PURigate Water Services

University of Hartford
Vellore Institute of Technology

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Executive Summary

Industrialization and globalization have led to rapid economic growth in India. Contributing to this success is the leather industry which had exports of $3.4 billion in 2009-10, is among the country’s top ten foreign exporters, and employs about 2.5 million people. Accounting for more than 37% of the exports, the Vellore region is critical to the success and economic benefits provided by the leather industry. However, India still has the highest population of poor people and millions per day go without the proper amount of nutrients. Currently, there are 410 million people in India living below the $1.25 poverty line. Tanneries contribute to the food security issue because they dump their waste, contaminating the ground and ruining harvests. With food already inaccessible to many, decreased agriculture production threatens the future.

The soil and irrigation water used by farmers has high levels of salinity and alkalinity from tanneries’ waste, causing health and water issues, as well as significantly reducing crop yields. Through our market research, farmers have identified tannery waste as the main problem and are searching for ways to reverse the trend of decreasing productivity. Our company will provide an affordable solution by (1) treating the farmer’s own groundwater using a reverse osmosis system with an energy recovery device, a proven worldwide desalination technology; (2), remediating the farmer’s unproductive soil by “washing” the top soil with the clean treated water; (3) enhancing the agricultural yield by irrigating based on soil moisture content thus minimizing current practices of overwatering of crops and overconsumption of groundwater; and (4) instituting a price structure that promotes the use of water conservation techniques and the growing of the crops that are most sustainable for Vellore’s climate. In order to serve farmers using their own water resources, our RO system will be mobilized using a truck to travel to different farms.

In Vellore, 20% of the land has been classified as unproductive because of high salinity and alkalinity. This indicates that there is a large potential market for our services. To start, we will target farmers, who own unproductive land near tanneries, have their own bore wells, and irrigate their crops. To make our enterprise financially sustainable, we will sell the brine to the tanneries at the market price of $1/m³. The tanneries currently purchase untreated water for their process and the brine from our process should be acceptable for brine curing. This will allow us to affordably provide our water services to the farmers.

The problem is basic: tannery wastes have contaminated soil and ground water thus reducing agricultural productivity. The most effective solution is basic, too: attack the problem at the root. Without clean irrigation water and clean soil, crop yields and quality of life will continue to decline. The most technologically advanced methods for food processing and distribution may be introduced, but until the simplest ingredients; water and soil, are accessible, the deterioration of agriculture will fall farther. With over 70% of India’s population in rural areas, the growth of healthy crop yields is not just crucial to farmer’s businesses, but to people’s survival.

Each individual in our organization will be critical in fulfilling our mission. The Board of Directors in the United States will give support and direction. The Director and managers stationed in India are responsible for daily operations and strategy. Our venture combines technological capabilities with an agricultural-minded support group to address the issue of food security.
Introduction

Lack of available clean drinking water has been a problem in India for decades. Since a small startup company has limited resources, one district is chosen as a main focus. Vellore is home to many historic landscapes, as well as housing the Vellore Institute of Technology. Out of the available 488,864 hectares of land, 30.4% of the land is sown with popular crops such as groundnut, paddy, and sugarcane. Even though the farmland can be used for agriculture, there has been a decreasing yield in crops over the years. The purpose of our business model is to provide a service to clean farmer’s irrigation water with the goal of increasing their crop yields. Vellore is one of the many districts in India impacted by the contaminated water left behind as waste from the tannery industry.

According to research from Tamil Nadu Agricultural University shows that the Vellore district has advanced their farming procedures over the years and now are considered a “developed” region. Farmers understand the factors contributing to their poor crop yields and many are learning about new farming technologies. Our business model utilizes a reverse osmosis (RO) system and an energy recovery device to desalinate the irrigation water. By cleaning the water directly used for farming, the soil is also being remediated for future growing seasons. The Vellore district is faced with problems that will continue to escalate if they are not addressed soon. Some farmers are actually leaving Vellore to farm elsewhere because they cannot survive in the current conditions. Our business is determined to increase crop yields for farmers so they can make a living without having to leave their home.

