Implications of the Grand Ethiopian Renaissance Dam (GERD) on the Lower Nile River Basin

Indigenous People's Water Rights in the Colorado River Basin in the Face of Climate Change

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

As climate change continues to drive innovation across sectors and stakeholders, investigating how certain water management practices and agreements interact has the potential to enable positive outcomes for surrounding populations and environments. The Grand Ethiopian Renaissance Dam (GERD) will have implications on the Lower Nile River Basin's agriculture, water security, and industry. Also, these factors have the potential to cause an amplification of political tensions within the region between nations. Infrastructure investments such as the GERD serves as a way to mitigate the potential effects of climate change by offering adequate storage volumes for drought periods (Jeuland et al.. 2017). Furthermore, as 80% of the water in Egypt is used for agriculture, understanding how this water is being used and the ways in which it can be utilized more efficiently will allow for increased resilience as climate change influences rainfall variability (Piesse, 2019).

For the STS portion of the thesis, the implications of shifting water resources for indigenous peoples in the Colorado River Basin due to climate change will be analyzed. This group is a key stakeholder in water resource planning for the watershed, as indigenous people hold water rights which can influence the future of the region (Walton, 2015). However, with thirteen tribes in the Basin with unresolved water rights claims and some tribes that do not use their full allocation of water resources, policy-making efforts to sustain communities and build economies must take into consideration how the needs of these communities will change over time (Colorado River Research Group, 2016). However, each tribal group has unique goals for their water rights, where some groups lease their water to metropolitan areas and others use their water supplies for irrigating agriculture (Walton, 2015). There are 29 federally recognized tribes

within the Colorado River Basin, with control over 20 percent of the basin's annual average water supply (2016). Some of these tribes within the region include the Chemehuevi and Ft. Mohave in the Lower Basin, the Ak Chin and Ft. McDowell in Arizona, and the Navajo and Southern Ute in the Upper Basin (2016). Furthermore, as the global temperature increases by 1 degree Celsius, the Colorado River's average flow decreases 9.3%, highlighting the importance of creating Basin-wide agreements in order to balance supply and demand (Kuzdas, 2021). These agreements ought to begin by enabling indigenous tribes to have proper access to their water rights in order to meet basic water needs (2021).

These two regions, the Lower Nile River Basin and the Colorado River Basin, are both faced with climate change impacts on their hydrology and in turn, the communities that rely upon them require careful planning to create a sustainable future. Analysis regarding how these systems are shaped by outside factors such as the filling of a dam in Ethiopia or water allocations in Arizona can help to inform best practices for the sustainable use of natural resources.

Leveraging Sustainable Water Management Practices to Increase Resiliency

The research team will analyze the GERD's effect on the Lower Nile River Basin in order to inform strategies for water management in the face of a changing climate and needs of the surrounding communities. A paper authored by Allam and Eltahir in 2019, Water-Energy-Food-Nexus Sustainability in the Upper Blue Nile (UBN) Basin, uses a model to allocate land and water resources optimally to rain-fed agriculture and water for agriculture and power production while maximizing total benefits. The paper further outlines the necessary tradeoffs between agricultural expansion and hydropower generation required within the region in order to limit stress on stakeholders. Additionally, an analysis of farming systems and

agricultural productivity was done by Karimi (2012), where: “interventions like supplemental irrigation, rainwater harvesting, and application of soil water conservation techniques can increase productivity in many rain-fed areas…”. Thus, in order to determine the effectiveness of GERD-related water management practices within an agricultural context, one must incorporate power generation and hydrologic impacts into an economic analysis. Analysis for the research team will include reliance on previous research on the relationship between hydropower and agriculture in prior case studies. An example of an analysis of the tradeoff between agricultural water allocation and power production was that of the High Aswan Dam conducted by Katherine Oven-Thompson, Luis Alercon, and David Marks (1982). As seen in their research there was an inverse relationship between power produced and water allocated to agriculture (1982). Within the context of climate change, rainfall variability has influence over water security in Sudan and Egypt. Thus, the utilization of LANDSAT imagery will lead to conclusions about variations in land cover and hydrology in the region as a function of the GERD’s filling (Kansara, 2021; Elagouz, 2020).

