FIRST GLOBAL 2021

DISCOVER & RECOVER

Learning from today to build a better tomorrow with STEM.

PHASE 3 CHALLENGE

Category: Environment

The Challenge

The purpose of Phase 3 is for each alliance to propose a solution to a relevant problem in their community that falls into one of four (4) categories and develop a solution to help solve using STEM.

Team Belize_Grenada

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Alliance Summary


Team Grenada


Team Belize

We are Team **Grenada** and Team **Belize**:

Like the Grenadian flag, Team Grenada is full of life, energy, and positivity. Team Belize carries the colors from the flag of blue and red; calm but passionate. Utilizing the opportunity given by First Global, students across the world are now connecting through STEAM education to bring noteworthy change. As a part of the 2nd and 3rd Phase of the FIRST Global Competition, Team Grenada and Team Belize have formed an alliance to formulate a solution that will help countries across the globe facing similar situations to theirs.

Grenada and Belize are both English speaking countries, however, Grenada is a tiny island that basks in the Caribbean Sea, whilst Belize is a mainland territory that rests on the coast of Central America. Team Belize_Grenada consists of 18 members within the age range of 14 to 18 years, with 12 members from Belize and 6 from Grenada.

Due to the rise in cases of Covid-19 in both countries, we were restricted from conducting much field study, however, that did not deter us from completing this project. In the process of working together, we have realized that our similarities and differences sprouted ideas which made this project exceptional.

Project Summary

Title: Sargassum seaweed to biofuel and fertilizer.
Category: Environment

Team Grenada and Team Belize formed an alliance because we were focusing on similar aquatic environmental problems. Team Grenada was focused on the Sargassum seaweed that was affecting their shores and Team Belize was focused on the eutrophication that was affecting one of their rivers.

Figure 1: Impact of Sargassum Seaweed – photo credit: Clement R. Commodore

As a result, both teams thought it would be possible to somehow combine elements of both projects in order to create a common solution to work on. However, since both teams' countries suffer from the effects of the influx of Sargassum seaweed along their shorelines, it was decided that we would expand on Team Grenada's project.

Sargassum seaweed is a type of large brown seaweed that floats in island-like masses and never attaches to the sea floor (National Oceanic and Atmospheric Administration, n.d.). Although the seaweed serves as a home and nursery for some species of aquatic life, when left unchecked and in huge quantities, it is mainly detrimental to the countries whose shores it lines. In the water the seaweed can hinder fishermen's boats and entangle some marine animals that try to come up for air, additionally when it washes up on the shore it begins to rot giving off toxic gases as well as a pungent odor, which can affect the respiratory and neural health of persons in the area. As a result of this problem, our teams have decided to use a biodigester as a safe and natural way to get rid of the seaweed piling up on our shores. This solution will also give us two useful outputs that can benefit our countries' economies.

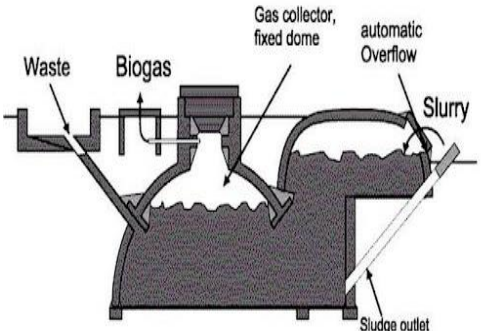

Figure 2: Process of a biodigester https://finishmondial.org

A bio-digester is used to break down bio-waste and can be used to harvest methane gas, which is an alternative to fossil fuel. The bio-digester is able to break down the bio-waste through the use of microorganisms. When natural bacteria are introduced into the digester, they break down the bio-waste producing methane and the remaining sludge can be used as liquid fertilizer in farming.

Topic Selection

Both teams were working on marine based problems in the environment category, however, Team Grenada's problem with an excess of Sargassum seaweed on their shores, was common for both countries and so it was decided that the teams would work on that project. With both teams sharing a common problem, the need for a solution was of paramount importance. This is due to the impact the seaweed has on the marine life of both Grenada and Belize. Also, the accumulation of the seaweed affects the lifestyle and well-being of the residents of both countries.