Background

While India’s economic growth has been impressive, the country still has the largest number of poor people and it is estimated that half of the population does not have enough money to buy minimal amount of daily food requirements. In the Vellore region where the tannery industry has thrived, it is estimated that between 30-40% of the population lives below the poverty line. Even more troubling is that the excessive use of water by the tanneries and the improper discharge of waste that has contaminated the soil and groundwater. These actions have adversely impacted farmers and hindered the agricultural productivity of the region. For example, it is estimated that over 55,000 ha of productive agricultural land has been contaminated in the State of Tamil Nadu. To maintain agriculture as a major activity in the district and to reduce food security issues that prevent many poor people from affording the minimal daily nutrient requirements, our social enterprise endeavors to clean the contaminated groundwater, remediate the soil, and improve crop yield.

Proposed Venture

Mission

Our mission is to provide solutions; both affordable to the customer and sustainable to the business, that increase crop yields per annum by remediation of contaminated soil utilizing water treatment technologies.

Motto

‘We help farmers increase yields by going to the root of the problem; and decontaminating their water and soil.’

Objectives

Establish a sustainable business in the Vellore region of India

- Establish relationships with farmers and tannery owners
- Hiring- Recruit and hire our staff within the first two years
• Operational- Purify irrigation water in order to remediate soil and increase crop yields, and work towards establishing a sustainable water supply
• Marketing- Attract customers by educating farmers on more efficient farming methods and water conservation
• Financial- Break even by year 3 of operations

**Strategy**

Strategy for the start-up venture is based on our business idea, analysis of the market need, market potential, and competition. The four components of our strategy include efficiency, mobility, reliability, water sustainability, and education. Together, these characteristics will provide us with a competitive advantage and help us achieve our objectives.

**Efficiency**

We will use a reverse osmosis (RO) system and pressure exchange (PX), or similar device, in purifying the ground water from farmer’s bore wells. The RO system will have a 100,000 gallon per day capacity and we will pump for 18 hours each day, which will be sufficient to serve our customers. The PX device will reuse the pressure from the brine and save energy.

**Mobility**

The key to our service is having a mobile RO system so we can reach a large area of farms. The more soil we can remediate, the more crop yields we will be able to increase. With a stationary RO system, we would only be able to serve the farm that is located close to the system. Our mobile system allows us to serve multiple farmers per day.

**Reliability**

There are frequent power cuts with the grid in the Vellore region, usually for two hours during any given day and for eight hours once per month during maintenance work. Since the RO system and water pumps require power to pump water into the irrigation system, we would have a generator in our service truck to ensure reliable service.

**Water Sustainability**

Using a handheld device we will measure the moisture content of soil. We will calculate the appropriate amount of water needed for successful crop growth so that the crops are not being over-watered and wasting water. Vellore region experiences monsoon season from June to December, accounting for over 80% of the annual rainfall. If rainfall provides the appropriate amount of moisture for the crops, this will decrease the amount of irrigation water needed.

There are several government departments, non-governmental agencies, and nonprofit organizations, such as the Agricultural Research Station and Watershed Support Services, working to educate farmers and implement water conservation methods for farming. Our partnership with local groups is a large part of our social responsibility.

Since our RO system will produce brine, we needed to find a safe way to dispose or reuse it. Our plan is to sell the water to tanneries, giving tanneries a chance to help resolve the problem that their operations created. Tanneries have to pay for their water anyway, and the salt content does not adversely affect the hides like it does the crops. The revenue made from selling the water to tanneries would be used to discount the price of our services for farmers,

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1 Field research
essentially benefitting the farmers more than the tanneries. As it is our main source of revenue and we have a contract with the tanneries, 75,000 gallons of water will still be pumped to deliver to the tanneries even on days that it rains. Brine holding-tanks will be located near the farms and tanneries for convenient brine pump-in and pump-out.

**Education**
Properly organized advertising campaigns will be implemented to educate farmers about methods to increase crop yields and make their water source more sustainable. Our ads will reinforce our mission, while providing teaching lessons.

**Target Market**
Our service will target medium to large sized farmers in the Vellore region, who have bore wells and irrigation systems in place, and are experiencing low crop yields due to contaminated water. Just over 50% of crops in Vellore district are irrigated, as oppose to rainfed.²

Our secondary target market is tanneries who want to purchase brine at a discounted price. Tanneries need to purchase water for their operations, but it does not need to be purified. They would provide the majority of our revenue, which is beneficial because we are a social venture wanting to make our service most affordable for the farmers who will help solve food security issues.

