the barrage is 5,40,000 hectares of land[4]. Although work on the project started in 1960, its actual implementation began in 1979. The building of the canal system took place in 1984-85. The barrage was completed successfully in August 1990 and its operation commenced in 1993. The Dalia Barrage is a concrete structure, 615 meters long, fitted with 44 Nos. Radial gates having a discharge capacity of 12,750 cusecs of water[5]. The barrage diverts water through a canal head regulator (110 meter long) with a discharge capacity of 280 cusecs. There is a 4,500 km long network system of canals for supply of irrigation water to the fields. It is a gravity irrigation project and there is an automatic flow of water at all stages through the barrage regulation. No pumping cost is involved in it.

The Gazoldoba Barrage: The Gazoldoba Barrage stands across the same Teesta River in the Jalpaiguri district of India. The total target area of the barrage is 228,000 acres[6]. After the independence of Bangladesh, when Bangladesh Government gave a serious thought into undertaking the Dalia project, India had started to construct a barrage at Gazoldoba, which began to be used for irrigation in 1993. The Gazoldoba barrage started to withdraw water excessively in the dry season in 1996, when the Dalia barrage (Bangladesh) was in full operation for irrigation[7]. According to the Bangladesh Water Development Board (BWDB), due to the operation of the Gazoldoba Barrage (India), the water flow of the Teesta River decreased significantly, threatening the Dalia irrigation project. Exclusive control of Teesta's water in the dry season at Gazoldoba makes the Dalia Barrage useless, and furthermore, sudden release of excessive water through the Gazoldoba Barrage (India) in the rainy season causes floods and bank erosions, and leads to serious sufferings by the people in the Bangladesh area of the basin.

Ⅳ Problems of the Dalia Barrage Project

Problems of the Dalia Barrage Project were identified through a survey conducted on the

4) *The Daily Ittefaq*, July 29, 2000, Bongshal, Dhaka, Bangladesh.

5) (BWDB) (July, 1993) *Teesta Barrage Project* July, Vol. IV, p. 1-6. Bangladesh Water Development Board (BWDB), Rangpur, Bangladesh.

6) Teesta Barrage-*A Glory of West Bengal Irrigation*, Inauguration of Trial Irrigation, January 19th, 1987, West Bengal, India.

7) *The Daily Star*, August 29, 1998, Dhaka, Bangladesh.

socio-economic and environmental condition prevailing in the target area. Here, we will not discuss the survey results in detail, rather try to identify the problems, only as following:

Internal Problems: After the commencement of the operation of the Dalia Barrage Project, the internal problems are identified as related to the water supply, distribution, use and scarcity of water etc. More precisely the internal problems are:

1. The outlet canals are low and sometimes water spill over and damage other crops.
2. Most canals are made not by concrete structures and causes damage every year due to leakages.
3. Negligence of the water distribution management committee and sometimes guards sleep at night when the water is usually distributed.
4. Water is not supplied in time or when needed.
5. The water supplied through the canals is not enough. Insufficiency of water reduces the land productivity after starting to cultivate a certain crop field.

External Problems: These problems are mainly related to claims and accusations of insufficient supply of water, dryness of the Teesta River etc. More specifically, the external problem is related to "want of water" for cultivation by the Dalia Project's targeted farmers. One hundred percent of the respondents (through sample selection 760 actual respondents responded out of a total population 7500 heads of household) speak of lack of water supply. They can't cultivate their fertile land due to insufficient supply of water. Almost all of them are aware of the Gazoldoba Barrage built by India at the upstream of the Dalia barrage in the Indian territory. Due to unilateral control of dry season water at Gazoldoba, the Dalia front is dry. Thus the operation of the barrage in dry season at Dalia is stopped. Many of them claim with convulsions that they used to row boats and fish during the dry season in the mid 1990's. But, now what a pity, the river is dry!

Besides this, due to stopping of the natural current of the Teesta in the dry season, the river bed has been filled up with sands and the river has lost it's natural motion.

The sudden release of ice-melted water in the summer causes flash flood in the Bangladesh territory and damages a huge amount of summer crops like "Aus paddy", "Kawn", "cheena", vegetables and groundnuts etc.

