Maison Bint Ahmed School for Basic Education(12-5)

Research title:

Sustainable development: plant recycling, Nargile as a model.

Preparing by the students:

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Abstract:

Plant waste resulting from agriculture in general and from Nargile plant and coconuts in particular constitutes a local environmental problem. When these wastes accumulate for a long period, they attract insects that transmit toxins and diseases to residents in neighboring areas. These unexploited piles also produce methane gas. It is harmful to the environment and is considered one of the gases causing global warming. Some farmers and sellers may burn this waste to get rid of it, which causes more air pollution.

Sustainable development aims to establish thinking in a way that preserves the environment for future generations. Therefore, this study was based on finding mechanisms and methods to preserve the environment by exploiting Nargile waste & recycling it to improve the quality of the soil so that crops grow better & in accordance with GLOBE protocols.

We studied the effect of adding Nargile waste to the soil on soil properties (pH, salinity, and conductivity) and its effect on the growth of crops.

A plan was drawn up to implement the study by choosing the site for carrying out the study, which is the school laboratory, and using two agricultural pots, one of which had Nargile waste added to it and the other without it. Then the specific protocols were applied, the measurements were repeated on three soil samples taken from the two ponds. Monitor the growth of crops, then collect results and data and discuss them within the team.

After applying the protocols and comparing the results between the two planting pots, the team found that the second pot (soil with plant residues) had a lower average pH, while its average conductivity and salinity levels were higher, and the plants grew noticeably faster and better in it, which means that the Nargile waste improved the quality of the soil.

Key Words:

Nargile: It is one of the famous tropical fruits that grows on the beaches and is used in the manufacture of many foods and cosmetic materials. Nargile is the name used in the Sultanate of Oman for coconut trees, as these trees grow largely in the southern part of the Sultanate of Oman, in the Dhofar Governorate, to suit the climate of that region with the climate suitable for the growth of this type of palm.

Soil acidity: The PH of a soil solution.

Soil conductivity: A measure of a material's ability to absorb electrical charge transfer and used as a measure of soil salinity.

Methane: It is a chemical compound with the chemical formula CH4, and it is considered one of the gases that contribute to increasing global warming.

Research questions:

1- What is the effect of adding Nargile plant waste on soil properties?

2- How can we benefit from Nargile plant waste in recycling and achieving sustainable development?

Introduction:

Sustainability in education refers to adopting an approach that strikes a balance between meeting the needs of the present and ensuring the continuity of education for future generations. The most important of which is encouraging an environmentally friendly life and raising awareness of the importance of protecting the environment.

The biological natural system was originally a sustainable system, but the increasing numbers of humans and their different patterns of consumption have affected and continue to affect all biological systems. (Joseph Agard et al., 2007)

Dhofar Governorate is unique in its crop of Nargile, or coconuts, which is considered one of the national crops of the Sultanate of Oman and has great economic and tourism importance. It is characterized by its high tolerance to salinity and thirst and its many uses and products, such as Nargile water, oil, fibers, and waste, which are used in many industries, as Dhofar is considered the only home for Nargile cultivation in the Arab region.

The GLOBE team from Ms. Maison's school noticed the accumulation of large quantities of leftover Nargile and coconut fruits that had been consumed in scattered piles around consumer outlets, as well as the presence of large quantities of food processing waste remaining after extracting oils from these fruits without adequate exploitation, and some farmers were resorting to burning this waste to get rid of it.

These and other practices will allow solid waste, such as food waste and fruit peels, to collect insects that transmit toxins and diseases to crowded places. In addition, this waste pollutes the atmosphere with gases released from it, such as methane, which is considered a greenhouse gas, or the smoke resulting from its combustion. The danger of waste lies when it is combined with the water that may reach it, causing water pollution. Its accumulation also distorts the aesthetic and urban view of the areas in which it is located, which has a mental and psychological impact on public health (Environmental News, Al-Ajili, 2016).

In this research, we will study plant waste from Nargile and coconuts and ways to benefit from them in agriculture, use them as fertilizer to improve soil quality, for example, or recycle them in a way that serves the environment and consolidates the concept of sustainable development.

On the right are piles of the remains of spent Nargile fruits.

Below is a picture of ripe Nargile fruits.

Search methods:

1) A study plan has been developed to organize work, fill gaps and redress potential errors.

1- Determine the exact location of the study.

