Egypt, Sudan and Ethiopia, that are located within the Nile River basin system, produced around 44 million tons of cereals in 2011. This volume of production was unable to satisfy the overall demand, and hence, the region was forced to import about 21 million tons of cereals. Except in Ethiopia, agricultural production in Sudan and Egypt depend exclusively on irrigation since rainfall in these countries is both inadequate to support food production and erratic in its occurrence. Both countries use irrigation water from dams constructed at the various districts along the Nile River. In 2011, Ethiopia also announced the construction of the Grand Ethiopian Renaissance Dam (GERD) along the Blue Nile River, a sub-basin within the Nile River basin system. This dam will have a capacity to store up to 70 billion cubic meters of water that will be intended to produce 15 billion kilowatt-hours of electricity from hydropower and to irrigate agricultural land. The sheer size of this dam and the potential loss to evaporation can affect water allocation among riparian countries and exert more strain to the existing water scarcity challenge in the region.

Such as many international river basins, the Nile basin faces a complex management situation that has not yielded basin-wide or sub-basin institutional arrangement. The GERD dam ushers a new challenge for loosing up the existing hydro-political relationship among the riparian countries. With lack of water allocation agreement and management of the Nile River, the current situations could complicate the cooperative process (known as the Nile Basin Initiative) that has been in place for the past two decades.

Furthermore, the prevalent resource degradation problem of about 525 million cubic meters of top soil erosion in Ethiopia hinders the region’s capacity to sustain both food production and ecological life. The threat of environmental damage in the basin is seriously degrading existing freshwater supplies. Hence, managing Blue Nile River without dealing with resource degradation problem may worsen the existing water scarcity challenges facing these nations and the food security of their vulnerable citizens.

Using a partial equilibrium economic optimization model originally developed by Nigatu (in a different work), we model the effect of this dam on the existing and future land irrigation and hydropower production in the region. In addition, we propose three alternative water rights arrangements with and without intraregional water trade and internalizing externality. We evaluate the performance of each institutional arrangement by estimating the efficient allocation using the social planner setting.

1 Disclaimer: The views expressed are those of the authors and do not necessarily reflect the views of the Economic Research Service or the U.S. Department of Agriculture.
The results suggest that Ethiopia could use Nile water to its comparative advantages of producing more electricity than its potential use once GERD would be fully operational. This helps diversify its agricultural based economy to a new frontier of selling electricity to its neighboring countries and importing more food commodities. Since generating hydropower in Ethiopia is a non-consumptive water use, Sudan and Egypt will use water for food production. The social planner could also assign water for an economic sector that generates the highest economic benefit to the region regardless of water right arrangements. Hence, damming the Blue Nile River helps indirectly Ethiopia and directly Sudan and Egypt to produce food. It is estimated that countries could invest more than $680 million dollar to reduce soil erosion, and water market will provide more cost-effective tools for resource protection than the current use schemes.