Above all, when the Gazoldoba authority is unable to manage the excessive pressure of water of any heavy rainfall in the Teesta valley, they suddenly release the water by opening barrage gates through the Teesta river---- which creates a devastating flash flood in the Bangladesh area and makes unbearable loss of crops and lives every year.

Causes of the Problem:

All the problems identified above are mainly caused by lack of water in the Teesta River in the dry season. The external problems are the root of all internal problems. There are some nominal internal problems, which can be solved easily if the main and external problem for which

the river is dried up can be mitigated.

V Disastrous Effects of the Gazoldoba Barrage on Bangladesh

Problems Created by Withdrawal of Water in the Dry Season

There are various types of problems created by the effects of the Gazoldoba barrage such as damage of crops, damage to the environment etc., which can be divided into 'Short Term' and 'Long Term' effects.

The short term or immediate effects are:

1. Reduction in agricultural production due to insufficient water for irrigation in dry season and over flooding in the rainy season.
2. Reduction in aquatic population (e.g.- fish).
3. Transportation problems; boats render useless, tributaries are dry during dry season.

The long term impacts on Bangladesh:

1. One fourth of the fertile agricultural land of northern Bangladesh will become wasteland due to shortage of water.
2. Twenty one million lives would be affected through environmental and economic ruin.
3. An estimated annual economic loss of over half a billion dollars in agricultural, fisheries, navigation and industries (approximately) is likely to occur.
4. Frequent flash flooding and environmental imbalance due to changes in the natural flow of the Teesta River.
5. Arsenic contaminated underground waters are being frequently used for irrigation and creating serious health hazards.

VI Problems Created by Excessive discharge of Water and Deluge (Effects of Recent Severe Flooding)

Many rivers having their origins in the Himalayas have flown through Bangladesh and fallen into the Bay of Bengal. When there is excessive rainfall on the Himalayas, or the snow and ice on the mountain melt more than usual, the excessive water flowing through the Ganges, the Brahamaputra, the Teesta, and the Dharla etc. inundates the adjoining areas. This creates a yearly natural calamity. However, sometimes artificially caused flash floods also occur in the Padma and the Teesta. When excessive water in the rainy season exerts pressure on the Farakka and the Gazoldoba barrage and becomes threat to this barrages, the authority open up all the sluice gates all at once to get rid of all the excessive water causing flash floods in Bangladesh. Had the barrage not barred the natural flow of the rivers (even with the excessive water from the Himalayas), these flash floods would not have occurred. The flash floods of March-April that have occurred in the last few years were basically artificial floods. In the March-April season, before

Gazoldoba many farmers used to cultivate paddy (Boro), jute Kawon (one kind of food grains), peanuts etc. in the lowlands, which helped in providing for food and employment.

Crop Damages

Bangladesh has experienced natural calamities of different severities during her history. But climatic events seem to be worsening in intensity, duration and frequency in recent years. One of the main causes of recent flooding is sudden release of huge amount of water through the barrage gates like Farakka, Mohanonda, Dahook, Gazoldoba etc. When the authorities can't manage the excessive water on the upper part of their territory, they suddenly release them to Bangladesh by opening the regulators. The floods of 1998 in comparison with all previous floods in this country were of a very long duration. In 1998, three quarters of a million hectares of agricultural land was submerged and most of the autumn rice crops were ruined. Crop losses have been estimated at around $300 million. The country was airlifting supplies to remote areas after the virtual collapse of the country's road network, and with road communications being cut off in many parts of the country, prices of food were soaring.

Due to the flood, the season for planting of Aman *)paddy was over without seeds having been planted. This raised the specter of future food deficit. Farmers were not the only ones affected, as agricultural wage laborers also had been unable to earn an income.

