Deutsches Institut für Entwicklungspolitik
German Development Institute
d·i·e
Jahre | 1964 – 2014

Briefing Paper 10/2014

'Green and Clean?' Hydropower between Low-carbon and High Social and Environmental Impacts

Summary

During the last decade, hydropower has made a remarkable return to the global agenda, after having been absent due to heavy criticism because of its social and environmental impacts.

The proponents of hydropower development claim that hydropower is 'clean' and 'green' and can thus support low-carbon development paths. Combating climate change requires electricity generation from sources with low greenhouse gas emissions (GHG), and because hydropower is a low emitter, it has the potential to contribute to the protection of a global public good: the global climate, and to foster economic growth and social development. It is this potential which brought hydropower back to centre stage.

However, the role hydropower can play in mitigating global climate change creates a dilemma: Is hydropower desirable because of its ability to provide low-carbon energy, or undesirable because of its local environmental and social impacts? The answer is neither straightforward nor simple, and difficult decisions have to be made.

There is no doubt that global warming is the major threat of this century. But local social and environmental impacts of hydropower schemes continue to exist, and the more positive view on hydropower carries the risk that the negative impacts – on people and on resources – are overlooked. These impacts should not be set aside too easily because of the benefits of low-carbon growth. With all knowledge and experience gained, the renewed attention to hydropower also provides an opportunity: the opportunity to develop and operate dams in a more socially and environmentally friendly way. Given that hydropower can play a role in providing affordable and flexible renewable energy, the overall aim should be to choose the least bad or lowest impact option for providing affordable and low-carbon electricity. National agencies should be supported in order to ensure a well-informed and equitable balance between global and local benefits and costs.

Whether one likes it or not, hydropower will feature in many energy development and climate mitigation plans in this century. Let us use this momentum to develop hydropower the right way.

Climate change brings a renewed interest in hydropower

During the last decade, hydropower has made a remarkable return to the global agenda, after having been absent due to heavy criticism on account of its social and environmental impacts. Worldwide, it is the major source of renewable electricity, and will continue to be so (Figure 1) but with remarkable differences across continents related to the potential exploitable.

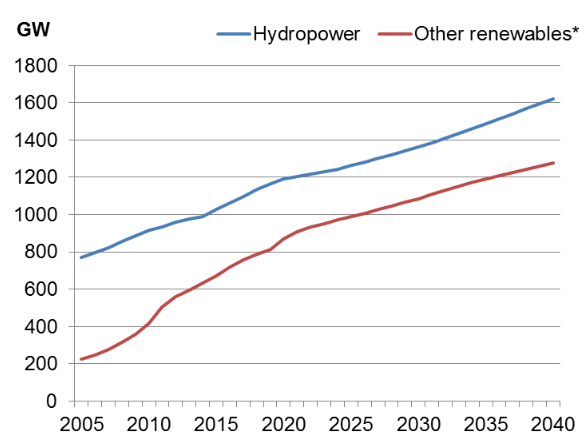
Africa uses less than 10 percent of its technical hydropower potential. Asia, which has by far the greatest absolute potential, uses about 30 percent. In comparison, South America uses 26 percent, North America 39 percent, and Europe 53 percent. Looking at sub-Saharan Africa (SSA), the majority of the renewable projects are hydropower plants. Nine large hydropower plants already registered with the African Union's infrastructure development programme (PIDA) are expected to deliver an additional 12,880 MW until 2020 and Grand Inga alone could add 43,200 MW up to 2040. The Africa-EU Energy Partnership (AEEP) has already committed to installing 10,000 MW by 2020 along with the increase of other renewable generation capacities.

In the Mekong river basin, China alone increased its hydro generation capacity during the last 20 years by 15,000 MW and plans to install a further 8,500 MW; Laos and Cambodia are planning to add another 13,500 MW.

While other renewables have grown even more quickly than hydropower since 2005, on a global scale, hydropower is expected to continue to provide the largest renewable capacity (see Figure 1).

The proponents of hydropower development claim that hydropower is 'clean' and 'green' and thus supports low-carbon development paths. Combating climate change necessitates providing electricity from sources with low greenhouse gas emissions (GHG), and hydropower has the potential to contribute to the protection of a global public good: the global climate, and to foster economic growth and social development which rely on securing reliable and sufficient electricity.

Figure 1: Recent and projected global development or renewable energy capacity



* Include wind, solar, geothermal, biofuels, waste, tide/waves/ocean

Source: Annual Energy Outlook – www.eia.gov/ies

It is this potential which brought hydropower back to centre stage.

However, the role hydropower can play in mitigating global climate change creates a dilemma: Is hydropower desirable because of its ability to provide low-carbon energy, or undesirable because of its local environmental and social impacts? The answer is neither straightforward nor simple.

