Politics of the Grand Ethiopian Renaissance Dam: The Role of Egyptian Farmers

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Adam O'Neill

Spring 2022

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

Advisor

Rider W. Foley, Department of Engineering and Society

Introduction

Do we live in a world that could see nations warring over water? The Grand Ethiopian Renaissance Dam (GERD) has given reason for rumor. It is the newest and largest hydroelectric dam being built in the Nile River Basin in Ethiopia near the border of Sudan. Filling this dam would restrict water availability to Egypt and to a lesser extent Sudan (Yang et al., 2021). Ethiopia, Sudan, and Egypt rely on the waters of the Nile River Basin to sustain their populations' water, food, and energy security to varying degrees (Heggy et al., 2021). 85% of the Nile originates in Ethiopia, but very little actually is needed or used there (Mbaku, 2020). Alternatively, Egypt relies on the Nile for 90% of its water needs (Heggy et al., 2021). The dam could damage downstream water quality, affecting crop yield (Elagib et al., 2021). All the while, it will generate electricity for millions of unelectrified residents of Ethiopia (Heggy et al., 2021), a conflict of interest leading to heightened tensions between the three nations (Mbaku, 2020).

The region is likely to experience extended drought in the near future during the filling period of the dam which compounds to increase water scarcity downstream (El Bastawesy et al., 2015). Particularly, the crux of scarcity lands on Egyptian farmers, the primary utilizers of Egypt's Nile water supply through extensive irrigation, on whose labor the burden of supplying Egypt's food and subsequently upholding the national Gross Domestic Product (GDP) rests (USAID, 2020). When the lifeblood of Egypt's agriculture dries up, the first to feel the effects are the farmers.

Management of the over-utilized Nile waters is a contentious issue, requiring careful expression of scientific findings. Researchers have struggled to identify an optimized GERD operation system that balances physical water budget needs as well as political interests of the three nations involved (Wheeler et al., 2018). To properly address this multifaceted issue, efforts

must be made to understand the history of water-politics unfolding during the last century which inform stakeholders' various perspectives on water rights.

The GERD is a political artifact (Abdelhady et al., 2015), created, controlled and shaped by political entities, and such effects on Egyptian farmers cascade from the politics of the GERD. Egyptian farmers are an important yet vulnerable and overlooked social group in the Nile water resources system. The GERD's politics are mixed into the water, carried downstream hundreds of miles to arrive in the canal of an Egyptian farmer. This research seeks to understand the misuse of those politics by illuminating the role of Egyptian farmers. The end goal is two-fold: to give visibility to an invisible and overlooked social group, and to illustrate and inform equitable water utilization by cooperative management of the Nile River Basin resources.

System View of the GERD

To understand the big-picture system in which Egyptian farmers exist, the operation of the GERD and its relation to other system components must also be understood. The filling period of the dam may have negative effects on downstream water security, land use change, agriculture and resilience, power production, and ultimately economic and human wellbeing. Spatial, hydrologic, and economic data paint a picture of the GERD's effects, quantifying human impacts based off modeling techniques that co-evolve hydrologic conditions and Egypt's macroeconomy (Basheer et al., 2021). Ultimately, consideration of the technical operation of the dam is inextricably nested in international politics and transboundary river management, as will be discussed henceforth.

Hydrologic models simulating rainfall, land use and agriculture changes, river flow, power production, and reservoir filling scenarios inform possibilities of how the Nile's resources will be affected by the dam. Published models, such as those from El Bastawesy et al. (2015),

Heggy et al. (2021), and Wheeler et al. (2018), help to understand the GERD in the context of the internationally managed Nile River. Regarding water security, El Bastawesy et al. (2015) presents hydrologic data analysis and makes predictions that the variability in rainfall in conjunction with the filling of the GERD would pose challenges to Egypt and Sudan due to potentially major abstractions in flow (El Bastawesy et al., 2015). The authors showed that a 20% annual rainfall variability could be expected soon. The GERD has a high probability of operating during a period of low rainfall and high filling rate which could hinder downstream flows significantly (El Bastawesy et al., 2015).

Heggy et al. (2021) reached similar conclusions with albeit wider reaching implications informing the investigation into water security, agricultural land use change, and economics. The authors accomplish this through economic modeling of seven different GERD filling scenarios, showing the worst and best-case scenarios in terms of their impact on Egypt's water budget. In worst-case scenarios in which Egypt and Ethiopia do not cooperate at all, filling the GERD would increase Egypt's water deficit by 31 billion cubic meters per year ($BCMyr^{-1}$) during the filling period, a third of their water budget, resulting in a loss of agricultural land by 72% and GDP of $51B, which is 8% of national GDP (Heggy et al., 2021). The study then pivots to economic feasibility modeling, in which it suggests better irrigation practices on Egypt's end, notably without suggesting that Ethiopia must adjust its operations or cooperate for Egypt to maintain status quo (Heggy et al., 2021).

In that vein, a large portion of the end users of the Nile's waters are irrigation farmers. Irrigation is a key factor uniting investigations into land use and agriculture change, agriculture and resilience, and water security. Alternatives to intensive irrigation such as perennial cover crops as suggested by Basche and Edelson's (2017) review of agricultural and land use data

through GIS analysis offer potential solutions to Egypt's pending loss of agricultural water in the absence of international cooperation.

In contrast, most models, according to Wheeler et al. (2018), are developed using hypothetical infrastructure configurations that do not or could not reflect the actual dams in use or planned. They argue that the effects of increased hydrologic variability can be managed best by solutions in which Ethiopia cooperates and shares water with downstream nations – solutions which this model facilitates, rather than new, costly, or unrealistic infrastructure configurations (Wheeler et al. 2018). Wheeler et al. (2018) suggests cooperation as a best-case scenario. In the following investigation, the assumption will remain that cooperation can yield the best results for all three nations, but it is not required specifically for Egypt to mitigate the negative effects of the dam.

Sociotechnical analysis informs the question of cooperation and equitable utilization within the system of the GERD. The unavoidable introduction of less predictable factors such as national governments and social groups, as opposed to technical considerations such as drought probability, agricultural yield, or hydropower production into this system implies that its creation and use depends on political factors. Hence, analysis of the GERD requires careful attention to the people that win or lose as it fills, and the power afforded to those people.

Techno-Politics of the GERD

Different scales and styles of water governance structures lead us to the people in question. Engineers manage reservoir releases, controlling for hydropower, downstream erosion, and water quality. Farmers divert water into their canals with or without conscious permission or participation in larger scale water governance structures. Water is produced as an interplay between social groups at different scales (Barnes, 2014).

