CONTRIBUTION 5.4

Investigating the Effectiveness of Three Different Growing Methods for Seamoss Farming in Saint Lucia

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Abstract

Seamoss is a common marine macroalgae found globally, that has been cultivated in Saint Lucia for decades. Recently, seamoss production in Saint Lucia has increased significantly, fueled by increased global demand. This is reflected in the price increase of seamoss after 2019 when more people joined the sector owing to job loss on account of the COVID-19 pandemic. The increased production of seamoss has been beneficial to the economic sector in Saint Lucia and may have contributed to the country's coastal blue carbon store. Increased loss of planting material occasioned by unfavourable weather and sea conditions influenced an investigation into determining the most effective growing methods for seamoss farming in Saint Lucia. Test plots were set established at various locations using three growing methods, namely: a biodegradable tube net, a plastic tube net, and the traditional plastic monoline. The rate of growth of the seamoss and the substrate material's durability were monitored and compared across the three growing methods. The traditional monoline method proved to be effective as it allowed for the continued growth of the propagule, by promoting the free movement of nutrients and sediments off the plants. However, the plastic tube net, was the most successful growing method since it retained the most propagules during periods of rough seas and had the highest overall growth rate.

KEYWORDS: fisheries, disaster risk resilience, climate change, mariculture, seamoss

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1. INTRODUCTION

Seamoss or Irishmoss is a common marine macroalgae found globally. In Saint Lucia and the rest of the Caribbean, seamoss is used most commonly in beverages. The seamoss is thought to be an aphrodisiac and because of this, as well as other reputed health and nutritional benefits associated with it, it is highly sought after. Some species of seamoss are also used in cosmetics and as a solidifying agent in ice-cream (CANARI, 1997).

Initially, seamoss farming in Saint Lucia was done with a *Gracilaria* species, a small red algae which had a low carrageenan percentage. Eventually, the switch was made to *Eucheuma cottonii (E.cottonii)* when the species was introduced in 2013 as part of the Department of Fisheries' initiative to diversify the crop, in an attempt to find a species with a higher carrageenan content, which in turn would produce a higher quality product. Seamoss farming is conducted mainly in coastal sheltered areas, with planting and maintenance being done by members of the community (CANARI, 2003). The nutrients that are needed for seamoss growth are obtained directly from the seawater and so is crucial to have currents that flush the site where the farm is placed. Presently, the seamoss is tied to plastic ropes which are attached to stakes or poles that are affixed to the seabed.

However, during periods of extreme weather events or when a farm is abandoned, the poles become a hazard to marine animals and humans alike. Firstly, they may break during storm surges and can pose multiple problems including damage to property, destruction to coral reefs and other marine habitats, and possibly even injuries to people who are unaware that there are broken poles in the area. Also, the loss of plastic lines may not only contribute to entanglement of marine organisms, but marine organisms can ingest the lines and die. Additionally, the plastic may become degraded, further contributing to the presence of microplastics within the food chain. The lines can also become entangled in the propellers of boat which could be quite dangerous, especially to fisherfolk who use small pirogues. These problems have prompted the need for more environmentally friendly farming methods to be implemented (Perpetuo Reis & Pereira, 2014).

In addition to the multiple environmental problems associated with seamoss farming, Saint Lucian farmers have been experiencing accelerated loss of product owing to praedial larceny and conflicts with other coastal resource users. Due to the open nature of local farms and lack of legal tenure of the marine space by farmers, people can remove large quantities of seamoss plants from the lines during the night after the farmers have left the area. People also collect seamoss that has washed onto shore from farms during the day. These actions have not only put a greater strain on the farmers financially, but it raises countless safety issues for them. Moreover, conflict among recreational users of the coastal areas, seamoss farmers, and fishers has resulted in added pressure on other community members.

2. METHODOLOGY

A list of possible site locations around Saint Lucia were considered. The sites were chosen to include areas where seamoss farming was practiced, as well as other sites which could be viewed as potential farming areas. Upon evaluation, four (4) locations were considered: Monchy, Micoud, Savannes-Bay, and Laborie (see Figure 1).

