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A REVIEW OF THE GANGES TREATY OF 1996

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ABSTRACT: The critical review of the Ganges Treaty of 1996 (Treaty '96) between Bangladesh and India regarding the water flow in the dry season (January to May) through the river Ganges has been made using an analytical approach based on an hydrological frequency analysis of flows released to Bangladesh at Farakka (West Bengal of India) and the Gumbel's extreme-value distribution. It also includes a simple analysis of flow data at this point. First, two years of data (1997 and 1998) were studied just after the Treaty'96 was signed. After an analysis of the treaty, it is observed that the treaty was followed more effectively in 1998 than in 1997. Since it is concluded that the sharing of flows fully depends on the availability of water at Farakka, the upstream reach of the Ganges, both countries (Bangladesh and India) would do better to augment the flows upstream for their own interests though compliance with the terms of the treaty. A copy of the Ganges 1996 treaty is attached herewith for a clearer understanding of this paper.
KEY TERMS: Ganges River, international water law, treaties, international rivers, water allocation.

INTRODUCTION

The Ganges is an international river with its basin spread over China, Nepal, India, and Bangladesh; it originates at an elevation of about 23,000 feet in Gangotri on the southern slope of the Himalayan range. From there the river traverses south and southeastward in India for about 1,400 miles. About 11 miles below Farakka, India, it forms the common boundary between India and Bangladesh and continues about 63 miles before finally entering Bangladesh near Rajshahi. The total course of Ganges before discharging into the Bay of Bengal is about 16,000 miles (2,500 km) (Abbas, 1984). Since water is a scarce resource and the Ganges is an international river, there needs to be a treaty or agreement to assure the proper utilisation of water.

When there was no barrage on Ganges at Farakka, India, there was no question about sharing the water. At that time water flowed naturally through the Ganges and its distributories. After constructing) the Farakka Barrage (in India) in 1975, vital questions arose as to who would control the gate of the barrage, and for what purposes and how much water would be used, and how water would be shared between Bangladesh and India. To get answers to these questions, the need for a treaty or agreement was felt by each basin state and so the agreement 77, MOU 82, MOU85 and lately the Treaty'96 are made to share the water between Bangladesh and India.

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BRIEF HISTORY OF DIFFERENT AGREEMENTS, MEMORANDA OF UNDERSTANDING, AND THE TREATY OF 1996

The Ganges dispute was recognised in 1951 when Pakistan protested to India about the proposed Farakka Barrage. Negotiations had been pursued between India and Bangladesh, and prior to 1971 with Pakistan, on this issue for the last 40 years. Instead of converging towards an acceptable sharing arrangement, the issue had become more complex with many other issues related to a sharing arrangement. There have been several short-terms sharing agreements: the first Ganges Water Treaty was worked out in 1977. Subsequently, the Memorandum of Understanding of 1982 (MOU82), and MOU85 were developed. The most recent agreement is Treaty'96. Since the proposal for diversion of Ganges water was first disputed in 1951, discussions and negotiations can be divided up into the following seven phases (Nishat, 1996).

Table 1: Different phases of discussions and negotiations

Phase (Period)	**Focus**
Phase 1 (1951-74)	How to finalise respective shares before commissioning the barrage. Discussions on respective claims and their justifications.
Phase II (1974-76)	Issue of flow augmentation raised. Failure in bilateral negotiations. Barrage operation begins in 1975 with concurrence of Bangladesh. Unilateral withdrawal of waters by India in 1976. Issue taken to UN by Bangladesh
Phase III (1977-82)	Ganges Water Agreement (1977-82) signed and implemented Discussion on augmentation fails. Treaty not renewed despite provisions to do so.
Phase IV (1982-88)	Memoranda of 1982 and 1985 implemented. Provisions similar to 1977 Agreement except it contains a guaranty clause. All regional rivers brought to the discussion table. Both sharing and augmentation options discussed. Both sides review augmentation proposal.
Phase V (1988-92)	Negotiations continue but without success. Divergence in approach. Relationship between sharing arrangements and augmentation proposal becomes a very critical issue.
Phase VI (1993-1995)	No dialogue and India has unilateral control over the Ganges.
Phase VII (1996- Present)	Treaty is signed to share water resources according to the terms of the treaty.

