

# Naumore Storage Project Should be the Last Resort of Development on the Main Course of Rapti (West), Nepal



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**Abstract:** Water, food and energy are three essential elements of life and, therefore, they need to be made internally secured in a long lasting manner. In the case of Nepal, river waters are the basic sources of all these elements and are the only resources available indigenously in Nepal for these purposes. Rapti (West), being medium size river of rain-fed nature, the dry spell continues long from December up to the end of May; at the same time the flood waters available particularly in July, August and September create havoc by flooding in the downstream reaches. The Kapilvastu area which can be commanded by the Rapti (West) river does not have other dependable sources for fulfilling its requirements. The only way to fulfill its requirements without affecting downstream users is, thus, to capture a portion of flood water of Rapti behind a storage dam aimed at diversion to Kapilvastu for use during dry season. An appropriate site for such purpose is located at Bhalubang. Hence, this site needs to be developed first to ensure the diversion to Kapilvastu and then a much higher storage dam site at Naumore could, later at appropriate time but within 25 to 30 years after development of Bhalubang site, be developed for increasing the flow regulation potential of the Rapti River so that the hydropower generation, flood control and intensification of irrigated agriculture at its commandable areas, could be maximized.

**Keywords:** Water, Energy and food securities, Naumore Storage Project, Rapti River, Nepal

## Rapti (West) River

The Rapti (West) river is formed by joining Mari Khola with Jhimruk Khola. The main Rapti course from the confluence is about 185 km long before crossing the Nepal - India border. It flows through Deokhuri valley towards west. The Deokhuri valley floodplain lies in the north of Dunduwa range. Before entering the Banke flood plain, the Rapti river is confined at Sikta to a narrow valley between Siwalik range in the north and Dunduwa range in the south. At the entry to Banke floodplain, the river turns southwards and receives Dunduwa Nadi (River) as a right tributary and then after flowing through Banke floodplain enters into India (See Figure 1).

## Use of Water of West Rapti

The main use of water of West Rapti river was confined to irrigation purpose. Since the historical time, the water of main Rapti and its tributaries were utilized by means of traditional farmers' irrigation systems particularly in the Deokhuri valley. The preliminary study of West Rapti multipurpose project carried out by a joint venture of East Consult, Hydro Engineering Services and Nepal Consult in March 2004 lists 26 farmers' built irrigation systems in the Deokhuri valley accounting for a gross command area of about 10,680 ha. Besides, there exist some irrigation systems implemented by Department of Irrigation (DoI). They are Arjun Khola Irrigation Project (504 ha) and Dunduwa Irrigation Project (1450 ha). Among the projects implemented at later dates, the right bank project lying in Deokhuri valley is Praganna Irrigation System which unifies existing 18 individual farmers' systems with a gross command area of about 5770 ha and left bank projects lying in Banke district are Rajkulo (1520 ha) and Phattepur Irrigation Projects (2050 ha) with a total command area of 3570 ha. Presently the Sikta Irrigation Project (Reference-1) which is under construction in three phases has a cultivable command area of 42,760 ha including the rehabilitation of existing Dunduwa Irrigation System in the western side. All these irrigation areas are dependent on transit flows available from time to time.



Figure 1: Project Locations on Rapti (West) River

## Indian Eyes on Rapti Waters

In the early seventies during the time of royal visit of the then King of Nepal to India, the then Indian Irrigation and Power Minister Dr. K. L. Rao made a presentation on various river valley projects including the flood-control project in the Rapti river named Jalkundi Storage Project. When the proposal prepared later

on by the Indian Irrigation and Power Ministry was sent to Nepal along with an index map, the Foreign Ministry of the then HMG/N forwarded it to the then Water Power Ministry of HMG/N for study (Reference 2). It was found that the Jalkundi Storage Project initially formulated in 1958 AD and revised in 1973 AD envisages construction of dam at Jalkundi, 188 ft. high with a flood cushion of about 23 ft involving a submergence of about 71,000 acres or about 28,735 ha fertile land of Deokhuri with live storage volume of 1.5 million acre feet or  $1800 \times 10^6$  m<sup>3</sup>. The index map attached to the proposal shows a water conduit system of about 10 km laid across Dunduwa range to a powerhouse to be constructed at the Indian side of the border. From the above it was not difficult to understand that by submerging the huge fertile land of Deokhuri valley in Nepal and giving it a name of flood control project, India intends to take all the regulated Rapti flows to India for their uses, hence, there was no response from the then HMG/N side on the proposal. After some time, the then Indian ambassador to Nepal had come to see the foreign secretary of HMG/N to raise the question about Rapti Flood Control Project at Jalkundi along with other projects. Regarding the Jalkundi project, the ambassador's verbatim was as follows (an unofficial translation from Nepalese version, Reference -3):

