

Drip Irrigation For Water Scarcity For Tillaberi Community in Niger

Jareen Mohammed, Shaoqin Li, Akram Uddin, Omar Mohamed

The City College of New York

Writing for Engineering ENGL 21007

Julia Brown

May 1st, 2023

Summary:

In Niger, 54% of the population lacks access to clean sustainable water (Reid 2023). Specifically, the Tillaberi region will be our focus because nearly 92% of that community lives in rural areas, where there is a chronic shortage of clean water (Eib 2022). To combat this, we propose implementing a drip irrigation system to deliver fresh clean water for agricultural purposes. Drip irrigation is known for numerous benefits such as water conservation, crop quality, soil protection, and labor/ energy efficiency. For above-ground drip irrigation systems, the pricing varies anywhere from \$223-\$2000 depending on the size of the field. For underground drip irrigation systems, the pricing varies from \$815-\$4335 depending on the size of the field (Lawn Love 2023). There will be at least 15 farmers on each farm and the cost for training for each farmer is \$50, therefore the overall training cost will be \$750. The cost for maintenance that needs to be done annually at least will be \$500. For unexpected maintenance, we estimated it to be \$2000. Although it may be expensive at first, it reduces overall costs for farmers. Jareen Mohammed will be in charge of installing the drip irrigation systems based on prior experience in installing desalination plants. Shaoqin Li will be in charge of the training for the farmers to get introduced based on prior experience in teaching technical systems. Omar Mohamed and Akram Uddin will be in charge of the maintenance based on their prior experience in maintaining drip irrigation systems.

Introduction:

Water scarcity is a problem that communities in Niger face constantly. Water is essential to sustain ecosystems, and maintain hygienic/sanitation purposes, and agriculture. Only 3% of the Earth consists of fresh water, while 8 billion people rely heavily on this resource (Water scarcity 2023). The lack of fresh water for agricultural and drinking purposes forces people to travel long distances creating a waste of time. As a result, an estimated \$260 billion is lost globally every year due to this (Water & the economy 2023). In Niger, about \$1,373,026,936 is the annual cost to address all water-related challenges (Howell n.d.). In the Tillaberi community, 92% lack access to clean water for their crops, thus the community is suffering financially.

In this modern day and age, no person should have to worry about attaining fresh and clean water. Although there is no one magical solution to solve this issue entirely there are steps we can take to help ease the burden by implementing a drip irrigation system for the Tillaberi community. Drip irrigation systems have been implemented and proven successful in the Middle East. This system is versatile, thus it can be used for communities and agricultural purposes. Implementing drip irrigation systems in the Tillaberi region will reduce water usage by up to 70% compared to other irrigation methods. It will increase crop-yield quality and help lower financial costs in the future. Our proposal will include a project description that will describe the technical aspects of the proposal, its advantages, and disadvantages, along with a budget to put into perspective the resources needed for this type of project.

Project Description:

Drip irrigation is an advanced method that delivers fresh clean water directly to a plant's root zone in small precise amounts. It is able to do this through a network of pipes with emitters. This system can be modified to deliver water at different rates and frequencies depending on the crops' needs such as water requirements, soil type, or climate conditions.

Technical Aspects:

1. **System Design:** The design includes determining the crop water requirements and soil type that affect water delivery. The system needs to ensure each plant receives the same amount of water while minimizing water losses.
2. **Water Source and Delivery:** The water source for these systems can come from a river or pond. The Tillaberi community is near the capital Niamey, which is on the Niger River. The Niger River will be the source of water used for these systems. The water must be filtered first to remove any impurities that can clog the emitters. After the filtration system, the water is delivered to the plants through a piping system that can be placed either above or below the ground.
3. **Emitters:** Emitters need to be placed within the system to regulate the flow of water. They vary in different size and type. Emitters must be selected depending on numerous factors such as the crop's water requirements and soil type.
4. **Controllers and Sensors:** This system can be controlled and monitored using technologies such as timers, sensors, and remote monitoring. The controllers have to be programmed to turn off and on depending on the crop's water needs and climate conditions.

