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Ocean Farming: A Sustainable Way To Feed The World

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Introduction

For areas of the world where arable land is rare, there is an urgent need for alternate agriculture techniques because underwater spaces are untapped and enormous. The Nemo's Garden® Project attempts to establish a sustainable and alternative agricultural system. Its underwater greenhouses, called biospheres, were built for regions where plant development is challenging under terrestrial conditions owing to climate change. The Sanremo Research Centre for Vegetable and Ornamental Crops (CREA-Centro di Ricercar Orticoltura e Florovivaismo) greenhouse-grown basil was chosen as the model plant for the study of its phytochemical, physiological, and micromorphological parameters. While micromorphological tests between control and biospheres samples did not reveal any discernible alterations, phytochemical investigations revealed that the essential oil chemotype had changed from methyl eugenol/linalool to the methyl form of eugenol. Sesquiterpenes predominated in the biosphere samples while oxygenated monoterpenes made up half of the emission in the control sample, indicating that the headspaces were also different. The physiological examination also revealed differences: the biospheres samples had greater levels of total chlorophyll, total carotenoids, and total polyphenols, with an increase in antioxidant activity and polyphenol content of, respectively, 31.52% and 13.3%.

The only way to grow these plants and see that they are not being harmed by any external factors is through use the Hydroponics method of farming which essentially means creating biosphere and making the plants get enrichment.

Abstract

Aquaculture, or "ocean farming," is a sustainable way to produce food by raising aquatic plants and animals in marine habitats. In this abstract, the salient features of ocean farming are examined:

Different techniques for cultivation: Farms can raise a range of species, such as seaweed, shellfish (oysters, mussels, clams), and finfish, using submerged cages, floating buildings, or seabed facilities.

Benefits to the environment: Some methods of ocean farming can enhance the health of the ocean. By filtering water, seaweed reduces dead zones and eliminates contaminants. Eating shellfish also cleans the water, making the ecosystem better.

Sustainable food source: Without depleting wild fish stocks, ocean aquaculture provides a means of satisfying the growing demand for seafood. It uses few resources, like as fertiliser or freshwater, hence it's a resource-efficient method.

Potential for regeneration: Certain methods, such as when seaweed and shellfish are grown together, a balanced ecosystem is created that supports habitat restoration and biodiversity.

All things considered, ocean farming offers a viable way to produce food sustainably and improve the marine ecosystem.

Explanation on Hydroponics

With the use of a nutrient-rich solution, hydroponics is a technique for growing plants without soil. Various inert media, such as perlite, vermiculite, or coconut coir, are used to grow the plants. A pump is used to move the nutrient solution through the media as the plants take the nutrients they require from the solution.

Compared to conventional soil-based farming, hydroponic gardening has a variety of benefits, including:

Faster growth: Compared to plants grown on soil, plants produced in hydroponic systems often develop more quickly. This is because the plants do not have to spend energy looking for nutrients in the soil because they have immediate access to the nutrients they require.

Higher yields: Compared to soil-based systems, hydroponic systems can offer higher yields. This is due to the plants' lack of restrictions, which the nutrients that the soil has access to.

Water usage is lower with hydroponic systems than with soil-based ones. This is due to the water's reuse and recycling.

Less pests and disease: Compared to soil-based systems, hydroponic systems are more resistant to pests and disease. This is so that the plants do not grow in direct touch with pests and illnesses that are most likely to be found on the ground.

The setup and use of a hydroponics system is rather straightforward. A simple hydroponics system, fertiliser solution, and inert material are all you require. After setting up your system, you may begin sowing seeds or seedlings.

Simply lay the seeds in the inert medium and water them thoroughly to plant them in a hydroponic system. Water usage is lower with hydroponic systems than with soil-based ones. This is due to the water's reuse and recycling.

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Simply lay the seeds in the inert medium and water them thoroughly to plant them in a hydroponic system. The implying that it lacks any dietary components on its own. The plants will receive all of their nutrients from the fertiliser solution as a result.

Use a nutritionally balanced solution. All of the crucial nutrients, such as nitrogen, phosphorus, and potassium, that plants require should be present in the nutrition solution. Nutrient solutions are available already produced or you can make your own.

Keep an eye on the nutrition solution's ph. The nutrition solution's pH value should range from 5.5 to 6.5. To check the pH of the solution and make any necessary adjustments, use a pH metre.

Give the plants adequate light. Plants require a minimum of six hours of light each day. You must utilise grow lights if you're growing plants indoors. When the plants are fully mature, harvest them. Depending on the type of plant, ripening takes a different amount of time. Make care to check on your plants frequently so you can harvest them when they're ready many hydroponics system types.

Although there are many various kinds of hydroponic systems, the following are the most typical:

Deep water culture (DWC): A DWC system suspends the plants in a constantly recirculating nutritional solution. The plants' roots dangle into the solution and take in the nutrients they require.

In a system using the nutrient film method (NFT), plants are cultivated in a trough or channel through which a thin film of nutrient solution flows. vegetation's roots are submerged in the nutritional solution continuously.

The roots of the plants are suspended in the air and misted with a nutritional solution in an aeroponics system. In terms of water usage, this kind of technology is quite effective.

Advantages of hydroponics

- In addition to the advantages, I previously listed, hydroponics also provides the following advantages:
- Hydroponic systems can be used year-round, regardless of the climate, to grow plants. Because they are not growing in the ground, the plants are not impacted by temperature or weather fluctuations.
- Low space requirements: Plants can be grown in a small area using hydroponic systems. They are therefore perfect for indoor plant growth or urban gardening.
- Hydroponics reduces weeds.