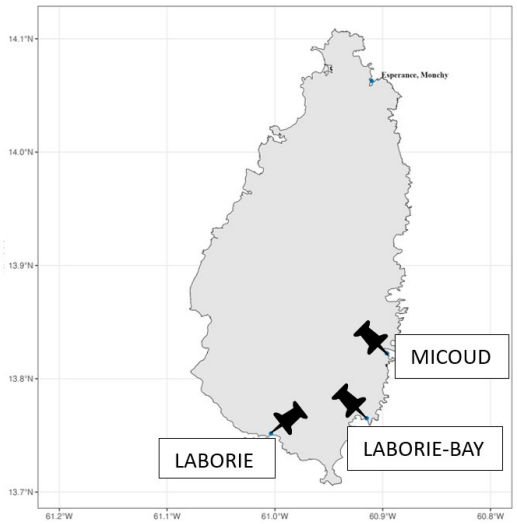

Figure 1. Map of Saint Lucia showing test sites

After site selection, initial site visits were undertaken in order to assess the suitability of the area for the project. The site was examined, and records were made of various environmental parameters, including human activities and vegetation cover, among other things. The presence of biological threats, such as parrotfish and macroalgae, and other potential threats, such as the level of solid waste found in the area, were recorded.

Following this, the test plots were demarcated using floaters and buoys and the farms were set up using two methods; the floating (horizontal) monoline method using the plastic lines, and the floating (horizontal) method using the tubular nets (plastic and biodegradable)

The size of the test plots at the different sites was chosen based on various factors including manageability, available resources (planting material, nets, and lines), and available sea space. The GPS coordinates of the sites were then recorded for future reference. Propagules (*E.cottonii*) were then acquired for planting. After the lines were '*seeded*', they were weighed and placed in the water.

For the floating line method (horizontal), three (3) eight-foot plastic lines were attached to two (2) main supporting ropes at each end. The lines were placed no less than 20cm apart to avoid entanglement of the seamoss. The supporting lines were then fixed to the bottom using cement blocks and the lines were placed perpendicular to the current to prevent excessive breakage of propagule. Buoys were attached to demarcate the area and to keep the lines afloat. The propagules were then attached (using '*tie tie*') every 20cm on the plastic line.

Figure 2. Fisheries officers tying the seamoss propagule onto the plastic line using the 'tie tie' method.

Three (3) eight-foot lines were cut from both the plastic and biodegradable tube nets, and these were tied in the same manner as the plastic monoline. The seamoss propagules were then evenly spaced inside the tube net using the PVC pipe.

Figure 3. 'Seeded' plastic tube net with the E. cottonii propagule

The number of propagules placed in the net was the same as what was tied on the plastic line, for uniformity.

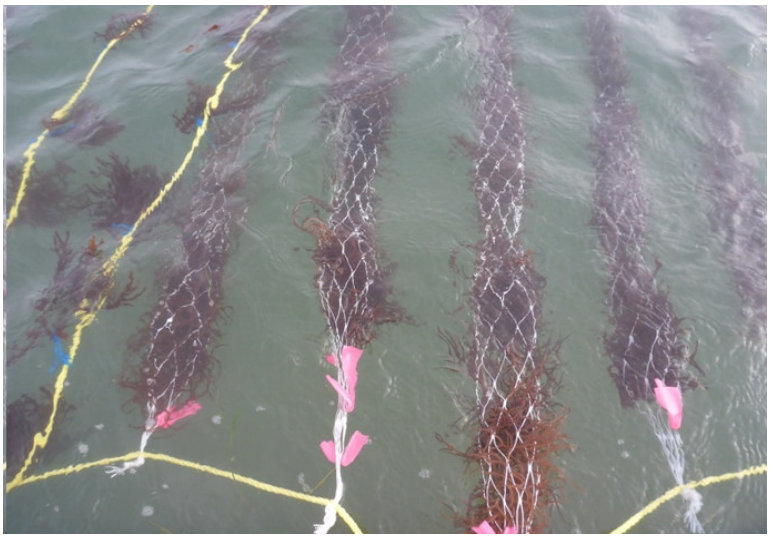

Figure 4. Farm set-up using both the 'tie tie' method (on the left) and the tube net method, both plastic and biodegradable nets (center and right, respectively)

The plots were maintained and monitored bi-weekly for a period of seven (7) weeks until it was time to harvest the seamoss, and water parameters such as temperature and pH were tested upon each visit. Once a week, the weight of each line, monoline and tube net, was recorded per site.

After the growth cycle was completed, the final weight of the lines was recorded and the seamoss was harvested, bleached, and dried. Anchors were removed, and the buoys were cleaned and stored for future use.

Figure 6. Seamoss collected at the end of the growing period in Micoud

3. RESULTS

3.1 Laborie

The test plot in Laborie was placed near the shore and maintained by the Fisheries officers. The seamoss grew slowly in the first two (2) weeks but the plots were disturbed when the buoys were stolen and the lines cut (*see Table 1*).

