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BACK TO THE BLUE THROUGH OCEAN FERTILIZATION- A CRITICAL APPRAISAL

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Abstract:-

Ocean fertilization refers to dumping iron (as powdered iron sulphate) or other nutrients (e.g. urea) into the ocean in areas with low biological productivity in order to stimulate phytoplankton growth. In theory, the resulting phytoplankton draw down atmospheric CO2 and then die, falling to the ocean bed and sequestering carbon.

Stimulation of phytoplankton production through the intentional introduction of iron fines to iron-poor areas of the ocean surface is called Iron Fertilization. This is intended at accelerating the carbon dioxide (CO2) sequestration from the atmosphere and enhancing the biological productivity.

Iron is a trace element necessary for photosynthesis in plants. It is highly insoluble in seawater and in a variety of locations is the limiting nutrient for phytoplankton growth. Large algal blooms can be created by supplying iron to iron-deficient ocean waters. The algal blooms facilitate the nourishment of other organisms.

The world's oceans play a key role in keeping atmospheric carbon levels in check, largely through the work of phytoplankton. These organisms consume carbon dioxide from the atmosphere as they photosynthesize; those that aren't eaten, as well as their waste, sink to the seafloor and take some of that carbon with them and there it can lie for hundreds or thousands of years. Since then, a number of scientists have pursued the possibility of iron fertilization as a relatively simple way to draw down carbon dioxide from the atmosphere and help in stopping climate change

Some researchers, governments and companies think the concept is still worth exploring. With more of their research on the ocean iron fertilization process scientists may figure out methods to overcome these disadvantages in the coming times.

Key Words:- Phytoplankton, Carbon Sequestration, Iron Fertilization, Biological Productivity, Climate change.

1. INTRODUCTION:-

Our planet is experiencing global warming due to the emission of greenhouse gases. The emission has created wide range of changes in the climatic pattern all over the world. This includes glacial melts, rising sea levels, migration and extinction of species, increase in disaster vulnerabilities and so on. This process after some more years will become irreversible leading to a great impact on human species. Scientists predict global

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temperature will increase through human-made greenhouse gases which will lead to severe weather damage. (https://climate.nasa.gov/effects/)

The IPCC's Sixth Assessment report, published in 2021, found that human emissions of heat-trapping gases have already warmed the climate by nearly 1.1 degrees Celsius since pre-Industrial times and is expected to increase more by 1.5 degree Celsius in the decades to come. Our future will depend on the total amount of carbon dioxide getting added to the atmosphere which is a cause of worry for all.

Oceans are the largest home of marine microalgae which is the main constituent of phytoplankton responsible for more than half of world's annual carbon fixation. However the productivity of plankton is limited by the nutrient Iron. Ocean Fertilization is a process of adding Iron (Fe) to enhance the productivity of microalgae to absorb carbon dioxide to slow the process of global warming and climate change. (Zeebe and Archer, 2005; Aumont and Bopp, 2006; Glibert *et al.*, 2008) This approach is effective, environment friendly and potentially sustainable. The photosynthesis process of the algae consumes not only carbon dioxide (CO2) but also nitrogen (N) and phosphorous (P). Since the levels of N and P are usually greater than Fe levels, the addition of Fe into the ocean can stimulate the photosynthesis and enhance carbon absorption.

Objectives:

How did the oceans help the amount of CO2 in the atmosphere decrease?

What is the process of iron fertilization that can help remove CO2 from the atmosphere?

What are the Pros and Cons of Ocean Fertilization?

How does ocean fertilization help climate change?

Methodology-

The paper tries to analyse the ocean fertilization process which helps to remove carbon dioxide from the atmosphere based on scientific data and reports. It is an initiative to know more about the process and its importance to control climate change.

2. The Process:-

Scientists have estimated that if they fill the ocean with iron dust the ocean will increase the ability to absorb carbon dioxide from the atmosphere to neutralize climate change and global warming. The process is done through geoengineering which doesn't involve harmful chemicals to increase the amount of phytoplankton in the ocean which will enable to absorb more carbon dioxide out of the atmosphere when this process is administered. Phytoplankton can thrives well in iron-rich areas, small amounts of iron if could be added to parts of the ocean it will tend to produce a lot more phytoplankton to solve the problem.

