Sustainability Innovation

Designing The Solution Of Enteromorpha Invasion In Qingdao To Protect Marine Life

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Summary

At the time the project has begun, Qingdao is experiencing the trouble of Enteromorpha. And more importantly, Qingdao has been plagued by Enteromorpha for years. The outbreak of Enteromorpha create inconvenience in the life of Qingdao citizens; the outbreak of Enteromorpha has become Qingdao' s annual normality. However, the outbreak this year is much more serious than before. Tons of salvaged Enteromorpha is laid on the beach, producing bad smells, blocking the beach, effecting Qingdao' s tourism. Regarding Enteromorpha outbreak as a severe problem in our society, we choose "Designing the Solution of Enteromorpha Invasion in Qingdao to Protect Marine Life" to be our topic.

The first thing we set about doing is generating solutions to address the problem. We looked up the causes of Enteromorpha in Qingdao and ways to control its growth. We looked at it in different aspects and grouped solutions with similar themes. The outcome of solutions was better than our expectation.

After the solutions were improved, one person was responsible for creating criteria to evaluate our solutions. Then, we discussed in our group chat and expressed our views on each proposal and rank them from 1 (poorest) to 8 (greatest). To make the evaluation clearer, we convert it into a table form.

As for making action plan, one person was responsible for adding detailed steps. The rest of the team discussed the feasibility of the actions.

Because there was not enough of time and money; and no advanced facilities and technologies, we failed to build a real model to test our solutions. But we made a small survey for our solution. We simplified the solutions to 1000 words and ask people for their view and advice. We interview our classmates and teachers to get feedback and selected the valuable evaluation. Then we revised our solutions based on the feedbacks.

There are a lot of time arrangement problems during our project when the summer vacation is over. But we eventually overcome the difficulties.

The experimental process is too complicated for us to carry out in a short time for the model
building, but we are doing our best to reach the requirement in an easier way.

Choose the Topic

Identify the Challenges

Challenge 1: High demand for people's environmental protection consciousness (the most important challenge).

It is firstly important for government to notice that environmental protection needs to be done. They are the people who make decision and policies, also the institution people believe in. Although forcing people is not the ideal way to solve a problem, governments do need to make rules when necessary. If the government do not have consciousness, it will be hard to drive environmental action in citizens because the government is not setting up a good example.

What will happen if people do not have the consciousness? For example, if the crab seedling company is not willing to reduce the use of chicken manure because they will lose profit and they does not see how Enteromorpha has affected the environment, Enteromorpha outbreak will only continue to go worse and worse. It is difficult to address the problem without people’ s consciousness.

If excessive Enteromorpha used up all the nutrient in the sea, it will take up big amount of oxygen in the water body, which will in turn kill other organisms in the ocean because they cannot breathe. All inversible changes in the ecosystems have big impact on human being. When it comes to the time that only few species of lives are available on earth, human has already put their destiny into great risks.

Challenge 2: The growth of Enteromorpha is difficult to predict.

The reproductive capacity of Enteromorpha is very strong. They can grow from a small, almost invisible pieces to a huge collective. They can reproduce so quickly that they can easily cover the surface of a lake in a short period of time.

Enteromorpha reacts differently to different conditions. The growth of Enteromorpha is affected by factors like the content of nitrogen and phosphorus, temperature, and light intensity. It is easy to control the growth of Enteromorpha in a lake because these factors are mostly stable; and compared with the coastal ecosystem, a lake is much smaller. However, in the coastal ecosystems, the living conditions of Enteromorpha can change so rapidly that any information about Enteromorpha at stage one, might change quickly to stage two. This rapid change makes it hard for human to implement measures on time. In the end, people might fail to control its growth because there are so many unpredictable changes.

This challenge inspires us that if we want to stop the over propagation of Enteromorpha, the most effective way is to prevent from happening. Because once it starts to grow in a suitable condition, it is always hard to stop it in the process. Finally, we could only end up with mass amount Enteromorpha waiting to be cleaned.

Challenge 3: It takes a lot of time and money to develop new technologies.