*"If Nepal does not help in this project, India, in no way, can control the Rapti flood. Due to Rapti-flood, about 10 lac Indian people suffer every year and thousands of dwellings are submerged. Taking this situation into account, HMG/N has to consider this aspect from the humanitarian ground too. It is true that this project will submerge some lands in Nepal but the submerged area can be made touristically attractive lake; irrigation and power projects could be implemented, even the arrangement for resettlement of the people of that area could be done. In exchange, the life of tenth lacs of Indian people will be improved. Even a sentiment like, If Nepal and India are real friends, is it too much to ask from a friendly country?, was expressed by the ambassador. It was also indicated during that visit that as soon as the submergible area will be actually estimated, provision of substitute land as well as the compensation could also be made."*

In response, the foreign secretary of the then HMG/N stated that the Nepal Government is aware of the Rapti floods. With a view to avoid damage to Nepal and to provide relief to India from the Rapti floods, the Nepalese technicians have worked out one good alternative, which will provide more effective results than by the Jalkundi project. Then, the then Indian ambassador suggested a joint study for that project. Since then, the then HMG/N had started to pay serious attention to utilization of waters of Rapti (West) river.

### **Project Studies on Main Rapti River Course**

The first departmental study for a storage dam on Rapti (West) was centered to a location which will yield sufficient regulated flow that will fulfill the year-round irrigation water requirements to available agricultural lands in Nepal commandable by the

project site. This site was identified at Bhalubang in the upstream of east - west highway bridge over Rapti. The site was investigated and commandable irrigation areas were determined through appointment of an international consultant, Lahmeyer International of Germany on November 26, 1974.

The study was carried out at prefeasibility level and the study report was produced in June, 1976 with the title of "Western Rapti Multipurpose Project: Prefeasibility Study". The irrigation area ranged between 40,350 ha to 111,065 ha and the hydropower production from 92 MW to 135 MW in terms of installed capacity and 400 GWh/yr to 966 GWh/yr in terms of average energy production. The recommended variant has following features:

Catchment area	: 3680 km <sup>2</sup>
Full Supply Level (FSL)	: 385 m
Dam Crest Elevation	: 393 m
Minimum operating Level (MoL):	: 350 m
Submergence Area	: 38 Km <sup>2</sup>
Gross Storage	: 1390 x 10 <sup>6</sup> m <sup>3</sup>
Active Storage	: 970 x 10 <sup>6</sup> m <sup>3</sup>
Dead Storage	: 420 x 10 <sup>6</sup> m <sup>3</sup>
Dam Height (from the river bed)	: 90 m
River Bed Elevation	: 303 m
Total Irrigation Area	: 80,350 ha
Kapilvastu	: 30,715 ha
Deokhuri	: 9,635 ha
Banke	: 40,000 ha
Total Hydropower	: 107 MW/663 GWh per year
Bhalubang	: 45 MW
Surainaka	: 62 MW

The WECS (Water and Energy Commission Secretariat), considering that this Bhalubang site proposed by Lahmeyer International would submerge a large cultivated land and populated area, dispatched a team for reconnaissance level survey through walkover to explore the possibility to shift the dam site upstream. The team identified a site at Naumore at about 200 m downstream of the confluence of the Jhimruk Khola and Mari Khola. The Nepal electricity Authority (NEA), then, undertook the surveys and investigations for furthering the level of study. Before finalizing the areas of surveys and investigations, the NEA team examined various alternative dam sites in the vicinity of WECS dam site and finally decided that the dam and headworks should be located 1.5 km downstream of the confluence of Jhimruk and Mari Kholas. The final report on preliminary study of Naumore multipurpose project was produced in July 1988. As per this study the features of the project are as follows:

Catchment Area	: 3430 km <sup>2</sup>
Normal Water Level (NWL)	: 535 m
Minimum Operating Level (MOL):	: 485.4 m
Gross Storage	: 1380 x 10 <sup>6</sup> m <sup>3</sup>
Active Storage	: 800 x 10 <sup>6</sup> m <sup>3</sup>
Dead Storage	: 580 x 10 <sup>6</sup> m <sup>3</sup>
Dam Height (Maximum)	: 208 m

Two underground powerhouses were planned - one at the toe of dam as right bank development and

the other as the left bank development.

