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Use of sargazo as a natural fertilizer

Nowadays, one of the most important activities in the primary sector is agriculture, as it represents 70% of the sector in total. In some countries the economy is based on agriculture, usually those with low resources tend to sustain their economy with the agriculture. However, what happens if the weather changes fastly from a flood to a drought in less than a few months? This is what is happening in some countries as a result of the climate change, but that is not the only problem that affects the agriculture: pests are increasing, as a result, more than 40% of the total agrarian production is destroyed by huge groups of insects every year, with the consequence of the increase in hunger in the poorest countries.

However, not always agriculture suffers damage as a result of other problems, sometimes it produces them. A perfect example are the chemical fertilizers. It is well-known that the fertilizers are a useful tool to increase the production and the quality of the food, nevertheless when used in great abundance, they can produce ecological and health problems.

Chemical fertilizers pollute the soil and water. When combined with high temperatures of the sea as a consequence of global warming, the algae start growing uncontrollably producing tons that end up on beaches like Caribbean ones, polluting the ecosystem and being toxic.

Moreover, it is a health problem because the fast decomposition of seaweed produces toxins and gasses such as hydrogen sulfide, methane and CO₂, that are not safe to breathe. One of these seaweed is called sargazo and as many others, it produces unpleasant smells which drive away tourism, affecting and reducing the amount of money obtained from this sector.

Mexico is one of the countries most affected by this problem. They have tried a solution that is really effective. It consists of making fertilizer from the seaweed, reducing their amount and making a cheaper and more ecological fertilizer. The only disadvantages are that it is not as effective as the chemical fertilizer and that the Mexico government does not take advantage of this resource.

The main problem of the sargazo can be solved by creating a cycle, where the sargazo is transformed into fertilizer, reducing its amount and therefore, the pollution of the sea.

Country and family

Mexico is a country with a population of 128,9 million people, 95,8% of them have a job and the other 5% equals 2,1 million people unemployed. The rural population is over 23% and the urban population is the majority (77%) [1].

The United Mexican States has as a form of government a presidential federal republic, its president has two more charges, being the head of the state and the commander-in-chief of the armed forces. As for the government, it can be said that it is divided into three main parts which are the federal Union (judicial, executive, legislative), the state government and the municipal government [2].

As it is mentioned before, agriculture is an essential economic source with over 5,5 million agrarian workers and only 56% of these people are farmers, the rest being those who work for them. The average salary of an agrarian worker in Mexico is approximately \$5,505 per month, however, on average the Mexican society has a remuneration of 7,380 \$ per month, a difference of 1,875 \$ per month [3].

Despite the fact that the farm laborers gain much less than a standard worker, Mexico is one of the most important exporters regarding corn, avocado and sugar cane. This is not by chance, the United

-the hot humid climate and hot sub-humid climate that cover over 27,7 % of the total land of the country [4].

Related to this, in 2014 Mexico produced 23 million tons of corn, which is exported to other countries. Mexico earned with agriculture more than 675,000 million of Mexican pesos. A big difference compared to what tourism produced in 2021: only 215,579 million Mexican pesos.

The benefits of a balanced diet are well-known. Nevertheless, in Mexico not all families can afford fruits or vegetables, as a healthy diet cost is estimated at around 6 thousand pesos per month [5].

One of the most expensive fruits is the yellow peach, which costs around 43,78 Mexican pesos/kg and the artichoke with a price of 90,53 Mexican pesos/kg. This means that most of the Mexican families don't eat the recommended amount of fruits and vegetables contributing to overweight and cardiovascular diseases. Not only are the fruits and vegetables costly, but also the meat and fish are increasing their prices. The effect is an obese population that reached 71% in 2021, producing two hundred thousand deaths per year due to diabetes and cardiovascular diseases [6].

Unfortunately, food is not the only problem that affects people's health. There is also a lack of potable water or an irregular supply that affects 32% of the population, over 10,497,000 houses, that results in 44 million of Mexicans without water [8].

Challenge and impact:

The Earth population is continuously increasing, so some countries need huge amounts of products to meet the necessities of the population. This is why fertilizers are used, as they increase the crops yields. The most effective are the chemical ones because of their fast action, but what is the problem? The main consequence of these chemicals are the water and land pollution, which produce destruction of ecosystems or an algae overgrowth that kills the native species.

When a chemical fertilizer is used in large quantities it degrades the soil in two different forms: physical degradation and chemical degradation.