Hydroponics can be used in any sea, but it is important to consider the specific conditions of the sea when choosing a hydroponics system and selecting plants. Some factors to consider include:

Salinity: The salinity of seawater can vary depending on the location. Some seas, such as the Dead Sea, are very saline, while others, such as the Baltic Sea, are less saline. Hydroponics systems need to be designed to accommodate the salinity of the seawater being used.
Temperature: The temperature of seawater can also vary depending on the location. Some seas, such as the Red Sea, are very warm, while others, such as the Arctic Ocean, are very cold. Hydroponics systems need to be designed to operate within the temperature range of the seawater being used.
Waves and currents: Waves and currents can be a challenge for hydroponics systems. Hydroponics systems need to be anchored securely to the seabed and designed to withstand the forces of waves and currents.

Despite these challenges, hydroponics can be a successful way to grow plants in the sea. There are a number of companies that are developing and operating hydroponics systems in the sea. For example, Nemo's Garden is a company that operates underwater hydroponics greenhouses off the coast of Italy.

Here are some of the benefits of using hydroponics in the sea:

Increased yields: Hydroponics systems can produce higher yields than traditional soil-based systems. This is because the plants have direct access to the nutrients they need and are not limited by the nutrients that are available in the soil.
Reduced water usage: Hydroponics systems use less water than traditional soil-based systems. This is because the water is recycled and reused.
Year-round growing: Hydroponics systems can be used to grow plants year-round, regardless of the climate. This is because the plants are not growing in the ground and are not affected by changes in temperature or weather conditions.
Reduced environmental impact: Hydroponics systems can have a reduced environmental impact compared to traditional soil-based systems. This is because hydroponics systems use less water and fertilizer.
Overall, hydroponics is a promising technology for growing plants in the sea. Hydroponics systems can produce higher yields, use less water, and have a reduced environmental impact compared to traditional soil-based systems.

In reference to this Nemo’s garden is company that is presently doing this using this method and creating wonders in the field of hydroponics.
Agriculture's fastest-growing industry, hydroponics, may eventually control how food is produced [3]. People will turn to innovative technologies like hydroponics and aeroponics to generate extra channels of crop production when population rises and arable land shrinks as a result of bad land management. We simply need to look at a few of the early adopters of this technique to gain a peek of the future of hydroponics. Land in Tokyo is quite expensive because of the city's expanding population. The nation has shifted to hydroponic rice farming to feed the populace while protecting valuable land mass. Without using any soil, the rice is harvested in underground vaults. Four harvest cycles each year can be carried out because the environment is fully managed.
Israel, which has a dry and arid climate, has also successfully used hydroponics. Crops have been grown hydroponically in 40-foot (12.19-meter) long shipping containers by a business by the name of Organistic. Berries, citrus fruits, and bananas—all of which are often unsuitable for Israel's climate—are cultivated in huge quantities there. The yield from using hydroponics technology is 1,000 times higher.
The use of hydroponics and other water-saving methods for food production is required right now and is expected to become more widespread over time as water becomes scarcer and more valuable as a resource.
Compared to soil gardening, hydroponics requires a lot less water. In soil farming, most of the water we provide to the plants is lost to leaching deep into the soil and is not available to the plants' roots, whereas in hydroponics, plant roots are either completely submerged in water or constantly covered by a film of nutrients mixed with water, keeping the root zone hydrated and fed. This procedure uses recovered, filtered, replenished, and recycled water; thus no water is lost. Crops can use waste nutrient solution as a substitute for water.
The hydroponic system to conventional agriculture and shows the savings in irrigation water, fertiliser, and improvement in food and water productivity. By recycling the run-off water, NFT-based hydroponics can cut irrigation water use by 70% to 90%.
Under controlled hydroponic conditions, it is feasible to produce high-quality, high-value vegetables while consuming 85 to 90% less water than conventional soil-based farming. Salinity, dissolved solids, and pathogens are frequent components of groundwater and dam/river water sources that can affect plant condition and output. While some of these elements may help crops, others must be minimised.

The tomato, cucurbits, lettuce & leafy vegetables, peppers, and other food crops are included in the worldwide hydroponics market by crop type. In 2018, the largest market sector was the tomato, which accounted for 30.4% of the global market.

Tomatoes, lettuce, and other leafy vegetables are among the crops that hydroponics is predicted to produce more of. The demand for hydroponics culture is growing in Europe and Asia Pacific as customers become more aware of the superiority of high-quality greenhouse-grown veggies. The biggest market for hydroponics-related sophisticated technology is usually Europe. The second-largest hydroponics market, which is anticipated to expand steadily, is in Asia-Pacific. The Netherlands, Australia, France, England, Israel, Canada, and the United States are among the world leaders in hydroponic technology. Netherlands is the world leader in Commercial hydroponics account for 50% of the value of all fruits and vegetables produced in the nation, with a total area of 13000 ha under tomato, capsicum, cucumber, and cut flowers (Netherlands Department of Environment, Food and Rural Affairs, NDEFRA).

The adoption of hydroponics as a farming technique is significantly hampered by the enormous initial cost of the system, which is estimated at USD$ 110,000 for a 46.5 m2 farm that is not fully automated [48]. Thus, it is crucial to create new, better goods and services to aid UA based on hydroponics. Such technologies must be scalable to meet growers' needs, not just for large-scale operations but also for medium- and small-scale ones, taking into account the limited amount of space that may be used for farming. Buehler and Junge [49] have demonstrated that, in Europe, Asia, and North America, where the devoted surface is more favourable, the practise of growing food in urban areas has increased dramatically since 1988 than 150,000 m2. Hydroponics is essential for the establishment of UA and might make a substantial contribution to achieving SDG 11. However, it requires the creation and uptake of the right technology. Gnauer et al who propose a framework that integrates heterogeneous devices on various computing layers to monitor and optimise the production process, describe some technologies suitable for indoor farming. In addition, they created the AgroRobot, an aeroponics-based robot for growing microgreens. The AgroRobot has a touch-screen graphic interface created with Nexion, and an Arduino Nano8 is used to manage watering and lighting. Additionally, various accessories for this project—like culture trays—are produced using 3D printing technology.