### **Right Bank Development**

Installed Capacity	:	160 MW
Annual Energy	:	431.5 GWh
Net Head	:	181.3 m
Tailrace Tunnel	:	300 m long

### **Left Bank Development**

Installed Capacity	:	306 MW
Annual Energy	:	979 GWh
Net Head	:	317.3 m
Tailrace Tunnel	:	25.15 km long

### **Irrigation Facilities**

#### **Right Bank Development**

Deokhuri	:	9,635 ha
Banke	:	40,000 ha

#### **Left Bank Development**

Kapilvastu	:	30,715 ha
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When the NEA upgraded its study level to prefeasibility level in 1990, the dam height was reduced to 190 (maximum) thereby reducing the gross storage, installed capacity and annual energy to respectively  $1021 \times 10^6 \text{ m}^3$ , 245 MW and 932 GWh. The tailwater level has been fixed at 358 m. But the irrigation components were excluded from the study. Even a re-regulating dam needed to smoothen the peak release and not to adversely affect the existing irrigation water supply was not incorporated in the study.

The review study made in 2001 further reduced the dam height to 169 m, thereby reducing the gross storage capacity to  $810 \times 10^6 \text{ m}^3$ , installed capacity to 207 MW and annual energy to 844.5 GWh. In both the NEA studies, the B/C ratio at 10% discount rate is just close to unity (in 1990 study it was 0.955 and in 2001 study it is 1.03).

Probably due to the sectoral bias seen in the Naumore study, the Department of Irrigation (DoI) commissioned an independent new study entitled "Preliminary Study of West Rapti Multipurpose Project" by employing a Joint Venture (JV) of local consultants comprising of East Consult, Hydro-Engineering Services and Nepal Consult in May, 2003. The JV submitted the final report in March, 2004. The study attached high priority for irrigation water supply to Kapilvastu sub-project as there is no dependable alternative water source than the Rapti (West) River source for this sub-project area. The dam proposed at Bhalubang was of lower height in order that Naumore dam site is not submerged, at the same time it could regulate the flood-water to the extent needed for supply to the Kapilvastu irrigation sub-project and is able to re-regulate the peak release from Naumore hydroelectric project when the later will be implemented. Accordingly, a Terms of Reference (ToR) for Feasibility and Environmental Impact Assessment (EIA) studies of Kapilvastu irrigation project dependent on Rapti water stored at Bhalubang reservoir had been formulated (for locations of projects see Figure 1).

On the other hand, the Nation-wide Master plan

study on Storage Hydroelectric Power Development conducted by Japan International Co-operation Agency (JICA) and the Ministry of Energy (MoE), Government of Nepal with the NEA as counterpart agency in its final report submitted on March 20, 2014 has recommended, in high power demand scenario, the Naumore (245 MW) storage hydroelectric project for commissioning in the fiscal year 2030/031 B.S. (Reference-4)

Now, the Department of Electricity (DoED) is intending to undertake the feasibility and EIA studies of Naumore site giving the project's name, again, as Naumore Multipurpose Project through employing the foreign consultants in association with local consulting firm(s).

### **Security Issues**

Food, energy and water are essential elements of life and, therefore, they need to be made secured internally in a long lasting manner. Nepal, due to its geographical location, even had to airlift basic imports like petroleum fuels from Bangladesh when India slapped an embargo on Nepal in 1989 (Reference 5) and again the undeclared embargo of present days has created problem due to shortage of petroleum products including cooking gas. As water is the main indigenous resource in the Nepalese context, for food and also for energy, the cautious approach in utilization of water resources is vital.