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Iron fertilization can be done easily by involving small boats that can spread iron dust in specified areas to help blooming of phytoplankton in large amount within twenty four hours of dust spread into the blue oceans. The idea of ocean fertilization though have faced controversies gained momentum in 1980s. Scientific world saw potential in this process as a low cost method for reducing negative climate changes. Plankton grown on shallow waters create a good feed for marine organisms. Carbon is then integrated into the waste materials which settles in the deep ocean floor. After the plankton blooms, it dies and then sinks to the ocean floor where the carbon will be stored as sedimentary rock.This means that carbon gets isolated in the deep oceans fertilizing the ocean with iron. In other words Ocean fertilization proposes the addition of nutrients to the ocean surface, which ultimately controls the amount of carbon that is sequestered.

Three ocean fertilization experiments have been conducted in the Southern Ocean so far one in 1999 was a 13-day Southern Ocean Iron Enrichment Experiment (SOIREE), the second experiment was for 21-day Eisen or Iron Experiment (EisenEx-1) in 2000 and the third was in 2002 taken up by Southern Ocean Iron Experiment (SOFeX) all of which produced significant increases in planktonic biomass and decreases in dissolved inorganic carbon in the water column. Simply adding iron to the marine ecosystem may not enhance the removal of carbon dioxide but the process needs to be continuous to have a big impact required.

3. Pros and Cons of Ocean Fertilization-

Fertilization offers the prospect of both reducing the concentration of atmospheric greenhouse gases with the aim of slowing climate change and at the same time increasing fish stocks via increasing primary production. The reduction reduces the ocean's rate of carbon sequestration in the deep ocean.

Critics are concerned that fertilization will create harmful algal blooms (HAB) as many toxic algae are often favoured when iron is deposited into the marine ecosystem. Scientists are optimistic about the impact of carbon sinking as the main objective of iron fertilization is to create a positive increase in the plankton growth leading to the desired result.

The Positive Impact-

Ocean iron fertilization has a number of benefits. With the release of iron particles in the water they become food for the algae. When they bloom they absorb the harmful carbon dioxide for carrying out photosynthesis. These tiny pieces of iron then sink in the ocean and lock away the hazardous gas for years together.

The advantage is the cost estimate for ocean seeding to cut down the carbon dioxide which is much lower than the present cost of other mechanisms that we use commercially.

The addition of iron will also benefit the marine food chain because iron aquatic plants need iron for their healthy growth. The process of ocean iron fertilization also known as carbon sinking will also enhance the marine biological productivity.

Can this be better?

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Various research and experiments conducted for over three decades on this process of reviving the marine ecosystem and help in combatting climate change has resulted in negative feedbacks. But turning a deaf ear will not bring good results. Getting back to their research with carefully designed and upgraded technology to come up with positive results. Since ocean seeding has led to showing about twenty-five percent reductions in atmospheric CO2, they want to work over every tentative insight of the process and want a fruitful consequence.

The Negative Impact-

With the process of iron seeding, the plankton growth will be stimulated. This may also mean that algae growth in deep oceans will enhance. But, the requirement of phytoplankton bloom is more on the shore than deep inside. The earlier experiments in reference to the iron fertilization hypothesis pointed out that this method may not be an efficient method to trap and store CO2. Colossal ocean area would have to carry out the process that may be not so practical. The iron seeding can also stimulate the growth of some algae species that give rise to red tides and other toxic acids in the oceans, disturbing the marine ecosystems.

4. Conclusion-

The process of iron feeding certainly has the potential to significantly make a change in algae blooms, the aquatic life and perhaps even the environment of the earth. With various low downs of the process, there is a considerable benefit and that is mitigating global warming. We have now realized how oceans can help in cutting down the atmospheric carbon.

With a rise in global warming and a quick need for removal of carbon and other toxic contents from the atmosphere, any promising technique, which promises to execute this demand, would seem great. The iron seeding process anticipates the reverse of global warming, but with certain flaws. With their research on the ocean iron fertilization process scientists may figure out methods to overcome these disadvantages in the coming times.

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