Environmental and social impacts of hydropower are a major concern

For centuries, single and multi-purpose dams have contributed to the economic and social development of civilisations; they have controlled hydrological variability, protected settlements and agricultural land from flooding during the wet season, and provided water for irrigation and domestic use during the dry season. Last but not least, for about a century now, they have also been used to generate hydroelectricity.

However, dams were and are not without impact: obstruction of upstream-downstream connectivity and regulation of natural flow variability have led to ecosystem degradation, also affecting the livelihoods of the communities depending on them. Inundation of reservoir areas has led to the forced relocation of communities and land confiscation without adequate compensation, or with the failure to pay it. Until the year 2000, on a global scale between 40 and 80 million people had been displaced due to dams, and only a few resettlement action plans have so far been worth their title.

The negative social and environmental effects of dams stimulated the emergence of a worldwide anti-dam movement which caused a decline in new dams between 1970s and the end of the 1990s. Public acceptance was the lowest ever, and the resistance against dams discouraged investors and development banks from funding.

This growing criticism led to the development of criteria for sustainable dam construction. The 'new framework for decision-making' by the World Commission on Dams (WCD 2000) may be the most well-known, but it was also considered by some governments and financial institutions to hamper development. Nevertheless, it served as a reference for the safeguarding policies of major development banks. The Equator Principles and the Hydropower Sustainability Assessment Forum provided other frameworks developed together with investors and the hydropower industry to assess and manage social and environmental risks and to uphold minimum standards. Unfortunately, neither the WCD's nor other sets of international standards have shown a straightforward impact. Research on selected emerging and developing economies shows that actual practices often fall short of comprehensive environmental and social impact assessment studies (for individual projects as well as for entire river basins), of environmental management and resettlement action plans, as well as of meaningful participation in decision-making (Scheumann / Hensengerth 2014). In this respect, the WCD has not brought an end to the protracted debate on the pros and cons of dams; but it has provided a valuable input to the ongoing debate about what sustainable development and decision-making means in relation to dams.

How clean and green is hydropower?

GHG-emissions from hydropower schemes are low, but not zero. The Intergovernmental Panel on Climate Change (IPCC) found overall emissions of hydropower per unit of energy generated to be 100 to 250 times lower than those of fossil thermal plants. Although not fully emission free, hydropower has the potential to replace and prevent large amounts of emissions. Hydropower can contribute to the phasing-out of thermal power plants, and affordable electricity from hydropower plants can – at least to some extent – replace diesel generators if connections to grids exist. In the tropics in particular it is important that reservoirs are cleared of vegetation in order to reduce the generation of methane and other GHG.

Moreover, hydropower can be combined with other forms of renewable energy sources and can facilitate their introduction. Unlike solar and wind power, hydropower plants with reservoirs can store energy and, combined with quick start and shut-down capabilities, it enhances the efficiency and stability of electricity grids. This way, hydropower supports the development of other renewable energy sources, and hence a further reduction of GHG-emissions.

While hydropower schemes can contribute to reducing global GHG-emissions, hydro-electricity generation is also sensitive to climate change. The 2013 IPCC report predicts that certain regions will have wetter while others will have drier conditions (IPCC 2013) which would affect both average and seasonal flows and thus reduce production, if peak discharges cannot be stored. On the other hand, in the case of increased climate variability, hydropower reservoirs can play a role in climate adaptation by attenuating floods and droughts.

'Small' is not always beautiful

The positive connotation of hydropower schemes in the light of its low-carbon emissions carries the risk that social and environmental impacts are overlooked. Along these lines, often, 'small' hydropower, 'small' dams and run-of-river schemes are promoted as having less negative impacts than large storage dams. However, there is no linear relationship between size and impact.

Small and large are not unambiguous as the various different definitions in Box 1 show. The indicators have in common that they describe design characteristics of hydropower schemes, but not their impacts. The discussion should *not* be about whether a hydropower project is *large* or *small* but about whether its *impacts* are high or low, and whether there are means available to reduce impacts. We thus strongly argue in favour of not applying too simple indicators to assess whether to support hydropower schemes or not.

Box 1: 'Large' versus 'small' hydropower

Installed capacity (megawatts, MW) is a common way to distinguish between large and small. The European Union, for example, has adopted 20 MW as a limit for hydropower plants (HPP) to be counted as small.

The International Commission on Large Dams (ICOLD) uses a dam height of 15 m to identify large dams. Social and environmental impacts depend on the area inundated and the flow regime regulated in combination with existing land use and types of ecosystems.