Before the commissioning of the Farakka Barrage, an interim arrangement was made for a test run to release a flow of 11,000 to 16,000 cusecs through the Feeder Canal from 21 April to 31 May 1975 and releasing the remainder for Bangladesh. After 1975, there was no renewal of this arrangement and unilateral withdrawal by India continued causing disastrous effects on the Ganges-dependent areas of Bangladesh, mainly in the south-west region. Repeated protests against the continued unilateral withdrawals were of no avail, and Bangladesh took the matter to the United Nations. Through intensive efforts of the Non-aligned countries at the United Nations, the General Assembly adopted a consensus statement on 24 November 1976, in which the parties decided inter alia, to have an urgent ministerial level meeting to negotiate a fair and expeditious settlement.

Pursuant to the General Assembly's consensus statement, negotiations continued between the two countries, and the Ganges Waters Agreement was signed on 5 November 1977 for sharing the Ganges water during the dry months from January to May each year for a period of five years (1978-1982). The Agreement provided 34,500 cusecs for Bangladesh and 20,500 cusecs for Calcutta port in India and guaranteed a minimum flow of 27,600 cusecs for Bangladesh during the lowest 10-day average flow period between 21-30 April. The Agreement specified inter alia, a schedule for sharing of the flow on a 10 day basis; the guarantee of a minimum of 80 percent of the amounts mentioned in the schedule for Bangladesh to protect against withdrawals from upstream reaches; the

formation of a joint Committee comprising representatives of both the governments who would implement sharing arrangements; the carrying out investigations leading to augmentation of the Ganges flow at Farakka within three years by the Joint Rivers Commission (JRC) created in 1972; and a review of the Agreement by the two Governments at the end of the third year. During the Agreement period, Bangladesh and India exchanged their proposals for the augmentation of the Ganges flow, which were reviewed jointly by both parties. The Bangladesh proposal envisaged optimum utilisation of the water sources of the Ganges basin by the construction of storage dams in the upper reaches of the Ganges in India and its tributaries in Nepal to conserve the monsoon flows for augmenting dry season flows. India's proposal was to transfer water from the Brahmaputra through a link canal across Bangladesh to the Ganges above Farkka. The proposal of each country was not acceptable to the other, and on the grounds that the obligation under the Agreement was not fulfilled, the Agreement was not renewed in November 1982. However, the governments of Bangladesh and India did sign a Memorandum of Understanding (MOU) on 7 October 1982.

The MOU of 1982 included provisions for burden sharing instead of achieving a guaranteed minimum flow. Besides sharing, the MOU asked for submission of pre-feasibility studies of the augmentation schemes proposed by both parties. Accordingly in 1983, the countries exchanged their updated proposals for augmentation, based on the "Report on Pre-feasibility Study of the India and Bangladesh Proposals for Augmenting the Dry Season Flows of the Ganges at Farakka" that was completed in 1984. In view of the differences of opinion, it was not possible to make any recommendation acceptable to both countries with regard to the optimum solution for augmentation of the dry season flows of the Ganges at Farakka, which could be rapidly implemented. Thus, the two sides rejected the proposals in March 1984. The MOU expired in 1984 and as no formal arrangements for sharing the flows in future years were made, Bangladesh made serious efforts to reach a formal agreement but without success.

In the absence of the agreement, there was no sharing during the dry season of 1985. After painstaking efforts, the two countries signed another MOU on 22 November 1985 for sharing the waters of the Ganges at Farakka for three dry seasons commencing in 1986. Like its predecessor, the MOU of 1985 included provision for burden sharing instead of guaranteed flows. It also provided for negotiation on the flows of all common border rivers between the two-country including the Ganges. The sharing of the Ganges flows under the MOU of 1985 ended in May 1988. Between 1988 to 1996, in the absence of any sharing arrangement, Indian's unilateral withdrawal of the Ganges waters during the dry season at Farkka continued at an alarming rate which was evident from the dry season flows of the Ganges at Hardinge Bridge. The Gorai, which is the main tributary carrying water to the south-west region of Bangladesh, became totally dry at the beginning of the lean period. The progressive utilisation of the waters upstream in India, coupled with the massive unilateral withdrawal of Farakka Barrage, culminated in the lowest recorded flow a Hardinge Bridge of 13,521 cusecs in 1992, compared with historical average flows of 75,000 cusecs during the last ten-day period of March.

