Forum: Sustainable Development Goals 14

Issue: Addressing the impacts of ocean acidification

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Introduction

30% of the carbon dioxide (CO2) that is released in the atmosphere is absorbed by the ocean. The levels of atmospheric CO2 increase from human activity such as changing land use (e.g., deforestation) and burning fossil fuels (e.g., car emissions), due to this the amount of carbon dioxide absorbed by the ocean also increases. When CO2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions that creates implications for the ocean and the creatures that live there.

Worldwide, sustained efforts have only begun to monitor ocean acidification, this does not allow researchers to predict exactly how ocean acidification impacts will cascade throughout the marine food web and affect the overall structure of marine ecosystems. Scientists, resource managers, and policymakers recognized the urgent need to strengthen the basis for sound decision making and action due to the accelerating pace of ocean acidification.

There is very little time to waste, the urgency for action is highlighted for the issue of ocean acidification. The fundamental chemistry of our ocean is changing from carbon dioxide (CO2) (burning fossil fuels). Due to the rise of carbon dioxide in the atmosphere, the oceans have become 30% more acidic over the past 150 years and it affects our global oceans.

When Carbon dioxide dissolved in seawater, the water then becomes acidic which results in harming the organisms living in the acidic ocean. This impacts the food chain and results in affecting the economic activity of tourism and activities. Since 1850, the acidity in the ocean has increased by 26 %, this change is 10 times faster than at any time in the last 55 million years.

Definition of Key Terms

Carbon dioxide (CO2)

Carbon dioxide, (CO2), is a colorless gas with a strong odor and a sour taste. It is one of the most important greenhouse gases linked to global warming, but it is a component of Earth's atmosphere

(about 3 intensity in 10,000), formed in the combustion of carbon-containing materials, in fermentation, and the respiration of animal and needed for the plant for the process of photosynthesis of carbohydrates.

Deforestation

Deforestation is diminishing and cleaning of woodlands by people. Deforestation is probably the biggest issue in worldwide land use. Deforestation solely depends on the territory of woodland cleared for human use, including expulsion of the trees for wood items and croplands and brushlands. The idea of cutting trees and taking them out from forests disregards and crushes the woods. Sometimes, in any case, even fractional logging and unplanned flames slim out the trees enough to change the backwoods structure significantly.

Fossil fuels

Fossil fuel is a hydrocarbon-containing material of organic origin formed inside Earth's crust that can be utilized as a wellspring of energy. Non-renewable energy sources, like fossil fuel, incorporate coal, oil, petroleum gas, oil shales, bitumen, tar sands, and substantial oils. All contain carbon and were shaped because of geologic cycles following up on the remaining parts of natural issues delivered by photosynthesis, a cycle that started in the Archean Eon (4.0 billion to 2.5 billion years ago).

Chemical reaction

A chemical reaction is a cycle where the reactant and at least substances are changed to one or more different substances. Chemical reactions are either synthetic components or mixes. A synthetic response adjusts the constituent particles of the reactants to make various substances as items.

Hydrogen ions

The hydrogen ion, carefully, the core of the hydrogen atom isolated from its going with an electron. The hydrogen nucleus is a molecule conveying a unit positive electric charge, called a proton. The disengaged hydrogen ion, the symbol is H+, is hence usually used to speak to a proton. Since the uncovered nucleus can promptly join with different particles (electrons, iotas, and atoms), the confined hydrogen ion can exist just in an almost molecule free space (high vacuum) and in the vaporous state.

Ocean acidification

Ocean acidification the worldwide decrease in the pH of seawater is an outcome of the assimilation of a lot of carbon dioxide (CO2) by the seas. Ocean acidification is generally the aftereffect of stacking Earth's climate with huge amounts of CO2, created by modern vehicles and agrarian cycles. Since the start of the Industrial Revolution around 1750, about 33% to one-portion of the CO2 delivered into Earth's environment by human exercises has been consumed by the seas.

Background Information

The acidification is caused by humans' extra carbon dioxide. This caused the collection in the atmosphere by cutting down forests, burning fossil fuels, and other actions. One aspect of global climate change is ocean acidification. Any solutions made for climate change can benefit the future of the ocean as well. There are approximately only 30 monitoring stations, mostly in developed countries, capable of measuring ocean acidity. The biological impacts of acidification are not monitored enough anywhere in the world. Without better monitoring it, it is near impossible to identify areas of vulnerability or develop effective mitigation measures and management strategies.

Unfortunately, Our future holds even more challenges. By 2050, scientists predict that 86 percent of the world's ocean will be warmer and more acidic than anything in modern history. By 2100, the pH of the surface ocean could drop to under 7.8, or more than 150 percent compared to today's already-corrosive state—and potentially even more, in some particularly sensitive parts of the planet, like the Arctic Ocean.

