

# Nepal's Water Resources: Blessing or Curse ?

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**Abstracts:** For half a century, Nepal has been chanting the 'Mantra' of 83,000 MW hydropower potential. When Nepal was in its childhood as a young democratic nation in the 1950s, India, with its vast 'experience' under the British colonial rule (colonial mindset), extracted lopsided agreements on the Koshi, Gandaki and Mahakali rivers.

Whereas India irrigates 12,200,000 acres of land, flood mitigates flood hazards and benefits from other intangible benefits. Nepal gets a meager 160,000 acres irrigation facility (1.3 percent of total irrigation benefits) from these unequivocal biased agreements. The adverse social and ecological impacts in Nepal are unaccounted for.

Such water resource agreements have resulted in the sad present-day plight of Nepal: social life and industries are in total disarray with dimly low economic growth rates (GDP) forcing millions of Nepalese to seek employment abroad.

Before it gets out of hand, India's direct/indirect domination over Nepal's water resources and politics should end, so that Nepal can develop its economy and hydropower in peace.

Nepal should first develop run-of-river projects as per the modality of 456 MW Upper Tamakoshi Hydroelectric Project (cost 1000 US\$/kWh) and medium size storage hydropower projects (140 MW Tanahu). Muddling with large storage projects like 1200 MW Budhi Gandaki HEP will only further delay the execution of RoR projects. NEA's technical capability should be improved to build and oversee hydropower projects and INPS.

**Keywords:** Water resources, hydropower potential, Run-of-River, dam, LDC, INPS, Nepal

## Introduction

This year marks exactly 50 years since Dr. Hari Man Shrestha published his PhD thesis in 1966 on 'Cadastre of Potential Water Power Resources of Less-studied High Mountainous Region (with special reference to Nepal)'. Nepal's theoretical hydropower potential of 83,000 MW, as mentioned in his thesis, is still in the syllabus of school text books. At the time of golden jubilee celebration of this 'Mantra', our school children are asking 'why are we suffering from load shedding when we have such rich hydropower potential'? All responsible citizens of this country have a duty to give their answers to these children.

## Conspiracy Theory

Some of the main events and activities in power sector during the last 30 years are: bundling of power sector institutions in 1985 to create Nepal Electricity Authority (NEA), Electricity Act, 1992 permitting entry of private sector in hydropower projects, no government investment in hydropower projects since last 15 years, 1996 Mahakali Treaty with Pancheshwar to be commissioned within 8 years, fraudulent exaggerating Nepal's potential as 200,000 MW, government's emphasis on power export thus relinquishing extremely cheap projects like Upper Karnali HEP and Arun III HEP to Indian companies.

India's advice to learn from Bihar and Bhutan; Bihar is one of the most backward State in India. The annual per capita electricity consumption in this state is less than 100 kWh and pilferage is more than 50 percent, 300,000 Biharis are working

in Nepal. Being an Indian protectorate country with a population of only 700,000, Bhutan Model in Nepal's hydropower development cannot be applied.

All the above untoward activities warranted formidable results: load shedding increased from 2 hours (20 MW) to 13 hours (400 MW), power import increased from 20 to 300 MW (planning further to increase this to 600 MW), tariff increased from Rs 3.5 to Rs 9, pilferage increased from 20% to 30% and NEA is in the verge of bankruptcy. Fig 1. shows the System Load Curve on Dec. 23, 2014.

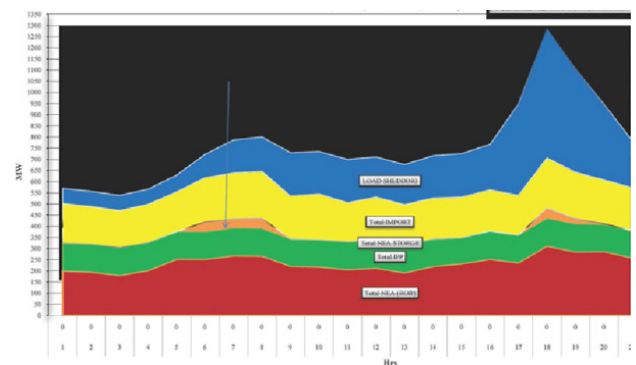


Figure 1: Annual Load Distribution of INPS

Source: NEA Annual Report 2015

No wonder the genesis of conspiracy theory emerged.

