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THE GOOD, THE BAD AND THE INEFFICIENT: ASSESSING DAMS WITH THE HYDROCALCULATOR

Dams are vital sources of electricity and irrigation, critical to improving the lives of millions worldwide. From environmental, economic and social perspectives, however, dams are by no means created equal. Some can be relatively benign while others have extensive negative impacts. Perhaps the single most important way to minimize impacts is to choose "good" dam sites. Doing so early on requires simple tools that generate comparable results across proposed locations.

In 2003, The World Bank released "Good Dams and Bad Dams: environmental criteria for site selection of hydroelectric projects.[1]" The report presented quantitative indicators for ranking proposed projects in terms of their likely environmental and social consequences. A good starting point, the report left ample space for further development. CSF has done just that with the HydroCalculator. The tool adds measures of economic return and greenhouse gas emissions and allows users to interactively analyze and compare projects. Our goal is for the tool to stimulate debate, transparency and ultimately good decisions on hydro development.

Figure 1. Dam developments analysed by the HydroCalculator tool and their respective Internal Rates of Return.

The HydroCalculator considers environmental, social and economic variables in it's calculations. The user can compute the economic feasibility of a hydroelectric dam investment based upon its costs and benefits over a 50-year period. Outputs also include the type and area of habitat impacted per megawatt (MW) installed generating capacity, as well as people displaced per MW. The HydroCalculator estimates CO2e emissions, deducting from the final output any greenhouse gas emissions from alternative sources that would be avoided by building the dam. In addition, HydroCalculator users can perform extensive sensitivity analyses, as well as comment on analyses done by others. These features are important because the dam projects are long-term investments with uncertain future costs and benefits.

Applying the HydroCalculator: An Analysis of Peruvian Dam Proposals

In 2010 Brazil and Peru signed an energy agreement, which, if implemented, would involve the construction of around six hydroelectric power plants in the Peruvian Amazon. By way of example we use the HydroCalculator to assess the comparative

merits of some of the larger of Peru's proposed dams, including several included in the Brazil-Peru treaty. Outputs for this analysis are displayed in Table 1.

The project with the lowest Net Present Value (NPV, a standard indicator of feasibility which should be at least zero for feasible projects) is the proposed La Balsa dam in the region of Cajamarca. The dam would have a negative NPV of over 1 billion USD. On the other hand, La Guitarra dam had the highest NPV, with a value of 261 million USD. Internal rate of return is a measure of feasibility that controls for the size of a project. This criteria shows Chaglla, Mantaro and La Guitarra to be the highest-return investments, and the first three in the list to be fairly convincingly infeasible.

If we look at other criteria the rankings change considerably. At a social level, the proposed Rentema and Paquitzapango dams perform most poorly, displacing 10 and 6 people/MW respectively. Paquitzapango dam generates the highest greenhouse gas emissions, 130,000 t/MW, almost twice as much as the next worst offender. Considering this criterion and habitat loss, the HydroCalculator clearly flags three problematic dam sites: Paquitzapango, Inambari and Pongo del Mainique. This result highlights the need to look at economic feasibility and other criteria at the same time; all three proposed sites showed positive NPVs. At the very least, these proposals warrant close scrutiny to their overall impacts, in particular the Paquitzapango dam, which scored poorly across both social and environmental criteria. It also happens to have provoked strong opposition from indigenous peoples in the area.

Potential Dam	Location	Internal rate of return (%)	Capacity (MW)	NPV (US$000)	Gross CO2e emissions (t/MW)	Inundated land (ha/MW)	Displaced people (/MW)
La Balsa	Cajamarca	4.94	915	-1,192,000	5,200	3	0.8
Cumba	Carrizales	5.99	825	-826,457	11,000	4.7	0
Chadinll	Shayuyo	4.69	600	-829,198	10,000	5	0
Rentema	Aramango	9.86	1525	-324,043	24,000	16	10
Inambari	Madre de Dios	11.2	2200	69,646	70,000	17	2
Chaglla	Chaglla	13.2	444	148,828	3,800	1	0
Mantaro	Tayacaja	15.1	286	165,903	3,600	1.5	0
Paquitza-pango	Quiteni	11.7	1379	182,109	130,000	40	6
Pongo del Mainique	Cuzco	12.1	942	211,384	62,000	19	0
La Gui-tarra	Huan-cavelica	15.6	433	261,483	4,600	2.3	0

Table 1. HydroCalculator outputs for Peruvian Amazon dam proposals, ranked for increasing Net Present Value (NPV)

Looking at the internal rate of return (IRR), we can also see that a number of those projects with positive NPVs may actual prove to be economically inefficient if costs were to increase only slightly. For example, sensitivity analysis of the Inambari dam, which at present shows a positive NPV of 70 million USD, shows that increasing construction time by one year or incurring 5% of additional unforeseen costs would yield negative NPVs of 128 million and 158 million USD respectively.

The HydroCalculator provides a platform where dam proposals can be compared under a standardised approach. In order to remain relatively simple, the tool omits certain aspects that would be considered in detailed feasibility and environmental studies, such as irrigation and flood control benefits, and specific impacts on plants and wildlife. The tool is also not set up to assess cumulative impacts, which requires multi-dam simulations and rich biophysical datasets. CSF appreciates any feedback in order to make the HydroCalculator a more useful tool to improve development decision-making.

The HydroCalculator can be accessed here, as can more detailed information on its workings and assumptions. To send us feedback please contact us here.

NOTES:

1. Ledec, George, and Juan David Quintero. "Good Dams and Bad Dams:Environmental Criteria for Site Selection of Hydroelectric Projects." *Latin America and Carribean Region Sustainable Development Working Paper* . 16. The World Bank, Latin America and Caribbean Region: November 2003.

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