The first one has an effect in the compaction of soil, which means that the porosity of the soil disappears, so the air and water that the roots receive are reduced, moreover, the roots have more difficulty penetrating the soil and reduced access to nutrients. As a result of the compaction, the most superficial layers are lost and with them the nutrients. [9]

The chemical degradation can be even more destructive as it produces acidification, which causes the loss of biodiversity and of fertile soils. Both surface and subterranean water are polluted by high concentrations of aluminum, which produce the destruction of aquatic life and the contamination of aquifers.

But not only the land and water pollution destroy ecosystems, also the proliferation of some species of algae can produce an irreversible damage on the natural balance of aquatic ecosystems, as it alters the food webs of some rivers or lakes and decreases the quality of the water. The main cause of the disappearance of the biodiversity in lakes with algae excess is the lack of oxygen that is consumed by some bacteria and the seaweed. [10]

Solution and recommendation:

The problems described in the previous section are the results of chemical fertilizers. I have proposed the following solution which can benefit the country in economic, ecological and health terms.

Firstly, it would be necessary to gather all the seaweed. This action would create new job positions. In the case of Mexican beaches, the amount of sargazo is huge, so this will ensure jobs and generate a benefit to the country. Moreover, if the coasts are clean they attract more tourists, benefiting the service sector, and also with the recollection of excessive seaweed, some skin irritations and infections will be avoided, such as dermatitis, making the coasts safer. Talking in economic terms, it is a great inversion as the raw material does not need to be imported or paid for, it is already in the

country.

Another point worth mentioning is the fact that this idea has already been tested by businesses or factories such as Salgax, Blue green Mexico or Renovare that try to reduce the pollution of sargazo by making products with this aquatic plant. Therefore this proves that making an organic fertilizer from sargazo is possible and some companies are trying to introduce it in the fertilizers market. [11]

It is not easy to replace the fast results obtained by the chemical fertilizers with organic ones, although the government can help, more specifically the Secretary of Agriculture and Rural Development. They could create an "organic fertilizers program", to provide information and teach about it. Another way to help would be trying to introduce this fertilizer in the international market by building collaborations with other countries. This has already been done with food production, obtaining as a result the eighth position of global exporter. But for the treatment and sale of sargazo some permissions are needed, not yet provided by the Secretariat of Ecology and Environment, so, if they gave those permissions to some organizations the beach would be cleaned and a new industry developed. [12]

Assuming the case that the government contributes and gives the permissions of taking the sargazo from the coasts, and that complying with all environmental protection measures, the next step is to send it to the different places where the seaweed is saved, like in Puertos Morelos and in other 7 spaces where they clean up the algae and let it dry. Then the sargazo will be sent to factories and transformed into the final product. At the moment there is a factory being built near the Mexican coast. [13]

Who will buy the sargazo? Nowadays healthy diets are very popular, so ecological and organic products are usually imported to countries which support organic agriculture such as the United States of America, Canada and Switzerland. Even if in Mexico the sargazo is not used by agrarian workers, it can be exported to foreign countries who don't have enough of it to make by themselves. The sargazo fertilizer improves the quality of the soil, it stimulates the seed growing, and it promotes biodiversity, among many other advantages, being a potential economic source from which Mexico can have big benefits by selling it to other countries. [14]

Finally, there is the most important question: What will happen if we run out of sargazo? Firstly, we need to know that not every agricultural exploitation can afford to buy organic fertilizers, and those who need fast production will not use them, so the pollution problem of chemical fertilizers will not be completely solved. However, we have the opportunity of making the ecosystem more balanced, with the chemical fertilizers increasing the growth of the sargazo and the excess of it being reused to make products or compost. It is obvious that the chemical fertilizers will continue to be used by agriculture because of their cheaper prices and their fast effects, but now we have another option, more eco-friendly, that can be mixed with compost to repair the soil.

Conclusion:

To summarize the above, Mexico is a country that depends on agriculture and tourism. The use of chemical fertilizers in agrarian activities is producing water pollution and the increase of sargazo. This brown algae is infesting the Mexico coasts, reducing the tourists and damaging the ecosystems. This can be solved by making a balance between the sargazo and the aquatic ecosystems by using it as a fertilizer. This idea will solve the problems of cleaning the beaches, health infections caused by bacterias living in the sargazo and it will improve some economic aspects, like unemployment.

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