First, the nations and their governance structures can be framed using review of large-scale social interplay with regards to water rights and governance. Second, the technical review presented above informs the possibilities available to the actual operation of dam technology. Third, at the scale of the end-user, an ethnographic account of Egyptian farmers' role in water use establishes a connection between the large and the small scale, illuminating the harm caused by the politics of the GERD. Each scale will be considered within the framework of techno-politics (Winner, 1980).

Techno-politics underlies and frames this discussion. The notion that an artifact such as the GERD can have politics, (i.e., power structures) of its own comes from Winner (1980). Winner (1980) argues artifacts are embedded with politics in part due to the designer's purposeful employment of technology for political reasons. The GERD and its restriction of water to Egyptian farmers is comparable to Winner's (1980) example of the tomato harvester, which was developed with specific intention to modernize tomato harvesting and yielded positive results but left human tomato farmers without work. Similarly, the Ethiopian designers of the GERD intend for it to modernize and provide access to electricity and water for their nation, yet implicitly deny downstream users such as Egyptian farmers access to Nile waters, imprinting the politics of access denial onto the GERD as much as they imprint the politics of modernization.

At the nation-scale, why does water governance look this way in the Nile River Basin? Hydro-egoism, a kind of uncompromising belief in entitlement to the Nile's resources (Rossi, 2021) is one possibility. The refusal to cooperate reflects hydro-egoism. Rossi (2021) describes the political arena around the Nile River Basin because of history and present water law philosophies governing Egypt, Sudan, and Ethiopia's management of the GERD. The author

argues that Ethiopia and Egypt stubbornly appeal to their hydro-egoism while perpetuating hegemonial water management, all of which contributes to the slowing and disabling of cooperative agreements. Colonial treaties and declarations regarding water ownership form the context of each nation's claim to the Nile, producing hydro-egoism. Hydro-egoism is then borne into techno-politics. Ethiopia is "enacting the techno-politics of national identity," as Edwards and Hecht (2010) would describe South Africa's apartheid state's employment of nuclear technology as a power pawn and national identifier.

At the scale of the operation of the GERD, the models described previously and the solutions available support cooperative management (Wheeler et al., 2018). Opening the door to Egypt and Sudan to hear their concerns and operate the dam at an optimized level would then re-imprint new politics on the GERD, politics of cooperation. It would create a new channel from Egyptian farmers to the Ethiopian water governance structure. The relation of farmers to larger scale groups is summarized in the Behavior Influence Assessment (BIA) (Jeffers et al., 2015). The model showed that increased food prices would cause the most unrest (Jeffers et al., 2015). This shows that Egyptian farmers are placed into a position of relative responsibility and importance as their food production ultimately drives social reaction to the GERD.

The GERD is one technology in a vast array of dams, pumps, canals, irrigation, water governance structures, national and international water ministries, and so on. Finally, at the scale of the farmer, only by asking how the water used by the Egyptian farmer is produced from rain to river, from governance structure to engineer, from dam to pump, from canal to farmer can the nature of the multi-scale issue at hand be properly understood, according to Barnes (2014). Barnes (2014) posits that water is made, not given, in that it travels through many decision nodes dictated by different social groups. The next step, investigated through this research, is to

understand how water for the Egyptian farmer is made by a critical decision node, the GERD, and how that decision produces harm.

Research Question and Methods

How does the imprint of Nile River politics on the GERD produce water in a way that causes harm to Egyptian farmers? Are farmers just an externality to the GERD and a victim to the tragedy of the commons, or does their specific position in the system of water and power give them a voice?

Egyptian farmers have an important role in using the Nile's waters to produce food for Egypt and turn a profit at the same time, and they are the most vulnerable to reduced water availability caused by the filling of the GERD. This research seeks to develop a case study of Egyptian farmers and the GERD within a techno-political framework.

The evidence gathered to develop the case study centers around the ethnography *Cultivating the Nile* (Barnes, 2014). Excerpts from this human-scale evaluation of techno-political effects of water security issues on Egyptian farmers are validated and contrasted by several recent media or agency reports such as Youssef (2020), existing treaties like the 1959 Sudan – UAR Treaty on Nile River allocations (Agreement, 1959), referred to as the Treaty, Water Security and Hydro-Egoism: Endogenous Hegemony and the Grand Ethiopian Renaissance Dam (Rossi, 2021), and finally the Behavior Influence Assessment, or BIA (Jeffers, 2015). The latter three sources were used to validate *Cultivating the Nile* (Barnes, 2014) and were cross validated by each other and the seven statements from the articles. Then, the thematic correlations were evaluated. Statements from these documents were thematically coded illuminate their correspondence to techno-political effects on farmers, and the validating statements from news and organizations were compared thematically to their corresponding

Cultivating the Nile (Barnes, 2014) claims to see if there is correlation between themes stressed by differing viewpoints about the same topics.

The process of selecting representative excerpts and thematically coding them for techno-political themes is ultimately subjective, but it informs the case by restraining subjective judgments to techno-political categories. Statements from *Cultivating the Nile* (Barnes, 2014), articles from reporting agencies and organizations, the BIA (Jeffers, 2015), Hydro-Egoism (Rossi, 2021), and the Treaty (Agreement, 1959) were chosen and coded based on their central claims and how much they illuminate five themes: Farmer's Water and Food Security, Water Governance Systems, Power Dynamics and Politics, Technology and Access, and Environmental Factors. These are described in further detail in Appendix G. To accomplish this, six excerpts from the first two chapters of *Cultivating the Nile* (Barnes, 2014) were chosen, found in Appendix A. All references to Excerpts 1 through 6 refer to those found in Appendix A. The excerpts were not chosen at random. Excerpts were chosen that highlighted Barnes' techno-political ethnographic findings, relating farmers to the technology and water governance structures they rely on. Evidence was then gathered to support these excerpts. This process is summarized in Appendix G.

All the articles and supporting evidence that were reviewed were connected back to the specific excerpts from *Nile* that they supported by corroboration according to Table 1, Appendix E. Then, each excerpt from *Nile* and each statement from every other piece of evidence was thematically coded for each of the five themes. The count of every occurrence or mention of a theme was recorded. This was translated to percentages as the lengths of excerpts and statements differed, and the results are tabulated in Table 2, Appendix E, and shown in Figure 2, Appendix D. Each *Nile* excerpt's themes were then compared to the averages of the percentages of their

validating evidence's themes. The similarity in each was assessed using a Cosine metric (Kheraj, 2019) according to Appendix F. This provided evidence of how perspectives have changed over time.