It is true that advanced technologies can always be helpful in solve Enteromorpha outbreak. But generating new technology is a problem as well because it requires money, time, and professional talents. Sometimes, technologies work out so slow that it takes plenty of years. Creating new technologies is therefore time consuming, money consuming and unpredictable because we never know if a technology can truly work. If we fail to create new technology, all the money and time people spend on it will be a waste.

Identify a Root Cause

All environmental efforts need the consciousness of human, including the issues about Enteromorpha. However, it is hard to mobilize people due to the following reasons:

1) Although protecting environment can bring benefits to people in long-term, people do not usually sense that benefit. Instead, what they feel is how protecting environment has made their life so inconvenient. Thus, considering their own benefits, people are not willing to sacrifice themselves.

For example, if we reduce the fertilizer (chicken manure) used in mariculture, crab production is likely to decline, which means the company will earn less money than before. Besides, protecting environment does not help a company to boost its profits. So, it is obvious that companies will choose to keep the profit high in the cost of increasing Enteromorpha that will damage ocean lives.

2) People do not feel the serious consequences of not protecting environment because the most significant impact does not fall on them, instead, they fall on other organisms that are not responsible for the environmental problems. Unfortunately, humans are land-live animals that do not care much about the ocean; thus, they fail to think of sea lives.

For instance, Enteromorpha continue to flow along the coastal line of east China of the surface of the ocean. They come from the south and started to propagate all the way to the north until they reach Qingdao. Other coastal cities do not feel the consequences because they have ever seen how serious it has become, not to mention other inland cities which barely have contact to the sea.

3) People do not regard themselves as a unity with the environment around us. Some people do not understand how the damage we do to the environment can eventually come back to us because they were not educated to acknowledge them or some of them do not believe in it.

These people do not understand how the ecosystem work; they do not pay attention to other parts on the earth where animals' and humans' habitats have been greatly harmed.

Generate Solutions

Making Enteromorpha processed products

1. (Exiting measure) Making organic seaweed fertilizer.

This is a basic way of making Enteromorpha into a value product. It treats Enteromorpha as an important source for developing blue economy (ocean-based or ocean-relevant environmentally friendly marine industries and economy) and serving green agriculture (the coordination of agricultural production and environmental protection).

However, this kind of low value product fail to cover the cost of salvage and transportation of Enteromorpha. So, we came up with new methods.

2. (New measures) Developing high value products.

These solutions can help to cover the cost of salvage and transportation of Enteromorpha since Enteromorpha is made into high value products.

1) Processing Enteromorpha as an adsorbent material in sewage treatment system.

It is found that Enteromorpha can have filtration effect and adsorption performance after a series of treatment. Enteromorpha after treatment can effectively remove heavy metal ions, organic pollutants, and inorganic pollutants in sewage to purify water. Thus, it can be used as an adsorbent material in sewage treatment system. In addition, the anticorrosion performance of Enteromorpha is greatly improved after the treatment. As long as Enteromorpha is regularly replaced, there will be no secondary pollution caused by Enteromorpha corruption.

2) Playing the medical role of Enteromorpha.

For example, Enteromorpha polysaccharide has the effect of detoxifying nicotine, which is good for smokers. We can use this characteristic to develop drugs that benefit the health of smokers.

3) Biological oil production technology.

We can extract bio-crude oil from Enteromorpha, then obtain gasoline and diesel oil

by separating and refining bio-crude oil.

4) Establishing biogas station.

The methane produced after the death of Enteromorpha is a clean energy. We can establish large biogas stations in urban areas to reuse the dead Enteromorpha. The salvaged Enteromorpha can be transported to the biogas station for treatment, then we can use pipelines to transport the generated heat to various urban areas to serve the residents.

Solving the problem of seawater eutrophication in Mariculture ponds (New measures)

1. Reduce the degree of eutrophication of seawater.

According to the research, many of the Enteromorpha found in Qingdao came from the river crab seedling ponds in Jiangsu province. Since the river crab seedlings feed on rotifers, large amount of chicken manure was deposited to the pond to ferment and then provided nutrients for unicellular algae (a type of alga used to grow rotifers). But this process also led to the eutrophication of seawater. As a result, Enteromorpha broke out.