The power density index (PDI) used under the Clean Development mechanism is only of relevance for the computation of net emission reductions from renewable energy. If the PDI – the installed capacity per unit of inundated area (W/m^2) – is less than 10, emissions from the reservoir are to be accounted for.

HPPs are also commonly classified according to their technical design and distinguished into reservoir HPPs and run-of-river HPPs. Run-of-river HPPs do not store water, and therefore affect downstream flow regimes and people to a lesser extent. However, run-of-river schemes may divert water through tunnels over long distances in order to create sufficient head, depriving entire river sections of water and affecting water rights and uses along these sections.

In favour of low-impact options

Internationally, the knowledge and expertise to create low impact dam solutions *is* available. Design, site selection, and the operation of dams influence environmental and social impacts, and can be adjusted to reduce them. Residual impacts should be compensated.

The assessment of environmental and social impacts and the development of low-impact solutions are hampered by technical, legal and political constraints (Scheumann / Hensengerth 2014). Environmental and Social Impact Assessment (ESIA) studies and/or Cumulative Environmental and Social Impact Assessment (CESIA) studies should not only be mandatory but of high quality; environmental management plans should be mandatory and enforced. Baseline data on ecology are however often not available or incomplete, and time constraints hamper multi-year assessments. Moreover, contractors may lack the knowledge and capacity in both the construction and operation phases to adhere to requirements laid down in construction and operation permits. Assessment of cumulative impacts deriving from the implementation of many projects along a river stretch or in a river basin is usually legally not required. Environmental management plans are not always mandatory, and where they are, monitoring compliance by public agencies is inadequate.

Income restoration in resettlement planning, and long-term revenue- and non-revenue-based benefit-sharing mechanisms should be applied to prevent that one group of a society one-sidedly bears the cost of electrification in particular and development in general. The revenues generated from hydropower will allow for the implementation of adequate environmental management plans and revenue-based benefit-sharing mechanisms. Taking stock of use-rights to land and water – an integral part of ESIAs – is a major issue if user-rights are informal and not registered resulting in inadequate identification of those eligible to compensation and to resettlement planning.

Trade-offs will continue to persist between the populace benefiting and those affected and between policy objectives such as climate change mitigation, nature and water resources protection and their utilisation. Participatory decision-making procedures should be introduced: those negatively affected must be heard and have a say. However, public participation is difficult in societies where the public has no voice in decision-making and where women are excluded from public life. Moreover, the status of ESIA in project decision-making is often weak, and projects often start without environmental clearance. In the 21st century it can no longer be justified to place the burden of development on local livelihoods and ecosystems. Investment in hydropower cannot be allowed to plunge one group into poverty – yet that is the risk.

Conclusions

The need for low-carbon and affordable electricity has brought hydropower back onto the development agenda. There is no doubt that global warming is the major threat of this century. But local social and environmental impacts of hydropower schemes continue to exist, and the more positive view on hydropower carries the risk that the negative impacts – on people and on resources – are overlooked. These impacts should not too easily be set aside because of the benefits of low-carbon growth. With all knowledge and experience gained, the renewed attention on hydropower also provides an opportunity: the opportunity to develop and operate dams in a more socially and environmentally friendly way. Given that hydropower can play a role in providing affordable and flexible renewable energy, the overall aim should be to choose the least negative or lowest impact option for providing affordable and low-carbon electricity. National agencies should be supported in order to ensure a well-informed and equitable balance between global and local benefits and costs.

Whether one likes it or not, hydropower will feature in many energy development and climate mitigation plans in this century. Let us use this momentum to develop hydropower the right way.

Literature

IPCC (Intergovernmental Panel on Climate Change) (2013): Climate change 2013 : the physical science basis – summary for policymakers, New York: Cambridge University Press

Scheumann, W. / O. Hensengerth (eds.) (2014): Evolution of dam policies : evidence from the big hydropower states, Berlin / Heidelberg: Springer

WCD (World Commission on Dams) (2000): Dams and development : a new framework for decision-making, London: Earthscan

Karen Meijer / Waltina Scheumann / Daniel Däschle / Ines Dombrowsky

Department IV: "Environmental Policy and Management of Natural Resources"
German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)

Tulpenfeld 6 · 53113 Bonn · Germany · Tel.: +49 (0)228 94927-0 · Fax: +49 (0)228 94927-130
die@die-gdi.de · www.die-gdi.de · www.facebook.com/DIE.Bonn · www.youtube.com/DIEnewsflash
ISSN 1615-5483

The DIE is a multidisciplinary research, consultancy and training institute for Germany's bilateral and for multilateral development co-operation. On the basis of independent research, it acts as consultant to public institutions in Germany and abroad on current issues of co-operation between developed and developing countries.