Case Study Results

The GERD acts as a spotlight to focus attention on the deeper issues of Egypt's mismanagement of water. Egyptian farmers are in the limelight because of the GERD. Instead of Ethiopian access denial primarily being imprinted on the GERD in a way that harms farmers, farmers reflect the politics they are subjected to back onto the GERD to define its techno-politics. The GERD is raising the political voice of the Egyptian farmer, and they have projected their long-suffered understanding of water governance onto the GERD.

"'There used to be enough water to make all this area green … Now, it is as you see,' he said… 'The dam means our death,'" states an Egyptian farmer in 2020, Abu Kassem, as he looks out over his farm that is barren and dying for lack of adequate water supply (Al Jazeera, 2020). Sometime between 2007 and 2014, Jessica Barnes completed and wrote her ethnography, *Cultivating the Nile.* A similar sentiment, nearly a decade before, is expressed by a farmer she befriended, Abu Khaled, "We are talking over cups of sweet tea one summer evening. The crops are not doing well, he tells me, because of the heat. It is hotter than it has been in the past. There is not enough water. The crops are tired… There is a pattern to this scarcity," (Excerpt 6, Appendix A). Scarcity has become a growing pattern over the last decade in Egypt. Water scarcity is not new to these farmers (Excerpt 3, Appendix A). Neither is the struggle with power expressed through technology as dams and weirs control who gets precious water. "The dam means our death," is the quintessential expression of the Egyptian farmer in the face of the GERD.

Barnes says, “Those at the ends of the canals (“below” [taht] as they say in Arabic) may have no water at all. Those at the heads of the canals (“above” [fowq]) are fortunate to receive the water first, but still may not have enough water to grow the crops they would like. Both face a type of scarcity,” in Excerpt 3, Appendix A. This is how Egyptian farmers perceive the GERD because of Egypt’s bureaucratic mismanagement of water and power.

Power Dynamics and Politics was a reoccurring and dominant theme in *Cultivating the Nile* (Barnes, 2014). Political statements were often paired with mentions of Egypt’s water bureaucracy and governance system. The battle for water was often fought between farmers and the water ministry, as shown by Excerpts 5 and 6 (Appendix A), through the medium of technology such as dams, weirs, and control structures, evidenced by the consistency of Technology and Access mentions in all six excerpts (Appendix D, E)

The articles validate that the farmer’s struggle was mainly with the water bureaucracy, and that it continues as the GERD becomes a threat. Reporting agencies were concerned with the stories of farmers suffering from water insecurity because of international and internal politics and mismanagement, as seen in The Africa Report 1 and Al Jazeera statements (Appendix B). Two of the articles, The Africa Report 2 and Egypt Today (Appendix B), were written specifically to draw attention away from the GERD’s effects and towards mismanagement of water in Egypt.

The similarity metric, if low, points to where narratives may have shifted. Excerpts 2, 4, and 5 were the lowest, as shown in Figure 1, Appendix D Excerpt 4, thematically, was about Water Governance Systems, and stated that ultimately development projects were in the hands of international donors, pointing out flaws in internal water management. But it scored low on its similarity to the articles that corroborated its claims. The articles also implied that water

management wasn't in the hands of the farmers, but they focused more on the technological causes of scarcity such as the looming GERD and the sufferings of the farmers themselves, as seen in both Al Jazeera statements (Appendix B). The Fanack Water article specifically defended water governance in Egypt, pointing to the many programs working to increase water use efficiency (Appendix C). The blame for scarcity is shifting to the politics held by the GERD, not Egypt's water bureaucracy. What are those politics?

They are visible on the international scale, where internal mismanagement is a less common theme. The supporting evidence statements were overwhelmingly skewed to Power Dynamics and Politics. Each included Technology and Access as a second major theme (Appendix D, E) The supporting evidence statement and *Nile* together illustrate a decline in cooperative efforts by Egypt and Ethiopia. "In case any question… needs negotiations with the governments of any riparian territories outside [of Egypt and Sudan], the two Republics shall agree beforehand on a unified view in accordance with the investigations of the problem by the Committee," (Treaty, Appendix C). This statement has given Egypt a stubborn dependence on the argument that they maintain oversight and veto power over projects initiated outside of Egypt and Sudan because of the Treaty. Today, that argument repulses Egypt from Ethiopia and vice-versa, resulting in Hydro-Egoistic deadlock.

"Hydro-egoism has been paradigmatically identified as likely to lead to violence when… the downstream country is highly dependent on the water; the upstream country is able to restrict the flow; and a history of antagonism between the two exists…" (Hydro-Egoism, Appendix C). These statements cross validate with Barnes' research. "Ethiopia's recent launch of the Grand Renaissance Dam (also known as the Hidase Dam) project on the Blue Nile, however, in direct contravention of Egypt's veto power, signals the upstream countries' unwillingness to continue

to accept the terms of an agreement to which they were not party," (Excerpt 1, Appendix A). It seems that cooperation is the Egyptian government's fatal flaw. If cooperation could flow between farmers and Egyptian government, as well as Egyptian government to Ethiopia, then equitable utilization may be within reach. "The best way to prevent unrest is to prevent or mitigate the GERD's impacts. Effective diplomacy is one strategy that was tested and found to prevent extreme unrest," (BIA, Appendix C).

Cooperation is a key power dynamic. The lack of cooperation is the political ideology imbued onto the GERD by all parties. Every statement speaks to how governments aren't cooperating or need to cooperate with each other and with the end users of the water.
The story hasn't changed over time for the Egyptian farmer, but now its implications are far more dire. The Africa Report 1 highlights discontent with their own government's management of water because farmers have no power to make decisions (Appendix B). The Africa Report 2 highlights animosity between nations as each sees different benefits to the GERD (Appendix B). The Al Jazeera article displays the reality of water scarcity to a farmer and the damage done, and the Egypt Today article tries to save face for Egyptian water ministry (Appendix B). The GERD now runs a plumb line through all of it. The bureaucracy is trying to teach the farmer how to save water (Excerpt 3, Appendix A), but farmers have always been aware of the inadequacy of their superiors manning the sluice gates to secure enough water for their livelihoods. Now they are existentially afraid of what will happen when the whole water governance structure sits proverbially at the "end of the canal" at the mercy of Ethiopia.

Discussion

This research falls into the debate of equitable utilization, defined as the reasonable and fair sharing of a resource's benefits (Kandeel, 2018). To illustrate, what The Africa Report 2

(Appendix B) deals with is a simple question of utilitarian ethics. Ethiopia sees the GERD as the greatest good for their country, with Egypt simply mismanaging their resource. Therefore, the most equitable utilization of *shared* Nile waters is surely the one that finally gives Ethiopian's access to electricity. Inequitable utilization is to let Egypt control the water according to the 1959 Treaty (Appendix C). Ethiopia believes they can both get what they need to flourish, even if Egypt suffers briefly from the filling period – they share the water, so they should share the burden.