## Indian Rivers Inter-Link Project: The Main Culprit

In the 1970s, Dr. K. L. Rao, former irrigation

minister of India, suggested that the surplus water of Ganga basin be diverted to deficit areas of western India (Fig 2). A series of dams have to be built in Nepal for the purpose of storage and canals would be built to transfer surplus water from the eastern tributaries of the Ganga to the west.

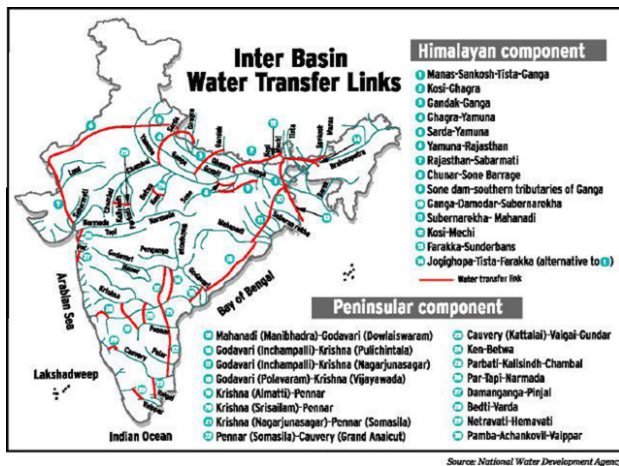


Figure 2. India's River Inter-link Project.

Some scholars have, questioned the merits of Indian rivers inter-link projects, and claim there are knowledge gaps between the claimed benefits and potential threats from environment and ecological impact. Ignoring these facts, India is going ahead with this dream project, and builds some link canals without the consent of upper riparian country, Nepal, as per international convention. As a result, large area of Nepal have submerged, including the historical site of Lumbini.

As 80 percent of rain falls during monsoon season, rest of the time river discharge is greatly reduced even in the Ganga basin. Without storage dams in Nepal to regulate water during the lean dry months, India's River Linking Project would not function at all. It is precisely for this reason that India has shown grand intreste in Nepal's water resources.

### Ecology and High Dam

For thousands of year, civilization flourished in the Indo-Gangetic plain. It accommodates about 45 % of the total Indian population i.e., 1/10 of world population. One of the reasons for increase of population is fertile land created by the rich soil transported by Himalayan river floods. But excessive use of chemical fertilizer and pesticide, the fertility of agricultural land has been greatly reduced.

The concept of river inter-link is half a century old; since then the population in the Ganga basin region has increased 3 fold and due to climate change, metrological/hydrological regime has changed significantly.

Due to un-affordability of expensive fertilizer, seeds and the resulting crop failure each year about 13,000 farmers commit suicide in India. The farmer suicide rates are lower in the Ganga basin region due to the fertility of land being better than in the

western region. But this figure may double if high dams are built in Himalayan region.

The biggest issue/problem is that high dams change the chemical, physical and biological processes of river ecosystems. Building a high dam with regulating reservoir in Nepal will trap the mineral rich sediments and nutrients. The silt free (clear) water flow will erode the downstream river bed which will further lower the ground water level (Fig 3).

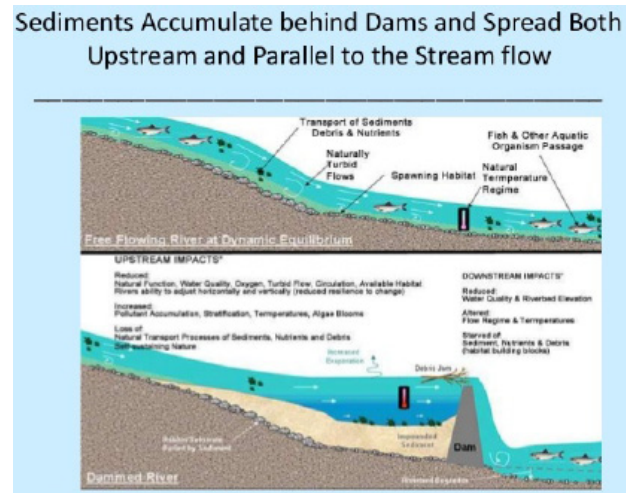


Figure 3. Changes of River-ecosystem by the Construction of High Dam.

Source: [http://www.vtwaterquality.org/wqd\\_mgtplan/images/DamEffects02.jpg](http://www.vtwaterquality.org/wqd_mgtplan/images/DamEffects02.jpg)

Ashwan High Dam built in 1970s, has trapped the sediments and nutrients flowing in the river Nile. This has caused the soil along the lower courses of the river less fertile. The farmers had to buy expensive fertilizer in order to produce as many crops. Recently, because of environmental and social costs and with the pressure from the 'dam-busters', the World Bank pulled out of a number of dam-building agreements.