Agriculture Applications 4.0They are making good progress into the world of hydroponics. For example, the Mycodo Environmental Regulation System is an open-source project that produced a graphical user interface that can be customised for indoor hydroponic production of leafy species [51]. In the kernel of a Raspberry Pi, especially, Mycodo runs in a Linux environment. The technological contribution of this system is its scalability, or the ability to add calibration procedures for sensors and control algorithms for variables like pH, EC, and humidity, among others, to the interface created by the authors. They also employed additive manufacturing for a few of the physical system's accessories.

Similar to this, the CNC robot Farmbot can cultivate a variety of leaf and fruit crop species using a hydroponic drip watering system. Their Users who lack technical knowledge can order their Farmbot ready for assembly. Creators give users with the knowledge and abilities required to download the CAD models and programming files [52].

Mauricio-Moreno et al. [53] offered an intriguing idea for the development of technologies specifically geared towards small-scale farming through the S3 production model, which consists of three components:

Sensing. the capability of a system to detect events, collect data, and precisely measure changes in environmental physical characteristics.

Smart. A system's ability to include control and actuation features that, after interpreting input data, help the decision-making process using predictive or adaptive logics. The adjective "smart" also increases one's capacity for multiple networked systems to function at once.

Sustainable. This idea relates to technological advancement from a social, economic, and environmental perspective.

It is a sustainable way to produce food.
It does not require the use of pesticides or herbicides.
It does not require the use of fresh water.
It does not require the use of land.
It can help to improve water quality.
It can help to create jobs and boost the economy in coastal communities.
Mediterranean Sea, which is a suitable environment for underwater farming. The Mediterranean Sea is relatively calm and has a mild climate, which makes it ideal for growing plants in biospheres.

Other types of seas that could be suitable for underwater farming include:

Tropical seas: Tropical seas have warm temperatures and abundant sunlight, which are ideal for plant growth.
Subtropical seas: Subtropical seas have mild temperatures and moderate sunlight, which can also be suitable for plant growth.
Temperate seas: Temperate seas have cooler temperatures and less sunlight than tropical or subtropical seas, but they can still be suitable for some types of plants.
The specific type of sea that is most suitable for underwater farming will depend on the specific plants that are being grown. For example, some plants may require warmer temperatures than others.

It is important to note that underwater farming is still a relatively new technology, and there is still a lot of research that needs to be done to determine the best conditions for growing plants in biospheres. However, the Mediterranean Sea has shown to be a suitable environment for underwater farming, and other types of seas with similar conditions could also be suitable.

Here are some of the factors that need to be considered when choosing a sea for underwater farming:

Temperature: The water temperature should be within the range that the plants can tolerate.
Sunlight: The underwater biospheres should receive enough sunlight to support plant growth.
Salinity: The salinity of the water should be within the range that the plants can tolerate.
Waves and currents: The underwater biospheres should be located in an area with minimal waves and currents.
Pollution: The water should be relatively clean and free of pollution.
By carefully considering these factors, it is possible to choose a sea that is suitable for underwater farming.

Here is a more detailed explanation of the factors that need to be considered when choosing a sea for underwater farming:

Temperature: The water temperature should be within the range that the plants can tolerate. Most plants can tolerate a wide range of temperatures, but some plants have specific temperature requirements. For example, some tropical plants may require water temperatures that are above 70 degrees Fahrenheit.
Sunlight: The underwater biospheres should receive enough sunlight to support plant growth. Most plants require at least six hours of sunlight per day. However, some plants can tolerate lower levels of sunlight.
Salinity: The salinity of the water should be within the range that the plants can tolerate. Most plants can tolerate a salinity range of 20-35 parts per thousand. However, some plants have specific salinity requirements. For example, some mangrove trees require water that is more saline than other plants.
Waves and currents: The underwater biospheres should be located in an area with minimal waves and currents. Waves and currents can damage the biospheres and disrupt plant growth.
Pollution: The water should be relatively clean and free of pollution. Pollution can damage plants and make them more susceptible to disease.

In addition to these factors, it is also important to consider the following when choosing a sea for underwater farming:

Depth: The underwater biospheres should be located at a depth where the water temperature is suitable for plant growth. The depth will also affect the amount of sunlight that the biospheres receive.
Accessibility: The underwater biospheres should be located in an area that is accessible for maintenance and harvesting.
Cost: The cost of constructing and maintaining the underwater biospheres will vary depending on the location.
By carefully considering all of these factors, it is possible to choose a sea that is suitable for underwater farming.

It is important to note that underwater farming is still a relatively new technology, and there is still a lot of research that needs to be done to determine the best conditions for growing plants in biospheres. However, the factors listed above can provide a good starting point for choosing a sea for underwater farming.

The reason to start on this method of farming underwater is to provide better level of food as we see the rise in demand and the never ending problems in agriculture this is one of the best methods to work with.

Objectives :

- To gain knowledge about hydroponics
- TO understand the concept of Nemo's Garden.
- To identify the awareness level of public on hydroponics and Nemo's Garden.