There are number of cases, even when in large Koshi and Gandak projects Nepal co-operated India to use almost fully (in a proportion of about 97:3) the diverted flow of these trans-boundary rivers, India raised objections even when Nepal moved forward for using waters from smaller river sources, as if there is no right to use the water from the rivers flowing in its own territory. For example, the Babai irrigation project, for which headworks including desanding basin and intake had already been constructed, was not able to deliver water at farm level due to inability to complete other infrastructures. The World Bank was supposed to provide financial support, but withdrew its financial assistance from April, 1986 even after the bank, through a separate study, became convinced of the fact that there will be no adverse effect to India by implementing the project. Similarly, the Kuwait Fund of Arab Economic Development (KFAED) withdrew its assistance in this project even after initialing on the draft loan agreement, due to, again, India's objection (Reference 6). There is another case - there was a meeting in New Delhi at the then Central Water and Power Commission (CWPC) between Nepalese and Indian experts in January 1978 in which the author was one of the members of Nepalese experts' team. In that meeting with respect to "Western Rapti Multipurpose project at Bhalubang", it was agreed that Rapti waters from storage will primarily serve the needs of Nepal and the surplus will be used in India. But, in August 1980 the Indian side went to the extent that they started even to claim the project (which is located well inside Nepal) as a joint project, as a consequence the joint Terms of reference (ToR), for upgrading the study level of the project to feasibility

level, required by CIDA (Canadian International Development Agency) for availing technical assistance could not be agreed upon. As a result, the forthcoming technical assistance to Nepal for upgrading the level of study to feasibility of West Rapti Multipurpose Project at Bhalubang through CIDA was postponed in February 1982.

In these contexts, securing the irrigation water supply to the fertile agriculture land of Kapilvastu from the West Rapti river should be the first responsibility of the Government of Nepal (GoN) in order to secure the increased food production considering that there is no other dependable alternative source of water for irrigation supply to this area, while in the mean time harnessing fully the hydropower potential concentrated in the river reach embraced by these projects should be the next priority. But, due to independent nature of studies that have been carried out for Bhalubang and Naumore projects by different sectoral departments, there has been a lapse in a way that these projects overlap to some extent (about 27 m by elevation). The tailrace of upstream hydroelectric project (Naumore) is at 358 m while the full supply level of the reservoir of downstream Bhalubang project is at elevation 385 m (Refer project features given above and Figure 2). In fact, instead of two large dams, one large and the other smaller would have been sufficient for full regulation of Rapti flows.

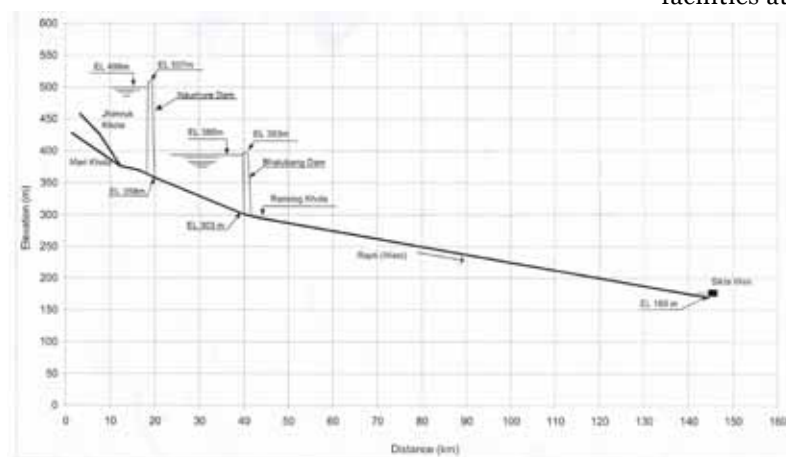


Figure 2: Proposed Dams by Previous Studies showing the Overlap

### Need of Developing Bhalubang and Naumore Dams in Succession in an Integrated Manner

Fuller development of intensification of irrigated agriculture takes long time. Similarly, simultaneous development of two storage dams on the same river may, in the Nepalese context, be constrained by several factors. On the other hand, the studies so far conducted for these projects are independent in nature and not integrated due to the reason that they are carried out by sectorally bias departments. For example, when Naumore storage project was studied by the NEA, it is power biased, even a re-regulation dam to smoothen the peak release has not been visualized which is essential not only for irrigation water supply but also to avoid high fluctuations on daily water flows in the downstream reaches. Similarly, when the study of Bhalubang Multipurpose Project was undertaken by

the Irrigation Department, it was not considered that the potential hydropower development site available at Naumore will be submerged by the Bhalubang reservoir. There is an overlap of some 27 m as stated above.