Production of Rice:

Bangladesh grows rice in three seasons on 11 million hectares of land. The cropping pattern shows that the major rice crop is Aman (57%), followed by Aus (22%) and Boro (21%)**) The general trend of cultivation is shown in the following table:

Table 1. The General Trend of Paddy Cultivation in 1996 (in million tonnes)[8)]

Rice Seasons	HYV	LV	Total	Percentage
Boro (dry season)	2.3	Nil	2.3	21
Aus (dry season)	0.9	1.5	2.4	22
Aman	1.5	4.8	6.3	57
Total	4.7	6.3	11.0	100
Percent	43	57	100	

HYV＝High Yielding Variety,　LV＝Local Variety

If we take an optimistic average yield of HYV rice of 40 mounds per acre and local variety

*）Autumn planting paddy depending on natural rains.

**）Boro-Summer planting High Yielding Variety (HYV) paddy by artificial irrigation system.

8）Alam, Jahangir (1998) , *Recent Trend in Agricultural Development of Bangladesh: Policy Implications; Economic Observer* July 1998, Vol. VIII, No. 5 Dhaka, Bangladesh.

of 15 mounds per acre, the following table shows the production of rice in these seasons:

Table 2. The General Trend of Paddy Cultivation 1997 (in million tonnes)

Rice Seasons	HYV	LV	Total	Percentage
Boro (dry season)	6.0	Nil	6.0	33
Aus (dry season)	2.3	1.4	3.7	20
Aman	4.0	4.7	8.7	47
Total	12.3	6.1	18.4	100
Percent	67	33	100	

Source: Alam, 1998

This trend of production has faced severe obstacles due to floods in 1998. A 50% loss of production of Aman and Aus would account for a loss of production of five million tonnes. Actually, in the Dalia barrage targeted area, farmers cultivated HYV types of paddy (which require irrigation) and the amount of production was on an average 80 mounds per acre. But the present situation at the Dalia Barrage project has compelled farmers to decrease HYV rice production.

Livestock

Besides the losses of human lives and crop damages, livestock had become a major victim of the floods. There was a severe crisis of both high ground and fodder; people were feeding their cattle water hyacinth, a poor substitute for fodder. Severe diarrhea broke out within a few weeks. Prices of poultry feed had gone up by 20 to 40 percent and many poultry farmers were facing huge losses.

Massive post flood agriculture rehabilitation was the order of the day. The country and its implanting agencies had not experienced anything like this in such an enormous scale. A concerted national effort was needed to put the rural economy back on its tottering feet.

Ⅶ Severity of the Problem at Dalia: Major Concern Published in Various Media, Some examples.

The major newspapers of Bangladesh have shown their concerns, publishing various news articles on the Dalia barrage and the dryness of the Teesta River in the dry season. Some of them can be cited here as examples:

“The Teesta barrage project on verge of closure as water flow falls”- it was the heading of the Daily Star on November 22,1997. Citing the reference of water Development Board (WDB), the Daily Star said, water flow near the barrage was recorded between 6000 and 7000 cusec during the first fortnight of 1996. But the flow virtually came down to 2,500 cusec during the same period this year. This has posed a serious threat to irrigation, riverine transports and fisheries as

the dry season is approaching when farmers of the region depend on both surface and underground water for cultivation of Irri and Boro crops.

The paper on August 30, 1998 reported that, "as a result of the unilateral withdrawal of the Teesta water by Indian authorities Bangladesh is getting only 10-15 percent (3,000-4,000 cusec). The lowest flow recorded on January 13th was only 2,600 cusec. But the country's largest irrigation project, the Teesta Barrage, constructed at a cost of Taka 1, 000 crore, and it's 34-kilometer main distribution canal need at least 8,000 cusec water in the lean season".

Another prime Bengali Daily—the Daily Ittefaq reported, (March 23, 1999) "the level of underground water has decreased, the minimum flow of the Teesta falls to only 176 cusecs".

Other newspapers and periodicals such as, the New nation, Dhaka Courier, Daily Sangbad, the Daily Inquilab, Daily Observer etc. also reported on the issue. Two research papers have also published in referreed journals.

Ⅷ　Dalia Problem: Is it a Man-made Disaster ?

In general sense, any unwanted misplaced energy or accident may cause a disaster. It may happen with or without warning. It can be classified as natural (such as earthquakes, floods, communicable diseases etc.) and man-made (such as warfare, chemical/biological pollution, collapse or captures of natural resources etc.). Protecting natural water bodies in such a way which can harm the riparian state is also a severe man-made disaster.