Review of Literature

The Nemo's Garden® project is an alternative production system for areas with limited arable land but significant water availability; it is therefore an interesting intervention to solve the climate crisis. The aim of this work was to evaluate the micromorphological, biochemical and phytochemical properties of Stevia rebaudiana (Bertoni) Bertoni grown under water in comparison with terrestrial samples. Micromorphological analyses performed on leaves using light microscopy, fluorescence microscopy, and scanning electron microscopy demonstrated general uniformity of trichome morphotype and distribution pattern. Histochemical examination showed the simultaneous presence of terpenes and polyphenols in the material secreted by trichomes from underwater samples and the predominant content of polyphenols in terrestrial samples; this was also confirmed by biochemical analyses (26.6 mg GAE/g DW). Characterization of non-volatile components, performed by HPLC–MS, showed similar chemical profiles in all samples, which were characterized by phenolic compounds and stevia glycosides. Volatiles, evaluated by HS-SPME in conjunction with GC–MS, showed sesquiterpene hydrocarbons as the major class in all analysed samples (80.1–93.9%). However, the control plants were characterized by a higher content of monoterpene hydrocarbons (12.1According to the Intergovernmental Panel on Climate Change (IPCC), the climate crisis is the most difficult challenge facing the world today. The United Nations and governments recognize the urgency of a rapid combined response at multiple levels, as demonstrated in the 2021 pre-COP26 conference held in Milan, Italy, and then at the 2021 COP26 chaired in Glasgow, Scotland. Among the possible interventions, a redesign of agricultural models should be considered, as the unsustainability of traditional methods is now evident. Despite being one of the main causes of climate change, agriculture is also suffering the consequences of this dramatic situation due to rising temperatures, variability of rainfall, water scarcity and many other adverse conditions that are expected to affect crop productivity worldwide. . To make matters worse, the world population is estimated to increase by about two billion by

2050, which necessarily means more pressure on the agricultural system to produce 80% more food globally; this will lead to the subsequent depletion of already cultivated land due to the lack of available land that can be used without jeopardizing the biodiversity of the ecosystem. These global trends require concrete measures to reduce the impact of agricultural production, which will lead to a transition to sustainability.

The Nemo's Garden® project (Genoa, Italy) can be an interesting alternative production system to address both the lack of arable land and climate change, especially in areas where the presence of water is significant (e.g. Currently, Nemo's Garden® consists of six underwater greenhouses, called "biospheres", located in Noli's Bay near Savona (Italy).

This innovative pilot underwater farm was developed to help the development of agriculture, especially in areas characterized by difficult environmental, economic, and geomorphological conditions. Despite the fact that the project was already established in 2012, cultivation in greenhouses began in 2015 with underground cultivation, which was followed a few years later by the development of a hydroponic system. Chlorophyll content was first studied to indicate plant tolerance to water stress. Total chlorophyll content is not different from Nemo samples grown in hydroponic solution, showing 1.09 and 1.05 mg/g FW, respectively. In the biosphere, pot-grown plants showed a lower amount of chlorophyll (0.81 mg/g FW), mainly due to the lower chlorophyll content, while the chlorophyll b content was the same as the other samples.

Other compounds, such as total polyphenols, also showed different values: control plants had 26.6 mg / g DW, and hydroponic and potted plants had almost twice the number of submerged plants with 15.83 and 10.55 mg / g DW. each tree.

Like the content of polyphenols, antioxidant activity determined by DPPH-assay and ABTS assays showed the same trend for polyphenols: control plants grown in pots in terrestrial conditions were higher than plants grown in submerged biospheres. Many areas around the world are flooded, with severe consequences for field crops. In order to contribute to the fight against climate change, in the present study, the effect of Nemo's Garden® underwater environment on different characteristics of S. rubidian was evaluated. The goal is to encourage a new alternative production system that is able to overcome the availability of agricultural land. The starting point of the work is a comparison between plants growing in underwater systems and plants growing on land. However, in the experiment, an underwater hydroponic system was installed, because it is known that hydroponic cultivation is more likely to reduce soil residues due to the high humidity in the biosphere.

The combined use of SEM and histochemical staining allows for a comprehensive description of the morpho-functional characteristics of trichomes, combining existing literature data. Like many species of the Asteraceae family, the epigeal epigraph of S. rebaudiana is characterized by both non-glandular and glandular trichomes. Morphological characteristics and distribution patterns are consistent with previous reports. The glands are attached to the leaf epidermis, with special attention to the trichomes, as described by Tateo et al. The secretory material is trapped between the cuticle and the bell of the skull, which is released by tearing or breaking the cuticle. SEM observation showed that in S. rebaudiana, as previously reported, the shell split along a predetermined line running through the centre of the ornamental head. However, as stated by other authors, cutaneous exudation can also occur. Histochemical tests revealed that the secreted material consisted mainly of phenols and terpenes. Tateo et al. also reported alkaloid production.

The studied samples showed the same general micro-morphological characteristics with the exception of the polyphenol content, which was dominant in the glandular trichomes of the surface samples. However, the analysed plants appear to be suitable for growing under all analysed growth conditions. Similar results were obtained from the biochemical analysis, which showed a lower amount of polyphenols in the Nemo plants than the control plants and consequently their antioxidant activity, since polyphenols are known to act as free scavengers. radicals and as natural metal scavengers. This contrast between plants grown in biosphere environments and terrestrial environments has been attributed to different cultivars being responsible for different plant sizes and behaviors. Previous studies have clearly shown the effect of nutrient fertilization, harvesting and other stresses (such as drought) on the production of metabolites such as polyphenols and steviol glycosides . In addition, another determining factor influencing the production of metabolites should be light intensity; Recently, some authors [9] proved that the growth of S. rebaudiana is affected by light intensity, which can contribute to changes in the metabolic response. Jarma-Orozco et al. It has been shown that plants grown in bio-space with greenhouse-based technology and reduced UV radiation have better photosynthetic performance.