During the New Delhi summit, held on 29 September 1988 between the heads of governments of Bangladesh and India, the Bangladesh Secretary of Irrigation and the India Secretary of Water Resources were assigned to work out an integrated formula for the permanent, long-term sharing of the flows of common rivers between Bangladesh and India. In order to break the stalemate in the sharing arrangement, the Secretaries Committee held six meetings alternately at Dhaka and New Delhi over three years from April 1990 to February 1992. They emphasized the need for immediate allocation of the Ganges and Teesta (another common river of Bangladesh and India) waters on a priority basis, including the sharing of waters from other common rivers as mandated. However, they could not decide on a general principle for the sharing of the waters at any of the common rivers, including the Ganges (Nishat, 1996).

BASIS OF THE TREATY OF 1996

Treaty '96 is based on the principle of reasonable and equitable sharing of water and the river basin approach. Non-Navigational Laws and the Helsinki Rules of 1966 are followed accordingly to formulate the treaty. Treaty'96 adopts Article IV of the Helsinki Rules: "Each Basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin." According to the treaty, the total availability of water will be measured and shared at Farakka (India) on the basis of the previous 40 years of historical 10-day average flows. There are also some provisions in the treaty for both parties to discuss options for the augmentation of the Ganges flow during the dry period and the way in which optimum allocation of waters of other common rivers between Bangladesh and India is possible These are guided by the principles of equity, fairness, and no harm to either party.

METHODOLOGY

In this study, hydrological analysis has been done using some control curves at Farakka to analyse and compare the flows of different years. A control curve is a line of some availability of flow plotted against a particular duration. Control curves for 10, 50, 75 and 90 percent flow duration were drawn based on Gumbel's method. Gumbel (1941) introduced the extreme value distribution, and it is commonly known as Gumbel's distribution (Gumbel's method). It is one of the most widely used probability-distribution functions for extreme values in hydrologic and meteorological studies and is used to estimate the magnitudes of probably flood peaks, maximum rainfalls, maximum wind speed, and other exteme events.

According to his theory of extreme event, the probability of occurrence of an event equal to or larger than a value x_0 is

$$P(X \geq x_0) = 1 - e^{-e^{-y}}$$

in which y is a dimensionless variable given by

$$y = \alpha(x - a)\ y = \alpha(x - a)$$

where

$a = \bar{x} - 0.45005\sigma_x$ and $\alpha = 1.2825/\sigma_x$.

Noting that the return period $T = 1/P$ and the value of the variate X with a return period T is

$$x_T = \bar{x} + K\sigma_x$$

where $K = (y_T - \bar{y}_n)s_n$

in which, y_T = reduced variate, a function of T and is given by

$$y_T = -[\ln . \ln T/(T-1)] \text{ or } y_T = -[0.834 + 2.303 \log \log(T/T-1)],$$

$\bar{y}_n$ = reduced mean, a function of sample size N, for N (($\bar{y}_n$ (0.577, s_n = reduced standard deviation, a function of sample size N for N ((s_n (1.2825. In practice the value of the variate X with a recurrence interval T is used as

$$x_T = \bar{x} + K\sigma_{n-1}$$

where σ_{n-1} = standard deviation of the sample (Subramanya,1994)

ANALYSIS AND RESULT

Control curves of 10, 50, 75 and 90 percent available flow have been drawn and the discharges of 1978, 1983, 1986, 1997 and 1998 at Farakka to Bangladesh are compared with these curves in figure 1. The top most control curve is for the flows available 10 percent of the time and the bottom one is for flows available 90 percent of the time. The figure shows that flows in 1978 and 1986 are above the 75 percent availability line whereas in 1983 and 1997 flow lines are below the average available 75 percent of the time, and at times below the 90 percent available flow. The 1998 flow line is partially above and below than 75 percent available flow.

