Role of Remote Sensing Technology on Monitoring Large Irrigation Project in North Bangladesh

MUHAMMAD F. BARI*

KIYOSHI TORII**

NOOR MD. RAHMATULLAH***

*Dept of Water Res. Eng. Bangladesh Univ.of Eng.& Tech (BUET)
Bangladesh

**Graduate School of Agric., Kyoto Univ., Sakyo, Kyoto,
Japan

***Graduate School of Informatics, Kyoto Univ., Sakyo, Kyoto,
Japan
Email:- bari@wre.buet.edu
Fax:- +880 2 861 3046
Phone:- +880 2 966 5650

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Abstract: Vast agricultural areas in the north Bangladesh suffered water shortage not only in the dry season but also in the monsoon season due to a small amount of rainfall and construction of a large irrigation system from Teestra River had been longed for since 1935 under English rule. In August 1990, construction of a barrage was completed in Teesta River and a dike for flood prevention was built at the same time. A main canal extending over 211.7 km in whole length, branch canals provided with regulators, drainage canals and culverts were completed. Tertiaries of 387 km in length and silt traps of 45 ha in area were also constructed. Irrigation in the upstream area of 6,500 ha was started in January 1993 and the area was expanded to 20000 ha in 1998. The irrigation area is planned to expand to 540,000 ha eventually. To monitor such a huge irrigation project, it is best to apply the remote sensing technology. We discuss the roles of the technology.

1. Introduction

The vast area in the north Bangladesh suffers from drought and water shortage every year. Drought is an everyday happening in this area.

Fig. 1 Project area in Bangladesh

The project area is bordered by the Teesta River on the north, Atrai district on the west, Shantahar-Bogra railway on the south and Bogra-Kaunia railway on the east as Fig. 1 shows. The area covers 750,000 ha of land and projects such as irrigation, flood prevention and drainage improvement are undertaken. The area of 540000 ha is irrigable. The project area involves 7 districts in the north Bangladesh.

The main purpose of the project is to increase agricultural production whereby to increase opportunity of employment.

The project aims at drawing water from the Teesta River and supplying water through a water supply network as irrigation water. A barrage has been constructed at Doani in Lalmonirhat district crossing over the Teesta River to supplement water mainly in the monsoon season. Water control that meets water demand in the dry season as much as possible is aimed at by performing irrigation rotation and devising cultivation period of crops.

Once the Teesta Barrage project is completed, farmers will be able to grow 3 crops a year. Innovative changes in the agriculture and inland water fishery are expected by acquiring the latest irrigation techniques and increasing employment opportunities.

Development in the communication basis has improved marketing system and establishment of household industries based on many agricultural products is expected.

A well-balanced landscape not only in the hydrologic aspect but also in the biological environment shall be achieved.

It is expected that such a big national project is started in the north Bangladesh and becomes useful for development of manpower and alleviation of poverty.

This project is planned to complete in 10 to 20 years and to mature in the further passage of history. To see the growth of this gigantic project and to make the best use of it while sensing danger, information that allows grasping the whole is indispensable. We are convinced that remote sensing and GIS techniques can give the answer.

Here, we would like to follow the progress of the project and discuss how to integrate remote sensing and GIS techniques.

2. Progress of the project

Fig. 2 shows the barrage which is a concrete structure of 615 m in length and it is provided with 44 radical gates to drain flood water of 12,750 m^3/sec. Flow volume of 280 m^3/sec at the maximum can be drawn from a sluice gate of 110 m in length. The canal system that supplies irrigation water to the beneficial land extends over 4500 km in the total length. The existing system (about 5,000 km) for drainage improvement in the basin shall become unnecessary and removed by improvement of hydrologic environment. The area under constant exposure to flood along the Teesta River shall be guarded by the flood prevention embankment of about 80 km in length.

Fig. 2 The Barrage constructed in Teesta R.

Silt accumulating in canals is the most troublesome problem in the management of a water distribution system in the main canal and tertiary canals. To solve this problem, a silt trap pond covering 45 ha was constructed adjacent to the intake gate in the main canal (Fig. 3).

