NIRMAL: LOW COST WATER PURIFICATION

I. Executive summary

Nearly one billion people all over the world do not have access to safe drinking water. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually.

Team Nirmal, comprising of students from Xavier Institute of Management, Bhubaneswar aims at purifying water and removing excess iron content from drinking water.

We bring to you, the use of bio-sand filtration combined with bamboo and coconut charcoal for purifying water, significant reduction of iron content in water and enriching the water contents. We also wish to engage the community in the business model and increase the overall awareness.

We intend to start the pilot program of Nirmal at Salia Sahi slum area, Bhubaneswar and then spread to other locations across Orissa and then other parts of India. The slum that houses around 5,000 plus houses is divided into ten different wards. The average income level of the slum residents ranges from 40$ to 98$ per family a month. People consumed the contaminated water as most of them could not afford purification techniques or were not aware of it. Also another group of people do not feel the need of filtering the water. Hence we intend to address the issue by providing a low cost water purification system using indigenous materials such that the system is easy to maintain and use.

II. Management Team

The team consists of two students of Rural management at Xaviers institute of management Bhubaneswar:

Sreevidya N Gowda – MBA Rural Management, BE Electronics and communication engineering

V Suma Pratyusha – MBA Rural Management, BE electrical and electronics engineering

Mentor:

Mr. Nunna Nath
III. Introduction

According to the WHO report, around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year.

The provision of clean drinking water has been given priority in the Constitution of India, with Article 47 conferring the duty of providing clean drinking water and improving public health standards to the State.

The state of Orissa and also many states in India have high Iron content in water. Iron concentration in wells and aquifers is typically between 0.5 and 10mg/L, and, as a result of water treatment, iron concentration in drinking water is typically less than 0.3mg/L. Iron concentrations of higher than 0.3mg/L in drinking water are noticeable to humans. Excess iron when left untreated, can lead to hemochromatosis, a severe disease that can damage the body's organs. Early symptoms include fatigue, weight loss, and joint pain, but if hemochromatosis is not treated, it can lead to heart disease, liver problems and diabetes. Excess iron in water also leaves a lingering iron taste in drinking water that makes consumption difficult.

The state of Orissa is prone to heavy monsoon and the long coastline makes is highly susceptible to floods every year. The floods of 1980, 1982, 2001, 2003 and 2011 in the State were particularly severe; property worth crores of rupees was destroyed in the floods.

The floods cause a large number of deaths; livestock perish; houses are washed away; paddy and other crops are lost and roads and bridges are damaged. It is during this vulnerable period that people are deprived of clean drinking water. In a report generated by Oxfam international, it was quoted that organisations found it difficult to provide clean drinking water to all the flood victims. All that was provided was a bucket of drinking water for days together. Hence we believe that our product will be extremely handy during a disaster relief for any aid agencies. Instead of transporting safe drinking water to the disaster affected area, it makes sense to transport the point of use purification system itself.

Field research by team Nirma conducted at Salia Sahi also reflected that most people who do not purify their drinking water suffered from various water borne diseases such as diarrhoea and dysentery and other illnesses. Also most people had to walk quiet a distance to the nearest tube well to bring home their drinking water.
Figure (1): Location of study - Salia Sahi

The factor we looked at:

• Availability of drinking water.
• Quality of drinking water.
• Awareness about drinking water quality.
• Current practices for treatment and storage.
• Perception about payment for water.
• Paying capacity.

IV. Business Description

The Problem

Presence of high iron content in the water and high occurrence of waterborne diseases as people consume water without filtration and purification. Orissa is known for its high levels of water contamination.
Value Proposition

Nirmal proposes to provide a purification system that purifies water, reduces iron content significantly as well as enriches the water. It is extremely cost effective.

We are focusing on the urban slums and rural areas in Orissa. We want to focus on these locations in Orissa that are very high on iron content. (1) Balasore, Bargarh, Bhadrak, Cuttack, Deogarh, J.Singhpur, Jajpur, Jharsuguda, Kalahandi, Kandmahal, Keonjhar, Kendrapara,Khurda, Koraput, Mayurbhanj, Nayagarh, Puri, Rayagada, Sambalpur, Sundergarh and Sonapur. The drinking water in all these locations is high on iron content.