As a result of withdrawing dry season water at the upstream, branch rivers, canals, ponds and wells, in the downstream country (Bangladesh) becomes dry. The water level of shallow tube-wells drop and there is a crisis of underground and safe drinking water, leading to diarrhoea, cholera, dysentery etc. This can certainly be referred to as a disaster.

Ⅸ　Meeting, Treaty and Solution Efforts.

The high level committee of JRC in both India and Bangladesh sat for meetings about 33 times for the Teesta water problem but no fruitful decisions were made.

The JRC (Joint River Commission) meetings and Water sharing commitment:

a) Since 1961 (when the Teesta Barrage plan was adopted by India) negotiation between the former governments of Pakistan and India did not bear any results.

b) After independence the Indo-Bangladesh joint river commission met over 90 times and only a treaty was signed for the Ganges river (1998). There is no explanation on how to use dry season water in both of the countries, economically benefiting equally. Rather, we see severe flood in the western part of Bangladesh due to sudden opening the Farakka (the barrage on the Ganges in India) barrage gates!

c) On November 26, 1976 the U.N. General Assembly adopted a consensus statement directing the parties to arrive at a fair and expeditious settlement.

d) The secretary level meeting of Joint River Commission (JRC) between India and Bangladesh was held at least 5 times. At the JRC meeting held at the Teesta Barrage Rest house

"Abashar" on August 31, 1997, the Indian delegation and water resource secretary Mata Prasad said "The draft Teesta water sharing cannot be finalized due to lack of sufficient data on the flow".

e) The Joint River Commission (JRC) between India and Bangladesh sat on last September 27 & 28, 1998 and December 30, 2000 in Dhaka but no fruitful results were made.

In the dry season of 2001 (December-May) Bangladesh did not get any commitment for water and the dry season has passed on and the file of the meeting was untouched. Treaties for bilateral cooperation are not likely to sustain due to lack of foresight and appropriate Policy model regarding highest Economic benefits of the Parties Concerned.

X Optimal Economic Use of International Rivers-Two Examples

Rivers have been used for economic purposes since ancient times. However, in early times its use was limited mainly to navigation and to some extent, for irrigation purposes (Smith 1931, Schachter 1977). In recent years, the use of water for agricultural and industrial purposes has increased tremendously. The demand has expanded vastly, even though the supply of fresh water has become scarce, owing to natural and anthropogenic causes (Schachter 1977).

Naturally, each river system forms an indivisible and unique physical unit, although it may be divided artificially by political frontiers (Smith 1931). From this basic fact emanates the concept of a 'drainage basin' which implies integral development, giving a high priority to maximization of benefits for the basin as whole, by reducing wasteful uses and developing a comprehensive and unified scheme to be followed by all those who are concerned (Schachter 1977). At Helsinki in 1966, the International Law Association has approved a draft set of very reasonable rules regarding equitable use of international river waters (Starke 1987, Schachter 1977). Of the various factors listed, the following points are worth mentioning:

(1) Water utilization of the river basin at present and in the past has to be considered;
(2) The extent to which the population of each basin state is dependent on the river water has to be taken into account;
(3) Research on the comparative costs of alternative means to meet the economic and social needs of the people of the basin states should be carried out;
(4) Care must be taken to avoid unnecessary wastage when utilizing river water;
(5) Availability of other resources has to be considered;
(6) The extent to which compensating one or more of the co-basin states for adjusting conflicting uses is practicable has to be evaluated;
(7) The extent to which the necessities of a riparian state can be met without causing substantial harm to a co-basin state has to be taken into consideration (Schachter 1977).

There are examples of treaties and provisions made for using the water of rivers by riparian states for the maximization of benefits and equitable distributions, which were signed long before the Helsinki resolution, and were successful. The first example I would like to cite is the treaty between Egypt and the Sudan (1926) by which Egypt got a reasonable share of the Nile water by

cooperating in building a reservoir at the upstream, within the territory of Sudan. This case is an example, proving that "mutual confidence and cooperation in all matters concerning the river and its waters" are of much greater importance than that of arbitral tribunals, legal rules and expert commissions joined together (Smith 1931, p. 83).

