

Oliver Neumann

Hydropower Performance in the PR China and Japan

A Comparative Assessment

Topic and Research Question

Renewable energy is often seen as a salvific tool to fight global warming and climate change. While Renewables indeed provide a large array of benefits compared to traditional sources of energy generation, they also feature distinct disadvantages. The thesis aims to develop a framework which enables a holistic assessment of hydropower performance on a country level. Thereby, it contributes to substituting a one-sided and superficial perception of “clean” renewable energies with a fact oriented analysis of their utility and impacts. This allows for the determination of the most suitable form of energy generation for any given situation. Accordingly, the thesis’ research question is:

How effective is hydropower for the PR China and Japan in order to achieve further progress in their respective energy sectors?

The thesis works under the premise that performance variations do not only occur between specific power plants (e.g. due to different flow patterns of respective rivers), but can also be identified on a larger scale, for whole countries or regions: an approach that is unique in contemporary research.

State of the Art

As of the time the thesis was written, comparable research on a holistic comparison of hydropower performance between China and Japan – or of any other energy source between any other set of countries was lacking.

Even on higher levels of abstraction, only a limited amount of literature was available, without taking into account general sustainability research. Nevertheless, there are some noteworthy publications that tried to assess hydropower performance on different scales. Among these, the UN Intergovernmental Panel on Climate Change’s Special Report on Renewable Energy (2012), the Integrative Dam Assessment Model by Kibler et al. (2012) and the Hydropower Sustainability Assessment Protocol developed by the International Hydropower Association (2010) are most comprehensive.

Due to the lack of applicable literature, the empirical part of the thesis relies widely on publications of a multitude of academic fields, such as biology, geology, economics or social studies.

Methodology and Approach

The methodological framework of the thesis is based on a Sustainability assessment, which reflects the energy sector goals set by China and Japan themselves, as well as the holistic and interdisciplinary approach required to answer the research question.

The “traditional” model of Sustainability, as applied in the thesis, rests on three pillars: economic efficiency, social equity and ecological sustainability. Accordingly, the indicators and specific parameters for the assessment of hydropower based energy generation in China and Japan are developed out of the three pillars:

Economic	Social	Ecological
Generation Efficiency	Community Engagement	Greenhouse Gas Emissions
Inland Water Transport	Involuntary Displacement	Biodiversity
Irrigation	Safety	Sedimentation

Each of these indicators has a number of parameters associated with it, which are assessed according to their impact on the overall hydropower performance (positive, negative or non-influential). In accordance with the concept of Sustainable Development, the parameters are treated equally, i.e. all indicators carry the same weight for the analysis.

Main Facts

The analysis shows that hydropower in China and Japan features several of the most extreme indicator gradations worldwide, such as such as most efficient hydro-based energy generation, number of Involuntary Displacement cases, Reservoir Induced Seismicity, and benefits to Inland Water Transport (IWT) in China, as well as the most inefficient hydro-based energy generation, the least possible IWT benefits and one of the lowest sedimentation rates in the case of Japan. Moreover, the analysis reveals developmental trends over the course of several decades, such as Community Engagement in Japan, which strongly disregarded citizens’ opinions several decades ago, but

transformed into a highly considerate relationship. Regarding the social performance in China, it has to be considered that, while at the time of the thesis the situation is clearly unsustainable, the central government has shown a strong desire to improve the issues through refined legislation and implementation oversight.

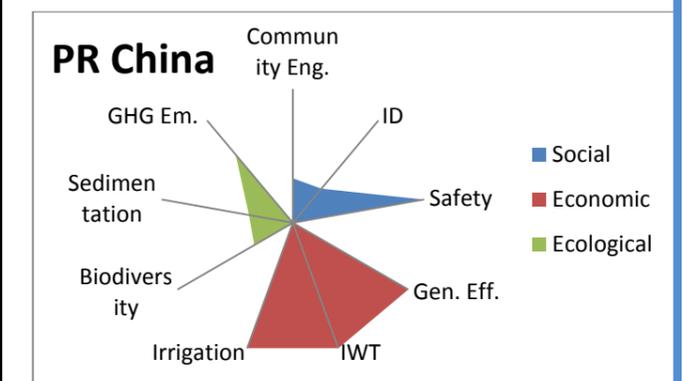
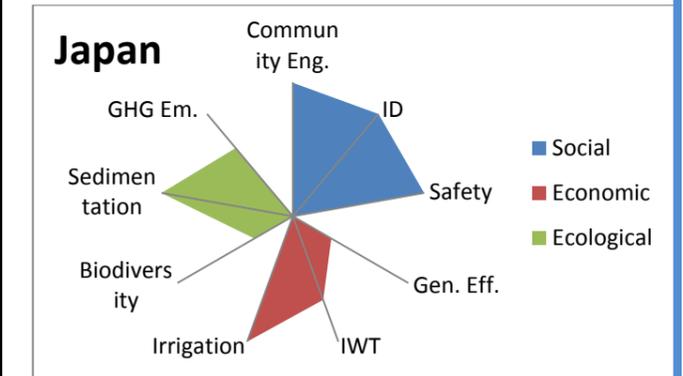
The analysis also shows that the third environmental indicator, Greenhouse Gas (GHG) Emissions, cannot be correctly assessed at this point in time. Traditional GHG analyses work under the assumption that hydropower is GHG neutral. However, recent research regarding the natural emissions caused by submerged biomass as a result of reservoir impoundment indicates that the emissions – which are a direct result of hydropower deployment – are significant. While no specific data are available, the analysis of hydropower deployment timeframes as well as plant latitude indicates strongly that hydropower related GHG emissions are significantly higher in China than in Japan.

Results

The thesis shows that the performance of hydropower in China and Japan differs substantially. China is characterized by significant economic benefits, with hydropower enhancing the country’s IWT and irrigation sectors, as well as providing one of the world’s most efficient water based power generation. Japan, on the other side, while also receiving noteworthy irrigation benefits, does not gain any advantages in the IWT sector. Even more important are the high costs of hydropower generation in Japan, which result in an overall very low economic performance of hydropower in Japan.

However, the social and environmental assessments show a contrary picture: Japan features an exemplary social hydropower performance, with negligible amounts of involuntary displacement cases, a highly active and citizen-centric community engagement, as well as an excellent safety performance. In China, on the other hand, hydropower has major problems in the social and environmental sector. Despite the good safety performance, negative aspects prevail, including the world’s largest number of hydropower related cases of involuntary displacement, coupled with insufficient compensation due to corruption and embezzlement, as well as community conflicts that often result in violent clashes between activists and law enforcement. Similarly, the environmental performance of

hydropower in China is substantially lower than that of Japan.



When translating the overall results of the analysis into percentages - 0% being an entirely negative performance and 100% being an absolutely positive performance - Japan performs approximately 20% better than China, with a rating of 65% and 44.5% respectively.

References

All references can be found in the full version of the MA thesis available at <http://othes.univie.ac.at/>

About the Author

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