

30,000 Megawatts of Solar Power

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Introduction

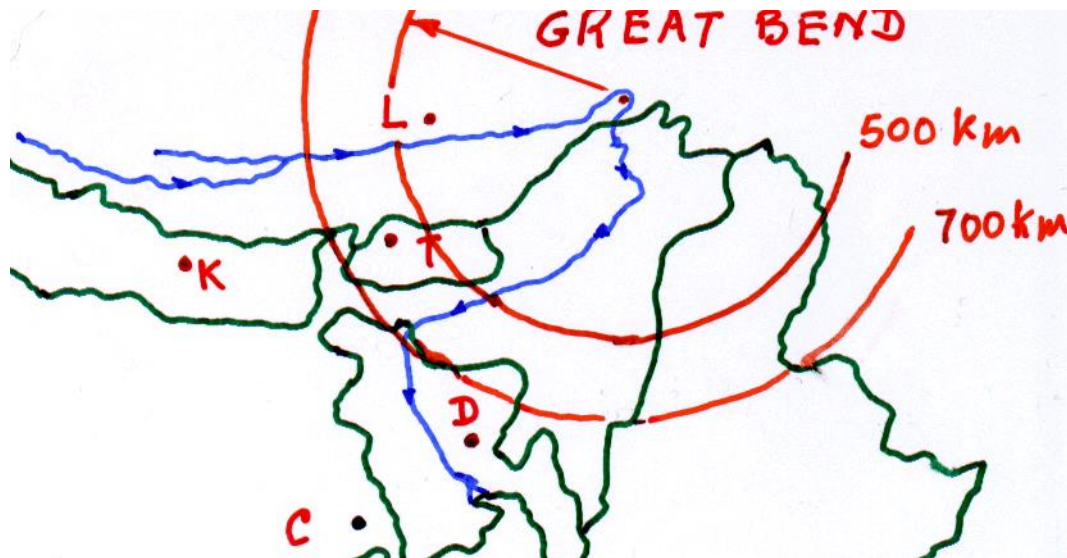
It is with great pleasure that I share my ideas with conference participants. Conferences such as this help publicize practical solutions to issues such as enduring poverty in South Asia. Since the audience is made up of technical people, a brief presentation is sufficient. The topic of the paper is the hydroelectric potential of the Great Bend of the Tsangpo/Brahmaputra, and the benefits which people living in the region may derive from it.

Hydroelectric energy is solar energy since it is the Sun, which evaporates water from oceans, driving the vapor into the upper atmosphere against the force of gravity. The vapor condenses into rain, releasing solar energy into streams and rivers where it is converted into the kinetic energy of flowing water. Hydroelectric energy has all the features which make solar energy so attractive, such as absence of exhaust gases, continuously renewable; but without the disadvantages of availability during daytime, difficulty of storage, and most important of all, cost.

The Great Bend

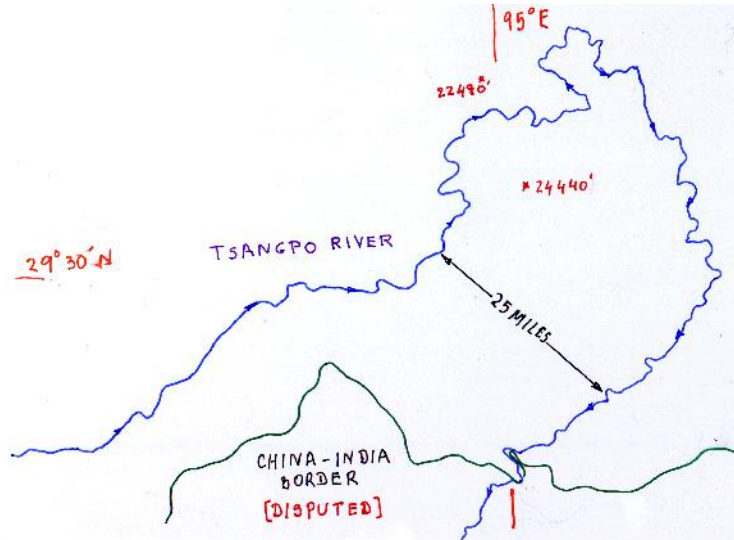
There is a geophysical feature in the Tsangpo/Brahmaputra river about 800-km northeast of Dhaka. The river Tsangpo flows east from its origin in Lake Mansrowar in the high Tibetan plateau, until it turns south and cuts through the Himalayas in a series of steep gorges, emerging on the Gangetic plain as the Brahmaputra. The U-turn of the river through the Himalayas is known as the Great Bend. Apart from the spectacular gorges, some of which are 10,000 feet deep, the Great Bend is effectively the site of a gigantic waterfall where the river falls almost a mile.

The geographic location may be seen in the figure below:



The river Tsangpo/Brahmaputra from its source to its mouth; major cities are marked.