We conducted interviews with locals and government officials which made us realize that there is little knowledge about the Sargassum seaweed and as to how it affects Grenadian citizens and the environment. On the other hand, the Belize Tourism Board (BTB) educated the public with Sargassum resources and information. However, with time and extensive research from the internet, we had a vivid image of the effects of the Sargassum seaweed on the local and global community. Due to this, the way forward became clearer as we generated ideas.

We determined five (5) steps that would be collectively crucial in the process of producing biofuel and fertilizer from Sargassum seaweed:

- *collection* of the seaweed from the sea
- *separation* of seaweed from in-organic materials and animals that use it as a nursery
- *preparation* of the seaweed by washing it with fresh water to remove the salt
- *transportation* of the seaweed to the location of the biodigester and
- *transformation* of the Sargassum seaweed into biofuel and fertilizer.

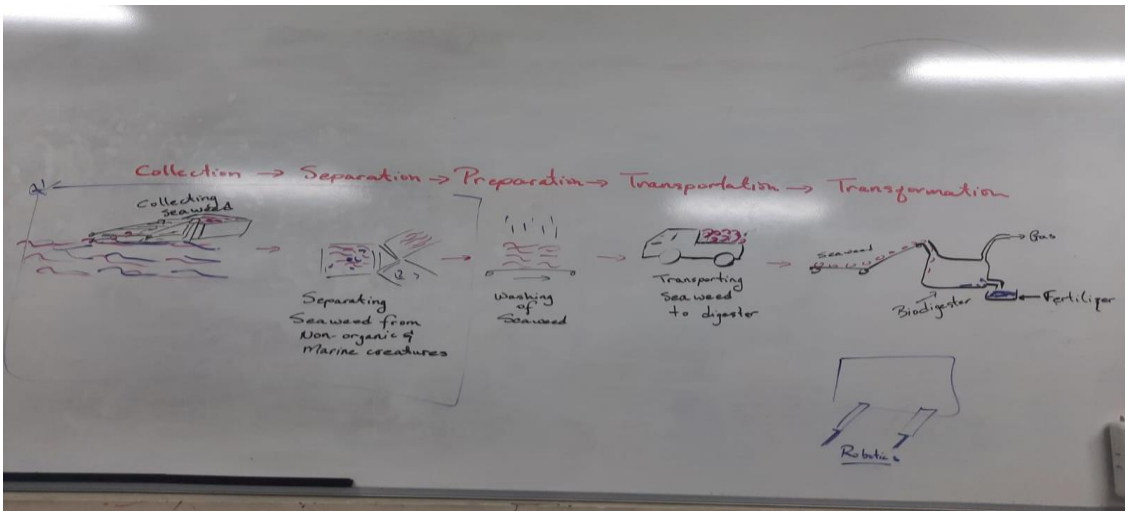

Figure 3: Process of Sargassum seaweed to biofuel and fertilizer.

Research

In order to gain a better understanding of just how much the seaweed was interfering with persons' daily life, we went to visit locations which were affected by it. There, we saw first-hand how intrusive the presence of the seaweed really was, as well as experienced the overbearing scent with which people have to live with it, once the seaweed washes ashore and begins to rot. Team Grenada was even able to speak to a fisherman who was able to outline how the seaweed hindered his, and others, ability to fish. He stated that their catch was affected due to their lines getting tangled and their boat engines also receiving damage due to the propellers getting tangled up and the raw water intake getting clogged, which leads to the engines getting burnt. Another issue they faced was accessing their boats, this is a struggle due to the density of the seaweed and the distance of the boat from the shore.

Team Grenada also made another visit to the site of a bio-digester with the intention of better assessing the feasibility of implementing it as a solution. Unfortunately, the digester was no longer in working condition, but we were still able to better grasp the concepts of how the process would take place.

The idea of a bio-digester is not new; however, the use of Sargassum seaweed as feed to foster methane is. We interviewed Mr. Earl Roberts, a lecturer at T.A Marryshow Community College (TAMCC) in Grenada who designs, procures, and builds bio-digesters. Roberts explains, "Sargassum seaweed has Sodium Chloride (NaCl), and in the presence of some bacteria, the NaCl slows down or halts the process (of breaking down the organic matter) if the volume of NaCl is too much for the number of bacteria present. Therefore, introducing Sargassum seaweed into the biodigester must be done gradually and carefully, not forgetting to wash the Sargassum in fresh water before putting it to use. I have done very small tests with Sargassum seaweed in the biodigester. The results have shown that during the initial run, the Sargassum did not produce enough gas. However, we do know that the biodigester was working on the Sargassum seaweed. Mixing the Sargassum with other organic matter in the biodigester can be more rewarding. We would get both fertilizer and bio-fuel." (August, 2021).

