A model system for the provision of potable water in Uganda using *Moringa oleifera* seed coagulant

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1. Introduction

The Centers for Disease Control (CDC) report that among an estimated 4 billion episodes of diarrhea annually there are 2 million deaths, mostly among children, with half of these episodes and deaths caused by waterborne bacterial infections. This problem is highly prevalent in the developing world, plaguing countries and communities without the resources to pay for a standard means of treating unclean water. The answer to solving this problem lies in the use of alternative and sustainable means of treatment.

As water is often treated in developed nations with commercial coagulants/flocculants, a reasonable and sustainable alternative in the developing world would be a natural coagulant/flocculant. Coagulant/flocculants cause debris in water to aggregate, so that the final product is suitable for human consumption. Natural coagulants/flocculants have been used for centuries in traditional water treatment practices throughout certain areas of the developing world.They have recently piqued scientific interest in addition to gaining widespread implementation by groups like the CDC, World Bank, and World Health Organization. A flocculant commonly used and studied comes from the seed of the *Moringa oleifera* (MO) tree. Its popularity is due in part to its ability to grow rapidly, even in poor, marginal soils, its requirement for little horticultural attention, and its resilience to the effects of extended drought. Native to northern India, the tree is now grown extensively throughout the tropics, and is found in many countries of Africa, Asia and South America. It is very efficient in clarifying and removing harmful bacteria from turbid water. Research conducted by the Mbarara University of Science and Technology (MUST) assessed the total amount of coliforms before and after clarification of water from the River Rwizi of Uganda. The use of MO seeds in the process showed that this technology eliminated up to 99 percent of bacteria found in water. Furthermore, a full seed pod can typically purify 5 liters of water that is not turbid, between 2.5 -5 liters of water that is moderately turbid, and about 2.5 liters of very turbid water. Similar studies have been performed confirming this work in various publications.

This proposal seeks funding for a project supported by MUST and local officials, which is to be implemented by Minh Quang Vo and James Davis Katumba in the Bubaare sub county of the Mbarara district of South-West Uganda. The main goals of the project are to plant a MO grove, educate the target community on how to use MO in treatingt unclean water, and construct two water treatment structures designed to hold and treat water with MO seeds. The tree's usage extends beyond being a primary resource for water treatment as it has both medicinal and nutritional value. With protein content and quality rivaling that of eggs, MO byproducts contain, ounce for ounce, more Vitamin A than carrots, calcium than milk, iron than spinach, Vitamin C than oranges, and potassium than bananas. In addition to these benefits, MO can be used to generate funds to supplement the current income of the community through the sale of its byproducts. These same byproducts can also be used in providing food to the community in an effort to lower existing nutritional disparities within the region.

*In an effort to meet page requirements, sources and references have been omitted but are available upon request

2. Project Aims

Working in the Bubaare sub-county of the Mbarara district of south-west Uganda, the primary aims of the project are as follows:

a) To set up a MO nursery bed, fostering the growth of the multi-purpose tree to ensure a sustainable supply of seeds for the people of the Bubaare sub county.
b) To educate the people in Western Uganda on how to use the seeds in the clarification of water using the materials and containers they possess.
c) To construct a structure/delivery system using MO seeds to clarify water for farmers, who have large

farms with many animals, in an area where natural sources of water are infectious to the livestock.

d) To construct the same structure for an area where there are valley dams supplying water that is normally turbid and untreated, providing the community with a source of potable water.
e) To prevent instances of malnutrition by promoting the use of the tree's nutritional byproducts in traditional cooking.
f) To look for a market for MO byproducts so that people tending to the trees can earn a supplementary income for themselves as well as provide supplementary funding for the project.

3. Implementation and Timeline

Scheduled to begin mid-May and end mid-August, all of the activities will be carried out simultaneously. The following are descriptions for implementation and projected required times for project goals:

a) As this tree can be grown by planting its cut limbs, planting of limbs and seeds will be a joint effort carried out by community members and MUST students. Projected time: 3-4 weeks
b) Education on how to use MO seeds will be carried out by James Davis Katumba and Minh Q. Vo in workshops/community meetings and in informal visits throughout community households. As it takes 6-8 months for planted limbs and 2-3 years for new trees to begin yielding substantial amounts of seed pods (2-400), the community will use MO seeds from the 3000 MO trees planted in neighboring communities by MUST. Expected workshops: 3-4
c) Water treatment structures will be constructed by a local construction company, with the assistance of community members. Projected time estimate from the engineer of the structure and construction company: a little under one and a half months.
e) Generation of additional revenue from MO byproducts will be actively investigated on the internet by Minh Q. Vo. An aim is also to develop a website selling MO products such as cooking oil, paper/artwork, etc. MO byproducts will also be sold at local markets.

4. Working Group

1. Minh Q. Vo	**2. James Davis Katumba**	**3. Christopher Melano Vaughn**	**4. Emmanuel Wamala**
University of Florida, USA	MUST, Uganda	Canberra university, Australia	MUST, Uganda
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	Primary contact and collaborator as MUST representative	Engineer and consultant for water treatment structures	Project consultant

5. Conclusion

Because we believe that a world without water is a world without peace, our greatest goal is to see access to clean drinking water become a worldwide standard, both in developed and developing countries. The use of MO seed coagulant in rural communities is an ideal means to this end because the seeds are cheap and sustainable. Additionally, the water clarification technique using these seeds does not require technically qualified operators.

Implementation of the MO water clarification project will provide the 300-400 inhabitants of the target community with clean drinking water. The benefit from this treatment will prevent the spread of waterborne disease and infection within this population. This will also curtail the expenses incurred by farmers with livestock that die from infectious diseases transmitted from drinking unclean water. In addition to the projects ability to develop a supplemental source of income, it will provide the community with a sustainable source of nutrition.

While the instant beneficiaries of the project are limited to 300-400 people, the long-term impact of the project will be far greater. Provision of potable water from the MO seeds will provide children the opportunity to pursue an education rather than having to walk long distances to collect clean water for their family. In addition, funding for this project will bring widespread attention to the use of MO in providing clean water to people, promoting its use throughout the country and the world.