

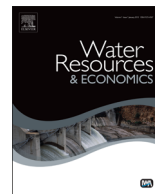


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Estimation of the transboundary economic impacts of the Grand Ethiopia Renaissance Dam: A computable general equilibrium analysis[☆]

Tewodros Negash Kahsay^{a,b,*}, Onno Kuik^a, Roy Brouwer^a,
Pieter van der Zaag^{b,c}

^a Department of Environmental Economics, Institute for Environmental Studies, VU University, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands

^b UNESCO-IHE, Delft, The Netherlands

^c Delft University of Technology, Delft, The Netherlands

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ABSTRACT

Employing a multi-region multi-sector computable general equilibrium (CGE) modeling framework, this study estimates the direct and indirect economic impacts of the Grand Ethiopian Renaissance Dam (GERD) on the Eastern Nile economies. The study contributes to the existing literature by evaluating the impact of the dam under three different climatic and hydrological scenarios, taking into account both the transient GERD impounding phase and the long-term operation phase in a global CGE setting. The results demonstrate the significance of the GERD in generating basin-wide economic benefits and improving welfare in the Eastern Nile basin. During the impounding phase, the GERD benefits mainly Ethiopia and to some extent Sudan. GERD impounding inflicts economic costs, however, on Egypt, especially if it occurs during a sequence of dry years, and depending on the level of water withdrawal in Sudan. The negative effects of the GERD on Egypt's economy are reversed when the GERD becomes operational. In that case, the GERD generates substantial economic benefits and

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* Corresponding author at: Department of Environmental Economics, Institute for Environmental Studies, VU University, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands.

E-mail address: t.n.kahsay@vu.nl (T.N. Kahsay).

enhances economic growth and welfare in all the Eastern Nile countries. Instituting a basin-wide power trade scheme would substantially boost Egypt's economy and thereby further increase the economic value of the dam.

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1. Introduction

Ethiopia is endowed with abundant water resources and enormous hydropower potential. Its theoretical hydropower capacity (650 TW h/year) is second only to the Democratic Republic of Congo in Africa and its technically and economically viable potential are estimated at 260 TW h/year and 162 TW h/year, respectively [33]. However, only a tiny fraction of this potential has so far been utilized. The total energy generated in 2012 was 6.4 TW h [22], which is equivalent to 4 percent of the economically viable potential and a mere 2.5 percent of the technically feasible hydro-electric potential of the country. With only 23 percent of all households having access to electricity and 96 percent of the population still relying on traditional biomass for cooking [23], the country's access to energy is severely constrained.

The energy constraint is exacerbated by increasing demand driven by increasing economic growth. Over the past decade, this was on average 10.7 percent per year [32]. The country's demand for electricity is forecasted to increase more than six-fold in the next decade from 6.3 TW h/year in 2013 to 40.5 TW h/year in 2023 [22]. The major drivers of this growth in power demand in the near future include expansion of the industrial sector, planned irrigation projects, a new national railway network and urban light rail system and the country's implementation of the UN's Universal Electricity Access Program (UEAP).

Sustaining economic growth and meeting the growing demand for electricity require further development of the country's energy sector. The five-year Growth and Transformation Plan (GTP) (2010/11–2014/15) targets boosting the country's hydropower generating capacity from 2000 MW in 2009/10 to 10,000 MW in 2014/15 [21]. The centerpiece of the plan is the Grand Ethiopian Renaissance Dam (GERD). The GERD, a €3.34 billion hydro-electric dam being built in the Blue Nile River, close to the Ethiopian border with Sudan, has a design capacity of 6000 MW and is reported to be able to produce 15.1 TW h/year upon completion [19]. The dam, which will have a height of 145 m and a total storage volume of 74 km³, is assumed to be used for power generation only. This would mean a massive additional energy source in the country and is expected to create enough supply to meet domestic as well as export demand for electricity.

The Ethiopian initiative to build the GERD is a unilateral move and the project has been a source of concern for downstream countries Sudan and Egypt. Ethiopia argues that the GERD will offer several benefits to downstream countries, including hydropower supply at a comparably cheaper price, flood control, water saving through reduced evaporation loss from the reservoirs of downstream dams and trapping silt. In order to create trust and consensus on the dam, the Eastern Nile countries agreed on the establishment of an International Panel of Experts (IPOE), with the task to assess the impact of the dam on downstream countries. According to a press release by the Ethiopian Ministry of Foreign Affairs [20], the IPOE's report indicates, among other things, that the dam could potentially offer significant benefit to all the three Eastern Nile countries. This corresponds with findings in previous studies. A study conducted by the U. S. Bureau of Reclamation (USBR) during the period 1958–1963 proposed a cascade of four major hydro-electric projects (Karadobi, Mabil, Mendaia and the Border) on the Ethiopian part of the Blue Nile Basin between Lake Tana and the Ethiopian-Sudan border [8]. Together these four dams would have a storage capacity of 73.1 billion m³ of water and a total installed capacity of 5570 MW of hydro-electric power and hence collectively compare to the GERD. Contrary to the GERD, the four USBR proposed dams included an irrigation component. Several hydrological models developed to evaluate the impacts of these dams (e.g. [5,6,14,15,30]) reveal that Ethiopia's development of the Blue Nile waters to maximize hydropower production would not substantially affect water supply to downstream countries. Only Block and Strzepek [6] considered here also the potential downstream impacts of the transient filling stages of the reservoirs on downstream flows.

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