To solve the problem, we suggest reducing the amount of chicken manure used for mariculture. The use of chicken manure must conform to the sustainable standard. Additionally, if there are not enough rotifers under the prescribed use of chicken manure, extra rotifers can be breed in an unnatural ecological base. The water used to culture rotifers need to be treated carefully to prevent ammonia-rich water from flowing into the ocean.

2. Improve water quality in culture pond (a small body of water with inlet and outlet connected to the open sea)

We plan to Install an aeration system at the bottom of the pond.
If Enteromorpha is found in the pool, open the oxygenating equipment in time to increase dissolved oxygen at the bottom of the pool and reduce ammonia nitrogen and nitrite and other substances.

Moreover, it is important to use the sterilization drug carefully when regular disinfection of the machine is required, otherwise it may affect the purity of the water.

Using an interception net

1. (Existing measure) Setting up interception net at the bay-area can hold up Enteromorpha drifting towards the coast.

We plan to set up nets in the key area (areas with great value of fishery or social use) and sea area for tourism. Interception net can help to hold up Enteromorpha in the fixed area. Instead of chasing Enteromorpha with a fishing-boat, we can salvage the Enteromorpha in the area regularly near the net.

To make interception net into full use, we have improved the use of interception net.

2. (New measure) We plan to lay an interception net at certain angle in the shallow sea area.

When the waves come, the Enteromorpha can be rushed to the net then collected. When the waves recede, only a small part of the Enteromorpha in the net will be affected and followed the waves back, which means we can trap most of them and keep them away from the coast. While collecting, people do not need to spend much time using a big forklift to collect the Enteromorpha from the beach repeatedly, and there is no need of too many workers. This solution is especially convenient for collecting Enteromorpha. People only need to retrieve the net and clear away the Enteromorpha on it, then put the net back on.

This solution only requires a little construction time. It also reduces the spending on forklift and manpower. It keeps the tourism industry going since the net keeps Enteromorpha away from the beach. The staff can clean up quickly and easily on a regular basis in the early morning or at 2 P.M., when there are relatively few tourists.

3. (New measure) We plan to construct interception nets outside the river crab seedling pond and the kelp breeding pond in Jiangsu province.

According to the research, many of the Enteromorpha found in Qingdao came from the river crab seedling pond and the kelp breeding pond in Jiangsu province. The nutrients provided for the seedlings and kelp in the pond also provided nutrition for Enteromorpha. Then with plenty of nutrients, the Enteromorpha grew in an incredible speed and flow all the way to the north. This is the main cause of the proliferation of Enteromorpha.

Thus, we come up with the solution of preventing Enteromorpha entering the mariculture pond—setting up interception net outside these ponds. This is a solution that help to prevent Enteromorpha into nutritional seawater, which would inhibit the breeding of Enteromorpha.

Another advantage is that it benefits the mariculture. The interception prevents Enteromorpha from consuming oxygen so that improves the water quality in the aquaculture area. Moreover, it guarantees the efficiency use of nutrients—all nutrients are absorbed by aquaculture products rather than useless alga.

Reducing sea temperature by calling on people to travel green (New measure)

1. Currently, global warming has led to sea temperature rise and speeded up the propagation of Enteromorpha as the increased seawater temperature is very suitable for the growth of Enteromorpha.

We suggest the government educate people about the effects of global warming on the growth of Enteromorpha. For example, they can take action like putting relevant publicity videos online or giving lectures and explanations to students to make people aware of the importance of reducing carbon dioxide emissions.

Establishing the experimental analysis system (New measure)

1. We plan to simulate the growth process of Enteromorpha to study the outbreak factor and marine environment changing rule. The simulation can provide scientific theoretical basis for controlling and early warning of Enteromorpha outbreak.

The government can support and provide funds for equipment improvement and help with the establishment of relevant laboratories.

Dealing with the pollutants in the sea

1. (Existing measure) The use of automatic filtering.