What Egypt sees is quite the opposite. They see the GERD as in South Africa's nationalizing nuclear technology according to Edwards and Hecht (2010). They see it as an expression of hydro-egoism, of national water ownership (Rossi, 2021). They see their unequal share of Nile water granted by the 1959 Treaty (Agreement, 1959) as necessary because of their unequal need for the Nile's waters. It is not a question of the greatest good, but of justice and fairness ethics. Ethiopia is seen as unjustly taking more than their share and leaving Egyptians to suffer, especially the farmers. So, the water ministries are rushing to implement efficiency upgrades to irrigation to manage their precious resources truly better. But Egyptian farmers see the same story that was told before the GERD began filling – an unfair system.

Of course, this is not the full picture. This is a narrow case study of Egyptian farmers as they relate to a piece of large, internationally controversial infrastructure. Information about the status and stability of the governments in question, other stakeholder's opinions of the GERD, and the actual costs of operating the GERD is left out of the analysis. Furthermore, the method of thematic coding is subjective and unempirical. As presented here, it does not allow for robust analysis, only for a look into the author's biased perspective into the sources selected. The results

produced were not intended to make definitive claims about the world, but to highlight patterns for further investigation.

In the future, less sources coded in their entirety multiple times by multiple people would yield more informative results as to the shift in narrative around the GERD. Furthermore, actual data backing up the claims of water stress made by some of the authors would greatly support the argument. There is also a volatile political arena surrounding this topic, and taking time to delve into that, accounting for civil war in Ethiopia and diplomatic sparring between Egypt and Ethiopia would put an enlightening lens on the topic. As always, with more time available, deeper study of the issue could be accomplished.

There are always human beings on the other side of the dam. At the end of the canal, you find a human being that will decide how view the technology that delivers their water. Embedded into structures that control the most important substance on the planet is the choice to see to that human being or to ignore them. Whether it is the choice of the engineer that brings them an equitable allotment of water is a discussion that this research will inform as my career ensues. Who gets gas, electricity and water is never as simple as building a pipeline directly where it needs to go.

Conclusion

Egypt's water governance system and technical resource management has produced scarcity such that Egypt is rapidly losing agricultural land causing suffering and stress to farmers. The GERD represents the ultimate extension of that struggle which delivers the final blow. It is an existential threat, and it is causing disarray in the water management community in Egypt. The obvious locus of power is Ethiopia. But Egyptian farmers have the power to influence the Egyptian government to push for cooperation. If Ethiopia refuses, it is up to the Egyptian water bureaucracy to manage the reduction of water due to the GERD in a sustainable

way by cooperating with Egyptian farmers and give them a say. As of now the GERD is still a perceived ill, and it does not have to mean their death, though it could if unchecked.

I envision others can build on the techno-political viewpoint on the impact of hydropower dams in the future. There will be more controversial dams, and climate change is accelerating the disparity in access to water. Recognizing the people that win or lose from large dam project can help to prioritize what voices need to be heard and can help to establish a bastion of cooperation instead of hydro-egoism.

References

Abdelhady, D., Aggestam, K., Andersson, D.-E., Beckman, O., Berndtsson, R., Palmgren, K., … Pilesjö, P. (2015). The Nile and the Grand Ethiopian Renaissance Dam: Is There a Meeting Point between Nationalism and Hydrosolidarity? Journal of Contemporary Water Research & Education, 155. https://doi.org/10.1111/j.1936-704X.2015.03197.x

Agreement Between The United Arab Republic And The Republic Of Sudan For The Full Utilization Of The Nile Waters. Sudan – United Arab Republic. November 8, 1959. Retrieved from: https://www.internationalwaterlaw.org/documents/regionaldocs/UAR_Sudan1959_and_Protocol1960.pdf

Al Jazeera. (2020, August 20). 'Means Our Death': Egyptian Farmers Fear Effect of Ethiopia Dam. Retrieved March 20, 2022, from https://www.aljazeera.com/news/2020/8/20/means-our-death-egyptian-farmers-fear-effect-of-ethiopia-dam

Barnes, J. (2014). Cultivating the Nile: The Everyday Politics of Water in Egypt. New York, USA: Duke University Press. https://doi.org/10.1515/9780822376217

Basche, A. D., & Edelson, O. F. (2017). Improving water resilience with more perennially based agriculture. Agroecology and Sustainable Food Systems, 41(7), 799–824. https://doi.org/10.1080/21683565.2017.1330795

Basheer, M., Nechifor, V., Calzadilla, A., Siddig, K., Etichia, M., Whittington, D., … Harou, J. J. (2021). Collaborative management of the Grand Ethiopian Renaissance Dam increases economic benefits and resilience. Nature Communications, 12(1), 5622. https://doi.org/10.1038/s41467-021-25877-w

Berihun, M. (2020). Dear egypt... Retrieved March 20, 2022, from https://www.theafricareport.com/30259/dear-egypt/

Cohen, Y. (2021). Egypt Has a Water Problem-And No, It's Not Only The GERD. Retrieved March 20, 2022, from https://www.atlanticcouncil.org/blogs/menasource/egypt-has-a-water-problem-and-no-its-not-only-the-gerd/

Edwards, P. N., & Hecht, G. (2010). History and the Technopolitics of Identity: The Case of Apartheid South Africa. *Journal of Southern African Studies*, 36(3), 619–639. https://doi.org/10.1080/03057070.2010.507568

Elagib, N. A., & Basheer, M. (2021). Would Africa's largest hydropower dam have profound environmental impacts? *Environmental Science and Pollution Research*, *28*(7), 8936–8944. https://doi.org/10.1007/s11356-020-11746-4

El Bastawesy, M., Gabr, S., & Mohamed, I. (2015). Assessment of hydrological changes in the Nile River due to the construction of Renaissance Dam in Ethiopia. *The Egyptian Journal of Remote Sensing and Space Science*, 18(1), 65–75. https://doi.org/10.1016/j.ejrs.2014.11.001

EgyptToday. (2018). No relation between Gerd, reducing rice agriculture areas: Egypt. Retrieved March 20, 2022, from https://www.egypttoday.com/Article/1/48962/No-relation-between-GERD-reducing-rice-agriculture-areas-Egypt