Research methodology:

This secondary studies technique pursuits to discover and consolidate the enormous frame of work associated with hydroponics. By systematically reviewing academic articles, books, reviews, and numerous other assets, this look at seeks to discover key standards, ancient developments, advantages, challenges, and emerging traits in the field of hydroponics. While primary studies includes carrying out new experiments or surveys, secondary studies performs a pivotal position in accumulating, organizing, and studying current records, thus contributing to a deeper know-how of the subject rely.

The objectives of this research method are twofold: first, to offer a complete overview of the present-day country of information in hydroponics, and 2nd, to pick out gaps and opportunities for in addition exploration. This methodology gets its data from sources like google scholar and research publication where this was spoken about and got the content from surveys from the age group of 18-21 age group.

In the subsequent sections, we will delve into the specifics of the research design, information analysis methods, and ethical issues that underpin this secondary studies methodology, all aimed at accomplishing a comprehensive expertise of hydroponics and its implications in modern-day agriculture**.**

Limitations :

Time Restraint: Research projects can call for large time commitments, particularly those that involve hydroponics testing and data collection. Project timetables may be restricted for researchers, especially if they are working under tight deadlines or financing cycles.

Budget Restrictions: Researching hydroponics can be expensive, requiring money for supplies, labour, equipment, and utilities (such water and electricity). A study's thoroughness and rigour may be compromised by research funding constraints that limit the scope of experiments, the acquisition of specialised equipment, or the recruitment of research staff.

Restricted Access to Resources: When doing hydroponics research, researchers may encounter difficulties gaining access to specialised facilities or resources, such as greenhouse space, controlled environment chambers, or analytical equipment for nutrient analysis. restricted availability of these resources can limit the breadth and calibre of research initiatives.

Technical expertise: Hydroponics research necessitates knowledge in a number of fields, including data analysis, engineering, hydrology, and plant physiology. If they lack the required expertise or there is a dearth of skilled staff to support the research activities, researchers may run into obstacles.

Plant Variety Availability: To evaluate the performance of various plant kinds under various nutrition regimes and climatic circumstances, hydroponics experiments frequently necessitate access to a wide variety of plant varieties. The breadth or usefulness of study findings may be limited by the scarcity of appropriate plant materials.

Seasonality and Environmental Variability: Research on hydroponics carried out in controlled settings attempts to reduce the impact of outside environmental factors. However, issues like seasonal fluctuations in humidity and temperature still need and light intensity, which can affect experimental outcomes and reproducibility. Risk of System Failure: Hydroponic systems are vulnerable to technical issues that could jeopardise research integrity and result in data loss, such as equipment breakdowns, nutrient imbalances, and pest infestations. To reduce these hazards, researchers must put strong monitoring and backup plans in place.

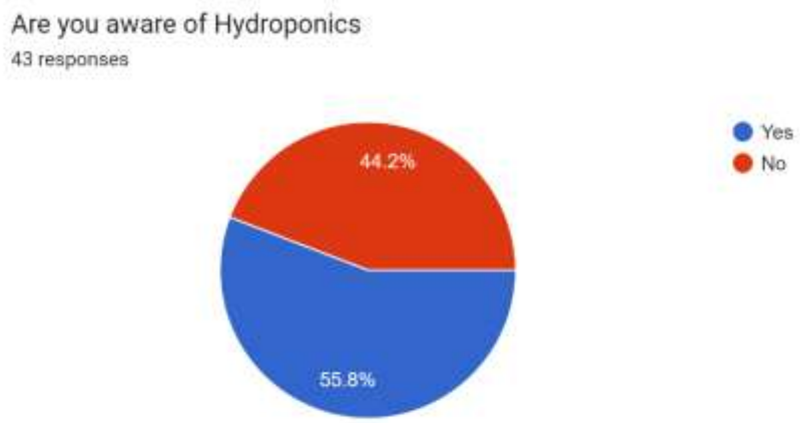
Regulatory Compliance: Depending on the nature of their experiments and the jurisdiction in which they are conducted, researchers using hydroponics may need to abide by laws governing the handling of genetically modified organisms (GMOs) and the use of controlled substances (such as pesticides and fertilisers).

Difficulties in Interpreting Data: Examining data from hydroponics studies can be difficult, especially when determining subtle physiological reactions in plants or evaluating interactions between several variables. Researchers may run into difficulties with statistical analysis and data interpretation, necessitating the use of sophisticated analytical methods. Knowledge Gaps and Uncertainties: Despite advancements in hydroponics research, there are still questions about crop physiology, long-term sustainability, and the best way to control nutrients. While navigating these unknowns, researchers must advance the field's continuing body of knowledge.

Through the resolution of these constraints and difficulties, scientists can improve the calibre and significance of their hydroponics study, propelling scientific understanding and aiding in the refinement of soilless cultivation techniques in the field of agriculture.

