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Financiers to discuss hydropower as climate-change mitigation, but dams are not 'clean energy' (commentary)

Commentary by **Philip M. Fearnside** on 26 February 2019

- *Nature, the world's highest-impact scientific journal, published a comment on February 20 by an advisor to the Climate Bonds initiative, who claimed that dams are good for the climate and should be given priority for subsidies when a group of 500 global financiers who participate in the initiative meets in London on March 5.*
- *The Nature comment is highly misleading, especially for dams in tropical areas where much of the future hydroelectric development is expected to occur. In addition to having a substantial impact on global warming during the narrow time window we have to contain climate change, virtually all planned dams would be built anyway for reasons unrelated to climate mitigation. Granting subsidies with "green" money drains funds away from alternatives with real climate benefits.*

- *Tropical dams have social and environmental impacts that dwarf those of other energy alternatives. Global financiers should better inform themselves about these impacts and the perverse effects of hydropower as climate-change mitigation.*
- *This post is a commentary. The views expressed are those of the author, not necessarily Mongabay.*

On February 20, Nature published a comment on hydropower claiming that dams are good for the climate and should be subsidized through the Climate Bonds initiative, a proposal that is to be discussed in London on March 5 by a group of 500 global financiers.

The comment's author, Mike Muller, an advisor to the Climate Bonds initiative and visiting adjunct professor at the University of the Witwatersrand in South Africa, presents a very partial review of the effect of dams on greenhouse-gas emissions in order to conclude that "financiers should fund hydropower to help mitigate climate change."

For instance, Muller's summary of hydropower and climate change is misleading, especially for tropical areas where much of the future dam construction is expected to take place and where reservoirs emit more than in other climatic zones. Tropical dams emit substantial amounts of greenhouse gases, and these emissions have often been understated (see here, here, here, here, and here). The role of dams as recipients of carbon credit in mitigation efforts has been perverse, not just for their own uncounted emissions but because they drain "green" money from alternative mitigation measures when virtually all of the dams are not "additional" in the spirit of the Kyoto Protocol (i.e., they would be built anyway without carbon credit because governments want them for reasons unrelated to climate mitigation — see here, here, and here).

Dead trees in the reservoir of Brazil's Balbina Dam. Tropical dams can produce substantial greenhouse gas emissions and are not "clean energy." Photo Credit: P.M. Fearnside.

Muller minimizes the role of dams in emitting greenhouse gases and implies a substantial exaggeration of their benefits in avoiding emissions. He points out the benefit of holding floodwater that would otherwise flow into natural wetlands downstream and produce methane

(CH_4), using as an example a wetland in Mozambique where he says floodwater flow is diminished by two upland dams. He suggests that this would apply to the vast seasonally flooded areas in Amazonia and the Congo, but his argument appears to lack a sense of scale. The Amazon is by far the world's largest river in terms of water flow, and the Congo, with only 20 percent of the Amazon's flow, is the second largest. The volume of water that would have to be held back in reservoirs to make a perceptible difference in the area and duration of flooding would be astronomical.

Muller states that "reservoirs should be seen as potential places to store carbon." As Muller acknowledges, some of the carbon held in the sediments deposited in the reservoir would have been deposited as sediments elsewhere anyway, either in a floodplain or in the ocean. He also points out that, if a dam were not built, part of the carbon transported downriver would have been emitted to the atmosphere anyway, just not in the reservoir. However, rather than the simple carbon balance implied as critical, the key factor is the form in which the carbon is emitted — as CO_2 or CH_4. The water flowing down the Amazon River emits a large amount of carbon dioxide. The key fact about hydroelectric dams and their emissions, both in the reservoir and downstream, is that a significant part of the carbon emitted is in the form of CH_4, methane, a far more potent greenhouse gas than CO_2, carbon dioxide.

Muller criticizes researchers who fail to distinguish the source of carbon being emitted from reservoirs, implying that if the carbon being emitted from the reservoir is of upstream origin, then the emissions can't be blamed on the dam because it would have been emitted anyway without the dam. Some of this carbon would indeed have been emitted anyway in the river downstream, and it is true that we need to study the carbon balance of whole watersheds (including the estuaries where carbon from the rivers enters the ocean), and determine the net effect of dams. However, when such studies do become available, the results may not be as favorable to dams as Muller believes they will be. The climate impact of dams is made even worse by emissions from roads built to reach the sites of new dams — an impact that is usually uncounted. This would be a major consequence of the proposal by Brazil's current presidential administration for a highway to an inaccessible area north of the Amazon River where 15 dams are planned, beginning with the controversial Cachoeira Porteira Dam.