Pump mechanical ship, trawl, oil barrier net and hand pump mechanical ship are the combination of construction ships and screw centrifugal pumps. While the machine is operating, a mixture of seawater and Enteromorpha is sucked into a container on the ship, then pass through the automatic filtration devices. After filtering, Enteromorpha and seawater ware successfully separated. Enteromorpha were transferred to bulk cargo hold and the seawater were poured back into the sea.

2. (New measure) Purification of sewage with new adsorbent material.

Researchers have discovered that if the Enteromorpha is specially treated, it will have a high adsorption performance of pollutants. The processed Enteromorpha can remove organic pollutants effectively and control the propagation of Enteromorpha. It can replace the traditional adsorption materials to be used in sewage treatment.

The new absorption materials can deal with the pollutants more efficiently, which can reduce the reproduction of Enteromorpha.

3. (New measure) Strengthen sewage treatment.

A big cause of green tide is seawater eutrophication. So, to solve the outbreak of Enteromorpha, we can start from preventing seawater eutrophication. We can set up sewage disposal plants to dissolve nutrients in the sewage treatment link through dephosphorization and nitrogen removal technology. Different levels of sewage treatment systems shall be set up according to the severity of water pollution in various regions. In areas with serious water pollution, we can build up sewage treatment plants with better efficacy; In areas with light water pollution, we can build sewage treatment plants with lower technology.

By doing different adjustment to different circumstances, the financial pressure can be reduced.

4. (New measure) Artificial wetland method

This is an approach that improve the water quality by using aquatic plants.

First, we can make a simulated wetland. Then, by utilizing the functions of filtration, adsorption, precipitation, ion exchange, plant absorption and microbial decomposition of the wetland, water quality can be improved through biological treatment technology. Finally, we need to control the direction of these currents, so that they flow toward their intended destination—the ocean.

Encouraging fishermen to salvage Enteromorpha (New measures)

1. Control Enteromorpha through the awareness of fishermen.

We all believe that it is almost impossible for fisherman to salvage Enteromorpha through environmental awareness. Thus, we come up with the idea of establishing Enteromorpha recycling station. The government can set up more than one Enteromorpha recycling station in different places. Fishermen can send the collected Enteromorpha to the recycling station and get corresponding rewards according to the amount they collected. The rewards could be tools needed for daily fishing and so on. This is a way to mitigate the severity when things get worse by making daily efforts.

2. Pack up the breeding valves regularly

For fishermen who farm sea products that their harvest season and the explode of Enteromorpha do not happen synchronously, they can pack up the breeding valve in April (the season before the explode of Enteromorpha) and clean up the fallen Enteromorpha. At the same time, the subsidy of government is also required. This is the other way to mitigate the severity when things get worse by making daily efforts.

The national governance of Enteromorpha

We have mentioned in the previous measures that the source of Enteromorpha in Qingdao is the marine culture pond in Jiangsu Province. This illustrate that controlling Enteromorpha is not only the regional responsibility of Qingdao, but the responsibility of the whole country. Every region should make the necessary efforts, especially coastal cities.

1. (The combination of existing measure and new measure) Enhance sewage treatment all cover the country.

The main sources of seawater eutrophication are domestic sewage, industrial sewage, agricultural fertilizer, rural livestock raising, and mariculture.

The whole country should be united. We are hoping that coastal city can manage the sewage treatment of exoreic river and industrial wastewater efficiently so that the water quality could reach the standard of sustainable development. Meanwhile, the inland cities should also keep a close watch on sewage treatment for domestic sewage, industrial sewage, agricultural fertilizer, and rural livestock raising, so as to avoid pushing the entire burden on coastal cities.

1) Domestic sewage and industrial sewage:

Collecting domestic sewage and industrial sewage by urban drainage pipe network and transport it to sewage treatment plant for treatment.

2) Agricultural fertilizer:

First, it is important to using chemical fertilizers scientifically. If the fertilizers are needed, we could plant more green manure to reduce the use of chemicals. It is also necessary to install an intercept dam to prevent the water containing chemicals coming from the cropland flowing into the river directly. Other methods like planting trees near the cropland can also contribute to reducing the pollution of water by chemicals.

3) Rural livestock raising:

We can try to improve the recycling and harmless treatment of livestock and poultry’ s manure.