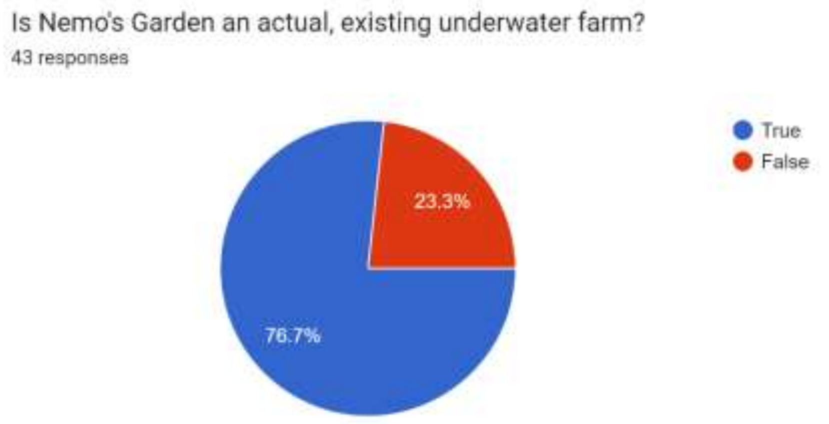
Nemo’s Garden Survey Analysis with Table and Interpretations:

No of responses	Yes	No
43	23	19



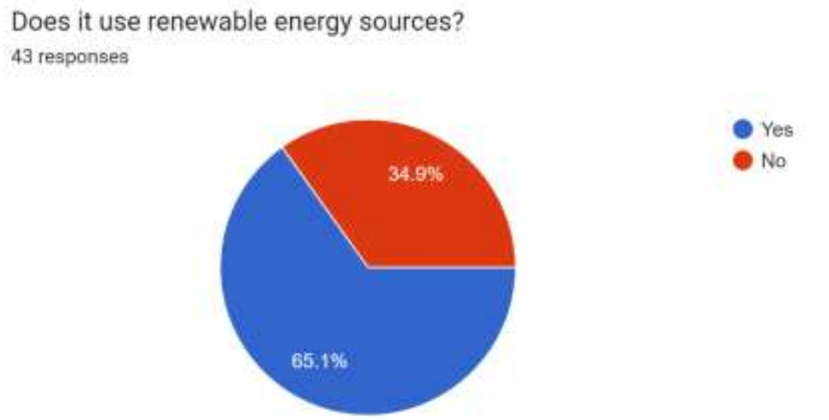
Out of 43 responses,23 respondents (i.e 55.8%) were aware of Hydroponics and 20 respondents(i.e 44.2%) are not aware of Hydroponics. Hydroponics might not be widely covered in mainstream media or educational curriculums, leading to limited exposure among the general population.

No of responses	Yes	No
43	33	10



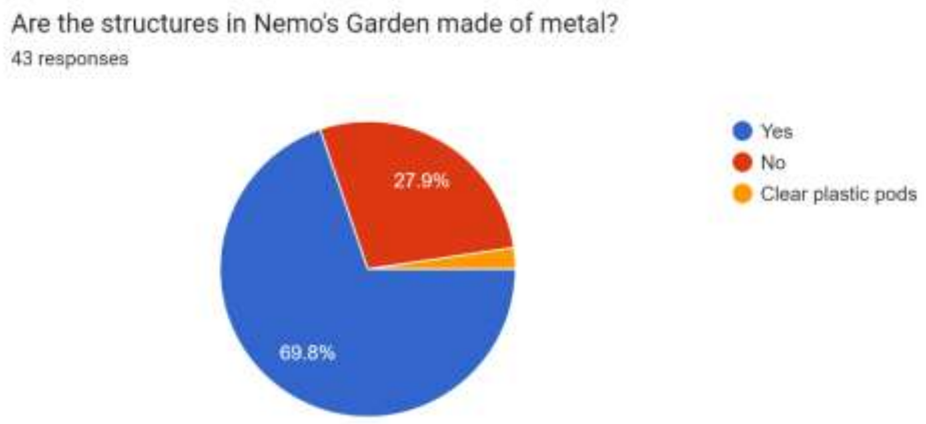
Out of 43 responses,33 respondents were aware of Nemo’s Garden and 10 were not aware of it.This is because Nemo's Garden is still in the experimental stage, and its commercial viability and scalability have yet to be fully demonstrated.

No of responses	Yes	No
43	28	15



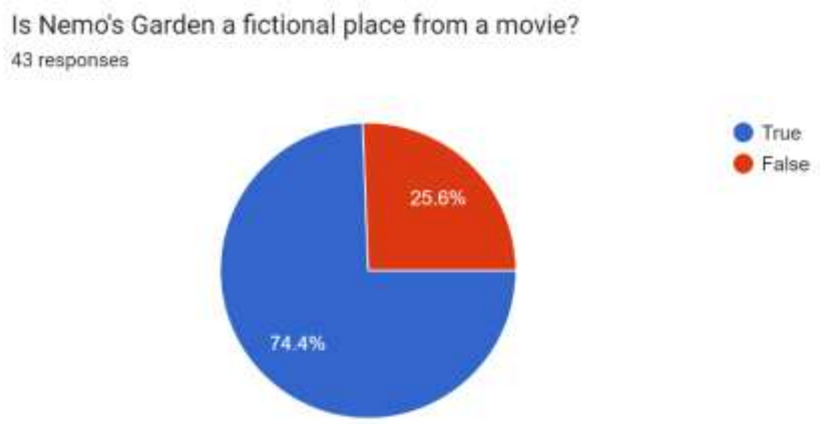
Out of 43 responses,28 respondents were aware of its use of renewable energy sources,15 respondents were not.This might be because of lack of detailed information