5. Maintenance and Operation: A drip irrigation system must be regularly maintained to ensure its best performance. This form of maintenance includes checking for leaks or clogs that can affect water delivery.

Is Drip Irrigation Feasible?

Drip irrigation is a practical method of irrigation that is successful in many developing and developed nations that face water scarcity. An example of successful drip irrigation techniques was in Israel, where 80% of their agricultural land is thriving through these systems. Drip irrigation is known to be cost-effective as it can decrease water consumption and reduce labor costs (Constantinoiu 2023). The village of Garou in the Dosso region of Niger has already successfully implemented drip irrigation. The system allowed the village to gain more income since they have a production schedule (Palmer 2019).

Benefits of Drip Irrigation:

There are many benefits to implementing drip irrigation systems in Niger such as water conservation, improved crop quality, reduced labor costs, fertilizer use, soil erosion, and energy savings (Gregg.dayley 2023). About 80% of the water that is normally wasted would be saved. Drip irrigation systems can save up to 50% of energy, which will lower energy costs. Crops such as corn, hemp, and cotton would benefit from drip irrigation (Carter 2016).

Resources Needed:

A drip irrigation system needs several resources to ensure its success. These resources include a water source and a pumping system. The type of pump will vary depending on the size

of the system. The tubing that will be used to deliver water to the crops needs to be made from polyethylene, or PVC depending on the pressure requirements of the system (Drip irrigation for vegetable production 2023). Filters will need to be included to avoid clogging the emitters and ensure an equal amount of water is delivered to the plants. There will need to be several fertilizer injectors to add nutrients to the water before it enters the system.

Potential Obstacles With Resolutions:

1. Clogging: To prevent clogging, filters need to be installed with periodic maintenance.
2. Uneven Water Distribution: Pressure regulators need to be implemented to maintain consistent water pressure.
3. Training: Farmers will need to attend training sessions to learn about the design and maintenance of drip irrigation systems. The training sessions will be provided once the systems have been set up.
4. Maintenance: Farmers will need to schedule routine inspections and perform maintenance tasks regularly depending on the system's recommendations. We suggest at least an annual inspection of the drip irrigation system. This costs \$500, which is expensive especially if you aren't having any issues with your system. However, regular maintenance is needed because, without it, the system will experience clogging over time. Weather changes are unpredictable and can cause the system to wear off over time. Farmers needed maintenance to help identify damaged components and replace them before a system failure occurs. Having an annual inspection will improve the system's efficiency because the maintenance crew can catch problems before they occur.

Budget:

Total Budget: \$102,425 (THIS DEPENDS IF IT IS ABOVE GROUND OR UNDERGROUND) For Above Ground: \$90,750 For Underground: \$14,925				
System Type	Estimated Cost Per System <i>Including Installation Labor</i>	Estimated Coverage Per System (Sqft)	Proposed Quantity to Be Installed	Cost
Above Ground	\$1,250	7,500	70	\$87,500
Under Ground	\$2,335	16,000	5	\$11,675
Training	\$50 for each farmer	All farmers	15 farmers	\$750
Maintenance (Annual Inspection)	\$500	Entire System regardless if it is above or underground	Once per year	\$500
Maintenance (Unexpected Inspections)	\$2000	Entire System regardless if it is above or underground	This is for emergency purposes	\$2000

Conclusion:

Drip irrigation is essential in combatting water scarcity in Niger, especially for the Tillaberi community. Due to population growth, industrialization, and climate change, there has been an increasing demand for water. Many of the methods currently used are becoming unsustainable, inefficient, and expensive. Implementing drip irrigation offers a solution to this issue by delivering water directly to the roots of the plant at a steady pace, thus minimizing evaporation or water loss. This results in farmers having significant water savings, which allows

efficient use of limited water resources. Drip irrigation will improve crop yields, thus the Tillaberi community won't have to import resources from another nation. This will help Nigerians save costs in the long run since they won't need to pay more for the same agriculture they have in-house. This system has made a tremendous decrease in energy as high as 50%. Studies from UC Agriculture and Natural Resources' Desert Research and Extension Center have determined that drip irrigation has reduced soil carbon dioxide emissions by 59% (Watermaster 2022). Considering the current climate change crisis our world is in, it is important to implement sustainable water solutions like drip irrigation. Drip irrigation has helped the village of Garou in Niger and now it's time for the Tillaberi community to get a chance.