2- Apply the selected protocols according to the proposed schedule.

3- Data collection and analysis.

4- Communicate with experts to discuss the team's results.

5- Writing the research and presenting it in the final form.

Table (1) research plan

work plan	the month
GLOBE team meeting and research title discussion.	October
Choosing a study site	November
Practice doing the protocols	December
Performing protocols and collecting data	January
Analyze the results and communicate with the experts	February
Submit the research in its final form	March

It was agreed to divide the roles between the team as follows:

Table (2) division of roles among team members

Supervisors & Maryam & Fatima	**GLOBE team meeting and research title discussion**
Supervisors & Maryam & Fatima	**Choosing a study site**
Maryam & Fatima	**Practice doing the protocols**
Maryam & Fatima	**Performing protocols and collecting samples**
Maryam & Fatima	**Analyze the results and communicate with the experts**
Maryam & Fatima	**Submit the research in its final form**

2) the study site:

The Maison School laboratory was chosen to carry out the research protocols, and it was prepared by adding small ponds for cultivation. It was listed on the GLOBE website as a study area.

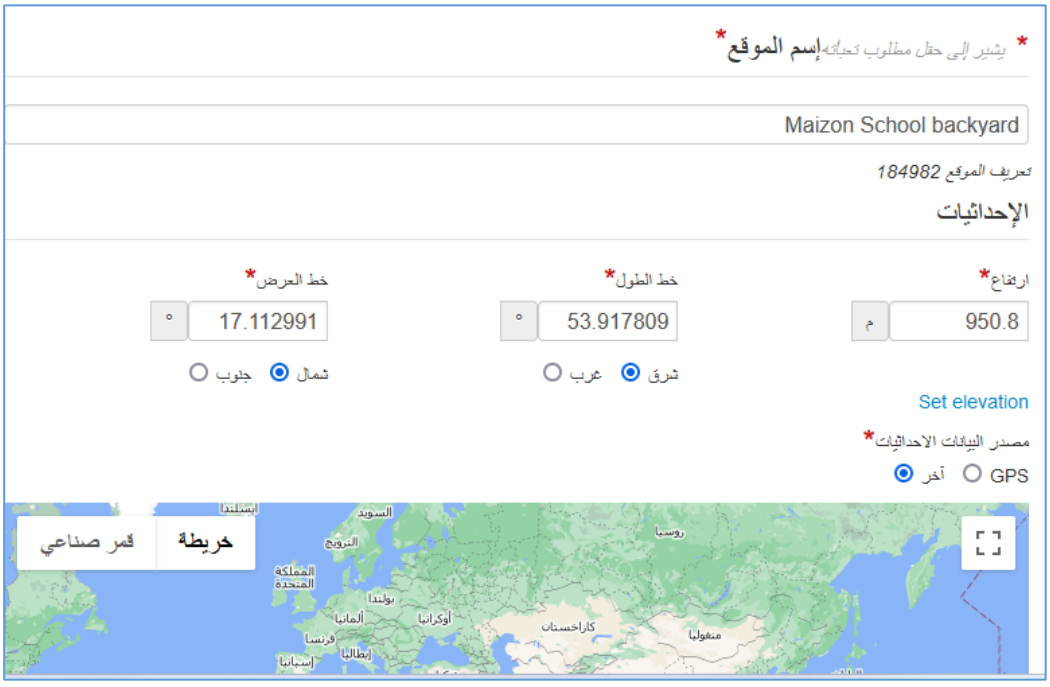


Photo (1): An aerial photo of the site via satellite.

Photo (2): the study site on the map.

Photo (2)