**Competition**

*Research Institutions*-Direct competitors are research institutions developing affordable salt-resistant seeds. These institutions are primarily focused on coastal farming where salt water is an issue. This type of solution disrupts natural processes by genetically altering the seeds. And even if successful in increasing crop yields, the problem of contaminated soil still exists.

*Developers*- There may be more valuable uses for the farmland. Unproductive land is cheap, so if developers offer a good price, and farmers feel the money outweighs the value of their future crop yields, they will take it.

*Water Purification and Distillation*-There are several companies providing water in the region, however, none specifically target the farmers and the issue of contaminated irrigation water and soil. Our competitive advantage comes in the form of effective techniques; remediating the soil, and efficiency; conserving water resources as we serve the farmers.

**Technology**

The PX Pressure Exchanger, by Energy Recovery, Inc. comprises our main critical advantage in agricultural water processing and remediating. According to the Energy Recovery website, the device can reduce the power required for desalination by as much as 60%.

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The device contributes to energy saving by converting energy from pressurized exhaust water to pump incoming sea water through the membrane and thus desalinating it. Because of the high pressures required for reverse osmosis, the energy saved by aiding the pumping of inbound sea water turns out to be a considerable amount.

The energy recovery system is expected to save approximately $39,000 over another system with comparable pump dynamics over a given year. In our target market, that savings is a critical advantage.

We assumed that we would achieve roughly 50% recovery with the PX system, because we are refining water that is much cleaner than sea water. With this assumption, every day we operate the system we will generate 75,000 gallons of clean water and 75,000 gallons of brine.

We expect to transport our system with a truck, and power it with either electricity or a generator separate from the truck which will initially run on petroleum based diesel fuel. The generator will be Pramac 50kW Diesel Generator, model number GSW70P, to supply the 39kW load of the system with back-up power in the case that the grid fails.

At virtually every demand point we encounter an efficiency of 1300 gallons of water produced per gallon of fuel, so our operational financial modeling was given numbers based on this efficiency on a per gallon basis, when we expect the generator to be operating. A majority of the time, power will be drawn from the existing electric infrastructure, due to the costs associated with relying on generators.

Organizational Structure
Our business venture will be a Limited Liability Corporation. Owners will have the advantages of limited personal liability and the ability to report profit/loss on personal income tax returns.

The team members from University of Hartford will form the Board of Directors. Individuals from Vellore Institute of Technology, as well as Hartford student/India resident Teja Sukhavasi, will form the management team. We will hire an agricultural manager to give expertise on crops, soils, irrigation, and other farming techniques. Technicians will be hired and receive training on the RO system and pumping process. Together, the business manager, agricultural manager, and technicians will be in charge of the day to day operations. With Tamil Nadu Agricultural University nearby, having agriculture initiatives similar to the objectives of our venture, we will look to their university community for agricultural manager and technician candidates.

Risks & Assumptions
*Farmers will not be interested in our services*
Based on field research, it is clear that contaminated water is an issue, affecting health, soil, and drinking water. Contaminated water has created a ‘progressive reduction in soil fertility,’
which is why we are focusing onremediating soil with purified irrigation water. In northeastern Tamil Nadu, 19% of the geographical area was under problem soils.\(^3\)

*The tanneries are not interested in buying the brine*

The contamination level of this water does not affect the tanneries. With our RO system producing about 75,000 gallons of brine per day, we could sell to just one tannery, offering a cost of $1/m³ (current market price). If necessary, we would discount the price. By producing revenue from selling the brine, we would help subsidize the costs of services for the farmers. Likely candidates are socially-conscious tanneries that are interested in helping the farmers whose land has been contaminated by leather production. We purchase tanks and place them in locations central to our general service area; we can store the brine until we have customers.

*Our system will take too long to remediate the soil*

Through research and data from experts in the field, we will be able to calculate the length of time it will take to turn unproductive lands into productive lands. Based solely on rainwater, complete remediation takes between 3 to 4 years.\(^4\) Using irrigation water as well would shorten this process.

*Our services do not achieve an increase in crop yield for farmers*

If crop yields do not increase that means the issue is not contamination in the soil and water. However, studies in Vellore region, many by Tamil Nadu Agricultural University, indicate that contamination is the problem.

