



# Roles of hydropower and dams in society, including mitigation and adaptation to climate change

Asit K. Biswas, Distinguished Visiting Professor, University of Glasgow, UK  
Cecilia Tortajada, Professor, School of Interdisciplinary Studies,  
University of Glasgow, UK

The societal roles that hydropower and dams can play, including mitigation and adaptation to climate change, are neither fully appreciated nor understood in most countries. These have been a serious bone of contention between pro- and anti-dam lobbies since mid-1980s. An important reason for this was the powerful movement that started in early 1970s, initially in the Western countries, and that proclaimed, “small is beautiful” and bigger is not better [Schumacher, 1973<sup>1</sup>]. From the Western world, this rather simplistic concept steadily permeated to the developing world. In 1995, *The Times Literacy Supplement* considered that book to be among the 100 most influential books published since the Second World War.

Since large dams are major structures, they were caught by this concept. From around the late 1970s, there was a strong movement, also in the West, by numerous activist social and environmental non-government organisations. They strongly promoted an anti-large dam bias.

## Large dams as a nation-building exercise

By the time this movement started, the ‘golden era’ of dam construction in the West, spanning from the 1930s to 1960s, was mostly over. In the developing world, the construction of large dams started as the countries became independent from their colonial masters from the late 1940s.

Newly independent countries, like India, Pakistan, Egypt, Ghana and Zambia, started a new era of large dam construction as an integral component of a nation-building exercise during the 1955-1970 period. These included, among others, the Bhakra-Nangal project and Hirakud dam in India, Tarbela dam in Pakistan, the High Aswan Dam in Egypt, the Volta dam in Ghana and Kariba in Zambia.

Thus, the Bhakra-Nangal project was considered by India’s first Prime Minister, Nehru, to be the ‘new temples of resurgent India’. Similarly,

when the USA arbitrarily decided that they would not financially support the construction of the High Aswan Dam, the first Egyptian President, Nasser, nationalized the Suez Canal and proclaimed in a speech in Alexandria that the revenue of the Suez Canal would be used to construct the High Aswan Dam. He went to say: “... we shall build the High Aswan Dam, but before building the High Dam, we have first to build the dam of dignity, the dam of integrity, the dam of liberty, and when we have built the dam of dignity, integrity and liberty, we shall have realised our hopes, and we shall then surely build the High Dam.”

Similarly, Kwame Nkrumah, first Prime Minister of Ghana, championed the construction of the Akosombo dam on the Volta river to usher in a new era of economic development. Kenneth Kaunda, first President of independent Zambia noted: “I might compare our African spirit to the rushing waters of the mighty Zambezi river ... Our will to be free produced tremendous power, just as the waters of the Zambezi harnessed by the Kariba dam have produced power for the whole country.”

## Increasing societal polarization on large dams

During the late 1980s and the 1990s, there was increasing polarization on the societal views of benefits and costs of large dams. The height of this polarization was reached around 1993, when the World Bank’s financial support for the Sardar Sarovar project, in India, abruptly ended. Thereafter, the World Bank cancelled Nepal’s Arun III project.

During the 1990s, major funding institutions like the World Bank and the Asian Development Bank mostly withdrew from funding large dam projects. This withdrawal was the net result of fierce opposition to large dams by activist social and environmental NGOs. This period proved to be the peak of opposition to large dams.

## Changing global view on dams

During the post-2010 period, discussions on the benefits and costs of large dams became more nuanced. Institutions like the World Bank and the Asian Development Bank decided to reverse their earlier policies and started to fund large dams again. In the past decade, both these institutions have been eclipsed by China in terms of building new dams, both within the country and also in parts of the developing world. There is no question that during the past 20 years, China has been, by far, the biggest dam building country of the world. During this process, the country has developed many new and innovative concepts in planning, construction and operation of hydropower dams. These, including extensive application of sensors, robotics, artificial intelligence and data analytics, have ensured that China is now the most advanced country in the world in terms of dam construction and management. Since China has constructed hundreds of dams, both within and outside the country, it has continually learnt from its experiences.

During the last two decades, policymakers in many countries and major international funding institutions, have realised that dams are important components of social and economic development. When properly built and managed, dams ensure people have reliable sources of drinking water, irrigation water for food production, clean energy, improved intermodal transportation and increased fish catch. All these contribute to improved standard of living and quality of life of the people.

However, like for any large infrastructure, planning, design, construction, and management of dams have to be rigorous so that all benefits are maximized, and costs are minimized. Only then they will contribute maximum net benefits to the society. This means impacts of large dams, both positive and negative, must be regu-

larly monitored. Unfortunately, this generally did not happen in the past, in either developed or developing countries. In addition, very few large dams have been objectively and comprehensively evaluated in terms of their positive and negative impacts after 10, 15 or 20 years of their operation. Thus, lessons, both positive and negative, have neither been learnt, nor used to improve planning and management processes. Some of the most authoritative studies are those by Scudder [2005<sup>2</sup>, 2016<sup>3</sup>, 2019<sup>4</sup>]. Other analyses include Bhakra-Nangal Project [Rangachari, 2006<sup>5</sup>], High Aswan Dam [Biswas and Tortajada, 2022<sup>6</sup>; Tortajada and Biswas, 2022<sup>7</sup>], Atatürk Dam [Tortajada, 2000<sup>8</sup>; Tortajada *et al.*, 2012<sup>9</sup>]. In the absence of more comprehensive assessments, myths and biases continue to be perpetuated.

