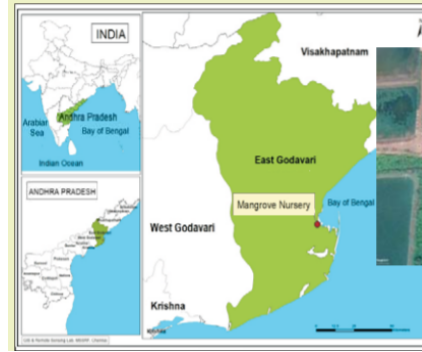


Literary Review Of the MS Swaminathan Research Foundation
On Mangrove Ecosystem Restoration, and The Restoration of livelihood
Around Coastal Areas



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Ecosystem-based Adaptation - Coastal Ecosystems

Flora Kafunda, Cedar Rapids
The World Food Prize Foundation
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M. S. Swaminathan Research Foundation
Science for Sustainable Development

MS Swaminathan Research Foundation
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Personal Reflection

The opportunity to work under the MS Swaminathan Research Foundation came as a surprise, much-needed direction for me. I am a sophomore in college now and often wonder what I want to achieve at the end of my four years here. What sort of impact I will leave. Apart from my perceptions of the research itself and the outcomes I was expecting, the chance to work with real-world heroes was extraordinary in itself, and I hope to have the opportunity to do it again. Like any other new project, this one also came with its challenges. A big one after the initial meetings was coming up with a weekly meeting timeline where we could converse on the literary research I had done, new research my mentor was working on, or any other bases we needed to touch on. We had decided to meet at 7 am my time. This arrangement, however, did not last very long as he got busy with fieldwork and me with more literary reviews. We opted to send weekly emails with an overview of what I had done for the week and any new questions I had come up with after my reading. I kept all my questions in a document that I sent from the publication for some answers and directions to answer them myself. It was genuinely challenging not to do the work in the field since my research was very hands-on. My focus included:

- Speaking to the local communities.
- Getting their input on new ways of conservation.
- Learning some of their experiences with nurturing the environment and their livelihoods.

There was a lot to learn and reinforce from this experience. I strengthened my knowledge of literature review and search. I want to be a researcher in the future, and this was a great pillar in my bedrock when it came to building my beginnings. Something important I learned was how this work intertwined with the general public. Over the summer, I was in a seminar, and we spoke extensively about the ethics of research and people's opinion. The people's perspective of

this field makes it truly special because you learn how to incorporate logical and systematic thinking into more natural, non-systematic, or algorithmic ways of daily life. This research reinforced some principles of community I will always use in my future work. I wish I had more time to learn and do more work since I enjoyed it very much. I was looking forward to being in the field after the covid emergency was over. I cannot wait to do more in the field data collection and analysis and meet those directly impacted by the changes around mangroves.

With all that said, I would like to extend my gratitude to Dr. Ramasubramanian for being an excellent mentor, Ms. Barbara Stinson, the President of the World Food Prize for such a wonderful organization, Mr. Keegan Kautzkzy, Director of Global Youth Programs and Partnership for walking and guiding me throughout the program. I have learned so much from all of you in one way or another, and I wish to continue doing the same.

Abstract

The MSSR Foundation aims to expedite modern science and technology for rural agricultural development and sustainability. They have been officially working as a Foundation for nearly thirty-five years now but have worked much longer than that. Their groundbreaking work in Indian Mangrove restoration has also been pivotal to the sustenance of the Indian coastal ecosystems, land, and livelihood. They also empower local women to pick up the mantle after them, which has indeed been nothing short of heroic. This paper tries to summarize some of the great work through their many years of service. It focuses on their innovative means to calculate Pmax in Pichavaram, their gendered studies on adverse climate effects on people, and how different birth genders react to them. This paper only briefly talks about the different ways the Foundation has been using to reclaim abandoned land and put it to good use. This paper is only a

glimpse of work done for one month. Although not all facts are presented below, they are some examples to demonstrate the incredible work the Foundation has done.

Introduction

Although described by many as smelly, swampy, and mosquito-infested regions (seacology, 2021), mangrove forests have played a pivotal role in the world's ecosystem. For centuries, they have provided shelter and environment for small animals, helped maintain carbon dioxide levels through sequestration, protect coastline livelihood during storms, and provided better water quality (seacology, 2021). They are the silent hero, whose importance to the world has unfortunately been forgotten by many. Given their primal geopolitical location along coastlines, they have been vulnerable and heavily harmed by human activities.