Now it is very clear why the Detail Project Report (DPR) of Pancheshwar Multipurpose Project (PMP), stipulated to be ready within six months of the ratification of the treaty in 1997, is still not ready in 2016.

Indian experts are very much aware of the ecosystem disruption created by building high dams. But India's admission of these bitter facts will warrant re-appraisal of Mahakali Treaty.

As per the treaty, Nepal is supposed to get 'equal' benefits from Pancheshwar project, whereas in Tanakpur and Sarada projects, Nepal virtually gets no benefit at all. Politicians in Bihar accord false promises of building Koshi high dam in Nepal during election time. If facts are disclosed they are sure to lose in the election. Thus building high dams has become a political gimmick both in India and Nepal.

With gradual understanding of environment/

ecology, at an International Conference Dr. Hari Man Shrestha accorded that out of total 83,000 MW potential, only 42,000 MW is technically feasible. If high dam storage projects are kept aside due to controversy and considering only the run-of-river and small storage schemes, the potential will be further reduced to about 20,000 MW. This hydropower potential will be just sufficient to take care of Nepal's own electricity needs for the next 25 years. At 90% exceedance, the hydropower potential is even less to just 12000 MW.

### Unequal Agreement and Treaty with India

Nepal has a number of agreements and treaties with India on water resources projects: Koshi Flood Control and Irrigation Project (1954), Gandak Irrigation and Power Project (1959) and Mahakali Treaty including Sarada, Tanakpur and Pancheshwar Multipurpose Project (1996).

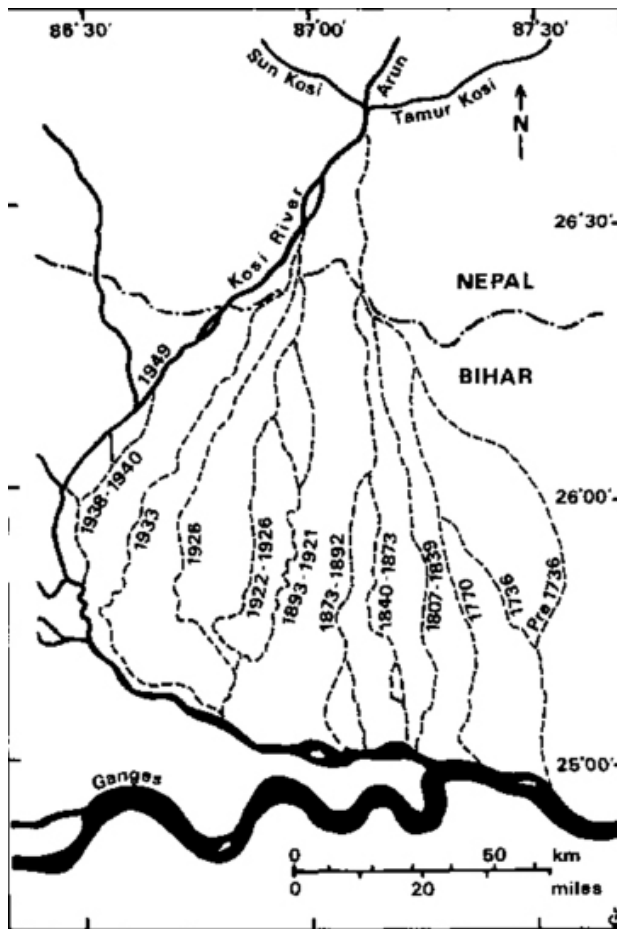


Figure 4. Kosi River shifted 120 km westward in 213 years time.

The Koshi river is known as the 'Sorrow of Bihar' because the river has shifted about 120 km westward in the last 213 years devastating huge tracts in north Bihar (Fig 4). The Koshi barrage project has anchored the river and provided irrigation benefits to 2,400,000 acres of lands in India. On the Nepal side the irrigation benefit is only for 60,000 acres of land. Huge tracts of fertile land and settlements were taken over by the Koshi project. However, 60 years later, a large number of farmers are still waiting to

be compensated. Nepal also supposed to have 10 MW electricity benefits, as the power house was washed away by the first flood, Nepal didn't get any equivalent compensation.