Table 1. Growth rate of the seamoss at the Laborie plot (weight in kg)

DATE	20-Nov	26-Nov	3-Dec
Biodegradable Tube Net	0.88	0.27	Buoys were missing and the plot was compromised.
Plastic Tube Net	0.76	0.86	
Plastic Monoline	0.45	0	

Unlike the other areas, the seamoss grew thicker in Laborie.

Figure 7. Two seamoss propagules used during the project period. The propagule on the left is from Laborie and the one on the right is from Micoud

3.2 Micoud

The test plot in Micoud was placed near another seamoss farm in the area and maintenance was undertaken jointly by the seamoss farmer and the Fisheries officers.

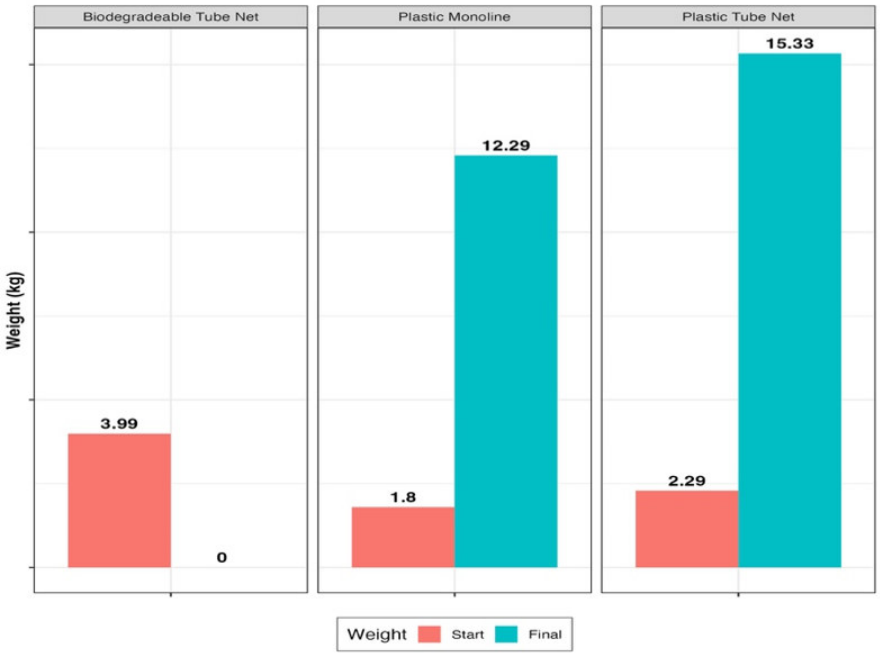

Figure 8. Change in weight of seamoss lines at Micoud test plot

The seamoss grew considerably well over a five (5) week period (*see Table 2*).

Table 2. Growth rate of the seamoss in Micoud over a five (5) week period (weight in kg)

	10-Nov	20-Nov	26-Nov	3-Dec	10-Dec
Biodegradable Tube Net	3.99	6.08	7.57	10.93	0
Plastic Tube Net	2.29	4.08	6.44	10.75	15.33
Plastic Monoline	1.8	4.76	8.39	13.47	12.3

The seamoss was a darker colour than the other propagules found in Savannes Bay and Laborie (southern plots).The seamoss also reached its peak weight quicker than expected resulting in it being harvested earlier, i.e. before the seven (7) week period.The biodegradable net did not withstand the weight of the seamoss and started breaking after the fourth week.

Figure 9. Breakage in the biodegradable tube net

3.3 Monchy

The test plot in Esperance, Monchy was placed near another seamoss farm in the area and maintenance was undertaken by the Fisheries officers.

