Thesis Project Portfolio

The Design of a Desalination Plant in New Orleans, Louisiana

(Technical Report)

An Analysis of Transboundary River Water Management of Northern Africa and Ethiopia's Struggle to Access Clean Water

(STS Research Paper)

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Today's water crisis is an escalating challenge impacting millions of people across the world every day. Between climate change altering weather patterns, prolonged droughts, and inconsistent rainfall many regions are left dry and in need of reliable water sources. Growing populations and increasing industrialization only exacerbate the strain on freshwater supplies, while pollution from agriculture and industry continues to contaminate existing resources. Moreover, inadequate infrastructure and transboundary water disputes prevent equitable distribution, leaving vast sectors of the global population without access to clean drinking water. This crisis not only threatens the welfare of marginalized communities but also undermines food security, economic development, and environmental stability. Due to this pressing issue, two separate studies were conducted to offer insights into how different regions are tackling this challenge through innovative water management strategies.

The technical portion of this thesis addresses New Orleans, Louisiana, where saltwater intrusion from the Gulf of Mexico threatens the freshwater supply, particularly in the Algiers neighborhood. The proposed solution is to construct a desalination plant, 60 miles south of the city in Port Fourchon. This facility aims to provide 10 million gallons of potable water daily using reverse osmosis (RO) technology alongside pretreatment and post-treatment processes to remove contaminants, ensuring high-quality drinking water.

In addition to water production, the plant will utilize its brine waste to form a divalent metal ammonia phosphate-based fertilizer and rock salt, minimizing environmental waste and creating additional revenue streams. With this approach, the facility is projected to produce 10 million gallons of tap water, 15 million kilograms of fertilizer, and 13 million kilograms of rock salt each day. Despite a capital investment of over $2.6 billion, the expected internal rate of return (IRR) of 27% and a $4 billion net present value after 20 years of plant life indicate the project's profitability. It is recommended that future design teams address discrepancies in flow rates and operational parameters between the design and actual plants to enhance efficiency and scalability. Improving the overall recovery rate of the RO unit, currently at 40%, is critical for increasing water production capacity and overall plant performance. Additionally, exploring alternative methods of extracting water from the brine stream could eliminate the costly multi-stage evaporators that currently account for over 80% of the equipment expenses.

Furthermore, the desalination plant stands as an innovative solution to New Orleans's water crisis, emphasizing both economic and environmental sustainability. Through careful

planning, creative engineering, and comprehensive financial management, this project serves as a blueprint to mitigate the Mississippi's saltwater intrusion crisis.

The socio-technical portion of this thesis examines Ethiopia's struggle to secure access to clean water, influenced by the complexities of transboundary river management policies and the involvement of various political actors. The study uses the Social Construction of Technology (SCOT) framework to analyze Ethiopia's participation in initiatives like the Nile Basin Initiative and the Grand Ethiopian Renaissance Dam (GERD). Comparing the situation to the Western Bug River Basin, the research identifies parallels in the deteriorating water quality caused by outdated environmental practices and inadequate regulation. This only further highlights the need for improved management and cooperation amongst all riparian states.

Despite investments in hydropower and irrigation, a very small percentage of Ethiopia's population currently has access to clean water. The GERD seeks to harness Ethiopia's water resources for economic development but has raised concerns about downstream effects on neighboring countries. Innovative technologies such as desalination plants, the Desolenator, and Warka Water towers offer potential solutions. While desalination plants could provide a reliable supply of fresh water, their high energy consumption and substantial capital costs require significant external support. The Desolenator, a solar-powered water purification device, is more affordable and suitable for remote regions, while the Warka Water tower uses atmospheric condensation making it a practical solution for rural areas.

Both studies highlight the importance of policy reform and innovative technology in ensuring equitable access to fresh water. Additionally, engagement with local communities in decision-making will ensure that policies are inclusive and effective. Technological integration should focus on immediate relief through smaller-scale solutions like the Warka Water tower, while long-term strategies should explore advanced technologies like the Desolenator and large-scale desalination plants with support from international donors and investors.

In conclusion, New Orleans and Ethiopia each face unique water challenges, but both can benefit from an approach that prioritizes collaboration, advanced technology, and sustainable practices. By integrating these solutions and involving stakeholders across the spectrum, it is possible to address water scarcity while promoting economic growth and environmental stewardship. Governments and organizations must work together to secure consistent access to

fresh water for all residents while minimizing environmental impacts and enhancing economic opportunities.