No of responses	Yes	No
43	30	12



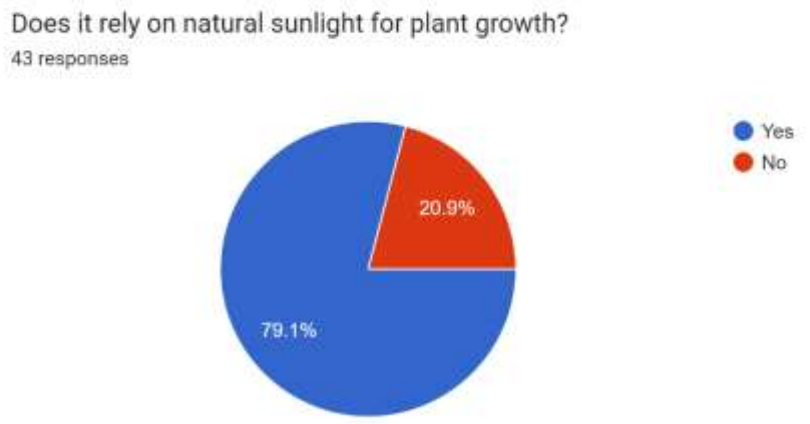
Out of 43 responses,30 respondents believe that it is made out of metal, while 13 respondents do not.1 respondent believes that it is made out of clear plastic pods. This visual aspect, combined with the underwater setting, can lead observers to assume that the material used is metal.

No of responses	Yes	No
43	32	11



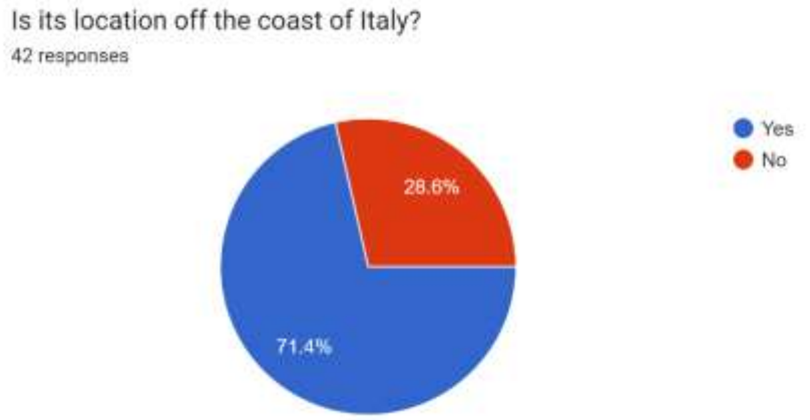
Out of 43 responses,31 respondents believe it is a fictional place, while 12 respondents do not. Nemo's Garden has been portrayed primarily in fictional contexts, such as in movies, books, or video games, people may associate it with fictional storytelling rather than real-world innovation.

No of responses	Yes	No
43	34	8.9



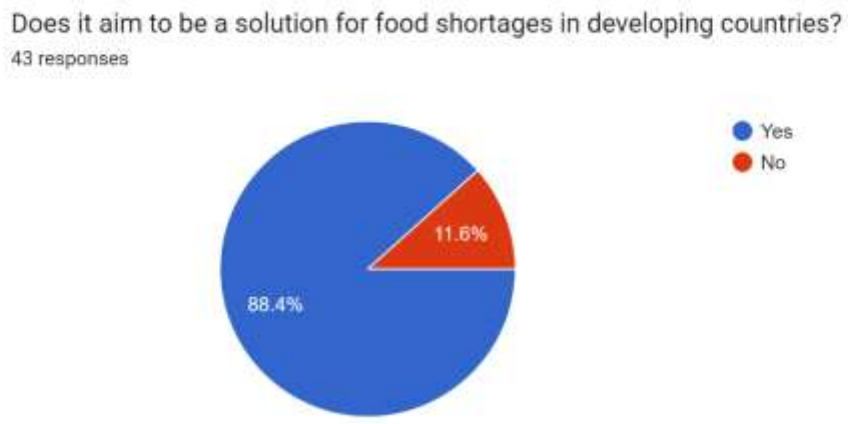
Out of 43 responses,34 respondents think that it relies on natural sunlight for growth,while 9 respondents do not. In traditional gardening practices, sunlight is a fundamental requirement for plant growth through the process of photosynthesis

No of responses	Yes	No
43	30	13



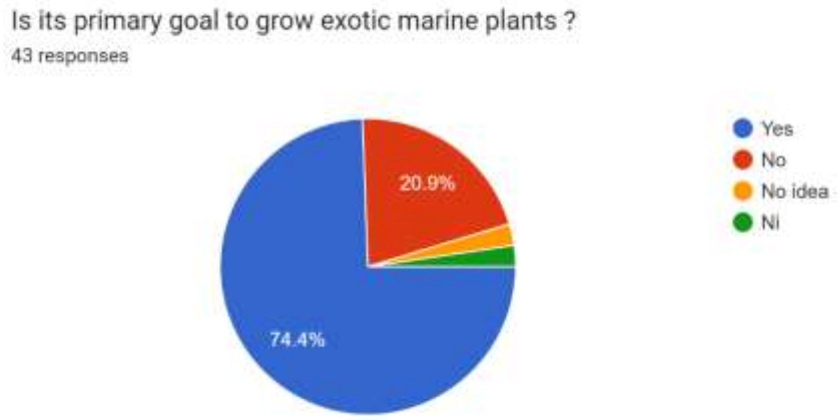
Out of 41 responses,30 respondents,believe it is off the coast of Italy, while 11 respondents do not.This might be because of the Movie Nemo which depicts it in the USA