Business Model

Team Nirmal will procure the raw materials such as plastic from Orissa from the local manufacturers; sand will also be procured locally. Both varieties of charcoal i.e bamboo and coconut charcoals will be procured from the neighbouring state of Andhra Pradesh that borders Orissa, from places such as i.e. Ichapura, Sompet areas and the coastal belt. The materials will be made available in the form of kits to the micro franchisee who will then sell the kits in the slum areas/ rural areas. They will also undertake servicing of the product. The reason we have chosen the micro franchisee model is that it offers three benefits; they are job creation, specific training, and effective delivery.

Most developing countries have extremely high unemployment rates, which force people to become entrepreneurs out of necessity to survive. These people typically don't create businesses that flourish. Micro franchises are proven business systems that have a much greater potential for growth and job creation

"Micro franchising has enormous promise. First, the model makes sense: it fits the reality of the bottom of the pyramid, has the right incentive structure, and can enable more people to have good jobs than the microfinance model (which truly requires entrepreneurial talent). Second, the model allows social entrepreneurs to invest in poor countries, allowing them to ‘do well and do good’ at the same time."

—Katherine Terrell, Professor of Business Economics and Public Policy, University of Michigan
Product Description

The Product development phase extended over a period of few months. It began with a bamboo shoot prototype, based on the shortcomings we then graduated to a ceramic prototype. Our final prototype is a result of analysis of strengths and weaknesses in the context of ease of usage, maintenance and costs.
Final Product Details

The water is poured into the system by opening the top lid. The top container has small perforations to reduce the speed of the water flow. The final product consists of two layers of filtration and purification. The water flows through the system under gravity. The bio sand layer removes pathogens and suspended impurities. It significantly reduces the iron content in water. The Bamboo and coconut charcoal layer further purifies the water and reduces the iron content in water. The purified water flows out of the outlet. Hence the system can be used for household purification of water. Refer Appendix A for more details.

Implementation Plan

Team Nirmal intends to implement the plan by including the community. Our implementation plan has 6 phases:

Phase 1- Pilot: Month1-Month3

- Locating the premises for manufacturing the purification systems.
- Distribute the purification systems to the early adopters.
- Collect feedback for further improvisation of the product.

Phase 2- Creating Awareness: Month2- Month4

- One of the important phases in helping the community understand the importance of clean drinking water and the hazards of consuming unclean water. This was clearly reflected during our survey, when 80% of the people surveyed did not feel the need to purify their water. Nukkad Natak that is street plays and dramas are an effective medium to reach out to the masses especially in the slums and rural areas. We would take the help of local NGOs for the same.
- Puppet shows another good medium to educate people living in the above mentioned areas. We want to use local youth and micro franchisees for both.
- On-site demonstrations of the product.

Phase 3- Identification and formation of micro franchisees: Month3- Month5

Based on our understanding of the local community and with the help of local contacts such as (MFIs, SPARC etc., and other NGOs working in Salia Sahi), we would identify enthusiastic and potential individuals for micro franchisees. The micro franchisees functions include collecting the water kits from team NIRMAL, identifying target groups in and around their locality, distribution of the systems to customers. We would connect
the micro franchisee enthusiasts with the MFIs for required financial support to start the franchising.

Phase 4 - Distribution: Month 5 - Month 12

Customers can also place orders that will be delivered by the micro franchisee.

Phase 5 - After completion of 1 year

We also wish to partner with Corporates who have product portfolio for the BOP (Bottom of the pyramid) and are willing to advertise them on the water purification system. We believe that this would be a good medium for the corporates to advertise themselves and reach out to the BOP.

Phase 6 - Expansion: After completion of 2 years

1. Accelerate the product programs to various locations in Orissa.
2. Hire workplace in the new locations.
3. Hire and train additional staff.
4. Employing the up gradations in our product.

V. Business Environment Analysis

Industry Background

Recognizing it as an ideal option for developing country applications, Dr. David Manz, a professor from the University of Calgary, developed the biosand filter in the early 1990’s to provide inexpensive, safe, drinking water for communities in developing countries. Bio sand filters since then have been successfully used in the developing countries. Bio sand filters were extensively tested and proven useful during the relief operations of earthquake at Haiti.