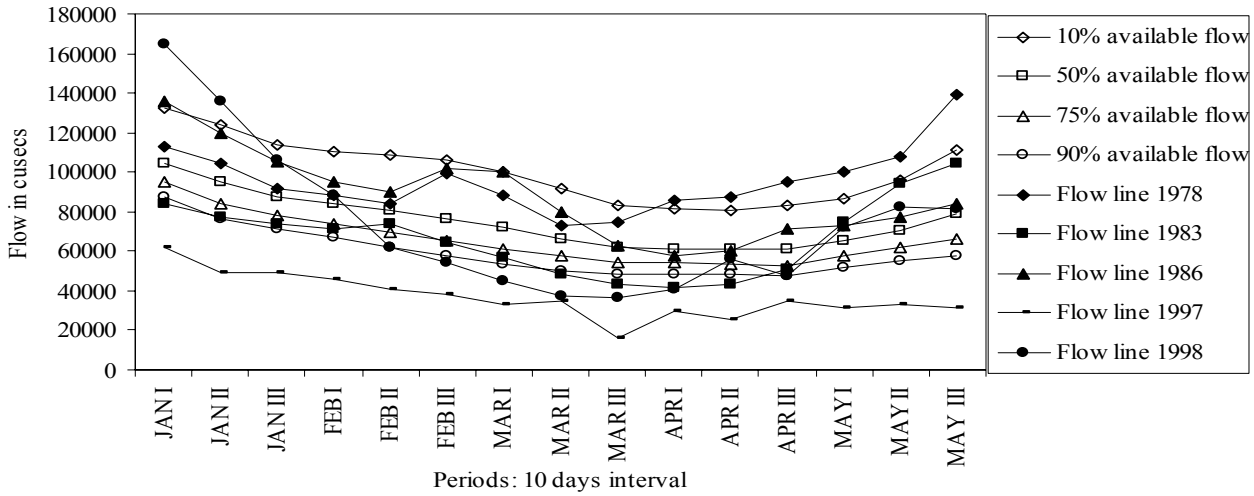

Figure 1: Comparing the flow line with control curves at Farakka

The Agreement in 1977 was made based on 75 percent availability of flow, which was followed by MOU82 and MOU85. So accordingly, the Agreement of 1977 is well implemented in the year of 1978 but not in 1983. The flows in 1997 and in 1998 are somewhat less than 75 percent availability of flow, but it can not be concluded that the Treaty'96 is not well implemented because it is based on the historical average flow of the Ganges at Farakka from 1949 to 1988. But it is true that in these years the flows are sometimes less than that of 1978, just considering this point it can't be said that the Treaty'96 is not well implemented in these two years as the share of both countries

Table2: Flow at Farakka in 1997 and 1998

PERIOD	**Actual flow release to Bangladesh in 1997 (cusecs)**	**Share of Bangladesh as per formula given in Annexure-I of 1996 Treaty in 1997 (cusecs)**	**Difference in flow between actual and share of Bangladesh in 1997 (cusecs)**	**Actual flow release to Bangladesh in 1998 (cusecs)**	**Share of Bangladesh as per formula given in Annexure-I of 1996 Treaty in 1998 (cusecs)**	**Difference in flow between actual and share of Bangladesh (cusecs)**
1	2	3	4=2-3	5	6	7=5-6
January 01-10	62019	62180	-161	164763	164797	-34
January 11-20	49556	49635	-79	135591	135566	25
January 21-31	48884	48672	212	105881	105866	15
February 01-10	45604	45604	0	88181	88186	-5
February 11-20	41029	41015	14	61831	61841	-10
February 21-28	38387	37399	988	54711	54738	-27
March 01-10	33489	33085	404	45322	45323	-1
March 11-20	35028	35000	28	37323	35967	1356
March 21-31	16528	13487	3041	36557	35000	1557
April 01-10	30137	35000	-4863	40474	38588	1886
April 11-20	25613	19526	6087	55952	50955	4997
April 21-30	35065	35000	65	47876	47901	-25
May 01-10	31722	31728	-6	72185	62203	9982
May 11-20	33021	33028	-7	82062	82062	0
May 21-31	31643	31654	-11	81218	81220	-2
Total flow	**557725**	**552013**	**5712**	**1109927**	**1090213**	**19714**

(Bangladesh and India) depends on the total available flow at Farakka and the basis of this treaty is different from the agreement of 1978 . To comment about the degree of implementation of the treaty it would be a fair comparison if a table which can directly compare between the shared value and released value of flow is drawn herewith. Presentation of such a table (table2) of flows could provide a clear understanding about the flow condition in 1997 and 1998.