The Gandak Irrigation and Power Project irrigate 2,884,000 acres of land in India. Nepal's irrigation area is only 100,000 acres. Due to India raising the level of power house tail race, only 5 MW out of 15 MW of power is available.

The 1920, Sarada Project built during British colonial rule, irrigates about 4,000,000 acres of land in India. Nepal gets no irrigation benefit, then Rana ruler sold/exchanged 4,000 acres of land of Nepal for Rs 50,000 to facilitate barrage building. The treaty of Mahakali renewed the Sarada agreement without any changes.

The Tanakpur Irrigation and Power Project were built illegally in the border river Mahakali in 1993 without consent of Nepal in violation of 'The Helsinki Rules on the Uses of the Waters of International Rivers'. The Tanakpur project irrigates 2,880,000 acres of land in India and generates 120 MW power. No irrigation benefits for Nepal, a token of annual 70 million kWh energy (5~10 MW power) is allocated to Nepal.

In summery from the above agreements and treaty, India irrigates 122,000,000 acres of land. Flood mitigation of 120 km laying waste to a huge tract in Bihar and other intangible benefits to India are not quantified. Whereas, the meager 160,000 acres irrigation facility (1.3 percent of total irrigation benefits). Population rehabilitation and environment/ ecological impacts in Nepal are unaccounted. No where in the world, even within Indian states such blatant one-sided agreement is contemplated.

### Creation of Nepal Electricity Authority: The Second Culprit

Incidentally, Dr Hari Man Shrestha and the writer of this article joined Electricity Department of Government of Nepal in the same year of 1966. At that time only 500 kW Pharping, 640 kW Sundarijal and 2,400 kW Panauti hydel plants with about 3,150 kW diesel plants spread within the valley supplied electricity to the capital city, Kathmandu. Biratnagar, Dharan, Birgunj in the Tarai areas had their own diesel and thermal plants. There was no Integrated Natioanal Power System (INPS).

During the 1960s, 1970s and early 1980s, Electricity Department in cooperation with bilateral and multilateral financing agencies did a commendable job in the power sector: commissioned about 250 MW of hydropower plants, built 132 kV transmission lines linking all major power plants and sub-stations to create the Integrated National Power System (INPS), installed a modern Load Dispatch Center (LDC) and even prepared the Master Plans of all three Koshi, Gandaki and Karnali river basins for the planned development of hydropower and irrigation projects.

But then in 1985, in the name of privatization, Nepal Electricity Authority was created by amalgamation of Electricity Department and Corporation under the aegis of the World Bank.

In Nepal, 80 percent of businesses and industries are managed/owned by Indians. Due to vague rules and regulations, open border and rampant corruption, a parallel economy equivalent to four times of the regular economy thrives in Nepal. This has been substantiated by the recent 'Panama Report'.

The key office-bearers of bureaucracy, 'the permanent government' are appointed on the recommendation of the 'Impresario' of parallel economy. They promote their pet hydropower projects through politicians/parliamentarians. The size, type and financial viability of such projects will have nothing to do with the requirements of the country. In such a scenario, liberal economy, privatization, FDI, BIPPA etc. have only cosmetic values. Genuine Nepalese private sector undertaking large scale hydropower projects are out of the question.

### **Foreign Direct Investment: The Third Culprit**

Due to favorable site conditions, the levelized cost of hydro generation in Nepal is only 2 to 3 US cents/kWh. The lenders, ADB and IFC, had soft corners for Nepal's pioneer Independent Power Producers (IPP), Norway's 60 MW Khimti and USA's 36 MW Bhote Koshi. Power Purchase Agreements (PPAs) were made in US\$ at a very high rate of 5.9 US cents per kWh. To get the higher PPA rates, these two rich-nation IPPs suffered no bad conscience in doubling the project costs.

As a result, NEA has to reimburse about US\$ 30,000,000 each year to these two projects of the richest nations for 25 years, about US\$ 750,000,000 – more than enough to build a 600 MW hydro project for Nepal's own domestic use.

The Energy Ministry has already doled out 5,157 MW of hydropower project licenses to Indian companies. This is 85.6 percent of the total license amount issued. As a result the country doesn't have a cost effective hydropower project at hand for immediate development even with a ready to use investment capital.

NEA, without any significant hydro generation of its own for the last 15 years, high priced PPA and power import from India, is on the verge of bankruptcy. A bankrupt NEA will naturally mean no cash, for the 40 odd IPPs generating about 300 MW. In essence, this means a total collapse of Nepal's power sector.