Fig.3 Silt trap pond covering 45 ha adjacent to intake gate of main canal

The Teesta main canal, Ranpur-Bogra and Dinajpur branch canals have been completed together with the attached regulator, bridge and culverts.

Fig. 4 Canal head works (110m in length , maximum intake flow: 280 m^3/sec)

Fig. 5 Main canal in project area and inspection road in the left bank

Fig. 6 A lined tertiary canal and paddy fields planted HYV rice.

As for secondary canals, 211.7 km have been completed but 9.0 km are left unfinished due to the problem of land accommodation.

Similar phenomenon is also seen in the construction of tertiaries and 37.46 km are left unfinished out of the whole length of 387 km.

Management of the irrigation project was started in January, 1993. In the planting season in 1997 to

1998, an area covering more than 20,000 ha was irrigated.

Outline of the area: The administrative unit in this area is divided into Ranpur Zila (2,160,000 population), Nilphamari Zila (1,349,000) and Dinajpur Zila (2,226,000) according to the statistics published in 1995. In Fig. 7, Kishoreganji (246,000), Saidpur (199,000), Jaldhaka (234,000) and Domar (176,000) belong to Nilphamari Zila while Badargani (213,000) belongs to Ranpur Zila and Birgani (135,000) and Parbatipur (270,000) to Dinajpur Zila. Populations are shown in bars in the locations of the respective cities. The figures visualizes locations of the Teesta River, natural rivers and main irrigation canals distributed in the area. It is considered that a global landscape design taking distribution of crop planting, irrigation water control, production timing, relationship with consumers, transport network for agricultural products, demand-based rice production, and allocation of areas producing fruits, vegetables, stocks and poultry into consideration shall be needed in relation to the management of this gigantic irrigation product.

Development in future and roles of remote sensing

1) Agriculture: The whole project was rearranged into phase-1 and phase-2. Following matters are considered to occur when phase-1 is completed. The planting area increases from 180% at present to 210%. Completion of the whole project will increase paddy production by 0.49 Mton and wheat production by 0.081 Mton. This is a work-intensive project and it leads to an increase of employment opportunities for millions of unemployed persons by participating in the implementation of the project and its maintenance, control and agricultural activities.

Implementation of the project produces employment opportunities for 1.04 million of persons/day each year in the maintenance and control of the project. In addition, an increase of 10.05 million persons/day is expected in the agricultural sector. As a result of agro-industrial prosperity, the socio-economic conditions in the region will be improved greatly.

2) Communication: Embankment extending over 1381.06 km is present on both sides of the irrigation canal of 690.53 km in length and these paved roads are used as village communication roads on one hand and is very useful for exchange of remote villages on the other. These roads 2-5 m in width are constructed on the banks in a straight line or drawing gentle curves.

3) Fishery and poultry: This project produces water areas covering 50 km^2 in total including the main canal and secondary canals nearly 150 km in length, main irrigation network extending 600 km and a vast silt pond. These water areas give places suitable for fishery and poultry of ducks.

4) Plantation: It is planned to plant about 700,000 trees around irrigation canals and water-use facilities. This program has already been started and it is necessary to carry out production of nursery trees by the project itself to continue the project to success. This project is in progress in Ranpur and Mohipur. These plans will contribute greatly to the national plantation policy and environment protection.

5) Environment control: In the catchment basin including the dam reservoir and canal system, green vegetables are grown and the trees planted along banks will give a favorable condition to environment. The vast area in the north Bangladesh which started to show desertification is changing into agricultural land and green revolution is under way. Appearance of

new flora and fauna is already starting. In the comprehensive aspect, the socio-economic condition is beginning to change. The project that serves as an usher to a change in living conditions of regional inhabitants in a favorable direction has been started.

6) Recreation and tourism: Nothing in particular was present in this area before implementation of the project. The space for recreation was very scarce.

The gigantic barrage filled with water, the green park and flower beds in the vicinity of the intake gate adjacent to the barrage, wetlands spreading over the old flood plains of the Teesta River and the silt pond are producing a truly beautiful landscape. Birds flying from the Himalayas make the water surface of the dam reserved by the barrage a natural paradise.