Muller presents an unreferenced graphic comparing life-cycle emissions from different electricity sources that shows hydropower to be lower than all other options except nuclear and wind power. Presumably this reflects an average emission for existing dams (i.e., mostly in the temperate zone) rather than future (largely tropical) dams. It also presumably makes the calculation of methane impact based on Muller's statement that methane is "a greenhouse gas that is some 20 times more

potent than carbon dioxide." This alludes to the 100-year global warming potential (GWP) value of 21 for methane in the 1995 second assessment report of the Intergovernmental Panel on Climate Change (IPCC). The problem is that we don't have 100 years to bring global warming under control. The result would be very different if Muller had used the much higher values from the most recent report (the AR-5 of 2013-14: Working Group I, page 714), especially the 20-year GWP that is most relevant to keeping global temperatures below the limits in the Paris Agreement: the relevant GWP value for converting CH_4 to CO_2-equivalents would be 86, more than quadrupling the impact of methane from tropical dams.

The life-cycle emissions emphasized by Muller represent another source of distortion from the perspective of policies on mitigating climate change. Life-cycle analyses normally assume a useful lifespan of 100 years for dams, and the impact of this option is calculated by summing emissions over the life of the dam and dividing by 100 years. The problem is that a tropical dam produces a huge emission in the first few years after filling the reservoir, followed by a substantially lower (but not zero) emission for the rest of the dam's life. If we are to hold global temperatures within the Paris limits, what counts is what is emitted in the next 20 years, not what will be emitted up to a century in the future when, assuming current trends, the Paris limits have long been surpassed. This is added to the fact that tropical dams emit CH_4, which has its impact in these critical years for containing climate change. The IPCC's AR5 estimates the average lifetime of CH_4 as 12.4 years, whereas CO_2, which is the main gas emitted by other alternatives, has a much milder effect that is spread over a period approximately ten times longer.

The Santo Antônio dam on the Madeira River in Roraima state, Brazil went into operation in 2012. This Amazon mega-dam has produced massive floods upstream in Brazil and Bolivia, killing livestock, flooding rural villages, and generating an international political crisis. Photo Credit: PAC Program, Brazil, licensed under CC BY-NC 2.0

Muller refers to hydropower as "cheap energy" and "affordable electricity." However, this is a myth that was effectively debunked by Ansar and coworkers, whose worldwide review of hydropower projects shows that the normal pattern is for a dam to cost much more than was thought when the decision was made to build it, and to take much longer to begin producing electricity than originally thought, resulting in big dams being largely uneconomic. The prevalence of dam projects stems from the heavy subsidies they receive through low-interest loans from national and multinational banks, government guarantees and other forms of taxpayer assistance. Hydropower is also not "cheap" from the point of view of non-monetary costs: it has enormous social and environmental impacts as compared to other options.

Muller lauds the IPCC for having "resisted calls to include reservoirs as a specific source of greenhouse-gas emissions." This is an unfortunate aspect of the IPCC's history that needs to be reverted. A classic debate on hydropower emissions between this author and the then-head of ELETROBRÁS (Brazil's government energy agency) in the journal Climatic Change made the need for IPCC attention clear (see here, here, here, and here). In refereeing the debate, Cullenward and Victor called for an IPCC special report specifically on hydropower emissions — a call that has yet to be heeded.

Muller repeatedly uses the term “lobbies” to refer to those who question hydropower as a mitigation option. It should be mentioned that a significant number of scientists are concerned about the emissions of tropical hydropower and the wisdom of promoting dams as climate mitigation. This is especially the case for those who are not financed or employed by the hydropower industry.

Muller ends his comment by opining that “Certainly, hydropower should be on the table on 5 March, when 500 global financiers meet in London to discuss climate-friendly infrastructure through the Climate Bonds initiative.” I hope that these financiers will inform themselves before this discussion.

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