References:

- Carter, A. (2016, November 29). Irrigation, Drip. Center for Agriculture, Food, and the Environment. Retrieved May 1, 2023, from <https://ag.umass.edu/vegetable/fact-sheets/irrigation-drip#:~:text=A%20well%20designer%20drip%20irrigation,other%20types%20of%20irrigation%20systems>
- Constantinoiu, M. (2023, February 28). How Israel used innovation to beat its water crisis. Retrieved April 17, 2023, from <https://www.israel21c.org/how-israel-used-innovation-to-beat-its-water-crisis/>
- Drip irrigation for vegetable production. (n.d.). Retrieved April 17, 2023, from <https://extension.psu.edu/drip-irrigation-for-vegetable-production>
- Eib. (2022, February 9). Fresh water in Niger undercuts violence, as well as offering better living conditions. European Investment Bank. Retrieved May 1, 2023, from <https://www.eib.org/en/stories/niger-water-development>
- Gregg.dayley. (2023, February 28). Why use a drip irrigation system. Retrieved April 17, 2023, from <https://hydrosrain.com/why-use-a-drip-irrigation-system/>
- How much does drip irrigation cost in 2023? - lawn care blog: Lawn love. (2023, January 24). Retrieved April 17, 2023, from <https://lawnlove.com/blog/drip-irrigation-cost/>
- Lucas Howell, T. L. L. C. (n.d.). Niger. Water Action Hub | Country. Retrieved May 1, 2023, from <https://wateractionhub.org/geos/country/160/d/niger/>

Narayanamoorthy, A. (2021, December 06). Tap drip irrigation to Save Water. Retrieved April 17, 2023, from

<https://www.thehindubusinessline.com/opinion/tap-drip-irrigation-to-save-water/article27688289.ece#:~:text=The%20on%2Dfarm%20efficiency%20of,40%20per%20cent%20for%20FMI>

Palmer, C. (2019, October 9). In Niger, drip-irrigation helps farmers battle climate induced water woes. World Bank Blogs. Retrieved May 1, 2023, from

<https://blogs.worldbank.org/climatechange/niger-drip-irrigation-helps-farmers-battle-climate-induced-water-woes#:~:text=Seyni%20points%20to%20the%20village,been%20transformed%20by%20drip%2Dirrigation>

Reid, K. (2023, March 23). 10 worst countries for access to Clean Water. Retrieved April 17, 2023, from

<https://www.worldvision.org/clean-water-news-stories/10-worst-countries-access-clean-water#:~:text=Niger%3A%2054%25%20lack%20access%20to,and%20among%20the%20world's%20poorest.>

Watermaster. (2022, May 17). Environmental benefits of a drip irrigation system. Retrieved April 17, 2023, from

<https://watermasterirrigation.com/environmental-benefits-of-a-drip-irrigation-system/#:~:text=Saving%20energy&text=Drip%20irrigation%20pumps%20require%20less,by%20as%20much%20as%2050%25>

Water scarcity. (n.d.). Retrieved April 17, 2023, from

<https://www.worldwildlife.org/threats/water-scarcity>

Water & the economy. (n.d.). Retrieved April 17, 2023, from

<https://water.org/our-impact/water-crisis/economic-crisis/>

Wikimedia Foundation. (2022, December 9). Tillabéri. Wikipedia. Retrieved May 1, 2023, from

<https://en.wikipedia.org/wiki/Tillab%C3%A9ri>