Both the sectoral potentials could have been optimized in a more cost effective and pragmatic way, if they would have been studied in an integrated manner by a sectorally non-bias organization, perhaps in the present day context (when even the existing Water Resources Ministry has been inappropriately, in the context of Nepal, splitted into Ministry of Energy and Ministry of Irrigation), the Water and Energy Commission Secretariat (WECS) could be an appropriate one.

As indicated above from water supply security view point to Kapilvastu area, the Bhalubang multipurpose storage dam with a lower height (around 60 m from the river bed) with maximum full supply level of EL 358 m (which is the tail water level of Naumore powerhouse) just sufficient to store the needed water to Kapilvastu could be planned for first implementation to divert only a portion of the flood water stored in the reservoir exclusively for meeting the dry season (January to June) water requirements of Kapilvastu irrigation sub-project, as the transit flow available in the river during dry season are required for use in the existing facilities at downstream reaches. This dam will create

a reservoir with total storage of about  $585 \times 10^6 \text{ m}^3$  which will be able to fulfill the dry season irrigation water needs in the Kapilvastu area until the high dam Naumore storage project will be implemented (Reference 7). At the same time, a power plant at the toe of dam and a comparatively high head power plant at the Surainaka en-route to Kapilvastu could be implemented. This Bhalubang reservoir, in any way, is needed also for smoothening the peak release from the future Naumore hydropower plant. On the other hand, the flood water cannot generally be used as long as storage reservoirs are created for flow regulation. As there are no potential sites for creation of

flow regulating reservoirs at downstream in India in the river courses flowing from Nepal, there is no basis to claim the right of prior use in such flood waters.

Regarding Naumore storage dam, the dam height should be planned for maximizing the hydropower potential of the site through fullest way of regulating the wet season flow. From the topographical point of view, the dam height perhaps could reasonably be made higher than the proposed by the earlier studies. However, as indicated by March 2004 study, the Naumore dam is to be implemented not later than 25-30 years after commissioning of Bhalubang dam in order to enhance the life of the Bhalubang reservoir because the estimated life of filling up of the dead storage volume by sediment is 25 to 30 years.

### Final Words

As are evident from the facts mentioned above

international funding agencies and/or the aid giving countries do not want to be involved in those activities where there may be conflict of interest among the countries. The examples of withdrawal of assistance from the World Bank, KFAED and CIDA are clearly due to the influence/ protest by India. However, in cases where the internal resources have been used, the projects are implemented smoothly-take the example of on-going Sikta irrigation project, and already operating irrigation projects such as Bagmati and Kamala. Hence, for successfully securing the irrigation water supply to Kapilvastu area it is needed to mobilize country's own internal resources as far as possible and is to be aimed (as proposed above) at diversion of only the flood water stored in the Bhalubang reservoir in the first stage for which India does not have any basis to claim the prior use right. Naumore Storage Project, in no way, is to be implemented first and should be the last resort of storage development on the main West Rapti river course because it will kill Bhalubang diversion project depriving forever the diversion of even the portion of flood water to be stored in the Rapti at Bhalubang to acutely needed Kapilvastu irrigation area as the diversion from Naumore site to Kapilvastu involves a tunnel length as long as 25.15 kms as suggested in 1988 study. As such the priority focus of GoN must, now, be on the development of lower height multipurpose dam at Bhalubang primarily for storing a portion of flood water aimed at irrigation water supply to Kapilvastu irrigation sub-project and secondly for power production at the toe of Bhalubang dam and at Surainaka en-route to Kapilvastu irrigation area. Once this development will be completed then the way to development of Naumore site could be considered open for maximizing the flow regulation potential of the site thereby maximizing the hydropower generation potential of the river reach and achieving intensification of irrigated agriculture in the existing facilities in its command. In case funding could be arranged for simultaneous development of both the sites, this alternative could be pursued with much lower dam at Bhalubang aimed at carrying out re-regulating and diversion functions only, because in this case the Naumore reservoir will take the function of flood- water regulation. This case will, however leave the head available between tailwater level of Naumore powerhouse and high

water level of Bhalubang reservoir unutilized. But in no case the development of Bhalubang site should be left for the future.

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