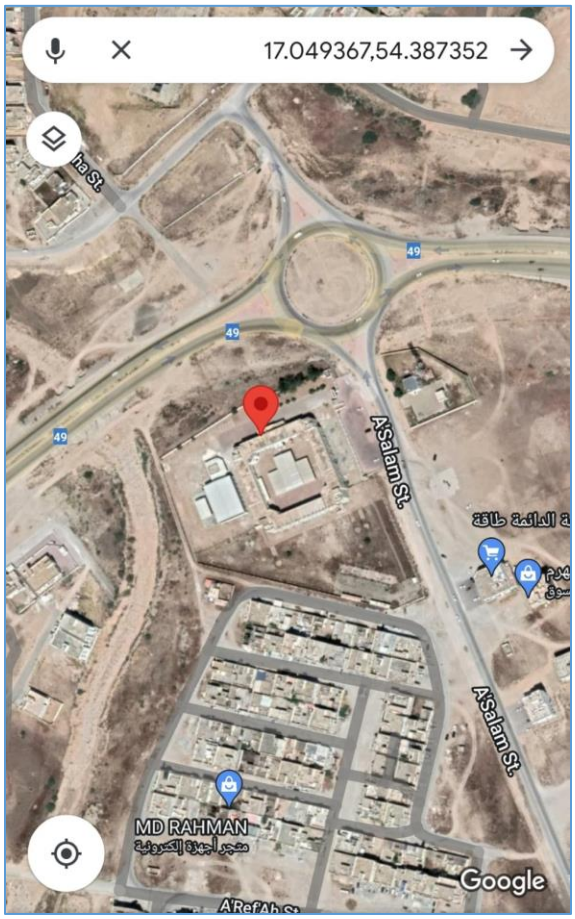


Photo (1)

3) Data collection and analysis:

- ✓ We used soil protocol, soil PH.
- ✓ After preparing the planting pots, only red soil was added to the first pot, and red soil + powder from Nargile waste was added to the second pot.
- ✓ The soil pH, soil salinity, and soil conductivity were measured by making a soil extract from the two samples, adding water (1:1 ratio), then measuring them with a pH device and a conductivity device.
- ✓ Natural seeds for planting (cowpea seeds) were prepared by soaking them in water for 24 hours before planting them in the soil.
- ✓ After planting, the soil was irrigated, and seed growth was monitored.

PH meter and conductivity meter used in the research.

To make soil extract: add an amount of soil with an equal amount of water, stir the mixture for 30 seconds, and repeat the mixing several times.

Some pictures of the team in action:

Monitor seed growth

The difference between the stem height of plants in the first and second pot.

Results:

General Notes:

1- When implementing the activity, the first time, we added a large amount of Nargile waste to the soil, which subsequently led to its rotting and the emergence of an unpleasant odor, which forced us to repeat the experiment using an appropriate amount of plant waste.

2- When we monitored the growth of the plants, we noticed that their growth was faster and stronger in the soil to which we added the Nargile, and the number of seeds that grew was greater.

3- The surface of the pot that contains only soil dries faster than the soil that contains the Nargile, and this may indicate - superficially - that the second pot retains more moisture.

***Average = sum of measurements divided by their number

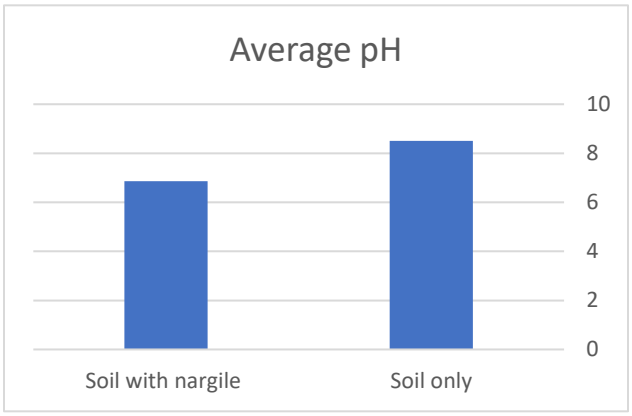
First pot (soil only):

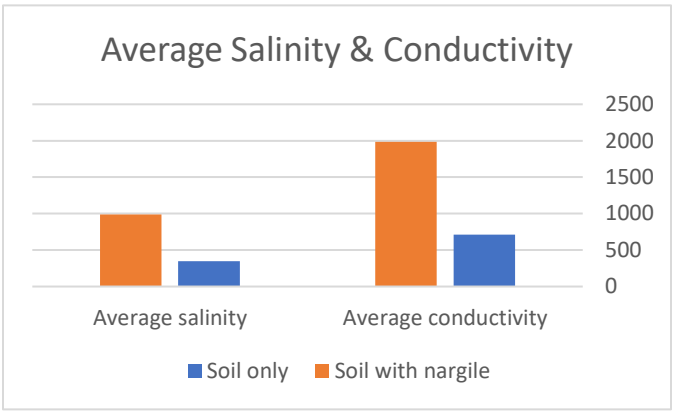
The protocol	Measure 1	Measure 2	Measure 3	Average
pH	8.45	8.54	8.50	8.5
conductivity µs	707	713	711	710.3
salinity ppm	349	344	343	345.3