Figure 4: Shows a balloon digester. The biogas is collected in the balloon.

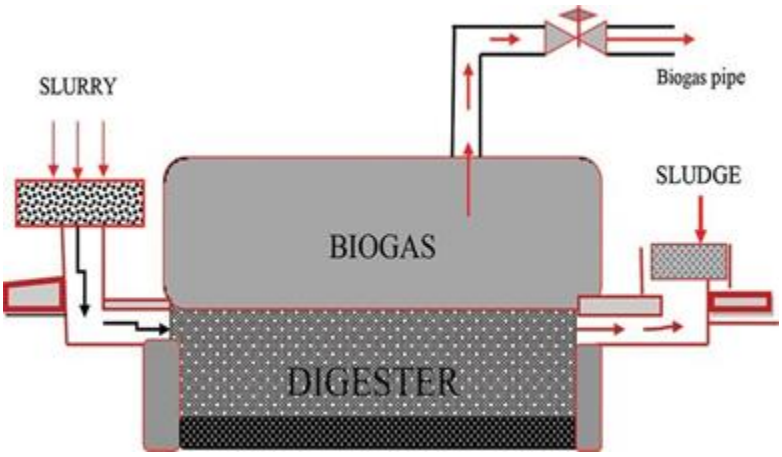

Figure 5: Balloon bio-digester adapted from www.intechopen.com

The advantages of the bag digesters include:

- low cost,
- simple technology,
- and easy to clean.

However, the disadvantages include:

- short lifespan,
- susceptible to physical damage,
- hard to repair,
- need high quality plastic,
- and difficult to insulate.

Questionnaire

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Proposed Solution

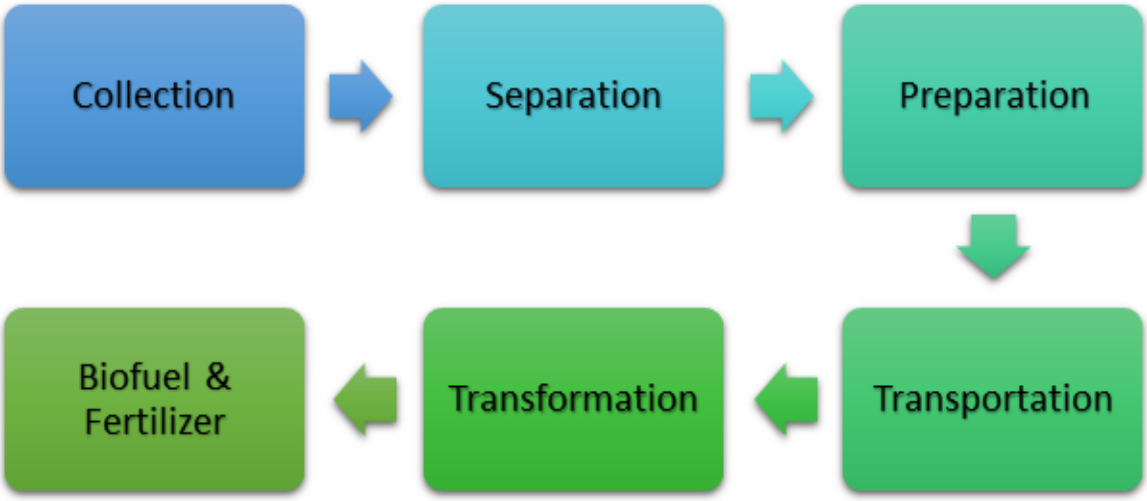

Figure 6: Process of converting Sargassum seaweed into biofuel and fertilizer

Sargassum seaweed has been gathering along the shorelines of countries around the Caribbean. Team BelizeGrenada's proposed solution has five (5) simple steps that will produce biofuel and fertilizer.

