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Water-energy-food nexus: Role of large dams

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The demands for water, energy, and food around the world have and continue to increase, due to population growth and improved living standards, among other factors. Each of the water, energy, and food sectors has its own dynamics, with supplies and demands changing with time and space, depending on the sources and needs. At the same time, however, there are also strong interconnections among the three, with water arguably playing a more central role. Adequate understanding of the water-energy-food nexus is critical for ensuring security in each of these sectors and for our overall sustainability. However, such is also very challenging, because we have only very limited knowledge of the nature and extent of interconnections among the three sectors, not to mention the dynamics within each sector. Research on the nature and properties of the water-energy-food nexus is gaining considerable attention at the current time, and is anticipated to assume even more importance in the future, especially with the potential impacts of global climate change on all the three sectors.

The present study attempts to further advance research on the water-energy-food nexus. In particular, the study examines the water-energy-food nexus from the perspective of large dams. For almost a century now, large dams, mostly constructed across large rivers, have been playing a key role in meeting various water, energy, and food demands, both in the developed world and in the developing world. As of today, there are about 50,000 large dams, with an aggregate water storage capacity of about 6,000 km3. These large dams: (1) supply a significant portion of domestic and industrial water, including for a number of megacities; (2) generate about 20% of the world's total electricity; and (3) supply water for about 30–40% of the total irrigated land (of over 270 million hectares).

To examine the role of large dams on the water-energy-food nexus, we consider large dam and socio-economic data at the global level over the past 50 years. The dam data include number of dams, reservoir capacity, and hydropower installed capacity. The socio-economic data include population as well as water, food, and energy consumption. We adopt the following procedure. First, we establish connections between dam development on the one hand and water, food, and energy consumption on the other. Next, we form groups of regions/countries according to the extent of connections between dam development and water-energy-food consumption. Finally, we project future dynamics of the water-energy-food nexus from the perspective of large dams, with due consideration to the potential regions/countries and suitable sites for dam construction.