Heggy, E., Sharkawy, Z., & Abotalib, A. Z. (2021). Egypt's water budget deficit and suggested mitigation policies for the Grand Ethiopian Renaissance Dam filling scenarios. *Environmental Research Letters*, *16*(7), 074022. https://doi.org/10.1088/1748-9326/ac0ac9

Jeffers, R., Bernard, M., Passell, H., & Silver, E. (2015). Behavior Influence Assessment of Impacts of the Grand Ethiopian Renaissance Dam on Unrest and Popular Support Within Egypt. *Procedia Manufacturing*, *3*, 4014–4021. https://doi.org/https://doi.org/10.1016/j.promfg.2015.07.965

Kandeel, A. (2021). Sub-Saharan Africa must respect North Africa's water rights. Retrieved November 01, 2021, from https://www.mei.edu/publications/sub-saharan-africa-must-respect-north-africas-water-rights

Kheraj, S. A. (2019). Similarity Measures — Scoring Textual Articles. Retrieved March 20, 2022, from https://towardsdatascience.com/similarity-measures-e3dbd4e58660

Kimenyi, M., & Mbaku, J. (2016). The limits of the new "nile agreement". Retrieved November 1, 2021, from https://www.brookings.edu/blog/africa-in-focus/2015/04/28/the-limits-of-the-new-nile-agreement/

Mbaku, J. M. (2020). The controversy over the Grand Ethiopian Renaissance Dam. Brookings. Retrieved November 1, 2021, from https://www.brookings.edu/blog/africa-in-focus/2020/08/05/the-controversy-over-the-grand-ethiopian-renaissance-dam/.

Rossi, C. (2021). Water Security and Hydro-Egoism: Endogenous Hegemony and the Grand Ethiopian Renaissance Dam. *Indiana International & Comparative Law Review, Forthcoming*. Retrieved from http://dx.doi.org/10.2139/ssrn.3921624

U.S. Agency for International Development [USAID] (2020). Agriculture and Food Security: Egypt. Retrieved November 1, 2021, from https://www.usaid.gov/egypt/agriculture-and-food-security.

United Nations. (1997). UN Convention on the Law of the Non-navigational Uses of International Watercourses. Retrieved November 1, 2021, from https://www.internationalwaterlaw.org/documents/intldocs/UN_Watercourses_Convention-English.pdf

Water use in Egypt. (2022, January 19). Retrieved March 20, 2022, from https://water.fanack.com/egypt/water-use/

Wheeler, K. G., Hall, J. W., Abdo, G. M., Dadson, S. J., Kasprzyk, J. R., Smith, R., & Zagona, E. A. (2018). Exploring Cooperative Transboundary River Management Strategies for the Eastern Nile Basin. *Water Resources Research*, *54*(11), 9224–9254. https://doi.org/https://doi.org/10.1029/2017WR022149

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121–136. http://www.jstor.org/stable/20024652

Yang, G., & Block, P. (2021). Water sharing policies conditioned on hydrologic variability to inform reservoir operations. *Hydrol. Earth Syst. Sci.*, 25(6), 3617–3634. https://doi.org/10.5194/hess-25-3617-2021

Youssef, A. (2020, October 22). Egyptian farmers living in the shadow of Ethiopia's dam. Retrieved March 20, 2022, from https://www.theafricareport.com/45385/egyptian-farmers-fear-ethiopias-gerd-will-change-their-livelihood/

Appendix

Appendix A. *Cultivating the Nile* Excerpts

From Barnes (2014)

Excerpt 1

"Egypt also has the power to veto any upstream water development projects that could impact this water allocation. Ethiopia's recent launch of the Grand Renaissance Dam (also known as the

Hidase Dam) project on the Blue Nile, however, in direct contravention of Egypt's veto power, signals the upstream countries' unwillingness to continue to accept the terms of an agreement to which they were not party…"

Excerpt 2
"The system of water distribution is therefore a highly centralized one. The ministry's influence stops, though, at the point where the water flows out of the canals and into the irrigation ditches, known as mesqa, which are managed collectively by the farmers. The point of water usage thus ultimately lies in the farmers' hands."

Excerpt 3
"In a workshop for ministry staff in Fayoum, the Egyptian consultant leading the workshop said, "We need to go to a farmer and say, 'Take care of that water. The Nile might dry up!' We need to make the farmer understand that water is limited." Ironically, just as he said this, the director general of irrigation in Fayoum, who was sitting next to me, received a call on his cellphone. "Inshallah by the end of the day you should get water," he reassured the person at the other end of the line. "We opened it up yesterday afternoon." Clearly whoever he was talking to was complaining about there not being enough water in a certain canal. That person had no need to be trained in scarcity. I would suggest that most farmers do not need "raised awareness" about water scarcity. Many are keenly aware of how limited water resources are."

Excerpt 4
"These new mechanisms of channeling water from canal to crop seek to remold the landscape of Egypt's water. To date, they are only present in the areas that donor projects have targeted for intervention. The everyday pattern of water movement through the fields is therefore tied to the decisions made by international consultants and ministry officials about which areas should be prioritized for improvement."

Excerpt 5
"The second moment, another meeting, this time in the reception room of a sheikh al-balad (a village leader who is appointed by the Ministry of the Interior). We are sitting on armchairs, once ornate and grand, now dirty and worn out. I am with community organizers from the ministry, who are here to explain to this village leader about the water user associations that the ministry is establishing (see chapter 3). The man interrupts the community organizers' explanation. "All I want is water, that's all, so that I can get the land ready for cultivation." He raises his voice, frustrated. "If you went to the canal now, you would see that there is no water in the canal. We've been complaining for ages (min zaman). We're tired. I myself am tired. We're at our wits' end!"'

Excerpt 6
"The third moment, a conversation with a friend of mine, Abu Khaled. We are talking over cups of sweet tea one summer evening. The crops are not doing well, he tells me, because of the heat. It is hotter than it has been in the past. There is not enough water. The crops are tired… There is

a pattern to this scarcity. Those at the ends of the canals are generally those who receive the least water. But even upstream farmers growing water-intensive crops like rice may consider their water to be scarce. In one meeting between farmers and ministry officials, a man started to complain about how his rice was suffering because of a lack of water. Someone at the back of the room interrupted him: "He talks about rice, but we don't have rice or wheat. I don't want to grow rice. I just want to cultivate my land!" Those at the ends of the canals ("below" [taht] as they say in Arabic) may have no water at all. Those at the heads of the canals ("above" [fowq]) are fortunate to receive the water first, but still may not have enough water to grow the crops they would like. Both face a type of scarcity."