The first step requires the collection of the Sargassum Seaweed. To do so we are proposing that filtering barriers be nested at a half mile away from the shore. This will prevent most of the seaweed from washing up onto the shore. The seaweed will then be collected and loaded onto boats and brought to land where the next four (4) steps will be implemented.

Sargassum seaweed acts as a nursery for aquatic creatures, and therefore we cannot proceed with the rest of the implementation process before removing them. Step two involves the use of a machine, equipped with sensors, that would delicately gather the sargassum seaweed, identify the aquatic animals and redirect their path so that they can be reintroduced to their natural habitat.

Step three, preparation, is where we wash the Sargassum with fresh water to get rid of the salt. This is important because if Sodium Chloride (NaCl) is present in the biodigester, it can slow down or halt the bacteria from doing their job. After the Sargassum is washed, it will be transported to the biodigester where the final stage can be completed.

The final step, transformation, is where the washed seaweed is gradually placed in the biodigester with other organic waste (e.g. cattle feces, plants) so that the process can be faster and produce a higher yield of end products. At the end, the biofuel will be captured and the remaining sludge will be used as liquid fertilizer.

Scale and Impact

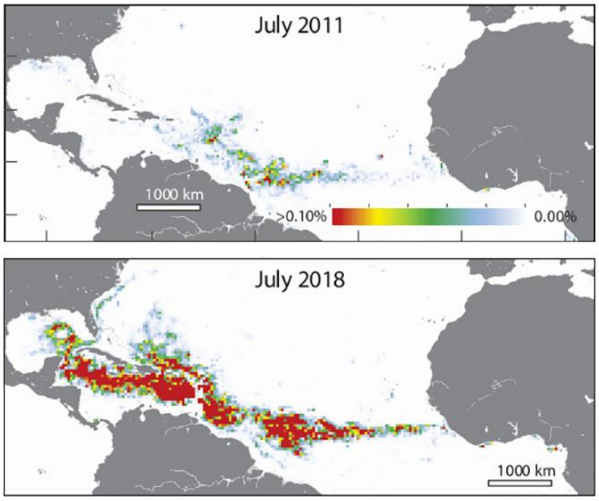

Figure 7: www.sciencealert.com

Even though the Sargassum issue is fairly recent, its effects are far reaching. Affecting most of the islands in the Caribbean and the eastern coastline countries of central and south America. This means that if Team Belize_Grenada can successfully implement this solution in our countries, we can inspire nearby nations, who have not yet found a way to address the issue, to move forward in this direction.

When the "Sargassum season" hits (typically from April to August) there is an abundance of it floating around in the Caribbean Sea and Atlantic Ocean, which will be more than enough to feed biodigesters in various countries. This means that jobs can be created in the countries that decide to adapt this solution from the persons required to transport and collect the raw materials to those responsible for sales and extraction of the biogas. In addition, economies will also benefit as they will be able to reduce the importation of fuel and fertilizer. Finally, agricultural sectors will benefit from the availability of organic fertilizers to enhance their yields and tourism and fisheries divisions will benefit from cleaner, more accessible beaches and waterfronts.

Although the solution wasn't carried out due to the recent spike in Covid-19 cases, we can be sure that the solution is feasible, cost effective and energy efficient. The alliance of Team Belize_Grenada gave us more insight on what the proposed solution can offer from thorough research. We are sure that not only can this solution be implemented in the Caribbean territories, but globally.

Limitations

The team knew that building each step of Phase 3 within the four (4) weeks given to complete it would prove difficult. While researching possible designs and considerations for building small prototypes for the first four (4) stages we quickly realized that one of the biggest issues was the fact that much was still unknown about the Sargassum seaweed and its effects.

Figure 8: Team Belize_Grenada Google Meet meeting

This problem was soon combined with an even bigger one, when COVID-19 forced us into a strictly virtual environment.

Left without a choice on the matter we decided to propose our steps towards the implementation process. Questions which had the team focus more on the element of research as opposed to the trial and error

that would be involved in building miniature models. A more scientific method was required in our approach to dealing with the problem. Hence, we refined our efforts and focused our project on research, which we believe will enable us to determine the most effective and practical solution methods.