*The depletion of the water supply prevents irrigation farming from being a sustainable practice*

Education and collaboration with organizations will support water conservation techniques. Instead of irrigating based on the availability of electricity, we will irrigate based on rainfall and soil moisture content, which will be optimized for each type of crop. This method will reduce water consumption while increasing yield.

*Farmers are not convinced that the benefits outweigh the costs of the service*

Pilot tests early on will give farmers a chance to see the impacts of our service. Our RO technology is consistent with systems used in United Nations projects and with companies such as Energy Recovery Incorporated with large scale desalination plants all over the world.\(^5,6\) Also, by producing a revenue from selling our brine, we will be able to subsidize service costs for the farmers. There is heavy demand for vegetables in nearby Chennai, so farmers would benefit tremendously when they can sell they crops.\(^7\)

*Our potential partners are not interested*

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\(^7\) Ibid. Palanasami, K.
Our strategy aligns with the work of local university programs and organizations. With a focus on minor irrigation with drip irrigation and reclamation of fallow/degraded lands, our objectives match those of the Tamil Nadu Agriculture University’s Vellore District Agricultural Plan (DAP).\(^8\)

*Farmers sell their unproductive land*

By talking with farmers, collaborating with existing support groups/programs, and proving our system with the pilot test, we plan to attract farmers towards our services and detract them from selling their land.

*Finding our Agricultural Manager and technicians*

Our partnership with Tamil Nadu Agricultural University will be beneficial to finding candidates with agricultural expertise in the Vellore region.

*Franchising is unsuccessful*

In the future, when analyzing our growth strategy, if there is not a demand for our services in other regions or countries, we will identify current social issues that our business can address.

**Implementation**

*Phase 1 (8-12 months)*

The summer will be made up of two parts; research in India and research in the U.S. In India, we will talk to farmers and tannery owners, and build trust with our target markets. To ensure we have our secondary market, we have to find a socially responsible tannery that would purchase wastewater for their operations. By asking questions and learning from the farmers, we will ensure that our service fulfills all their needs. To get a sense of the existing conservation methods, we will talk with organizations in the area. We will also meet with the company building our RO system to finalize the assembly of our system.

In the U.S., we will perform lab tests to remediate contaminated soil with clean water. It is important we know the timeframe of remediating different types of soil. Likely, more start-up funding will be necessary, so we will use these first several months to find investors. By the end of 12 months we will finalize a deal for the construction of our RO system.

*Phase 2 (6 months – 1 year)*

Based on the information and experiences from our time in India, we will implement our services on a prototype farm; about an acre on a farm that has volunteered to be the pilot tester.

Our RO system and devices for measuring soil content will be in place. During this pilot test, it will be an opportune time to develop an irrigation schedule based on temperature and rainfall. We will not have the truck(s) yet because our testing will be on a single plot of land. In the first year of the pilot testing, management will recruit and hire agricultural consultants and technicians. The time designated for the pilot test will act as a training period for the new employees.

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\(^8\) Ibid. Palanasami, K.
Phase 3 (By year 3)
After completing work on the prototype farm, and setting operations and policies in place, our business will be fully established. Having spent a few years in the area, we will have built strong ties with farmers and local groups.

Phase 4 (future)
Once our business is financially stable, we will develop the appropriate strategy to franchise our business so we can apply our model in other areas in need.

Social Value Proposition

Introduction
Social value is difficult to measure because it is not always a physical object that can be counted. However, outputs, the direct measurable results of our social venture, and outcomes, the changes made in the society, environment and economy, provide a detailed social value.

Social Outputs
1. Purified water- RO systems purifying salt water have 40% recovery. Since our system would be cleaning water that has less salinity, we are assuming a 50% recovery. Our system would produce about 75,000 gallons of purified irrigation water per day.
2. Remediated farmland- As of 2008, the area under problem soils was 40,951 hectares (101,150 acres). Wells in Vellore region have an irrigation capacity of 91745 hectares. Even if we only worked with half the farmers in the region, our service would be able to remediate the contaminated areas.
3. Soil moisture content measurements- In an effort to conserve water, soil moisture will be measured and only the necessary amount of water will be used to irrigate crops.
4. Water conservation techniques- By learning from and supporting existing conservation groups and programs, farmers can implement new methods to use less water during irrigation. For example, drip irrigation has higher water productivity in terms of kilogram per m$^3$ of water and Rupees per m$^3$ of water, as seen in Table 2 of the appendix.

