How efficient is The Grand Ethiopian Renaissance Dam?

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By Mehari Beyene

The Grand Ethiopian Renaissance Dam (also known as the Grand Millennium Dam), now being developed near the Sudan border in great secrecy, has raised questions about its environmental and human impacts the project will bring. I would like to comment on the technical and economic aspects of the dam. My analysis raises questions as to whether this project is an appropriate investment for a economically struggling country like Ethiopia.

A thorough analysis about the technical and economic viability cannot be done at this stage as most of the information about the dam is kept as a secret. But official figures that are so far disclosed by the Ethiopian government media outlet show that the dam has significantly low efficiency (known by engineers as the *plant load factor*)* that makes it a very expensive investment for Ethiopia. The project is expected to cost US$4.76 billion.

Government sources say the dam will have 15 units each with a 350 MW capacity, which gives the planned dam a total installed capacity of 5,250 MW. On the other hand, the total electricity production from this dam is expected to be 15,128 GWh on annual basis. These figures have been communicated in Ethiopian state owned media repeatedly (*Ethiopian Press Agency, Ethiopian Electric Power Corporation – 2011).* The dam will be 145 meters high, with a reservoir size of between 62-65 billion cubic meters.

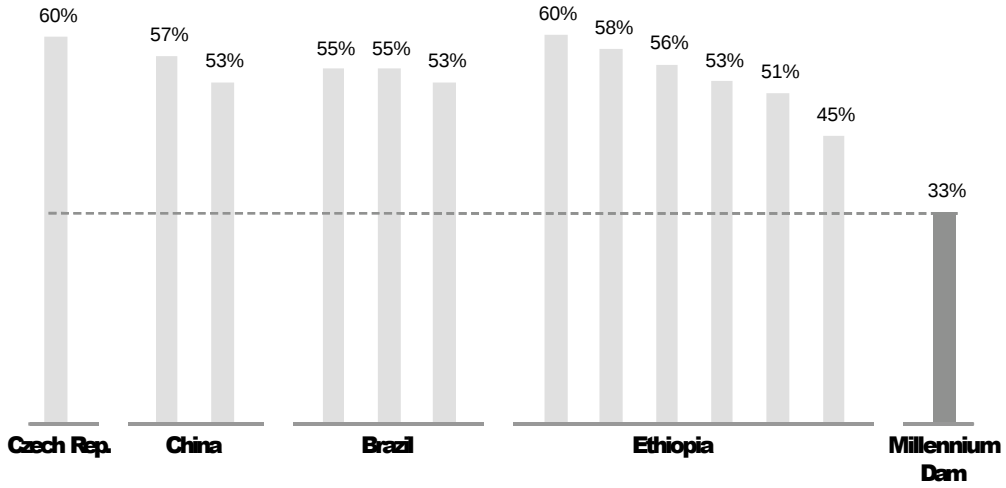
This equates into 33% efficiency (15,128 GWh x 100%/ (5.250 GW X 365 days x 24 hrs).
A 33% efficient hydropower dam is very inefficient based on both Ethiopian and international standards. This makes the electricity produced from the dam comparatively expensive. The table below shows a sampling of international hydropower projects with their respective efficiencies. The projects ranges from small to mega sizes and all projects have greater than 50% efficiency (*International Energy Agency, 2010*).

No	Country	Capacity (MW)	Energy (GWh)	Efficiency (%)
1	Czech Republic	10	53	60
2	Brazil	800	3,714	53
3	Brazil	300	1,445	55
4	Brazil	15	72	55
5	China	18,134	84,193	53
6	China	7,483	37,364	57

This argument can be further illustrated by taking a look at projects that are under construction in Ethiopia. The table below shows projects that are under construction/study with their respective efficiencies (*African Union - Hydropower for sustainable development presentation by Mihret Debebe, EEPCo CEO , 2011).*

No	Project	Capacity (MW)	Energy (GWh)	Efficiency (%)
1	Halele-Werabesa	422	2,233	60
2	Gibe IV	1,472	7,500	58
3	Geba I & II	366	1,788	56
4	Gennale III	258	1,200	53
5	Chemoga Yeda	278	1,250	51
6	Genale VI	256	1,000	45

The comparisons in the above tables are summarized in this graph:



What does a lower efficiency mean?

With an efficiency of just 33%, the electricity that will be generated from the planned dam is equivalent to a power plant with an installed capacity of 2,872 MW that has an efficiency of 60%.

The total investment for the current project could be reduced by at least 40-45% by building a smaller dam with a higher efficiency.

Mr. Hailemariam Desalegn, the Minister for the Ethiopian Ministry of Foreign Affairs, disclosed in an interview that the Grand Ethiopian Renaissance Dam is based on a study conducted in 1964 by the US Department of Bureau of Reclamation. However, that study proposed a much smaller dam with a capacity of 1,400 MW; this projectwas to be cascaded with other three dams upstream of the river (*IFPRI, 2007*). The project , known as the Border Dam, would have had an 85-meter-high dam, a reservoir just one-fifth the size of the Grand Ethiopian Renaissance Dam, and a US$1.5 billion price tag.

If the Grand Ethiopian Renaissance Dam was a multipurpose project (one used for water storage, irrigation or flood regulation as well as hydroelectricity), then a 33% plant load factor would be considered reasonable. However, the Ethiopian government has stated that the dam will be used

solely for electricity generation. This has to do partly with the topography of the area, which is mountainous and not suitable for irrigated agriculture.

In conclusion, a much lower height and lower capacity dam would be more efficient, more cost-effective, and would come with fewer social and environmental impacts.

There are many open questions about this dam. The Ethiopian government has chosen to begin the project despite its many critics and open questions. Ethiopians are being pushed and politicized to buy dam bonds that are supposed to cover the project's construction costs . Critics who raise questions about the project are labeled immediately as being associated with opposition parties and indigenous "terrorist groups." As an Ethiopian, I say the least the government can do is provide us with the required information and answer all open questions before asking us to shoulder such a massive investment.

*"*Plant Load Factor" is the relationship between a power plant's capacity to generate electricity and the actual amount of electricity it generates. If a hydropower plant were able to generate power continuously night and day, year round, it would have a plant load factor of 100%. Seasonal and annual variations in streamflow have a big impact on hydropower's plant factor. Climate change will make streamflow even more variable.*