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References

Dowrich-Phillips, L. (2020, July 22). Bajan chemists tap into beauty industry with sargassum skincare line | Loop Jamaica. Loop News. https://jamaica.loopnews.com/content/bajan-chemists-tap-beauty-industry-sargassum-skincare-line-2

Geronimo. (2020, June 30). Seaweed Can be Invasive, but We Can Turn It Into Biofuels or Fertilizers. Earth Buddies. https://earthbuddies.net/invasive-seaweed-biofuel-fertilizer/

Grenada calls for the sargassum problem to be treated as a climate change issue. (2018, May 9). Grenada calls for the sargassum problem to be treated as a climate change issue | NOW Grenada. NOW Grenada. https://www.nowgrenada.com/2018/05/grenada-calls-for-the-sargassum-problem-to-be-treated-as-a-climate-change-issue/

IICA and the Ministry of Agriculture of Grenada put Sargassum Seaweed to work for the benefits of Grenadian farmers. (2018). IICA.INT. https://www.iica.int/en/press/news/iica-and-ministry-agriculture-grenada-put-sargassum-seaweed-work-benefits-grenadian

Quinton, A. M. (2021, March 17). Feeding Cattle Seaweed Reduces Their Greenhouse Gas Emissions 82 Percent. UC Davis. https://www.ucdavis.edu/news/feeding-cattle-seaweed-reduces-their-greenhouse-gas-emissions-82-percent

Sargassum Seaweed Research. (2015, July 16). Sargassum Seaweed Research | NOW Grenada. NOW Grenada. https://www.nowgrenada.com/2015/07/sargassum-seaweed-research/

Turner, A. (2017). Sargassum - an overview | ScienceDirect Topics. www.sciencedirect.com. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/sargassum

Walsh, L. M., Sumner, M. E., & Keeney, D. R. (1977). Occurrence and distribution of arsenic in soils and plants. Environmental Health Perspectives, 19, 67–71. https://doi.org/10.1289/ehp.771967

Wang, M., Hu, C., Barnes, B. B., Mitchum, G., Lapointe, B., & Montoya, J. P. (2019). The great Atlantic Sargassum belt. Science, 365(6448), 83–87. https://doi.org/10.1126/science.aaw7912

Patrick Mukumba, G. M. (2017, January 25). Biogasification of Horse Dung Using a Cylindrical Surface Batch Biodigester. Retrieved from www.intechopen.com: https://www.intechopen.com/chapters/52682

Belize Tourism Board, N.D. Sargassum Resource

Retrieved from https://belizetourismboard.org/tourism-resources/sargassum-resource/

Acknowledgments

Foremost, we are thankful to First Global, and the opportunity given to provide a research paper on Sargassum seaweed. Without Phase 2, we would not have been able to form an alliance to form team Belize_Grenada. Thus, giving us insight to create a solution to a problem that has been negatively affecting not only the Caribbean territories but the world in Phase 3.

Our gratefulness reaches out to Mr. Chris Joseph, Climate Officer, Ministry of Climate Resilience, and the Environment, Grenada. Mr. Earl Roberts, Lecturer at T.A. Marryshow Community College (TAMCC). They provided important and clear guidance throughout our research for this project.

It would be amiss of me if we did not thank Mr. Clement Commodore, Ms. Charmain Charles and Mr. Collins Charles, all lectures at TAMCC, that worked diligently with Team Grenada Robotics 2021. Teachers of Belize High School; Mr. Alok Gupta, Mr. Carillo and Mr. Ray Liang, First Global Mentors. Mr. Godfrey Sosa, IT Director, Belize High School. They ensured that the project was done with high standards and brilliance. Our thankfulness cannot be expressed through just mere words, but we hope that this proposed solution will be existing proof.

Conclusion

In doing this project, a lot was learned as it relates to the ways to rid the environment of the effects of the Sargassum seaweed. We were able to conduct interviews with locals, read various articles and visit the areas impacted. Sargassum, if left unattended and allowed to pile up along our coastline can present many adverse effects. The project elaborates on the five (5)-step implementation process to address the problem of the influx of Sargassum seaweed while at the same time exploring the economic gains that stand to be made. Seaweed as a feedstock to the bio-digester requires ongoing research as to how the gains from the solution can be optimized.

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