Using Human-Nature Interactions to Investigate Water Rights

While water rights within watersheds have analytical components such as measurements of rainfall, drought, and flow, another important metric to consider is the qualitative information that informs water-related policy within the Colorado River Basin. Where water problems are often problems of justice, as “Changing water allocations – whether through reform policies, new technologies, or markets – implies complex processes of political contestation, negotiation and struggle.” (Zwarteveen, 2014). Using the framework in Richard White’s *The Organic Machine*, the energy system within human-nature interactions can be used as a lens into the

complexities of water rights for communities in the Colorado River Basin (Cohen, 2005). White's use of terms such as energy and organization can be applied to how indigenous peoples and other stakeholders view water, which then in turn can be analyzed against legislation on the river to see where improvements to water planning can be made.

Also, water-based infrastructure can often serve as a political object for structure within a socioeconomic system. Understanding whether certain water management practices are inherently working to build order within the world and how much these political objects may work to divide and unite societies can lead to the creation of water rights that instigate positive tangible arrangements of assets (Winner, 1980). Winner's work outlines the development of this social order, for example the use of Robert Moses's bridges in New York which kept minority communities away from a public park (1980). Indigenous communities within the Colorado River Basin are at risk of losing their power over water allocations as climate change is creating the need for a reimagined sharing of water supplies across the region (Finley, 2019). Shifting ideas in the face of climate change requires the use of Winner's description of political and physical meaning when outlining new steps for how water should be viewed. For the Colorado River Basin, water allocations for each tribe can be interpreted as a constraining force, as well as a pathway for freedom, for the indigenous populations that depend on the river's flows. A prioritization of uses for the water flowing within the region must be used in order to develop a sustainable future as the climate changes to a more arid one, where efficient water allocations must be made as a first step in comprehensive planning (Morrison, 1996).

Research Questions and Methods

The research team will gather information and data from various sources to determine positive and negative implications of the operation of the GERD so as to draw out connections between potential problems and solutions. Data collected will include but is not limited to satellite observations related to soil moisture, irrigation practices, past river flows and land use changes. Furthermore, an economic analysis will be categorized using parameters including but not limited Gross Domestic Product (GDP) on sectors impacted by the development of the GERD, such as agriculture and power generation. Ethiopia, Egypt, and Sudan are the immediate context in which the team will investigate these implications. By the end of the Fall 2021 semester the team will have outlined the necessary data and modeling efforts that need to be completed in the Spring 2022 semester.

For the STS portion of the thesis, a thematic analysis will be done to research the water rights of indigenous communities in the Colorado River Basin in the face of climate change. *The Organic Machine*, *Do Artifacts Have Politics?*, and other sociological focused models will be used in order to develop new ideas about how water management practices at federal and local levels have influence over the people in the region, economies, and the environment. This analysis will include interactions between the changing hydrology due to climate change, past and current legislation regarding water allocations for each indigenous tribe, and current research by policy groups. By the end of the Fall 2021 semester a literary review and the preliminary analysis will have been completed. Then, during the Spring 2022 semester, the STS research paper will be completed.

Conclusion

The ability to make informed decisions regarding water resources in the Lower Nile River Basin and in the Colorado River Basin enables communities to come together as the global climate changes. Current social tensions within the Lower Nile River Basin's countries of Sudan and Ethiopia and drought conditions seen in Lake Mead, a reservoir along the Colorado River, highlight the importance of proper water management planning and social coordination. Analysis in both of these regions across technical and social dimensions will yield results that can inform the other area of interest. Where understanding the management practices associated with a given economic output in turn provides a vantage point to view the associated societal and political implications. By understanding these factors, leaders across regions can become more informed as to how to frame their decisions for water resources and the communities that rely on them.

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