The second pot (soil + Nargile plant waste):

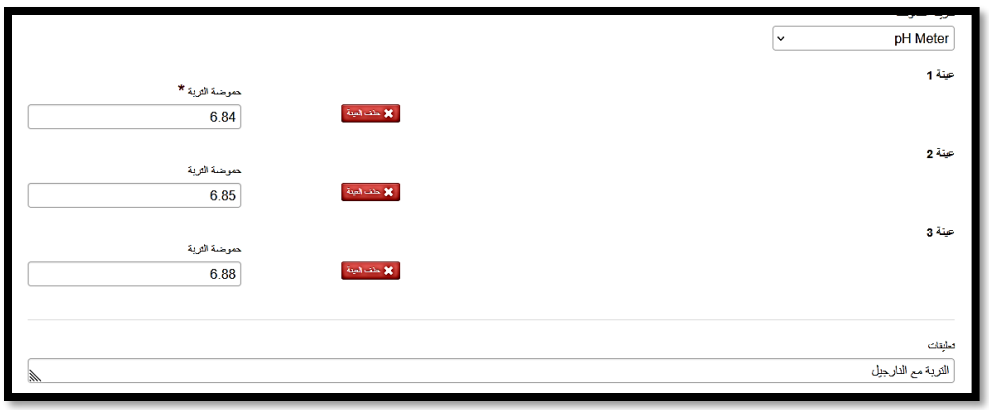
The protocol	Measure 1	Measure 2	Measure 3	Average
pH	6.84	6.85	6.88	6.86
conductivity µs	1982	1984	1989	1985
salinity ppm	986	989	995	990

*Organize the results graphically:





** Data entry to the GLOBE website:



Discussion:

After presenting the results and discussing within the team under the supervision of our teacher, we answered the first question: What is the effect of adding Nargile plant waste on soil properties?

From our measurements of soil pH, salinity, and conductivity, it is clear that the pH was lower in the soil to which we added Nargile plant waste (pH was higher), and also that salinity and conductivity were higher.

PH	Less in pot soil with Nargile plant waste (acidic)
conductivity	Higher in the soil with the Nargile plant waste
salinity	Higher in the soil with the Nargile plant waste

In order to explain the faster and better growth of seeds in the container containing Nargile, we searched on websites for the ideal pH for the growth of some vegetables, and it was approximately between 6 and 7 PH.

As for the second question, how can we benefit from Nargile plant waste in recycling and achieving sustainable development?

We have proven through experience that Nargile plant waste improves the quality of soil for agriculture, and therefore it can be used as a natural fertilizer for the soil. In addition, we have made small molds for agriculture made entirely of Nargile plant waste, and they can be used instead of plastic or nylon molds for planting seeds, and then the entire mold is transferred to plant it in the soil, there is no need to take the seeds out of it. It is completely organic, will decompose, and will be beneficial for the soil and for better plant growth. Thus, we have used all the waste resulting from the Nargile plant in useful industries, and we will explain the steps for that in detail.

Impact on the community:

While trying to answer the second question, we thought a lot about how we could transform our research into a practical application of sustainable development, that is, making our lives environmentally friendly to preserve it for us and for future generations.

During the work, we used plastic planting containers. Plastic is not an environmentally friendly material because it pollutes it, and its waste remains for hundreds of years without decomposing. We also noticed that the nurseries place the crops in black nylon bags, which are also not safe for the environment.

A plant from the nursery, inside a pot made of black nylon.

Therefore, we designed our own containers from the remains of the Nargile fruits, in which the seeds are planted, and after they grow a little, we transfer them entirely to the soil in the garden or farm. Because they are made of the Nargile plant, which is an organic material, they will dissolve in the soil without contaminating it.

Our organic pots are still under trial, and can be turned into a profitable project, whether in a school or any other institution that adopts this idea within the Sultanate.

We used Nargile waste (the hair-like part), moistened it with water to make it easier to shape, then pressed it between two pots to take the shape of the pot.