One of the areas where there have been some serious concerns has been involuntary resettlement as a result of inundation by reservoirs. This is not because knowledge is not available on how to carry out proper resettlement. In fact, the Egyptians carried out a good resettlement process for the High Aswan Dam in the 1960s [Scudder, 2016<sup>3</sup>]. There is no reason why, given political will and functional institutions, proper resettlement cannot be carried out where the standard of living and quality of life of the resettled people are significantly better than prior to the construction of the dams. If political will and functional institutions do not exist, not only construction and management of large dams would suffer but also other similar development activities.

### Large dams, climate change and sustainable development

There is no question that following the World Bank's decisions on the Sardar Sarovar project in India and Arun III dam in Nepal, there was a significant decrease in funding available for the construction of large dams. However, dam construction has been again high in the world's political and economic agenda. Thousands of dams have been built or are under construction or at the planning stage in numerous developing countries. Sardar Sarovar, a focus of the anti-dam activists, is now complete. Its benefits have already changed the social and economic conditions of the region. The area is on the way to becoming an important tourist attraction, as has been the case with the Three Gorges dam.

Climate change concerns have significantly added to the value of large dams. As extreme hydrological events like droughts and floods are becoming more frequent and intense [Biswas and Tortajada, 2016<sup>10</sup>; Tortajada, 2016<sup>11</sup>], the beneficial roles of large dams are being more appreciated by policymakers and the general public in developing and developed countries, as well as by international organizations. Dams have attenuated the flood peaks in all countries, and the stored water in reservoirs is helping all countries to withstand prolonged droughts. Even in the world's most economically powerful country, the USA, people in the arid north-western states are realising the roles large dams can play to preserve the socio-economic fabric of the society. Even very large dams, like Hoover or Shasta, do not have enough water at present to generate hydropower or provide water for irrigation. The situation would have been significantly worse without these large structures.

It is now generally appreciated that hydropower generation is an important alternative to generate electricity. Its greenhouse gas emissions are significantly less compared with fossil fuels and is able to stabilise renewable energy systems based on wind and solar power. Not surprisingly, countries like China have made, and will continue to make, heavy investments in hydropower dams, which also help to strengthen water security by reducing the adverse impacts of prolonged droughts and heavy floods.

The roles of large dams in reducing carbon emissions are still not fully appreciated. For example, a major benefit of the Three Gorges Dam has been moving a significant percentage of goods transportation from roads to inland navigation in the upper Yangtze River through its locks [Li *et al.*, 2020<sup>12</sup>] This has now eliminated millions of truck journeys, since goods are now transported by barges. This model of transport not only has reduced carbon emissions but also congestion, noise, and road accidents. The demand for river transportation has been so high that the Three Gorges Dam Corporation is constructing a second lock. These types of benefits are still not assessed during cost-benefit analyses of large dams.

While there is a renewed appreciation of the importance of large dams, it is essential that all existing and new projects are sensitive to their social and environmental impacts. All dams must be technically, financially, economically, socially, and

environmentally beneficial to society. Properly planned and managed hydropower dams will play an increasingly important role during the post-2020 world.



### References

1. Schumacher, E.F., "Small is beautiful", Blond & Briggs, London, UK; 1972.
2. Scudder, T., "The future of large dams. Dealing with social, environmental, institutional and political costs", Earthscan, London, UK; 2005.
3. Scudder, T., "Aswan High Dam Resettlement of Egyptian Nubians". Springer, Singapore; 2016.
4. Scudder, T., "Large dams: Long term impacts on riverine communities and free flowing rivers", Springer, Singapore; 2019.
5. Rangachari, R. "Bhakra-Nangal Project: Socio-Economic and Environmental Impacts. Oxford University Press, New Delhi, India; 2006.
6. Biswas, A.K., and Tortajada, C., "Hydropolitics of High Aswan Dam", Springer, Singapore (forthcoming); 2022.
7. Tortajada, C. and Biswas, A.K., "Impacts of the High Aswan Dam", Springer, Singapore (forthcoming); 2022.
8. Tortajada, C., "Evaluation of Actual Impacts of the Atatürk Dam", *International Journal of Water Resources Development*, Vol. 16, No. 4, 2000.
9. Tortajada, C., Altinbilek, D., and Biswas, A.K. "Impacts of Large Dams: A Global Assessment", Springer, Berlin, Germany; 2012.
10. Biswas, A.K., and Tortajada, C., "Water Security, Climate Change and Sustainable Development", Springer, Singapore; 2016.
11. Tortajada, C. "Increasing Resilience to Climate Variability and Change: The Roles of Infrastructure and Governance in the Context of Adaptation", Springer, Singapore; 2016.
12. Li, W., Wang, D., Yang, S., and Yang, W., "Three Gorges Project: Benefits and Challenges for Shipping Development in the Upper Yangtze River", *International Journal of Water Resources Development*, Vol. 37, No. 5; 2020.