The Great Bend is at a latitude of 29° 30' north and 95° east longitude. The northern end of the Great Bend is higher than the southern end by one mile. Although the total distance around the Great Bend is around 80 miles, the shortest distance is 16-25 miles. A sketch shows this:



Detail of the Great Bend



Satellite picture of the Great Bend

Hydroelectric potential

We can make a rough computation of the power potential. Taking the annual average flow rate of 80,000 cubic feet per second, and a drop of one mile, the figure comes to \approx 30,000 Megawatts. This is a stupendous amount of power as is evident when we compare this figure with the installed electric power capacity in the region (2900 MW in Bangladesh, 6200 MW in W. Bengal).

Construction

Penstocks (power conduit water tunnels) have to be drilled through the Himalayan ridges to divert the river water to turbines located downstream, a distance of 16-25 miles. Quite possibly there needs to be several power stages. As many as 15 separate penstocks may be needed to extract the entire power potential. Tunnels have to be constructed using technology appropriate for seismically active zones. I am leaving out construction details as they belong in a proper engineering feasibility study.

Economics of power

Is a project this size economically feasible? The annual revenue can be worked out: the total number of electrical units produced is:

$$30,000,000 \text{ (kW)} * (8760 \text{ hours}) = 263,000,000,000 \text{ kW-hours}$$

per year. Using an average cost @ Rs.5 (\$0.10) per kW-hour the annual revenue comes to \$24 billion.

Against this we have operation and maintenance costs @ 0.3¢ per kW-hour \approx \$1 billion per year.

What are the capital costs? Using an installation cost \approx \$1200 per kW, the cost of the power plant \approx \$36 billion. The entire capacity need not be installed right away; power capacity may be added in stages to meet demand, in effect spreading the investment over several years.

There are distribution costs too. Users are within 500 – 1000 km; double-circuit 500 kV transmission lines with 1000 MW capacity cost around \$1 million per kilometer, so we may allow another \$1 billion for transmission lines.

If we include a 4-lane highway from Chittagong to Dibrugarh @ \$1 million per km, we may add another \$ 1 billion.

The total investment is less than \$ 40 billion, compare this with the annual revenue. This project would attract private investors. Any Wall Street investment banker would find clients to fund this project. There is no need, neither is it desirable to seek government funding.

This is a bankable proposition.

End use

There are over 300 million inhabitants and therefore potential customers, within a 1000-km of the Great Bend. Ancillary projects such as export-based industries along the 4-lane highway from Chittagong to Assam can use an expanded port in Chittagong to import raw materials for processing and re-exporting finished goods through the port. Similar projects can be set up around Calcutta. Industries such as these will provide

employment for millions of people (many land-less laborers), generate tax revenue for schools, hospitals, roads, agriculture, infrastructure for civic needs among others.

This preliminary description and analysis show that the hydroelectric project, when combined with industrial investment, is an economically viable scheme. One cannot proceed further without a detailed engineering feasibility report, however, even with the information presented here it is apparent that should the project come to fruition the employment possibilities and the inevitable upsurge in economic activity and trade will bring the benefits of the Great Bend to a neglected part of the world.

Obstacles

The region is a seismic zone, the border is disputed between India and China; these are some of the obstacles which need to be dealt with. Obviously, there is need for regional cooperation, which has its own benefits.

Cross border sharing of water and power is more common than is apparent. Working examples exist, such as the United States/Canada [Niagara Falls and Columbia river] hydroelectric power sharing treaty, Cabora Bassa [Mozambique/South Africa], Paraguay/Brazil, Indus Basin Treaty [India/Pakistan; the Treaty has survived 3 wars and is largely responsible for the green revolution] and the Mekong River Commission [Vietnam, Cambodia, Thailand and Laos].

In south Asia power is distributed and controlled by government agencies. Inefficiencies abound eg. 40% of the power is stolen. Bill collection is perfunctory. Some state power agencies have outstanding debts of Rs. 55,000 crores. Enron made an attempt to export hydroelectricity from Nepal to India. They were thwarted by Indian state power agencies. I believe these 'paper' obstacles are stronger than they appear to engineers and scientists, who are knowledgeable about technical aspects but less so about bureaucratic hurdles. Quite possibly schemes such as this will be delayed by decades through bureaucratic maneuvering.

Recommendations

I have gone through the analysis and shown the promise; my recommendation is to form a regional body with representatives from Bangladesh, India, China, Bhutan and Nepal. Members may be chosen from professions such as: hydrologists, geologists, financiers, investments bankers, power engineers, diplomats, environmental engineers, industrialists and journalists. The goal of the body would be:

- (i) Produce a feasibility report within two years
- (ii) Negotiate rights in disputed region
- (iii) Raise capital
- (iv) Begin construction within five years.

In closing I would like to thank all the sponsors and organizers of the Conference. I am particularly grateful to Dr. D.M. Tagare for inviting me to present my ideas in this conference. I regret I am unable to be here in person.

I had given this presentation at the symposium on Commercialization of Renewable Energy Technologies Dhaka, Bangladesh, October/November, 2000.

China has announced its plans to build the proposed hydro-electric project described here.

Instead of the 30,000 MW estimated generating capacity, their estimate is 60,000 MW.

The details are presented in this link:

<https://english.ckgsb.edu.cn/knowledge/article/china-energy-ambition-inside-the-yarlung-tsangpo-dam-project/>