Appendix B. Article statements

The Africa Report 1
Egyptian farmers living in the shadow of Ethiopia's dam

"An activist in the leftist Revolutionary Socialist group whose family also depends on farming, tells The Africa Report that these rules have deeply affected the farmers and their livelihood.

"They were applied without any societal dialogue and without taking the opinion of the very people whose lives are affected by it," he says, adding "farmers are more concerned with securing food for Egyptians because their lives depend on it."

The activist who spoke on condition of anonymity says that: "Farmers do not constitute a political danger to the regime due to the competition among them and lack of any sense of solidarity or organisation."

"Members of the syndicate and the parliament only show up before the elections to gather votes and distribute smiles while we don't hear from them till the coming election," says Salem, a farmer from Luxor who also grew sugarcane but his produce has drastically decreased due to new regulations." (Youssef, 2020)

The Africa Report 2
Dear Egypt…

"Why is it that you mobilize your citizens on an issue that you have securitized—which should never have been securitized to begin with—when many of your tangible and imagined woes can be confronted at the home base? Again, this is not to antagonize but merely to point out that our negotiations currently being coloured with a lack of empathy will add to, not deduct from, our vast backlog of loads we each face in our homes. And what then when I continue to make use of my share of our water not only through my dam but a variety of other plans that I have?

Anyhow, my dear, I hear that you are already on the move to use our water better than you did in the past: cultivating less water-intensive crops and even collaborating with your mosques to

implement efficient use of water, and I hail you for that. After all, compared to your other bounties, and despite your continuous assertion that our water is a matter of survival for you but not me, we both know the contribution of your agriculture that takes up most of our water hardly contributes to your overall well-being. And, I know if you are honest with yourself, you will see the injustice of expecting me to not use what makes up a significant amount of all I have on that premise. I should also not pass without mentioning that others are faring well on much less water than ours." (Berihun, 2020)

Al Jazeera Statement 1
'Means our death': Egyptian farmers fear effect of Ethiopia dam

"Now 55, Abu Kassem looks out at what is left of his shrivelling farm, surrounded by barren wasteland that was once his neighbour's farmland – victims of dwindling irrigation in recent years.

"There used to be enough water to make all this area green … Now, it is as you see," he said.

In the past, he and other villagers irrigated their farms through canals linked to the Nile River, Egypt's lifeline since ancient times. It provides the country with a thin, richly fertile stretch of green land through the desert.

But years of mismanagement, corruption and increasing population led to the loss of at least 75 percent of farmland in the village and the surrounding areas, according to Abdel-Fattah el-Aweidi, head of the Gazaer Qouta Agriculture Association overseeing the area.

Now, Abu Kassem fears a dam Ethiopia is building on the Blue Nile, the Nile's main tributary, could add to the severe water shortages already hitting his village if no deal is struck to ensure a continued flow of water." (Al Jazeera, 2020)

Al Jazeera Statement 2
'Means our death': Egyptian farmers fear effect of Ethiopia dam

'"If the dam is filled and operated without coordination between Egypt and Ethiopia, its effect will be destructive to the whole Egyptian society and the state will not be able to address its repercussions," said Egypt's former Irrigation Minister Mohammed Nasr Allam.

It is estimated that a permanent drop of five billion cubic meters of Nile water to Egypt would cause the loss of one million acres (400,000 hectares) of farmland, or 12 percent of the country's total, he said.

Sudan says the project could endanger its own dams, though it would also see benefits from the Ethiopian dam, including cheap electricity and reduced flooding.

Abu Kassem's village, with the bland bureaucratic name of Second Village, was one of multiple agricultural communities created in Egypt in the 1960s by the socialist government of President Gamal Abdel Nasser. Built on reclaimed desert, it depends for irrigation on the Yusuf Canal, which flows from the Nile through Fayoum, fanning out in a series of channels.

The villagers enumerated the variety of crops they used to farm, ranging from cotton and vegetables to wheat and grains.

Now, most of the village's lands are barren. Almost all the Nile water that used to reach it is diverted into other agricultural projects or used for the growing population before it reaches Second Village, farmers say. Similar shortages of water have grown more common even in communities in the Nile Valley and the Delta, where farmers also face increasing salinity.

To irrigate, the village farmers now depend on wastewater from nearby towns, which is a mix of agricultural drainage and sewage.' (Al Jazeera, 2020)

Egypt Today
No relation between GERD, reducing rice agriculture areas: Egypt

"The government has taken procedures aiming to ration water consumption through preventing the cultivation of certain crops that need large amounts of water.

Minister of Irrigation and Water Resources Mohamed Abdel Ati decided to reduce the rice agriculture area in Egypt from 1,700,000 feddans to 724,200 feddans (1 feddan = 1.038 acres). According to the ministry, this decline will save three billion cubic meters of water. At the same time, the ministry is working on launching campaigns to raise farmers' awareness to reduce water usage.

On the other hand, some experts expect that reducing the rice cultivated areas will lead to a decrease in production, decrease the quantities offered in the markets and lead to higher prices and a trend towards imports to cover the needs of the local market to insure food security." (EgyptToday, 2018)

The Atlantic Council
Egypt has a water problem—and no, it's not only the GERD

"Declining per capita water availability is bound to impact Egypt's rural population directly. Egypt's agriculture sector accounts for only 11 percent of GDP, but it employs about a quarter of the population and supports the livelihoods of nearly a quarter more. This water-stressed sector, sustaining about half of Egypt's population, also consumes 86 percent of Egypt's freshwater withdrawals. Ultimately, water availability limits agricultural production potential and the amount of income the sector can sustainably support. If current trends continue, an increasing

amount of Egypt's already rural poor population could go jobless or struggle to make ends meet as a direct result of the agriculture sector's unquenched thirst.