4) Mariculture:

We can use physical treatment, chemical treatment, biological treatment of mariculture wastewater.

/1 Common physical treatment methods include mechanical filtration, foam separation technology and ozone purification technology. These technologies treat wastewater effectively through filtration, neutralization, adsorption, precipitation, and aeration.

/2 The chemical treatment is carried out in a specific container with an electric current applied to the water to remove dissolved nitrite and ammonia nitrogen.

/3 Biology treatment methods mainly include activated sludge process and biofilm process. Both methods achieve decontamination effect through absorption and decomposition of the organic pollutant.

2. (New measure) The propaganda over the whole country

The national governance of Enteromorpha also requires people to have corresponding awareness of environmental protection. Thus, we must do a good job of publicity and education if we want to make national efforts a reality. We can cooperate with network socialization media such as Weibo and Tik Tok, and publicize on the Internet by means of posters, short videos and promotional videos. Through these ways, people can understand the harm of Enteromorpha outbreak to human life, and the people’ s awareness of preventing Enteromorpha outbreak will be cultivated. In addition, schools can regularly carry out lectures and publicity on the hazards of Enteromorpha, so that students can develop the awareness of preventing and controlling Enteromorpha. Some posters can also be placed on billboards at street crossings and roadsides, so that the propaganda can attract the attention of people.

3. (New measure) Application of the previous measures that we have been discussed

We believe that the previous measures we come out to be implement in Qingdao and Jiangsu can be applied to other places. For example, “Solving the problem of seawater eutrophication in Mariculture ponds”, “Encouraging fishermen to salvage Enteromorpha”, “Dealing with the pollutants in the sea” and “Using an

interception net”.

Identify the Criteria

These five criteria are list in the order from 1 (most important) to 5(least important).

1. Feasibility: Does the solution match reality?

The plan needs to be executable, which means the expected outcome needs to match the actual outcome. We need to consider whether a plan is feasible seriously because a non-working solution may cause a waste in time and energy.

1) Does the solution match our core?
The solution needs to be closely related to the core issue with Enteromorpha outbreak.

2) Will this plan affect the normal operation of the region so that not be implemented as usual?
The solution cannot be extreme, or it might affect other activities happening in the society negatively.

3) Would we expect too much for a poorly performing solution?
The solution outcome should match what we expected.

4) Will there be any uncontrollable issue caused by the solution?
The solution should not solve the problem in the cost of causing other environmental issues

5) Would this solution be too technical to operate?
The solution should base on the level of technology in recent society. It should not be dramatic.

2. Continuity: Can the solution keep working for a long time?

It is important to use long-lasting solutions because the effect is long-term. If the solution loses its efficacy quickly, it cannot truly address the problem; it can only ease the problem.

3. Efficiency: How to achieve maximum processing efficiency in the controlled time?

Solving Enteromorpha outbreak requires people to act quickly to sudden incidents. Thus, it is very important to consider time and results in our solution.

1) Is the result of the project worth the time it takes?
The solution should be effective. It is not too time consuming.

2) If the plan is a post-outbreak processing measure, can it clear out Enteromorpha remaining in the ocean quickly?

4. Input costs: Is the funding planned properly enough for the government to undertake?

Even though controlling Enteromorpha can provide a better living environment for marine life, we also need to consider the economic capacity of the city. Therefore, Input cost should be reasonable.

1) Are the scheme worth people to spend money on?
Still, as we mentioned before, we need to focus on the core issue—preventing the outbreak by stressing water eutrophication. If money is spent on other things that are unnecessary, it does not worth.

5. Convenient operation: Is the process simple and easy to implement?

A complicated process might be time-consuming, hard to operate, and most importantly, lass impossible to succeed. This is because more complex a solution is, more steps there will be, thus more likely to include wrong steps.

Evaluate the Solutions

We evaluated our solution in the form of a table. Our evaluation in included in the PDF.

Evaluate the solutions (table)

Make an Action Plan

We have mentioned that the source of Enteromorpha in Qingdao is the marine culture pond in Jiangsu Province. This illustrate that controlling Enteromorpha is not only the regional responsibility of Qingdao, but the responsibility of the whole country.