The final result

Educational expert & STEM professional advice:

Mr. Mahfouz bin Ali Mahfouz Al-Mashaikhi, Statistical Data Collector, Department of Agriculture, shared with us the results of our research, and his advice to us was as follows:

The research has made a good connection between sustainable development and education, and this is exactly what we are looking for, for our students to learn how to become environmentally friendly in all aspects of their lives, in order to keep our Oman beautiful and healthy for us and for future generations.

As for the research idea, which can be transformed into a profitable project that is beneficial on the environmental and economic level, we emphasize supporting environmental projects and providing data, resources and equipment for experiments, which will have a positive impact on the implementation and success of the project.

All the best to the students on their environmental and educational journey!

Conclusion:

This study focuses on exploring the recycling of plant waste, using the Nargile palm as a model.

The study aims to improve soil quality to support the growth of plants and vegetables. Using GLOBE protocols, selected soil properties were studied, such as its pH, salinity, and conductivity.

The results showed that adding powdered Nargile waste increased the acidity of the soil and raised its levels of conductivity and salinity.

When monitoring plant growth, soil amended with Nargile residue showed stronger and faster seed and plant growth compared to soil without the additives.

This indicates the possibility of using Nargile waste to improve soil quality and increase crop production. Waste can also be used to produce environmentally friendly products, such as agricultural containers & pots.

Noting that the accumulation of plant and agricultural remains is a global problem, we chose only the distinctive plant that grows abundantly in our region to be the focus of study.

Recommendations and Suggestions:

- ✓ We faced a number of difficulties during our work, for example, calculating the appropriate amount of Nargile waste that we should use to get a good result. This was done through trial and error, as we gradually used the waste until we arrived at an appropriate way to add the Nargile waste to the soil without causing it to rot and the seeds to die.
- ✓ It was suggested that the Nargile waste be converted into natural fertilizer before adding it to the soil. Because this takes a long time, we may work on it, God willing, in the coming times.
- ✓ We were unable to measure soil fertility (potassium, phosphorus, and nitrogen nitrate) because the necessary tools were not available. Therefore, it was suggested to cooperate with institutions that possess these tools, such as laboratories of the Ministry of Agriculture, universities, etc., in order to obtain more accurate results.
- ✓ The planting molds that we made from Nargile waste are still under experimentation, and they can be improved by adding materials that increase their consistency, and also using better methods for pressing and compressing them instead of the simple method that we used.
- ✓ The experiments can be repeated using other vegetable seeds, such as peppers, tomatoes, and others, with the aim of obtaining more data that will help us confirm what we have found in this research.

Badges:

1- <u>I AM A PROBLEM SOLVER:</u>

In this research, our team investigated a local problem that has a global reach (different types of plant waste). We identified the problem and then proposed appropriate solutions to it. We presented several solutions, some of which were to improve the quality of arable soil and others to replace environmentally harmful materials with friendly ones for the environment. We are proud that our work attracts the attention of those concerned about the environment.

2- **I am a Collaborator**:

Our team was cooperative and everyone in the team did an excellent job. We divided the roles since the beginning of work on the project (the table is attached in research methods) and we helped each other to complete the research (See the work division table2), In addition to our cooperation with the local community to provide our assistance, and also to take advice to improve our work.

3- **I Make an Impact**: Our research is based on a local and global problem, we worked to identify the problem and find solutions, and we made recommendations to government and to work on fixing the problem based on our results, we have also raised awareness among the local farmers about this important topic, We hope that our research will achieve a solution to the problem of plant waste accumulation, and also create new job opportunities by investing this waste in various industries that are beneficial to society.

Feel free to visit our Instagram page

https://instagram.com/GLOBE_mezon_school?igshid=ZDdkNTZiNTM=

Thanks:

The GLOBE team at Maison Bint Ahmed School extends its thanks and appreciation to all who helped us to the completion of this research, whether through moral, logistical, or informational support, and we particularly mention:

Mrs. Tofool Al-Mashani, Principal of Maison School.

Mr. Mahfouz bin Ali Mahfouz Al-Mashaikhi, Statistical Data Collector, Department of Agriculture

GLOBE colleagues who have already had experience in this field.

The supervisors of the program, Asma Zaitoun and Fatima Al-Mishkhi.

References:

1- GLOBE Technical Office, (2012), Soil Protocol Note for the GLOBE Teachers Training Program.

2- Environmental News, (2016), a specialized environmental magazine, Oman.

3- Ministry of Education in the Sultanate of Oman, (2020), Student's Book on Science for the seventh grade of primary school.