Table 2 clearly shows that in 1997 the total flows released to Bangladesh exceed that required by the treaty by 5712 cusecs, although in January I, II, April I and in all of May releases were less than the quantity fixed by the treaty. The same situation occurred in 1998. So the study shows that during the first two years after the treaty, Bangladesh received an excess amount of water on the whole according to the Treaty'96 based upon the total available water at Farakka. Since the share of both countries depends upon the water available at Farakka flows need to be augmented upstream as the released amounts of water are not sufficient during dry periods for some specific uses. It is also inadequate to restore the environment and other conditions and to mitigate the harmful effects of reduced flows for a long time.

CONCLUSION

Water is a sensitive and scare resource in the 21st century, and the distribution of it among the co riparian states is a complicated and difficult task. A river system has to be considered as a whole from its source to its mouth for the optimum development of its water resources to get the best results. There has to be a broad outline of a plan covering the entire drainage basin to ensure the coordinated and harmonious development of the various works in relation to all the reasonable possibilities of the basin. Concisely, it can be concluded that theTreaty'96 has performed well during the first two years, though the flow reaches a very low level in March and April because of the inadequate available flow at Farakka. After reviewing the treaty 96', it is obviously that there is no way but to consider the entire drainage basin as a whole to ensure the optimum allocation of water for the benefit of each co-riparian state. Doing so, can mitigate the problems that have become increasingly serious over the years as a result of reduced flow and can guarantee a healthy economy of the co riparian states.

ACKNOWLEDGEMENTS

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APPENDIX
THE TREATY OF 1996

TREATY BETWEEN THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH AND THE GOVERNMENT OF THE REPUBLIC OF INDIA ON SHARING OF THE GANGA / GANGES VATECS AT FARAKKA.

THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH AND THE GOVERNMENT OF THE REPUBLIC OF INDIA.

DETERNNED to promote and strengthen their relations of friendship and good neighbourliness.

INSPIRED by the common desire of promoting the well being of their peoples.

BEING desirous of sharing by mutual agreement the waters of the international rivers flowing through the territories or the two countries and of making the optimum utilisation of the water resources of their region in the fields of flood management irrigation, river basin development, and generation of hydro-power for the mutual interests of the peoples of the two countries.

BEING desirous of finding a fair and just solution without affecting the rights and entitlement of either country other than those covered by this Treaty, or establishing any general principles of law or precedent.

HAVE AGREED AS FOLLOWS:

ARTICLE-I
The quantum of waters agreed to be released by India to Bangladesh will be at Farakka.

ARTICLE-II
(i) The sharing between India and Bangladesh or the Ganga / Ganges waters at Farraka by ten day periods from the 1st January to the 31st May every year will be with reference to the formula at Annexure I and an indicative schedule giving the implications of the sharing arrangement under Annexure I is at Annexure II.

(ii) The indicative schedule at Annexure II as refereed to in sub Para (i) above is based on 40 years (1949-1988) 10-day period average availability of water at Farakka. Every effort would be made by the upper riparian to protect flows of water at Farakka as in the 10 years average availability as mentioned above.
(iii) In the event flow at Farakka falls below 50,000 cusecs in any 10-day period, the two governments will enter into immediate consultations to make adjustments on an emergency basis, in accordance with the principles of equity, fair play and no harm to either party

ARTICLE-III
The waters released to Bangladesh at Farakka under Article I shall not be reduced below Farakka except for reasonable uses of waters, not exceeding 200 cuseces, by India between Farakka and the point on the Ganga/Ganges where both its banks are in Bangladesh.