Mangroves are designed in a way that, in small amounts, they can sustain their ecosystems. This sustenance includes providing building materials, fuel, fish, and shelter to locals. However, as they become more frequent, these practices also become detrimental to the sustenance and survival of mangrove forests. Their geolocation also plays a heavy toll on their rate of destruction, as coastlines are popular locations for agriculture, real estate, tourism, and harmful aquaculture practices. With similar patterns happening worldwide, it leaves our world vulnerable to many of the dangers mangroves shielded us from and some of the pleasures it provided. To put in perspective, in the last twenty years, about 50 percent of Myanmar's mangroves have disappeared (de Alban et al., 2020), and just one hundred years for the world to lose 50 percent of its mangrove forestry. One hundred years is a short time to lose so much of the world. This loss is equivalent to 3 life cycles of trees in tropical forests as they reach maturity in 30 years, but only one tree in the much cooler regions (localtree.com).

Many governments and organizations worldwide realize the importance of maintaining mangrove ecosystems worldwide and take appropriate measures to ensure safe practices are in place for their maintenance. One such place is the M.S Swaminathan Research Foundation (MSSRF), fighting for restoration as early as the 1970s(MSSRF, 2015). They realized the detrimental effects of deforestation happening on the coasts of India, along regions like Goa and Tamil Nadu. For many years, they have been at work, trying to reverse the lifetime effects of a short time.

This summer, I had the pleasure of reviewing and learning from the Foundation's outstanding work in conservation as they engineer new ways to save the Indian coasts, educate, encourage and inspire young people and locals in safe practices of protection and management of their livelihoods. From this research, before doing any field or data analysis, it is imperative to understand the background and current research done by MSSRF scientists and leaders as they strive to accomplish their goals. Some significant readings included the study of seasonal variation of net ecosystem exchange of carbon dioxide(CO₂)of mangroves in the Pichavaram forest, one of their study locations. This publication further investigates how we understand measuring net ecosystem exchange(NEE) of mangroves worldwide seasonally. Many questions, such as how varied NEE is worldwide and the impact of earlier losses, affect this global estimate(Gnanamoorthy et al., 2020). There is still work to do to understand and calculate NEE as well as predicted. Another poignant read was the article on the Gaja cyclone's impact on the livelihood and general environment of the coastal areas targeted. This paper illustrated, if not providing, a keen warning on the importance of mangroves and their restoration. It was also clear that people in the local areas took restoration seriously and were willing to listen. The MSSRF's productive engagement with the environment and the people is admirable. They vigorously strive

to educate, research, and teach both young and old ways to maintain and save the ecosystems in which they belong.

Research

Having been established in 1988, the Foundation has made so much groundbreaking work in establishing and restoring the coasts of India. Some of the Foundation's work was structured around understanding the land, its species, people, and the different practices to maintain their livelihood and the natural environment of their land. By analyzing the Foundation's historical research and interactions with the community, one can infer their steps to restore this dying world and how effective their methods are. From these papers, a prospective environmental scientist can also learn to ask the right questions regarding conservation. One article that led to asking such questions was the publication on NEE (Gnanamoorthy et al., 2020).

One of the many roles mangroves is in the assistance of carbon sink capacity that this writing explores and uses to measure NEE. We calculate NEE using the equation $\Delta C'$, and C' represents the concentration of CO₂ (Gnanamoorthy et al., 2020). However, carbon sink is threatened by many natural factors such as temperature, rainfall distribution, and sea level, all factors affected adversely by climate change. Human effects would be deforestation, overproduction, and harmful aquaculture. One question was how the Foundation maintains the carbon sink in their region because they cannot regulate natural phenomena to safeguard the plants. This, however, is a concern for the entire world. Climate is changing at an alarming rate, nearing irreversible peaks, and we as people are not versed in ways to solve most of these problems.