Bamboo charcoal has been used in many South Asian countries for water purification and enhancing the quality of water. Bamboo charcoal is known to be rich in a number of minerals. So bamboo charcoal not only purifies the water but also enriches it.

Coconut charcoal is extensively used in the process of refining and bleaching of vegetable oils and chemical solutions, water purification, recovery of solvents, recovery of gold etc. Though coconut charcoal is expensive than bamboo charcoal, it is most effective adsorbent and hence used for many industrial purposes also.

Competitor Comparative study

We have identified our competitors and done a comparative study. The details of the comparative study are mentioned in Appendix B.
VI. Financial Plan

Details of the financial plan has been mentioned in Appendix C

VII. Conclusion

Team Nirmal offers a unique and a very effective way to provide clean and safe drinking water to a sector of customers who are in dire need of it. The team has worked on providing the customers a good return on investment and a good life span. The product definitely has a competitive edge over a number of other similar products.

Team Nirmal is all set to cater to the needs of the largest slum in the city of Bhubaneswar called Salia Sahi through this product. The entire system is a sustainable system as it involves the community and focuses on increasing the awareness of the community.

We are of the belief that we are providing a socially responsible product catering to the unmet needs of a larger and a weaker section of the society.
Appendix A

Description of the water purification system components

Biosand Layer

The biosand filter (BSF) is an adaptation of the traditional slow sand filter, which has been used for community drinking water treatment for almost 200 years. The sand layer removes pathogens and suspended solids from contaminated drinking water. Contaminated water is simply poured into the top of the biosand filter on an intermittent basis. The water slowly passes through the diffuser and percolates down through the biolayer, sand and gravel. Treated water naturally flows from the outlet tube.

Pathogens and suspended solids are removed through a combination of biological and physical processes that take place in the biolayer and within the sand layer. These processes include: mechanical trapping, predation, adsorption, and natural death.

A summary of laboratory and field studies of the elements removed by the bio sand filter is as follows:

• Up to 98.5% of bacteria
• Up to 99.9% of protozoa
• Up to 95% of turbidity
• 90-95% of iron

Bamboo and coconut charcoal layer

Extensive studies have been conducted and it is found that bamboo charcoal is effective in removing around 70% of iron content in water. Coconut Charcoal is extensively used in the process of refining and bleaching of vegetable oils and chemical solutions, water purification, recovery of solvents, recovery of gold etc.

Appendix B
<table>
<thead>
<tr>
<th>S.N</th>
<th>Filter Type</th>
<th>Effectiveness</th>
<th>Time</th>
<th>Lifespan</th>
<th>Quality</th>
<th>Comparison over other filters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bio sand</td>
<td>Bacteria, Protozoa, Helminths,</td>
<td>0.8 litres/min</td>
<td>Plastic 10 years</td>
<td>Very effective to remove pathogens and turbidity</td>
<td>Not effective for chemicals</td>
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<tr>
<td></td>
<td></td>
<td>Turbidity, taste, Pathogens</td>
<td>minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Boiling</td>
<td>Bacteria, Protozoa, Helminths,</td>
<td>Need to heat</td>
<td>Needs constant</td>
<td>Very effective in killing pathogens</td>
<td>Needs fuel to boil water, pollutes the air</td>
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<td></td>
<td></td>
<td>Protozoa</td>
<td>water till it</td>
<td>replacement of</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>boils</td>
<td>the pot used</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>Ceramic Candle Filter</td>
<td>Bacteria, Protozoa, Helminths,</td>
<td>0.1-1 litre/hour</td>
<td>6 months-1 year</td>
<td>Effective for removing pathogens and turbidity</td>
<td>Not effective for chemicals; candle needs to be replaced; ceramic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turbidity, taste</td>
<td></td>
<td></td>
<td></td>
<td>holder is susceptible to breakage</td>
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<tr>
<td>4</td>
<td>Natural Coagulants</td>
<td>Very Effective for Turbidity</td>
<td>2+ hours</td>
<td>Seeds can be</td>
<td>Effective for removing turbidity and</td>
<td>Not effective for chemicals; may cause objectionable taste; the</td>
</tr>
<tr>
<td></td>
<td>(Moringa Seeds)</td>
<td></td>
<td></td>
<td>stored for a</td>
<td>somewhat effective for pathogens</td>
<td>coagulants need preparation;</td>
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<td>long time but</td>
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<td>containers need</td>
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<td>replacement</td>
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</table>