1. Enhance sewage treatment all cover the country.

Coastal city should manage the sewage treatment of exoreic river and industrial wastewater. Meanwhile, the inland cities should also keep a close watch on sewage treatment, so as to avoid pushing the entire burden on coastal cities.

1) Domestic sewage and industrial sewage:

The government can install filters on every drainpipe in residential areas, business districts and industrial estates in order to separate insoluble impurity in the sewage. Meanwhile, technicians need to replace the filter on time to avoid pipeline blockage and ensure that sewage will be transported to the sewage treatment plant. Since then, the sewage treatment plant is responsible for dephosphorization and denitrogenation for sewage treatment.

2) Agricultural fertilizer:

For all cities, the government can stipulate the amount of fertilizer farms can use according to the local agricultural crop conditions and the degree of water pollution caused by the local chemical fertilizer. The government could increase publicity about the benefits of using green fertilizers so that people can be encouraged to use green fertilizer.
In addition, farmers can plant trees beside streams, farms, and fields; the roots of these trees can absorb certain soluble nutrient, so that it can help to reduce the chemicals in the water bodies.

3) Rural livestock raising:

Poultry dung contains relatively large amounts of phosphorus. If they are directly discharged into the water, they are very likely to cause eutrophication of water body. To reduce the poultry excrement to the pollution of the water, phytic acid

phosphate enzyme can be added in the poultry feed for livestock to improve the absorption of phosphorus phytic acid in livestock body. As a result, phosphorus contents in the poultry excrement can be reduced.
As for the treatment of poultry manure, farms can make use of it through manure composting, or use biogas generated by anaerobic fermentation of liquid chicken manure for heating.

4) Mariculture:

The wastewater of mariculture contains excreta of organisms in the breeding process and excessive feed. The large number of soluble salts of nitrogen and phosphorus in the wastewater can easily lead to eutrophication of seawater. Seawater farms, therefore, should control the sewage wisely. First, wastewater can be collected into the sewage ponds of mechanical filter to carry on separation and Ozone purification technology. Secondly, seawater farms can use immobilized microorganism technology to hold on free cells that has been through biochemical treatment so that pollutants can be degrade. Then, with the help of specific chemical process, activated sludge treatment, and biofilm treatment, water quality can be highly improved.

2. The propaganda over the whole country

We plan to cooperate with network socialization media such as Weibo and Tik Tok, and publicize on the Internet by means of posters, short videos, and promotional videos. Through these ways, people can understand the harm of Enteromorpha outbreak to human life, and the people’ s awareness of preventing Enteromorpha outbreak will be cultivated.

In addition, schools can regularly carry out lectures and publicity on the hazards of Enteromorpha, so that students can develop the awareness of preventing and controlling Enteromorpha.

Some posters can also be placed on billboards at street crossings and roadsides, so that the propaganda can attract the attention of people.

3. Application of the other measures that we have been discussed

1) Mariculture wastewater treatment

To solve the problem that manure leading to the breeding of seawater eutrophication, the government can stipulate the amount of chicken manure used in mariculture industry area, and strengthen the management of chicken manure usage, as well as strictly control the wastewater.

In addition, in order to improve the water quality of the breeding ponds, we plan to install a ventilation system at the bottom of the pool and carry out disinfection on time.

2) Encourage fishermen to salvage Enteromorpha

For the areas where Enteromorpha erupts, the government can establish multiple Enteromorpha recycling stations and reward fishermen who gather a certain amount of Enteromorpha to encourage salvaging Enteromorpha.

For fishermen whose fishing season is different from that of Enteromorpha outbreak season, they can be encouraged to pack up breeding valve.

3) Strengthen sewage treatment measures

For the polluted sea water, we can use the pump mechanical ship seawater and Enteromorpha suction automatic filtration device. Enteromorpha will be separated from the seawater by centrifugal pump. When the pumping is over, seawater is poured back into the sea while Enteromorpha can be transported to the recycling treatment.