Another example of optimum utilization of river water through international cooperation is the shared enjoyment of the Columbia River between the U.S.A. and Canada. Storage tanks at the upstream of the river in Canada and electric power generation and flood control system at the downstream in the U.S.A. benefit both the countries equally. This was made possible by signing of a treaty in 1961 by the parties concerned (Islam 1987). In the present paper, we propose an optimal economic solution to the problem of sharing of the Teesta River water, in order to maximize the benefits for the people of the basin (in India and Bangladesh) as a whole, just as we have seen in the cases of the apportionment of the Nile water and the sharing of the Columbia water.

Remedial Measure: Some Suggestions

We propose some remedial measures to solve the problem of sharing of Teesta water, especially during the dry season between India and Bangladesh and also some other proposals regarding water management and control during rainy season. These are as follows:

Ⅺ　A Proposal for an Optimum Solution

a. An Optimal Approach to Sharing Dry-season Water

During the 1st phase of implementation of the Teesta barrage (Dalia), using irrigation water, an increasing trend in productivity of land was observed. However, since the commencement of the operation of the Gazoldoba barrage at the upstream, the Dalia barrage project, due to shortage of water, stopped operating for irrigation. Through the following estimation, we have shown a possible optimal sharing of the Teesta water considering the number of affected people and land productivity of both India and Bangladesh. The barrage at Dalia point requires at least 8000 cusecs of water (Daily Star, Feb. 21, 1998), assuming 40% of the total water flow in the dry season to remain active. So far, maximum amount of land (30% of the total target area) has been cultivated in the year 1996. This cultivation produced crops worth US$ 48.86 million. The sum of the total crop production during the last four years was valued at US$ 136 million. The total production has drastically decreased in the last two years (1998-1999). Assuming the ratio of the Teesta River water in dry season in India and Bangladesh as 85% (32,700) and 15% (4,900 cusecs) respectively, we optimize the share. That can be shown in Figure 1.

Figure 1. Optimization of Water Sharing between the two Countries

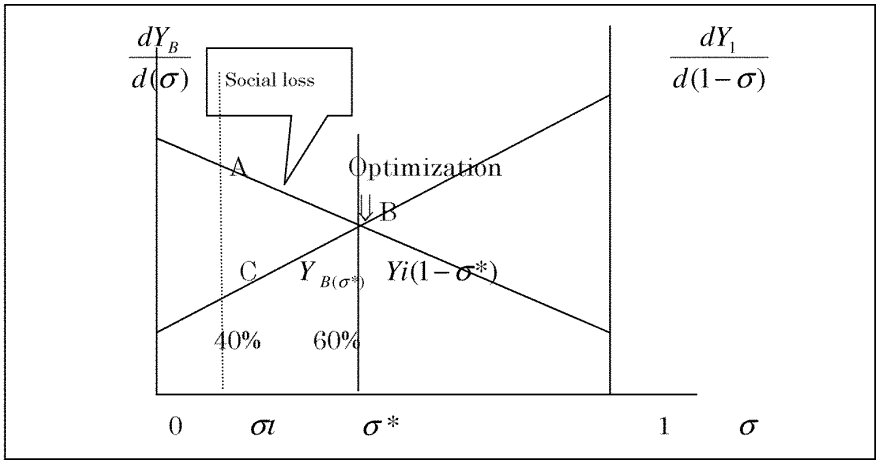

Figure 1 displays merits of an optimal sharing. The horizontal axis σ_i symbolizes a share of Bangladesh. So, $1-\sigma$, (measured to the left from the point 1) is that of India in the context of the Teesta River basin.

Left and right vertical axes measure the marginal productivity of water resources in Bangladesh and India respectively.