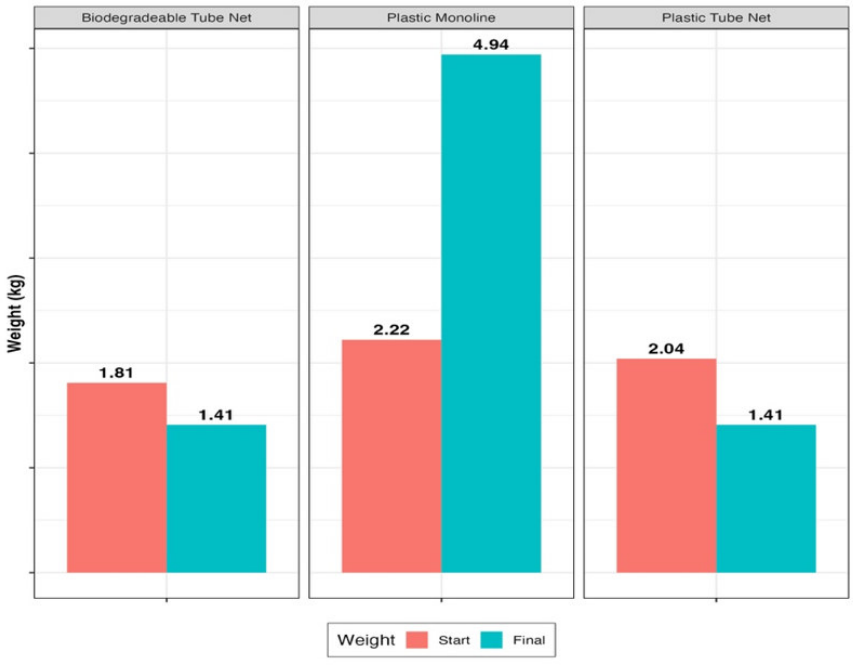

Figure 10. Change in weight of seamoss lines at Monchy test plot

The seamoss grew slowly in the six (6) week period (*see Table 3*).

Table 3. Growth rate of the seamoss at the Monchy farm (weight in kg)

	6-Nov	13-Nov	19-Nov	27-Nov	8-Dec	18-Dec
Biodegradable Tube Net	1.81	2.59	2	2.45	0	0
Plastic Tube Net	2.04	1.86	1.09	1	0.63	1.41
Plastic Monoline	2.22	3.13	2.99	3.45	4.68	4.94

After a period of intense rainfall, the Bay was heavily silted. The seamoss appeared stringy with bleached tips. This occurrence seemed worse in the biodegradable tube nets.

Figure 11. Stringy and bleached tips of the seamoss from the plastic monoline

3.4 Savannes Bay

The test plot in Savannes Bay was placed near other seamoss farms in the area and maintenance was undertaken by the Fisheries officers.

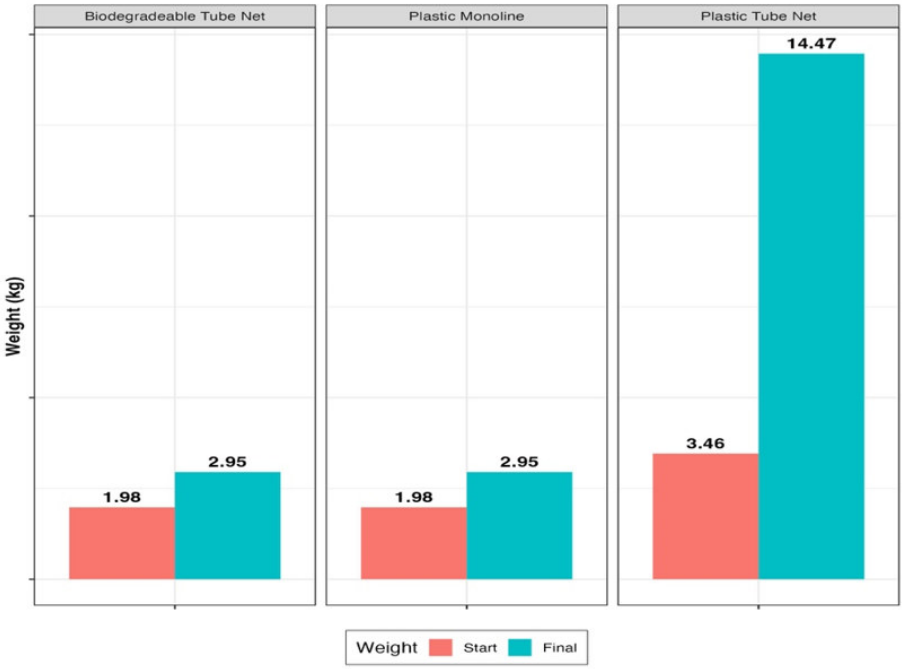

Figure 12. Change in weight of seamoss lines at Savannes-Bay test plot

The seamoss grew very quickly for the most part over the seven (7) week period (*see Table 4*).

Table 4. Seamoss growth rate in Savannes Bay (weight in kg)

	10-Nov	20-Nov	26-Nov	3-Dec	10-Dec	17-Dec	22-Dec
Biodegradable Tube Net	3.67	1.59	0	0	0	0	0
Plastic Tube Net	3.46	2.9	8.62	12.15	13.97	14.24	14.47
Plastic Monoline	1.98	5.22	5.8	5.8	4.26	4.76	2.95

The seamoss appears to have grown lighter than the other seamoss plants harvested during the study period.