In order to prevent the aggravation of seawater eutrophication, different degrees of dephosphorization and nitrogen removal can be used in sewage treatment plants in coastal cities according to the severity of local seawater pollution. The treatment should be adjusted according to different situations to reduce financial pressure.

To improve water quality with hydrophytes, wetlands can be used for filtration, adsorption, precipitation, plant uptake, and microbial decomposition. In the end, water should flow back to the ocean through current control.

4) Improve interceptor nets at the seaside

To make more efficient use of Enteromorpha interception nets, these interception nets can be laid at a certain angle to hold them up in fixed area, so that people can gather these Enteromorpha more easily and save a lot of time.

At the same time, to prevent Enteromorpha from entering the breeding pool to compete for nutrients, interception nets can be laid outside the breeding pool to block the passage.

Prototype and Test

Prototype Design

Based on the topic we have chosen earlier, it is hard for us to build a model and test our solutions within the model. Many of the solutions is based on government policy and ocean business. Some of the solutions also involves new technology that needs to be discovered. Building a model for our solution needs plenty of time, money, devices, and manpower. Thus, we are very sorry that high-school students like us cannot reach the requirement.

However, we simplified our solutions into a survey to get feedback from people, including teachers in the field of biology, and doctor from Ocean University of Qingdao.

Survey For Our Solution

Feedbacks learnt from users

We have shown our simplified solution to many teachers and students. What we get is what we expected—The teacher was more critical of our feedback and gave us more useful information.
Most of the students thinks that our solution is almost perfect that there is nothing needs to be changed. However, we regraded the teachers' feedback more important because they are more professional.

The teachers asked us to focus on the core issue of Enteromorpha outbreak, which is excess nutrients, or water eutrophication.
The teachers evaluated our solution and divided them into three categories: clearly feasible, possibly feasible, and likely not feasible.

1. The teachers think that "Establishing the experimental analysis system" is not necessary because there is already substantial laboratory capacity in marine conservation research. (Possibly feasible)

2. Some thinks that using filtering in the ocean water for salvaging Enteromorpha does not closely relate to the topic. In addition, event though Enteromorpha is

salvaged, the nutrient is remaining in seawater, salvaging Enteromorpha is not effective. (Likely not feasible)

3. The teachers regard sewage treatment and addressing eutrophication in mariculture pond as our priority. As they said, these solutions related closely to our core issue. One teacher also mentions that the idea of using artificial wetlands is excellent assuming space is available for such a product. (Clearly feasible)

4. Solutions like making Enteromorpha processed products are all placed in the categories of possibly feasible. The teachers said these measures do not address the core issue, but they still have some potential economic value. (Possibly feasible)

5. Also, the teachers pointed out the propaganda in public of protecting environment only works when the general public is able to take some action directly to solve the problem. There are no specific behaviors they can do to help or cause harm. Thus, in the case of Enteromorpha, it is not sure whether propaganda will work. (Possibly feasible)

There are also some other issues we find in our solution. Some of the solutions we described is unclear to students and teachers to understand. Other solutions do not have a definite result because the solutions are only at the theoretical level; We need further practice before we can
draw a conclusion.

Improvement for next iteration

First, it is very important for us to build up a true model to test our results. We can ask universities for extra help on equipment and technologies.

Next, according to the feedbacks we get from students and teachers, some of our solutions need to be change.

1. Instead of establishing the experimental analysis system, we will use the existing system to do research about the factors that affect Enteromorpha growth.

2. We decide to use filters only when there are large Enteromorpha collective. In other places like the mouth of mariculture pond, the filters will not be putting on as they do not work effectively in this case.

3. We will put sewage treatment and solving water eutrophication at priority because this is the core of the issue.

4. Making Enteromorpha processed products is not our priority, but we will keep doing it for financial help.

5. Instead of propagating to the general public, we will set up billboards in places where excessive nutrient is very likely to exist in water body to remind people of protecting ocean ecosystem. For example, we will propagate in farms where plenty of fertilizers is used by people.