In autumn, we can see Kanshanjhanga covered with snow from this spot. Many tourists and regional inhabitants come to this beautiful spot every day particularly to enjoy natural gift in winter.

With the progress of the project, the above scenarios are conceivable. It is necessary to monitor this area in detail to control these many factors and we consider that application of high resolution satellite image data of the latest performance is most suitable.

Future prospect

In the present study, we used Landsat 7 etm+ data (138-042) observed on November 17, 2000, as the basic image data though use of satellite image data obtained by MOS-1 and JERS-1 in Japan was also possible. Fig. 7 shows this satellite image after geometric correction overlapped with the project area. We attempted to locate the Teesta River, the barrage, main canal and main cities and to grasp populations in the cities from the figure. Fig. 8 shows the image overlayed with the actual canal networks and we use this figure as the basic analytical subject. In future, we would like to accumulate information from satellite images by dividing the area into each water distribution system and analyzing the actual sate of water use, crop planting, land use change and environmental assessment in each section to extract monitoring factors that are important for fruitful results expected by the implementation of the project and to improve the life standard of the regional inhabitants from the aspect of appropriate agricultural management.

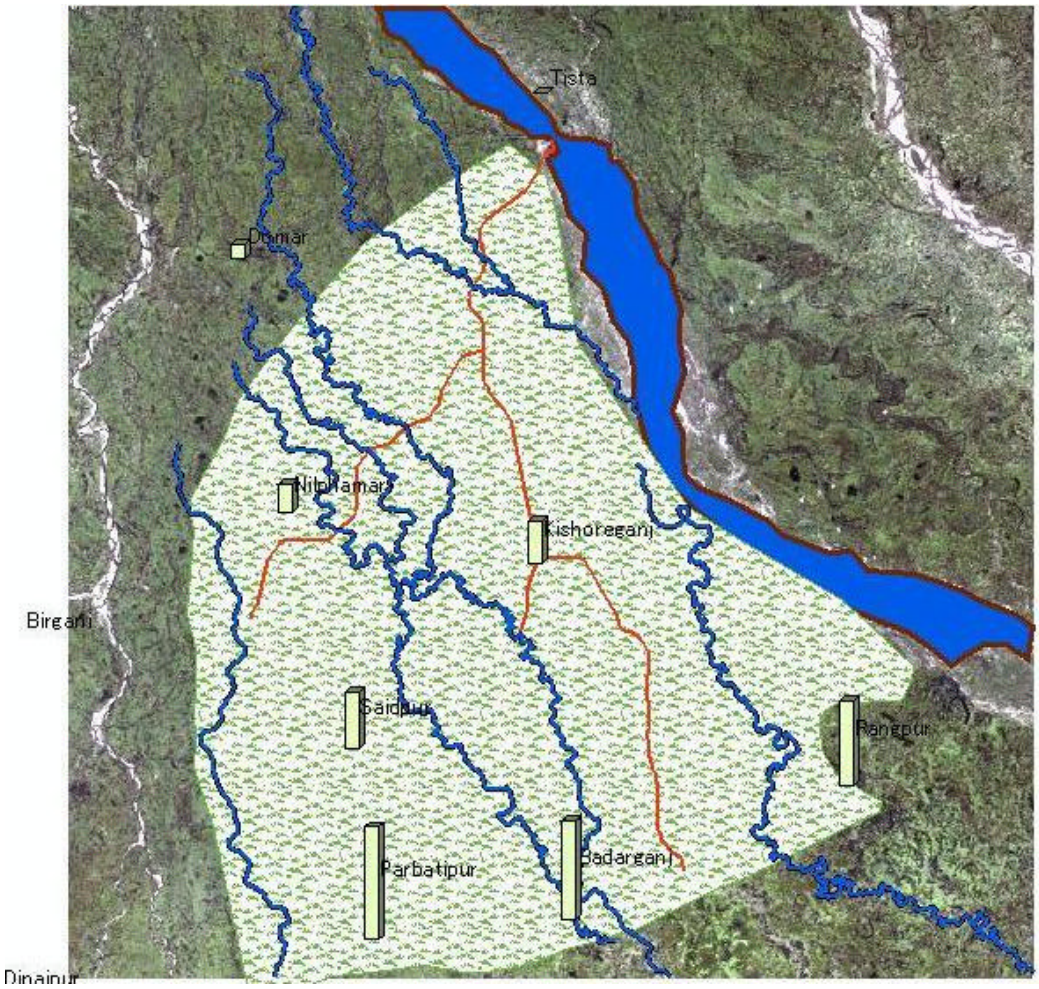

Fig.7 Satellite image of study area extracted from Landsat 7 etm+(observed 17Nov.2000, 138-042) and overlapped project area map including main cities and its population

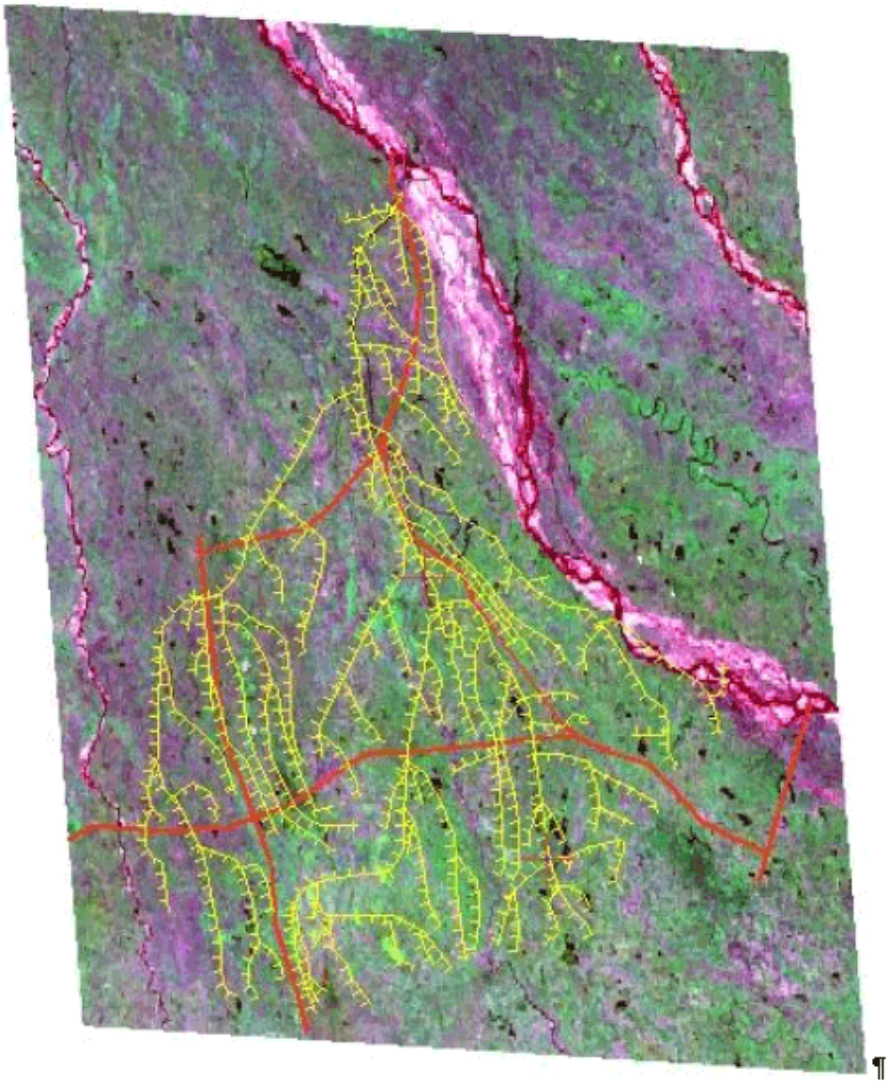

Fig.8 Geo corrected Landsat 7 etm+ image of Teesta Barrage project (Bangladesh) overlapped irrigation canal system and main road

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