ARTICLE-IV
A committee consisting of representatives nominated by the two Governments in equal numbers (hereinafter called the joint Committee) shall be constituted following the signing of this treaty. The joint committee shall set up suitable teams at Farakka and Hardinge Bridge to observe and record at Farakka the daily flows below Farakka Barrage, in the Feeder Canal, and at the Navigation Lock, as well as at the Hardinge Bridge.

ARTICLE-V
The joint Committee shall decide its own procedure and method of functioning.

ARTICLE-VI
The joint Committee shall submit to the two Governments all data collected by it and shall submit a yearly report to

both the Governments. Following submission of the reports the two Governments will meet at appropriate levels to decide upon such further actions as may be needed.

ARTICLE-VII

The joint Committee shall be responsible for implementing the arrangements contained in this Treaty and examining any difficulty arising out of the implementation of the above arrangements and of the operation of Farakka Barrage. Any difference or dispute arising in this regard, if not resolved by the joint Committee, shall be referred to the Indo-Bangladesh Joint Rivers Commission. If the difference or dispute remains unresolved, it shall be referred to the two Governments, which shall meet urgently at the appropriate level to resolve it by mutual discussion.

ARTICLE- VIII

The two Governments recognize the need to cooperate with each other in finding a solution to the long-term problem of augmenting the flows of the Ganga/Ganges during the dry season.

ARTICLE-IX

Guided by the principles of equity, fairness and no harm to either party, both the Governments agree to conclude water sharing Treaties / Agreements with regard to other common rivers.

ARTICLE-X

The sharing arrangement under this Treaty shall be reviewed by the two Governments at five years interval or earlier, as required by either party and needed adjustments, based on principles of equally, fairness, and no harm to either party made thereto, if necessary .It would be open to either party seek the first review after two years to assess the impact and working of the sharing arrangement as contained in this Treaty.

ARTICLE- XI

For the period of this Treaty, in the absence of mutual agreement on adjustments following reviews as mentioned in Article X, India shall release downstream of Farakka Barrage, water at a rate not less than 90 percent (ninety percent) of Bangladesh's share according to the formula referred to in Article II, until such time mutually agreed flows are decided upon.

ARTICLE - XII

This Treaty shall enter into force upon signature and shall remain in force for a period of thirty years and it shall be renewable on the basis of mutual consent.

IN WITNESS WHEREOF the undersigned being duly authorised their to by the respective Governments, have signed this Treaty.

DONE at New Delhi 12th December, 1996 in Hindi, Bangla and English languages. In the event of any conflict between the texts, the English text shall prevail.

(SHEIKH HASINA)
PRIME MINISTER,
PEOPLE'S REPUBILIC OF
BANGLADESH.

(H.D. DEVE GOWDA)
PRIME MINISTER,
REPUBLIC OF INDIA.

ANNEXURE - 1

Availability at Farakka	Share of India	Share of Bangladesh
70,000 cusecs or less	50%	50%
70,000- 75,000 cusecs	Balance of flow	35,000 cuscs
75,000 cusces or more	40,000 cusecs	Balance of flow

Subject in the condition that India and Bangladesh each shall receive guaranteed 35,000 cusecs of water in alternative three 10-day periods during the period March 1 to May 10

ANNEXURE – II

Schedule
(Sharing of waters at Farakka between January 1 and May 31 every year)

If actual availability corresponds to average flows of the period 1949 to 1988, the implication of the formula in Annex -I for the share of each side is:

Period	**Average of total flow 1949-88 (cusecs)**	**India's share (cusecs)**	**Bangladesh share (cusecs)**
Jan			
1-10	107,516	40,000	67,516
11-20	97,673	40,000	57,673
21-31	90,154	40,000	50,154
Feb			
1-10	86,323	40,000	46,323
11-20	82,859	40,000	42,859
21-28	79,106	40,000	39,106
March			
1-10	74,419	39,419	35,000
11-20	68,931	33,931	35,000*
21-31	64,688	35,000*	29,688
April			
1-10	63,180	28,180	35,000*
11-20	62,633	35,000*	27,633
21-30	60,992	25,992	35,000*
May			
1-10	67,351	35,000*	32,351
11-20	73,590	38,590	35,000
21-31	81,854	40,000	41,854

(* Three ten day periods during which 35,000 cusecs shall be provided)