4. DISCUSSION

Seamoss or Irishmoss is a common marine macroalgae found globally. In Saint Lucia and the rest of the Caribbean, seamoss is used most commonly in beverages. Seamoss farming is done mainly in coastal sheltered areas, with planting and maintenance being done by farmers of the nearby communities. The nutrients that are needed for seamoss growth are obtained directly from the seawater and it is crucial to have currents that flush the site where the farm is placed. Presently, the seamoss is tied to plastic ropes which are attached to stakes or poles that are hammered into the seabed. Recently, seamoss production has increased significantly over the

years due to the increased global demand and trade. This is reflected in the increase of seamoss from $15-$20 Eastern Caribbean Dollars per pound in 2019 to $25 to $30 Eastern Caribbean Dollars per pound in the beginning of 2020 (Serieux, unpublished data) (Serieux, 2020). This has resulted in many people joining the seamoss sector and establishing farms in several of the known farming areas such as Praslin and Savannes Bay. Not only has this increase been beneficial to the economy of Saint Lucia, but, it may have contributed to the coastal blue carbon store and ocean acidification delay in the Caribbean (Bindoff, et al., 2019). As a region that depends heavily on the marine environment for a multitude of services, the ability for seaweed plants to temporarily store atmospheric carbon, may yield potential carbon negative results thus, the promotion of seaweed cultivation, and subsequently seamoss farming, may prove to be a useful climate change mitigator (Bindoff, et al., 2019). Therefore, the expansion of the industry could be significantly advantageous for the region. However, many of the local farming practices may become unsustainable over time and different growing methods need to be considered in order to promote longevity of the sector.

Although notable seamoss growth was achieved using the three (3) methods at the different sites, some had more favourable growth rates than others. Based on the results obtained, the seamoss in Micoud had the highest growth rates during the period. Even though the activity ran for seven (7) weeks, the seamoss reached peak production at Week 4. At this point, the weight and size of the seamoss propagules in the nets caused breakage of both tube nets, with this being more noticeable in the biodegradable tube net. Additionally, the tube nets method retained more sediment compared to the monoline. This build-up of sediment within the nets would have likely restricted the growth of the seamoss since the particles may have impacted the rate of photosynthesis. Moreover, the enclosed environment formed by the net created a nursery for many organisms, such as lobsters, conch, and fish. The juvenile may have fed on the growing tips, further impacting the growth rate.

Savannes Bay also experienced positive growth rates during the period. However, strong currents and wave conditions led to multiple net breakages and propagule loss, nonetheless, these strong sea conditions assisted in the removal of sediment and organisms from the tube nets allowing for wider growth of the seamoss out of the nets. In addition to this, the seamoss grew lighter in colour compared to the other areas. This may have been a result of the lower nutrient levels, specifically nitrogen, since the mouth of the river was further from the farm, compared to the two (2) other sites. Additionally, a colour change may also been a result of increased exposure to direct sunlight (CANARI, 1997), which was the case in Savannes Bay. It was also observed, similar to Micoud, that the peak weight of the seamoss was achieved before the end of the grow-out period.

In contrast, the seamoss in Monchy experienced more challenges compared to the other plots. Firstly, the seamoss was regularly exposed to fresh water, from the nearby river, during the activity. This increase in freshwater concentration disrupted the normal growth patterns of the seamoss which in turn may have affected the carrageenan yield, which would have resulted in smaller and irregularly shaped seamoss. This change could be linked to studies that have shown that *Euchema spp*. are less tolerant to changing salinity levels and as such, experience drastic changes in growth patterns (CANARI, 1997). In addition, the anchor lines were cut multiple times during the activity and the seamoss lines were exposed to direct sunlight causing the bleaching of multiple plants. This high-stress environment led to the death of many plants, especially those in the tube net.

Furthermore, productivity rates of the seamoss propagules were also influenced by the type of growing method used. Productivity relates to the rate of growth of the plants, and with regard to seamoss farming, it would be beneficial to farmers to know the rate at which seamoss grows to determine cycle length. Firstly, the tube nets were more effective than the monoline method in securing the propagule. This would be advantageous especially if there is a need to introduce new species into the environment, as the risk of it breaking off and becoming a competitive

species in the area would decrease. However, the biodegradable tube net had the most inconsistent productivity rates overall since many of the nets were lost. For Savannes Bay, the seamoss in the plastic tube net showed steady weekly growth rates but the rates slowly plateaued in the final three (3) weeks. The plastic monoline, on the other hand, showed decreasing levels of productivity which may have been related to the weekly loss of propagule. Similarly, the productivity rate of the seamoss in the plastic tube net in Micoud also plateaued, which again, may have been a result of the limited space in the net. In Monchy, productivity rates fluctuated because of irregular growth rates caused by the increase in freshwater concentrations.

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