A solution that the Foundation came up with the government's help was the establishment of laws to safeguard protected regions of land along coastlines where it was punishable to fell or covert the land and its plantations for uses other than the ones already specified. The carbon sink

is estimated to increase as the biomass increases in the ground (reading questions). One negative effect of the decrease of carbon sink is the increase of P_{max} . P_{max} is the maximum photosynthetic rate, which is a taxing problem for the Indian coasts, as the most common species found there is the *Avicennia marina*. *Avicennia marina* has one of the highest photosynthetic rates of the species found on the Indian coast, second only to the *Rhizophora* species (Ritchie et al., 2015).

This led to exploring the manual on the mangrove nursery run by the Foundation as part of their Genetics Conservation Centre initiative. This was interesting because, as a student, mangroves are not a heavy topic or one of interest, so this reading helped me understand some of the growing histories of the land and the evolution of plants. The most dominant species in Tamil Nadu is *Avicennia Marina*, as it has the best chances and highest growth rates. They grow every monsoon season. As most mangroves are found within the inter-tidal areas, it is primitive to plant them accordingly; As the natural environment returns to degraded regions, the mangrove remains in that region. This is so they can protect the coast from some of the furies from the sea, such as cyclones(Ramasubramanian, 2020).

Education and Outreach

The work the Foundation does is very community-oriented. As a pro-nature non-profit, the organization aims to be pro-women and pro-poor to encourage and empower rural stakeholders to take a more proactive method in helping conserve their environment and communities(MSSRF, 2015). One of the most attractive aspects of this work was learning from people in the field and the residents about the best methods. Many articles exploring how the Foundation partnered with other organizations to develop sustainable ways to help the local

communities better preserve their lands. The efforts were in different categories ranging from fisheries to plantations and education.

1. Fisheries

One of the most harmful factors to the maintenance of mangroves is the harmful practices of aquaculture. In some regions, they clear land ultimately to maintain small ponds for shrimp and fish farming. One way of advancing sustainable development goals was to partner with IUNC, which led to the creation of IMFF. IMFF would then be responsible for the reclamation of abandoned coastal lands, saline lands, and aquaculture ponds(Saleem Khan et al., 2012). These lands would be given to farmers for mangrove plantation at no cost. This incentive is effective because, as people who live day to day based on a simple livelihood, this is a great motivator for them to take care of their environment and teach the younger children to love it the same way.

Some articles also explored gender disparities in the labor force, especially in fisheries, after the seasonal fishing ban in Tamil Nadu and Puducherry. The paper proposed some responses to hard times based on gender, class, and power. It was interesting to see all the relatively small details that lead to how resources are divided in a family whose source of income has been cut(Novak Colwell et al., 2017). This topic would be interesting to explore vigorously to establish a trend and find a way to limit some of the more drastic measures, albeit necessary, some families have to take when faced with a disaster.

2. Informational Education

Another novel way the Foundation has engineered has been the informal education of stakeholders in these rural communities. This is a fantastic opportunity for the researchers to obtain an outside perspective into the lives of the local community and come up with ways that can help the people as well(Khan et al., 2012). It is less complicated for a scientist to solve an

ecological problem without people's direct input and effect, as it is to incorporate and as part of the solution. To combat this situation, the Foundation came up with many participatory and hands-on methods for the local community to learn about the different ways they can help. The community is well aware of the degradation of their environment, which helps boost morale because they understand the importance of their work. Another way the Foundation uses, apart from the ones mentioned above, is having a training program for young people who understand the impact of the adverse effects of the degrading mangrove forestation to help rural farmers have a similar understanding (Khan et al., 2012). The critical point of this is learning how to form relationships with people, understand their perspectives, and teach them from their standing ground.

Conclusion

Mangroves are a crucial part of our world, more so our daily lives. They may not grow in our direct vicinity, but their impact on our climate and ecosystem is within our line of sight. This article summarizes some of the importance of mangroves, such as their great help in protecting coastlines, providing habitat for fish, and income for local communities. It is also imperative we remember the adverse effects climate change and human activities have had on their growth and maintenance. The MSSR Foundation has been a key and irreplaceable resource and network in the care of mangroves along the coasts of India, involved in many more programs to increase awareness of the proper methods of restoration and teach those less knowledgeable in the area on ways to improve their understanding and overall participation in making our world better, one tree at a time. I wished to have had more time to explore this topic, but unfortunately, I did not. I now have another great resource from which I will learn to grow into a better person of science who has the same symbiotic relationship with nature as mangroves with crabs.

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