### **The Price of Electricity in Nepal**

The price of electricity in an Integrated National Power System (INPS) depends on the generation cost. Worldwide, Thermal, Hydro and Nuclear plants are the three main source of commercial power generation. Depending on site condition, hydropower generation is very cost effective, renewable and

environment friendly.

Due to Perennial River flowing through mountains and gaining significant heights within short distance, Nepal is bestowed with sufficient hydropower potential to meet its power demand for the next 25 years.

The hydropower Levelized Cost = Total Cost (25 years)/Total Energy (25 years) for a 1000 US\$/kW project is 1.5 US cents/kWh and likewise for 2000 US\$/kW is 3 US cents/kWh.

The average electricity price in Canada is 10 US cents/kWh, India is 8 US cents/kWh and Nepal is 9 US cents/kWh. But if adjusted for the different price levels between countries, using Purchasing Power Parities (PPP), the electricity prices relative to purchasing power will be as such; Canada 8 US cents/kWh, India 19 US cents/kWh and Nepal 30 US cents/kWh. The GDP per capita income of Nepal is US\$ 2,260 and that of Canada is US\$ 42,600.

Recently, the government has increased the electricity tariff up to 14 US cents/kWh to meet the requirements of high priced PPA and expensive power import from India. This is not justified by any means in a country with 90 percent hydro generation system and having hydro potential to last 25 years.

Due to water as free raw material (Coal, Diesel, Uranium etc not required), the operation and maintenance cost of hydropower plant is only 2 to 3 percent of initial investment. Therefore, the generation cost of hydropower plant decreases with the passage of time. As such, the PPA rates and the tariff should be constant or in some cases in descending order.

Past experience indicates, because of low purchasing power of the consumer, tariff hike will simultaneously increase the pilferage. As such the crisis in the power sector will further deepen. Nepal with hydropower project's levelized generation cost of 2 to 3 US cents/kWh, can very well fix the PPA rate at 4.5 US cents/kWh (DPM late Sailaja Acharya in 1998 fixed the PPA rate for Small Hydro Projects at 3.5 US cents/kWh and for others at 4 US cents/kWh). Even adding transmission, distribution and management cost, NEA can make profit with the tariff of 7 US cents/kWh. If NEA builds hydropower projects for its own use the tariff can be further reduced to 6 US cents/kWh.

### **The Way Forward**

- Without large storage high dams, the canals of India's river link project will have no use. High dams have serious technical, environmental, ecological and social consequences.
- In the 21<sup>st</sup> century, India's policy of occupying Nepalese rivers and 'Micro Management' in the internal affairs of Nepal is not in the interest of both the nations. Nepal's hydropower potential is not sufficient to meet India's huge electricity needs, so India should strive for the alternatives such as nuclear power.

- If only the run-of-river and small storage schemes are considered, Nepal's hydropower potential will be reduced to about 20,000 MW. This hydropower potential will be just sufficient to take care of Nepal's electricity need for next 25 years.
- Nowhere in the world, rivers which is the pride and symbol of a Nation, is relinquished to the foreign company. The government should retrieve the license of all the rivers, which are in the bags of foreign companies .
- Nepal's priority should be first to develop cost effective run-of-river and small storage hydropower projects for its own use. Muddling with large storage projects like 1200 MW Budhi Gandaki HEP will only further delay the execution of RoR projects.
- NEA, with high cost PPA with FDI and power import from India is on the verge of bankruptcy. Hydropower projects should be built as per the modality of 22 MW Chilime Hydropower Project (cost 1,500 US\$/kW) and 456 MW Upper Tamakoshi Hydropower Project (cost 1,000 US\$/kW) with 70 percent NEA and 30 percent public investment.
- Construction, operation and maintenance of hydropower power plants and operation of INPS involve multi-disciplinary engineering skills. Unbundling a small organization of only 800 MW electricity networks and creating a number of new agencies will further weaken Nepal's already sick power sector.
- NEA must be made a strong efficient technical institution. NEA's manpower should be restructured in the ratio of 70:30 (technical: administrative) and headed by a technical person (from within the institution).
- Being one of the creators of NEA and privatization, the World Bank and ADB also bear the responsibility of rescuing Nepal's power sector from this quagmire.
- If Nepal generates cheap and reliable electricity from hydropower plants and utilizes it for the country's industry, transportation, irrigation and service sector, Nepal will achieve double digit economic growth.

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