Additionally, the declining per-capita water availability will increase Egypt's food security risk. Once a breadbasket of the Roman Empire, Egypt now imports about 40 percent of its food consumption in monetary terms, making it one of
the most food-import-dependent countries in the world. Wheat and corn are consistently both the most produced and most imported crops in Egypt, demonstrating that the country's inability to meet its most basic food needs domestically is not for lack of trying. After cereals, the amount of land used to produce fruit—much of it for exports—is a distant second. Global price shocks to staple crops can create severe shortages in Egypt and increase food prices drastically, and the declining per-capita agricultural production could make these price shocks more severe." (Cohen, 2021)

Fanack Water
Water Use in Egypt

"The MWRI's National Water Resources Plan (NWRP) to 2037 aims to safeguard Egypt's available water resources, which include its share of Nile water, groundwater, non-conventional resources and agricultural water. The NWRP includes the target to reduce agricultural, industrial and domestic water consumption to 80% of current usage. The plan also outlines clear procedures for dealing with current and future challenges in the water sector by implementing programs for desalination in coastal areas, modern irrigation, water reuse and water harvesting in areas other than the Nile Valley. The plan is based on four major pillars: creating an enabling environment, developing water resources, enhancing water quality and rationalizing water use." (Water, 2022)

Appendix C. Supporting Evidence Statements

BIA

"Unrest, combined with suppression of unrest and an emboldened population exhibits tipping point behavior. It is common to find the highest unrest well after the GERD's impacts are over. This counter-intuitive finding is largely due to the long delays in the system. Structurally, unrest is buffered by the Regime's ability to decrease the economic hardship of the population, and also by its ability to spread propaganda against the GERD. Propaganda against the GERD and food/energy subsides only delay unrest. The best way to prevent unrest is to prevent or mitigate the GERD's impacts. Effective diplomacy is one strategy that was tested and found to prevent extreme unrest. External shocks to food prices – not related to the GERD –would have a significant effect on popular support for the regime. A price shock occurring before the GERD filling period has potential to be more disruptive than a price shock after this period. Maintaining the support of the military matters, but can be effectively relied upon by the regime as a buffer while it concentrates on satisfying the population. If diplomacy with Ethiopia is ineffective at

decreasing GERD impacts, then military support becomes more important later in the period of effects." (Jeffers, 2015)

Hydro-Egoism

"Hydro-egoism represents the control of a riparian resource to the exclusion of downstream riparian interests, as most notoriously represented by the Harmon Doctrine… Hydro-egoism has been paradigmatically identified as likely to lead to violence when a series of conditions are met: the downstream country is highly dependent on the water; the upstream country is able to restrict the flow; and a history of antagonism between the two exists, where the downstream country is in a much stronger military position than the upstream country. Such conditions describe Egypt's modern historical relationship with Ethiopia." (Rossi, 2021)

Treaty

"1. In case any question connected with Nile water needs negotiations with the governments of any riparian territories outside the Republic of Sudan and the United Arab Republic, the two Republics shall agree beforehand on a unified view in accordance with the investigations of the problem by the Committee. This unified view shall then form the basis of instructions to be followed by the Committee in the negotiations with the governments concerned.
Should such negotiations result in an agreement to construct works on the Nile in territories outside the two Republics, the Permanent Joint Committee shall then assume the responsibility to contact the concerned authorities in those territories, in order to lay down all the technical details in connection with the execution as well as the Working Arrangements and maintenance of the works in question. After agreement on these points with the governments concerned, the Committee shall supervise the execution of the technical provisions of such agreements.

2. Since other riparian countries on the Nile besides the Republic of Sudan and the United Arab Republic claim a share in the Nile waters, both Republics agree to study together these claims and adopt a unified view thereon. If such studies result in the possibility of allotting an amount of the Nile water to one or the other of these territories, then the value of this amount as at Aswan shall be deducted in equal shares from the share of each of the two Republics.
The Permanent Joint Technical Committee shall make arrangements with the concerned authorities in other territories in connection with the control and checking of the agreed amounts." (Agreement, 1959)

Appendix D. Figures

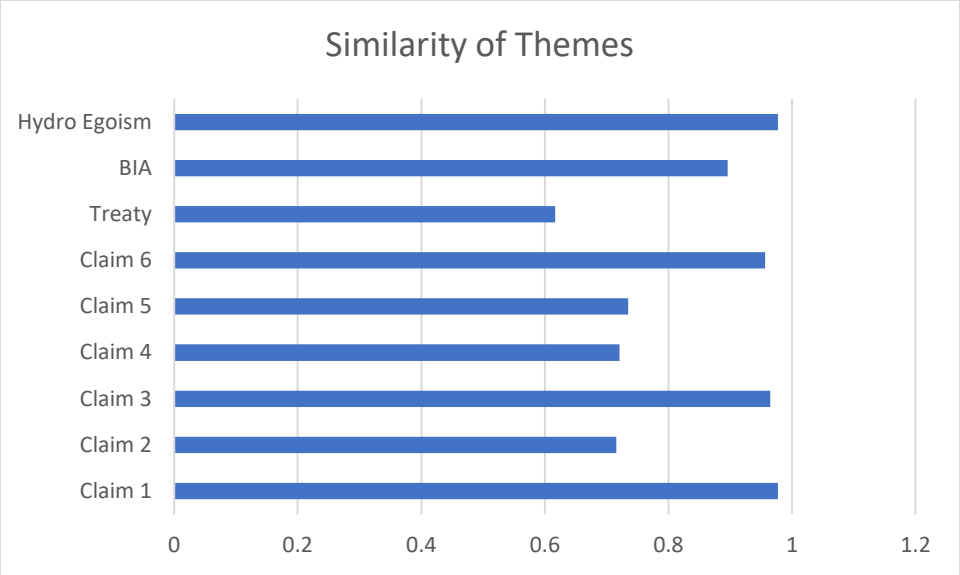

Figure 1. Bar chart measuring how similar in theme a statement is to it validating documents.