Team Credits

Jicheng Li
Jincheng Li is responsible for program planning, group discussions and making the identify criteria. Then she revised her own plan and combined it with that of the rest of the group to come up with the perfect solution. At start, Jincheng Li found the source and reasons of the Enteromorpha outbreak by consulting the information. She then asked local residents to look up information on the Internet and came up with what she thought might be effective ways to deal with Enteromorpha. She thinks of solutions in terms of both prevention and treatment. For the prevention. After the revising of the solution, Jincheng Li came up with the final solution of the experimental analysis system and she combined Yuan Yue’ s River crab breeding program to get the ultimate mariculture program. She also worked with Yuhan Liu and Ruofei Zha to complete the sewage treatment program. The national co-governance program was developed jointly by her and other members of the group. When the planning was over, she thinks of five pieces of identify criteria as the standards to measure when making our project.

Jiaqi Liu
Jiaji Liu collected information about Enteromorpha at the beginning, such as: How did Enteromorpha form? What are the hazards of Enteromorpha? What are the advantages and disadvantages of Enteromorpha? Then Jiaji Liu checked the existing governance scheme of Enteromorpha on the Internet and selected one for more detailed reference and extraction. Then, by looking up the literature on the Internet and asking students and teachers, three new treatment schemes of Enteromorpha are integrated, which are to use Enteromorpha as medicinal materials, reduce the rich oxidation of seawater, publicize on the social platform in the form of posters and videos, and carry out ideological education for people. After that, Jiaqi Liu consulted the information on the national plan to control Enteromorpha on the Internet. After understanding the birthplace of Enteromorpha, Jiaqi Liu came up with two points: 1. Control the national laver breeding land; 2. The government carried out ideological publicity to people. After discussing with the group members, she revised her plan. Finally, when the group completed the prototype, Jiaji Liu asked the opinions of two teachers and three students in the school and invited them to score the prototype.

Yuhan Liu
Yuhan Liu is responsible for analyzing two existed Enteromorpha management measures and coming up with two innovative ideas with some possible obstacles

when applying these plans, as well as arranging the background information and solutions for the nationwide Enteromorpha management plan and completing an action plan with specific implementations and an illustration of the solution design.

Ruofei Zha

Ruofei Zha submitted plans on time and helped to gather some of the plans and feed backs which helped the team a lot. Ruofei Zha searched much information in order to know more about the treatments that how to deal with the Enteromorpha. In the discussions, Ruofei Zha expressed her own opinions and ideas. Ruofei Zha asked people around her such as classmates, or teachers in order to get suggestions or feed backs from them so that the team can improve the plans.

Yuan Yue

Yuan Yue is the leader of this group. She is responsible for handling syntax errors and logical errors in the overall solution draft. She is also responsible for organizing meetings for discussions of plans and assigning tasks. She organized the integration of solutions and the discussion for "Evaluate the solutions". As for the contribution of completing tasks, Yuan Yue completed the task plates of "Identify the challenges", "Identify the root cause", "Prototype Design", and "Summary". She also participated in the revise and every layout of the task section to make sure the logic is clear, and the express is properly.

Onsite Conference File

Judge Comments

" Congrats to the team for exploring a very visible and visceral problem in the community. Enteromorpha and the threat from it, including of eutrophication, is a challenging problem to address given the very many causes for the problem in the first place.
It would have been helpful to look at the science for what causes Enteromorpha in the root causes section – overuse of fertilizer and the associated Nitrogen and Phosphorus contributing to the growth. This would have helped set the stage better for some of the proposed solutions, which the team have done a great job identifying.
The solutions identify a comprehensive set of measures. The section could have benefited from a systematic organization of solutions to avoid some of the repeated measures. I would caution that ‘reducing sea surface temperature’ while definitely a solution, is an incredibly complex ask as it requires concerted efforts from governments across the world and large-scale concentrated efforts. Even then it would take decades to see the changes reflected in sea surface temperatures.
I also appreciate the set of well thought of criteria and its application. As with any large infrastructure related effort dealing with water management, it is hard to set up realistic pilot projects. The team can consider marking up sketches of proposed solutions or creating short briefs describing the problem and solutions that they can share with community leaders as a potential next step. I applaud the team for a well-researched project and encourage them to continue engaging in this issue or other similar issues that improve the society and environment we live in.
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