Social Outcomes
By improving farmer’s crop yields, in quality and quantity, they will have a secure source of food for their families. Directly related to improved nutrition is better health. Also, by eliminating the contaminants in the water and soil, people will not be exposed to such health hazards.

Environmental Outcomes
Our service will use techniques such as drip irrigation, soil content measurement, and irrigation based on rainfall and time of day in order to make the water supply more sustainable in the area. Soil remediation will bring the soil back to its fertile state.

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Economic Outcomes
Since crop yields will increase in quality and in quantity, farmers will be able to sell their crops at higher prices. This will provide a stable source of income for farmers and their families, as well as put agriculture back on the economic map. By turning unproductive lands into productive farmland, the value of the land will increase.

Financial Analysis

Total Cost of the Project

- Reverse Osmosis system=$150,000
- Transportation=$10,000
- Generator cost, brine storage and miscellaneous expenses=$40,000
- Total cost of the project=$200,000

We would produce 75,000 gallons of pure water per day and 75,000 gallons of brine.

We would use the generator 25% of the time and use the electricity grid 75% of the time.

The tanneries are currently purchasing their brine for 1$/m^3, we intend to sell 75,000 gallons of brine to the tanneries for the same exact market price.

Cost price of producing a gallon of water using the grid 75% of the time=$0.0014845

Cost price of producing 75,000 gallons of water per day= $74.226

*For the irrigation of maize 1/3 of the water comes from rainfall and 2/3 from irrigation water. The above number is based on these specifications.

*The same technique would be used for different crops depending on the amount of water they need, rain water-irrigation water ration.

Over head cost per day (considering a span of four years)

=$136.98(200,000$/1460days)

Total cost per day=$ 211.20

Revenue from selling 75,000 gallons of brine to tanneries (at $1/M^3) per day

= $ 277.5
From the above analysis we have a profit of $66.3 just by selling our bi product to the tanneries before we even sell our 75,000 gallons of clean water.

Maize uses 0.5 acres to grow. It takes 5 hours per irrigation. The Maize crop period per season is 90 days. If we run our services for 16 hours a day, we can help 3 farms a day (running for 15 hours). Since each farm needs to be irrigated every 15 days, we can help 45 farms total. By the time that the last farm has finished, it will be time to irrigate the first farm again.

Cost Analysis

- Charge 2 rupees per m$^3$ of water.
- For a maize crop season, the total amount of irrigation (not including rainfall) is 518.4 m$^3$
- This means then that 2Rs x 518.4m$^3$ = 1036.8 Rs per 0.5 acres per season. This number comes out to about $23.39 per farm per season.
- For 45 farms $\rightarrow$ $23.39 \times 45$ farms = $1052.55$ for 45 farms for one season
- Since the crop period is 90 days $\rightarrow$ $1052.55 / 90$ days = $12$ per day
- This means that we will get $4 per farm per day if we help 3 farms in one day.
- Finally, for every irrigation period, we will charge one farmer 177.3 rupees (Just converted $4 to Rs.)
- If you take 177.3 rupees per irrigation period (every fifteen days), you then get $\rightarrow$ 177.3 / 15 = 11.82 Rs per day from ONE farmer.
- This then means that you would get 11.82 Rs x 3 farms = 35.46 Rs per day from 3 farms TOTAL.
Appendix