No of responses	Yes	No
43	38	5



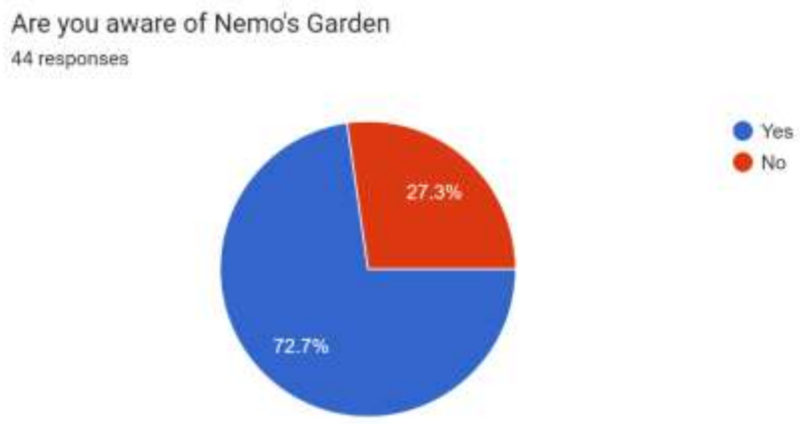
Out of 43 responses,38 respondents believed it could be a solution for food shortages in developing countries, while 5 respondents do not. If successful, projects like Nemo's Garden could be scaled up and replicated in various locations worldwide.

No of responses	Yes	No
43	32	9



Out of 43 responses,31 respondents believe that the primary goal is to grow exotic marine plants,12 respondents do not. Many promotional materials and media coverage of Nemo's Garden focus on the visually striking aspect of underwater structures adorned with lush greenery.

No of responses	Yes	No
43	31	12



Out of 44 responses,32 respondents were aware of Nemo's Garden, while 12 were not. This might be because it is still in the developing stage

Findings:

This study sought to examine the knowledge on Nemo's Garden, the research purpose was done through Google forms.

Hypothesis: Gave this research clarity about the understanding people hold about the concept of Nemo's Garden and it was in favour.

Participants:

The sample was evenly split by gender (50% female, 50% male).

Participants were recruited through Google form and online communication.

Participants were college students from a mid-sized public university in Bengaluru. India.

More than 60% of the participants reported that they are aware about the process and utilities related to Nemo's Garden. 88.4% participants believe it to be a solution to food shortage in various underdeveloped and developed countries.

More than 50% participants are aware about the concept of Hydroponics.

This Research paper gave us clarity about the knowledge {age group 18-23) holds for Nemo's Garden. These findings highlight the importance of future of farming. Future research could explore Nemo's Garden and Hydroponics expansion and scaling.

Suggestion:

Research: Take the time to educate yourself about hydroponic principles, techniques, and best practices. There are numerous resources available online, including articles, books, videos, and online forums where you can learn from experienced hydroponic growers.

Choose the Right System: Select a hydroponic system that suits your space, budget, and crop preferences. Consider factors such as scalability, ease of maintenance, and resource requirements when choosing a system.

Select Suitable Crops: Not all plants are well-suited for hydroponic cultivation. Start with crops that are known to thrive in hydroponic systems, such as leafy greens (lettuce, spinach), herbs (basil, mint), and certain fruiting crops (tomatoes, peppers).

Invest in Quality Equipment: While it's possible to build DIY hydroponic systems, investing in quality equipment can save you time and effort in the long run. Choose durable materials, reliable pumps, and accurate monitoring devices to ensure the success of your hydroponic garden.

Monitor Nutrient Levels: Proper nutrient management is critical in hydroponics. Invest in a quality nutrient solution and monitor pH, EC (electrical conductivity), and nutrient concentrations regularly to ensure optimal plant growth and health.

Maintain Environmental Conditions: Control environmental factors such as temperature, humidity, and light intensity to create an optimal growing environment for your plants. Consider using supplemental lighting, fans, and ventilation to maintain stable conditions indoors.

Practice Good Sanitation: Preventing contamination and disease is essential in hydroponics. Maintain cleanliness in your hydroponic system by regularly disinfecting equipment, monitoring for pests and diseases, and practicing good hygiene practices.

Experiment and Learn: Hydroponics is a dynamic and evolving field. Don't be afraid to experiment with different techniques, nutrient formulations, and crop varieties to find what works best for you. Keep detailed records of your observations and results to learn from your experiences.

Conclusions:

In conclusion, this study underscores the transformative potential of hydroponics as a sustainable agricultural practice, offering solutions to the pressing challenges faced by modern food production systems. As the global population continues to increase and arable land becomes scarcer, innovative approaches like hydroponics have emerged as essential tools in ensuring food security and mitigating environmental impact.

Hydroponic techniques, whether on land or in the sea, hold promise for revolutionizing traditional farming methods. Initiatives such as underwater greenhouses, exemplified by projects like Nemo's Garden, demonstrate the adaptability of hydroponics to diverse environments, enabling cultivation in areas where arable land is limited or unavailable. Controlled hydroponic systems facilitate efficient water usage, reduced exposure to pests and diseases, and optimal nutrient uptake, leading to higher yields and enhanced crop quality.

Moreover, the benefits of hydroponics extend beyond productivity gains. By conserving water resources through efficient recycling and reuse, hydroponic systems contribute to mitigating water scarcity, a critical issue exacerbated by climate change. Additionally, the controlled environment provided by hydroponics minimizes reliance on harmful pesticides and chemical fertilizers, thereby reducing environmental pollution and safeguarding ecosystem health.

Despite the challenges associated with adopting hydroponics on a larger scale, including high initial investment costs and specialized knowledge requirements, ongoing technological advancements and increasing support for sustainable agriculture are paving the way for wider adoption. It is essential to prioritize scalability, accessibility, and sustainability in order to maximize the benefits of hydroponics for global food security and ecological resilience.

Looking ahead, hydroponics offers a promising pathway toward a more sustainable and resilient food system. By harnessing the power of innovation and technology, we can unlock the full potential of hydroponics to feed a growing population, protect our planet's resources, and build a brighter future for generations to come.

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