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<thead>
<tr>
<th></th>
<th><strong>Ceramic Pot Filter</strong></th>
<th><strong>Bacteria, Protozoa, Helminths, Turbidity, taste</strong></th>
<th><strong>1-3 litres/hour</strong></th>
<th><strong>1-2 years</strong></th>
<th><strong>Very effective in removing turbidity and pathogens; provides safe storage to prevent recontamination</strong></th>
<th><strong>Not effective for chemicals; ceramic holder is susceptible to breakage</strong></th>
</tr>
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<tbody>
<tr>
<td>5.</td>
<td><strong>Chlorination</strong></td>
<td><strong>Bacteria and Viruses</strong></td>
<td><strong>Need to wait for half an hour after adding chlorine</strong></td>
<td><strong>Up to 5 years for tablets; liquid chlorine should used within 3 months of being manufactured</strong></td>
<td><strong>Very effective in removing bacteria; not effective for certain types of protozoa</strong></td>
<td><strong>Taste may not appeal to all; need to follow manufacturer’s instructions; needs to be kept away from children; not effective for turbidity, taste, smell, colour and chemicals</strong></td>
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<td></td>
<td><strong>Lifestraw</strong></td>
<td><strong>Bacteria, Protozoa, Viruses Helminths, Turbidity</strong></td>
<td><strong>8-10 litres/hour</strong></td>
<td><strong>Upto 3 years</strong></td>
<td><strong>Very effective in removing bacteria, viruses, pathogens and turbidity</strong></td>
<td><strong>Not effective for certain type of Protozoa; daily maintenance required,</strong></td>
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Clean the cartridge and pre-filter everyday to prevent clogging; 
Very expensive.

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<tr>
<td>8.</td>
<td><strong>Solar Disinfection (SODIS)</strong></td>
<td>Bacteria, some protozoa, viruses, helminths,</td>
<td>6 hours on a sunny; up to 2 days when cloudy; cannot use when raining</td>
<td>Bottles need to be replaced if they have a lot of scratches</td>
</tr>
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Appendix C

Producing of 1000 Numbers water purifiers per month

a. Land and building
   - 500 sq yards land with 1500 sq ft. Building
   - Work shop 1000 sq.ft.
   - Office 500 sq ft. including lab

b. Equipment

Project projections:

Per month

a. Rent for the workshop and office Rs 5/ per sq ft. Rs 7500.00
b. Electricity and water Rs 1000.00

c. Staff salaries
   - Manager/supervisor 7500
   - Accountant/office Asst 5000
   - Office orderly 3500
   - Watchman 2500 Rs 18500.00

d. Office expenses Telephones, stationery etc. Rs 5000.00

   **TOTAL** Rs 32,000.00

Raw material requirement

a. Bamboo charcoal & Coconut charcoal @ Rs 40 x 1000 Nos 40,000.00

b. Taps @ Rs 30 x 1000 30,000.00

c. Sand & Gravel @ Rs 30 x 1000 30,000.00

d. Plastic Buckets (3) @ Rs 150 x 1000 1,50,000.00
e. Labour @ Rs 100 x1000 1,00,000.00
f. Marketing exp. @ Rs 50 x 1000 50,000.00
g. PUC pipe @ Rs 20 x 1000 20,000.00

TOTAL Rs 4,52,000.00
Add 10% on investment Rs 45,200.00
Add 20% profit Rs 90,400.00
Grand total Rs 5,87,600.00

Cost of production:
1000 Numbers Rs 5,87,600/-
Cost of each unit Rs 587/-

Working capital requirement per 3 months @ 340,000 = Rs 13,56,000/-
Capital investment for lab and office furniture Rs 25,000/ (one time)

Total turnover per the year
12000 x 587 = Rs 70,44,000
@ Profit @ 20% for 12000 units will be around Rs 14,08,800/-
Hence the project will be viable