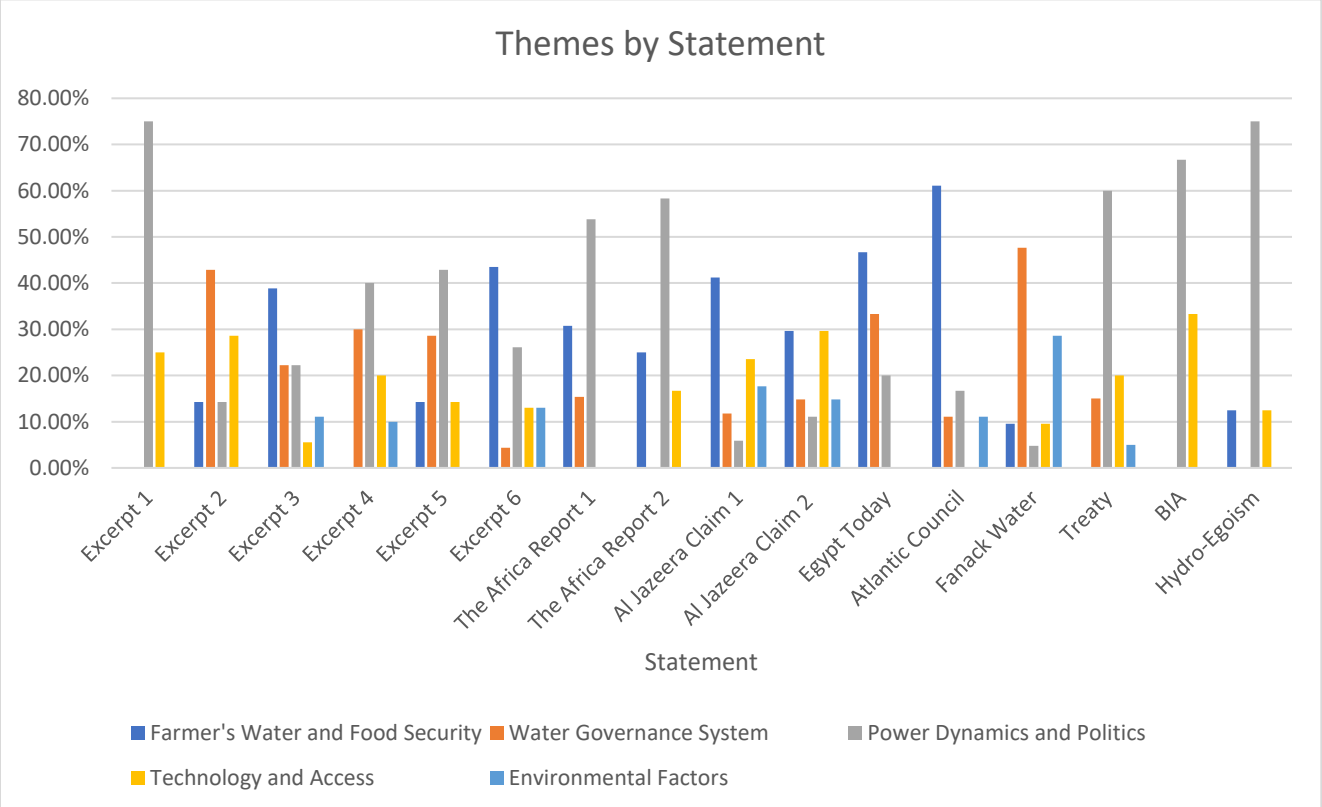

Figure 2. Percentage of each theme represented in every excerpt or article reviewed.

Appendix E. Tables

Table 1. Count of articles that corroborate each other.

Validations	Excerpt 1	Excerpt 2	Excerpt 3	Excerpt 4	Excerpt 5	Excerpt 6	Hydro-Egoism	BIA	Treaty	Count
The Africa Report 1				x	x	x				3
The Africa Report 2	x						x		x	3
Al Jazeera Claim 1		x	x	x	x	x				5
Al Jazeera Claim 2				x		x		x		3
Egypt Today			x			x		x		3
The Atlantic Council		x	x		x			x		4
Fanack Water		x		x				x		3
Hydro-Egoism	x									1
BIA			x				x			2
Treaty	x									1
Count	3	3	4	4	3	4	2	4	1	

Table 2. Percentage of mention of each theme by statement or article.

Statements	Themes				
	Farmer's Water and Food Security	Water Governance System	Power Dynamics and Politics	Technology and Access	Environmental Factors
Excerpt 1	0.00%	0.00%	75.00%	25.00%	0.00%
Excerpt 2	14.29%	42.86%	14.29%	28.57%	0.00%
Excerpt 3	38.89%	22.22%	22.22%	5.56%	11.11%
Excerpt 4	0.00%	30.00%	40.00%	20.00%	10.00%
Excerpt 5	14.29%	28.57%	42.86%	14.29%	0.00%
Excerpt 6	43.48%	4.35%	26.09%	13.04%	13.04%
The Africa Report 1	30.77%	15.38%	53.85%	0.00%	0.00%
The Africa Report 2	25.00%	0.00%	58.33%	16.67%	0.00%
Al Jazeera Claim 1	41.18%	11.76%	5.88%	23.53%	17.65%
Al Jazeera Claim 2	29.63%	14.81%	11.11%	29.63%	14.81%
Egypt Today	46.67%	33.33%	20.00%	0.00%	0.00%
Atlantic Council	61.11%	11.11%	16.67%	0.00%	11.11%
Fanack Water	9.52%	47.62%	4.76%	9.52%	28.57%
Treaty	0.00%	15.00%	60.00%	20.00%	5.00%
BIA	0.00%	0.00%	66.67%	33.33%	0.00%
Hydro-Egoism	12.50%	0.00%	75.00%	12.50%	0.00%

Appendix F. Calculations

Sample Calculation of Cosine Similarity Metric

A	B							XY		V		W
Claim 2	Average	Al Jazeera	Atlantic Cc	Fanack Water			A*B	SUM(A*B)	A^2	SQRTSUM((A^	B^2	SQRTSUM((B^2)
0.142857	0.372705	0.411765	61.11%	9.52%			0.053244	0.198435	0.020408	0.553283335	0.1389087	0.501069945
0.428571	0.234983	0.117647	11.11%	47.62%			0.100707		0.183673		0.055217	
0.142857	0.091036	0.058824	16.67%	4.76%			0.013005		0.020408		0.0082876	
0.285714	0.110177	0.235294	0.00%	9.52%			0.031479		0.081633		0.0121391	
0	0.191099	0.176471	11.11%	28.57%			0		0		0.0365187	
						Cosine	XY/(V*W)	0.715768				

Appendix G. Coding and Validation Reference

Thematic Code Key:

Farmer's Water and Food Security centers around statements made that directly or indirectly reference water or food shortages and security issues as they relate to Egyptian farmers. Water Governance Systems is a theme that is primarily focused on Egyptian bureaucratic institutions and their decisions regarding water management, especially as they relate to Egyptian farmers. Power Dynamics and Politics is a category that includes any expressions of power or lack thereof between social groups and is especially geared towards international power dynamics relating to the GERD. Technology and Access is any statement or mention of technology, especially technology that controls the movement of water, like dams or canals. Finally, Environmental Factors are mentions of environmental happenings generally outside of people or technology's immediate control, like climate, hydrology, and topography.

Summary of Excerpt and Statement selection:

Of the *Nile* Excerpts: Excerpts 1 and 2 were chosen from Chapter 1. Excerpts 3 through 6 were chosen from Chapter 2. Then, evidence was gathered to support these excerpts. Five statements were chosen from four articles by news outlets: two separate articles by The Africa Report, referred to as The Africa Report 1 and 2, two statements from an Al Jazeera article, referred to as Al Jazeera statements 1 and 2, and a statement from an Egypt Today article. These were chosen to reflect differing perspectives on each of the above themes. Two statements from separate articles written by political organizations, The Atlantic Council and Fanack Water, were also chosen. Statements from the three cross validating reports – BIA, Hydro-Egoism, and the Treaty were selected to the extent they refer to the case at hand.