Next-Door Coagulant: The WTP's New Sustainable Neighbor

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Highlights:

· *Moringa oleifera* as an alternative solution for WTP’s in isolated communities.

· Local production of plant-based coagulants: sustainable and strategic business.

· Sizing for planting and using a natural coagulant on a full-scale WTP.

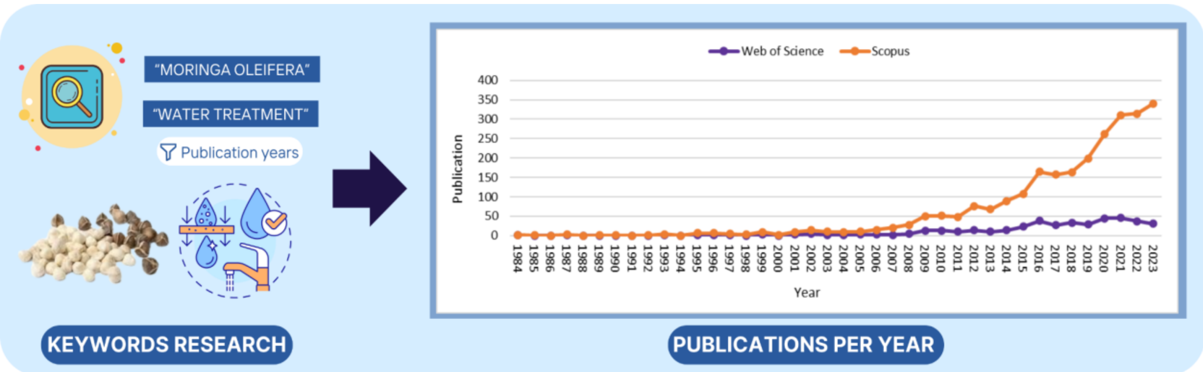
Keywords: *Moringa oleifera*; Isolated communities; Full-scale WTP.

INTRODUCTION

Despite progress in reducing inequalities in access to clean water, sanitation, and hygiene, the absence of these services remains a global concern. This lack exacerbates social and economic disparities, particularly for individuals living in isolated and rural communities [1].

In view of this problem, research into natural coagulants for water treatment has been increasingly conducted, with *Moringa oleifera* being one of the most popular plant-based coagulants in the area (Figure 1). Originally from India and adapted to tropical countries, this species is resilient to water crises and remains productive year-round. In addition to its importance in water treatment due to its coagulating properties, *Moringa oleifera* also finds a variety of applications in the food, pharmaceutical, cosmetic, and nutritional industries [1, 3, 5].

Figure 1. Database search on *Moringa oleifera* in water treatment.



This expanded abstract aims to use a coagulant solution derived from *Moringa oleifera* seeds for water treatment purposes, serving as an alternative to conventional coagulants. In addition, it will discuss the viability of growing a *Moringa oleifera* plantation near a water treatment plant in a hypothetical community.

METHODOLOGY

This study is based on a hypothetical community with a population of 2000 inhabitants and an average per capita consumption of treated water of 150 L/inhabitant/day. The water treatment plant (WTP) that supplies this population is of the conventional type, with a capacity of 3.5 L/s and the intention is to use a solution of the aqueous extract of *Moringa oleifera* seeds as a coagulant.

For the preparation of the solution, the seeds were shelled, crushed, sieved, and 5 g of the obtained powder were weighed. Then, 200 ml of distilled water were added to the weighed amount of powder, followed by 30 minutes of agitation. The extract was obtained by vacuum filtration (Whatman No. 1 filter paper) and the filtrate was placed in a 500 ml flask, making up the volume with distilled water. Jar test assays were conducted to determine the optimal dosage for raw water with turbidity levels T1 (21.30 NTU) and T2 (73.98 NTU), which were found to be 50 mg/L and 80 mg/L, respectively [4].

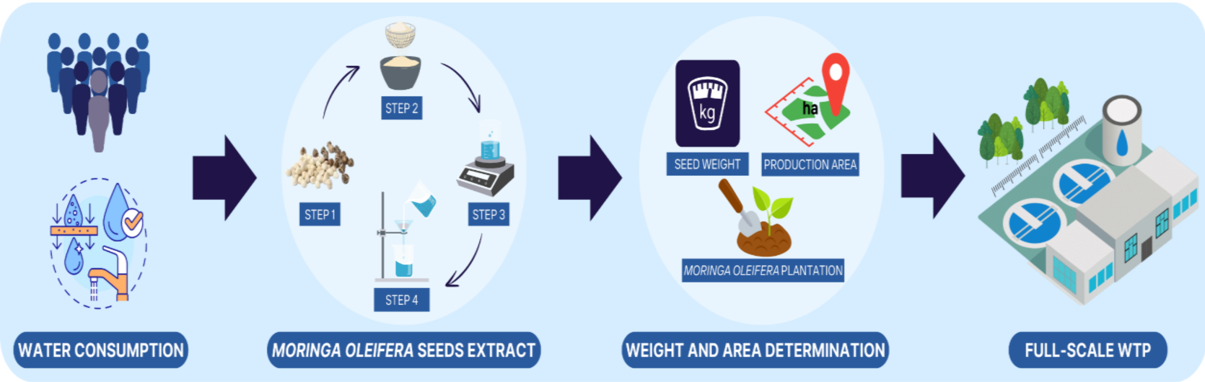
Based on the information, the necessary seed weight was estimated, with an annual production of 3-5 tons/hectare [2]. So, on average, 4,000 kg of seeds per hectare (ha) are obtained. It is worth noting that tree seed production begins between 6 to 12 months after planting. To determine the extent of the plantation area required to meet the demand of the WTP, the following equation (01) was used:

$$A = \frac{365.10^{-6}.H.C.S}{M} \qquad (01)$$

Where A is the annual production area of *Moringa oleifera* required (ha/year), H is the number of inhabitants (inhab), C isis the per capita water consumption (L/inhabitant/day), s is the coagulant dosage (mg/L) and M is the seed production area (kg/ha).

Finally, the area needed to plant the tree will be used to discuss the feasibility of planting *Moringa oleifera* near the WTP (Figure 2).

Figure 2. Methodology visual abstract.



RESULTS AND CONCLUSIONS

For T1, 50 mg/L of seed is used in the treatment, and for T2, 80 mg/L is used. Based on equation 01, to meet the demand of this community, a *Moringa oleifera* plantation of approximately 1.4 hectares would be necessary for T1 and 2.2 hectares for T2.

In Brazil, a rural property is considered small when it has 1 to 4 fiscal modules. For the most restricted fiscal module (5 ha), a property of up to 20 ha is classified as a small rural property. This module size is applied to regions with high population density and intensive agriculture.

In this scenario, the space occupied by the plantation for T1 and T2 water is considered a small property. This makes it possible to implement it in various regions.

Two turbidity scenarios were established in this study, considering that when turbidity is higher, the coagulant consumption also increases. Therefore, it is expected that the plantation will be designed to meet the needs of the scenario with higher coagulant consumption.

In isolated areas, where there is more space and reduced cultivation costs, the substitution of chemical coagulants for natural ones is a more viable option, especially in this context.

The main benefits of planting *Moringa oleifera* near the WTP include: financial savings and reduction of carbon emissions in transportation, delivery security (as some communities have restricted access due to geographical distribution), promotion of local commerce, and the utilization of all parts of the tree for other purposes, as previously discussed.

This study focused on *Moringa oleifera*; however, there are many plants capable of contributing to water treatment. This suggests the possibility of making the production of coagulants viable near WTPs by utilizing the plant that best adapts to the region of interest.

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