If the share is fixed due to some reason at the level of σ_i which is far less than the optimal share σ^*, there exists a social loss of triangle area ABC (the difference between the lost value of crops in Bangladesh due to the lack of water and the value of crops in India which can be produced in India by using more water than the optimal sharing) and σ_i which is not optimal from cooperative point of view of both countries in a general sense. Obviously, there is still a problem of showing the increase in $\Delta BC\sigma^*\sigma_i$, but it is not difficult, if Bangladesh at least gives up the rectangular area $AC\sigma^*\sigma_i$. So, a real problem will be how to share the ΔABC, area. If the share of Bangladesh increases from 15% to 40%, then an increase equivalent to the value of triangle area can be made possible. From economic point of view, an optimal sharing of a fixed amount of resource can be shown at the crossing point of the marginal productivity curves of both parties provided that both the curves are decreasing.

b. Establishing an Special Economic Block

A specific economic block can be established between India and Bangladesh, especially with the West Bengal province of India and Bangladesh. Social, political, economic and environmental issues between the two countries can be its infra-structural agenda. Some treaties on that infrastructure can be signed. Like the European Community and EURO, indifferent currency can be established for greater economic development. Beside this, large-scale irrigation project can be maintained with a joint venture approach. The people of both the countries can take part in the joint economic activities, such as:

Preservation of Rainy-season Water1

During the rainy season a huge amount of rainfall occurs at the foot of the Himalayas. Besides, the ice at the peaks begins to melt in summer, causing floods. In the delta region, the river's depth gradually decreases. As a result, any excess of water in the river inundates the adjoining areas and cause a great deal of damage. However, if India and Bangladesh take up a joint program as we have seen in the case of Nile water apportionment, reservoirs can be built at the upstream of the Teesta River in India to store the excessive water during the rainy season and share the stored water during the dry season. Reservoirs can also be built along the riverside within the Bangladesh territory to store the excessive water during floods, for use during the dry season through gravity irrigation.

Integrated Control of Flood Water

Integrated flood management program have to be planned and implemented for floods during the rainy seasons, as well as the flash floods of summer, to save a huge amount of crops and wealth from damage. Early forecasting of floods through remote sensing could help. Unilateral initiative by Bangladesh is not likely to work, because of the geographical situation. Most of the floodwater (except rainwater) comes to Bangladesh from the upstream, over which she has no control. Therefore, taking into account all related factors---- such as rainfall, ice melting, barrage control---- an integrated and comprehensive flood control program has to be adopted and implemented.

Bilateral Trade and Business:

For the betterment of the people of the Teesta River basin area (both in India and Bangladesh), we recommend the following *(Some General Proposals):*

*While planning and policymaking, emphasis must be placed on an optimal and amicable water sharing and on a suitable trade model.

*Bangladesh should make certain arrangements, for example, to take measures so that Indians, using the Teesta River water (at Dalia or northern districts), can get some opportunities for business and trade in Bangladesh territory;

*Joint ventures (co-project or bilateral agricultural projects) should be encouraged in establishing mills and factories (e.g. rice mills, tobacco husking mills, paper mills, food processing mills) dependent on crops produced in the Teesta region.

For Reducing Such Conflicts and Ensuring Justice:

*The donors or donor countries should have some restrictions on the construction funds of such barrage or irrigation projects, when it has a possibility to harm riparian states. The feasibility studies before granting such funds should be foresightful.

*Both Bangladesh and India are recognized as third world countries. So, both the countries should try to cooperate with each other for socio-economic development, rather than engaging in different types of conflicts, and wasting time and resources.

*Considering the number of affected people in both India (8 million) and Bangladesh (21 million)[9], we can say that, it would be quite consistent with the principle of justice for Bangladesh to get an equitable share of the Teesta water during dry season.

However, we must remember that "mutual confidence and cooperation"(Smith 1931 p. 83) between the leaders of India and Bangladesh is necessary for an economic policy to be implemented properly. Leaders of both sides have to be sincere in their efforts. They must also have an open mind and be ready to accept rational suggestions given by their counterparts.

Ⅻ Conclusion

In this paper, we have discussed the problems related to the Teesta Barrage Project in Bangladesh, causes of the problems and their effects. We believe that something must be done very soon to mitigate these problems by ensuring equitable and joint socio-economic benefits for both India and Bangladesh. We are carrying out research with an aim to find an economic solution for the emancipation of the Teesta basin inhabitants.

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