Table 1: Land Productivity of various crops (well irrigation)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production (Lakh tonne)</th>
<th>Convert to kg</th>
<th>Area under each crop (Hectare)</th>
<th>Convert to acre</th>
<th>Production per hectare (Lakh tonne/hectare)</th>
<th>Production per acre (kg/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>1.93</td>
<td>193,000,000</td>
<td>52100</td>
<td>21,093</td>
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<td>9150</td>
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<td>Sorghum</td>
<td>0</td>
<td>0</td>
<td>355</td>
<td>144</td>
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<td>0</td>
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<tr>
<td>Maize</td>
<td>.132</td>
<td>13,200,000</td>
<td>4555</td>
<td>1844</td>
<td>.000029</td>
<td>7158</td>
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<tr>
<td>Groundnut</td>
<td>.310</td>
<td>31,000,000</td>
<td>15535</td>
<td>6289</td>
<td>.000002</td>
<td>4929</td>
</tr>
<tr>
<td>Gingelly</td>
<td>.005</td>
<td>500,000</td>
<td>690</td>
<td>279</td>
<td>.0000072</td>
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<tr>
<td>Sugarcane</td>
<td>1.279</td>
<td>127,900,000</td>
<td>13468</td>
<td>5453</td>
<td>.000095</td>
<td>23455</td>
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<tr>
<td>Ragi</td>
<td>.336</td>
<td>33,600,000</td>
<td>11510</td>
<td>4660</td>
<td>.000029</td>
<td>7210</td>
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</table>

Table 2: Water Productivity of Bananas - Surface vs. Drip<sup>11</sup>

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Unit (Acre)</th>
<th>Water (m3)</th>
<th>Yield (kg)</th>
<th>Income (Rs)</th>
<th>WP (kg/m3)</th>
<th>WP (Rs./m3)</th>
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<tbody>
<tr>
<td>Surface</td>
<td>1.5</td>
<td>8121.6</td>
<td>10500</td>
<td>126000</td>
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<td>15.51</td>
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<td>Drip</td>
<td>.50</td>
<td>2524.5</td>
<td>5000</td>
<td>60000</td>
<td>1.98</td>
<td>23.76</td>
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Chart 1: Organizational Chart

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Chart 2: Use of Water

- Pump water from farmer’s bore well
- Pump water through RO system
- Purified Irrigation water
- Farm: Healthier, stronger crop yields
- Brine
- Tannery: Discounted water sold to tanneries for revenue

Chart 3: Social Impact Value Chain

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Activities</th>
<th>Outputs</th>
<th>Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Farmer’s well water</td>
<td>Desalination using mobile RO system</td>
<td>10,000 gallons per day</td>
<td>Improved crop yields, more profitable goods, &amp; food security</td>
</tr>
<tr>
<td>Agricultural expertise</td>
<td>Conversation techniques and sustainable business practices</td>
<td>Remediation of 40,951 ha under problem soil</td>
<td>Less exposure to contaminants</td>
</tr>
<tr>
<td>Hard-working, goal-oriented staff</td>
<td>Soil moisture content measurements, and other methods, will teach farmers they can reduce the amount of water used for irrigation</td>
<td>More sustainable water supply</td>
<td>More valuable farmlands</td>
</tr>
</tbody>
</table>

Without our service; hopefully other groups and services would try alternative solutions to eliminate the contaminants from the ground. However, there is the chance that many people would try to improve food security without addressing the issue of ground contaminants, which would mean contamination continues to ruin farmer’s lands and harvests. The worst case scenario would be if no other solutions were attempted or all ideas failed, and food security and poverty continued to threaten the lives of those living in the area.
Chart 4: Diagram of PX System, by Energy Recovery
Chart 5: PX Power Model
*all numbers based on sea water

<table>
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<tr>
<th>B</th>
<th>C</th>
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<th>E</th>
<th>F</th>
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<td>106</td>
<td>103</td>
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<td></td>
<td>m³/hr</td>
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<td>24</td>
<td>10</td>
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<td></td>
<td>m³/day</td>
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<td>35,056</td>
<td>200</td>
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</tbody>
</table>

**INPUT DESCRIPTIONS**

- **Unit:** Metric or English
- **Inputs:** m³, m³/day
- **Flow:** m³/hr
- **Pressure:** bar
- **Pump:** kW
- **Power:** $/kWh
- **Currency:** $
- **Operating:** %

**HIGH PRESSURE PUMP**

- **Efficiency:** 90%
- **Power:** 45.2 kW

**CIRCULATION / BOOSTER PUMP**

- **Efficiency:** 59%
- **Power:** 3.3 kW

**SYSTEM FEED PUMP**

- **Efficiency:** 97%
- **Power:** 0 kW

**SYSTEM POWER RESULTS**

- **Total Power Consumption:** 29 kW
- **Specific Power Consumption:** 2.31 kWh/m³
- **Power Consumption:** 8.7 kWh/kgal

**Warnings:**

**Suggestion:**