This fast change is tremendously affecting theine life in the sea. It especially affects corals, oysters, and other creatures with delicate carbonate shells or skeletons, which is weakened even by the slightest change in the ocean's acid balance—similar to the way acid rain corrodes limestone buildings. It disturbs the sense of smell for fish. It may even change the way sounds transmitted through the water which makes the underwater environs slightly noisier.

200 years since the industrial revolution began, due to human actions, the concentration of carbon dioxide (CO2) in the atmosphere increased. During this time, the pH of surface ocean waters has fallen by 0.1 pH units and since the pH scale is logarithmic, this change represents approximately a 30% increase in acidity.

Carbon Dioxide CO2

The oceans have always been back and forth with carbon absorption and evaporation from the atmosphere to water. But this exchange became slower over thousands or tens of thousands of years. Humans have caused that slow exchange. And because of the increasing levels of carbon dioxide in the atmosphere, more CO2 is dissolving into the ocean. The ocean's average pH is now around 8.1, which is basic (or alkaline), but as the ocean is continuing to absorb more CO2, the pH decreases and the ocean becomes more acidic. Since the 18th century, the beginning of the Industrial Revolution, humans have added 400 billion tons of CO2 to the atmosphere. That's the result of the vast amount of burning fossil fuels for energy, the production of cement, the cutting down of forests, etc.

Carbon dioxide is naturally in the atmosphere and dissolves into the ocean. The water and carbon dioxide combine to form carbonic acid (H2CO3), a weak acid that dissociates into hydrogen ions (H+) and bicarbonate ions (HCO3-).

Most of that carbon dioxide (CO2) stays in the atmosphere and it traps heat and contributes to global warming. But with each year that passes, the ocean sucks up 25 % of all the extra CO2 emitted. For the past few hundred years, about 30 % of all the extra carbon dioxide humans have caused in the atmosphere has pervaded down into the oceans.

The good news is for the atmosphere. Without the extra carbon dioxide being absorbed, the planet would have heated up even more than it already has. But it is bad news for the oceans and marine life.

pH scale

Since the late 1700s, the oceans had equilibrated to be with a pH of about 8.1 which made it slightly alkaline (roughly the same acidity as an egg white). The pH scale runs from 0 to 14, with 7 being a neutral pH. Anything higher than 7 is alkaline (or basic) and anything lower than 7 is acidic. The ocean's pH has shifted the geologic time scales. During cold stages, Oceans became more alkaline up to 0.2 pH units, and it became more acidic by the same amount when the planet warmed up. But it took thousands of years for those changes to happen which gave marine creatures plenty of time to adapt to the change.

The surface of the oceans has recorded a 0.1 pH unit drop since the start of the Industrial Revolution in a blink of an eye in evolutionary time. While 0.1 units might not sound like a drastic change, but it means that the water is 28 % more acidic than it was before because the pH scale is logarithmic. The pH scale is an inverse of hydrogen ion concentration, so the more hydrogen ions mean higher acidity and a lower pH.

Impacts of ocean acidification on shell builders

Ocean acidification is already impacting many ocean species, especially organisms that make hard shells and skeletons by combining carbonate and calcium from the seawater. The rise of acidity in the oceans reduces the availability of carbonate components critical for shell-building. This happens due to the available carbonate ions (CO32-) bond with excess hydrogen. the results in a reduction of carbonate ions available to calcify organisms to build and maintain their shells, skeletons, and other calcium carbonate structures. if the acidity levels in the ocean get high enough, the oceans corroded shells to the point they dissolve.

If ocean acidification is left unchecked it could affect marine food webs and lead to substantial changes in commercial fish stocks and threaten the food security and protein supply for millions of people and also global fishing industries.

By mid-century ocean regions may be inhospitable for coral growth and reefs will begin to erode faster before they even grow. Regions depending on healthy coral reefs will be impacted the most for tourism and fisheries.

Pteropods or ”sea butterflies” are an important part of many food webs and are eaten by organisms ranging in sizes. The tiny sea snail is about the size of a small pea eaten by tiny krill to whales. When a pteropod is placed in seawater pH and carbonate levels expected by the year 2100 if acidity keeps increasing, the shells slowly dissolve after 45 days. Severe levels of pteropod shell corrosion have already been discovered in the Southern Ocean, which encircles Antarctica.

Ocean acidification impacts on fish and seaweeds

Ocean acidification or changes in ocean chemistry can affect the behavior of other non-calcifying organisms too. The ability for some fish (like the clownfish) to detect predators decreases and the ability to locate suitable habitats is also affected due to the high levels of acid in seawater. This results in the entire to be at risk.

Although marine species will be harmed by ocean acidification, seagrass and algae can benefit from the high levels of acidity in the ocean because they require photosynthesis just like plants on land.

Our changing ocean

It is estimated that by the end of this century the acidity levels of carbon dioxide in sea waters of the ocean could have around 7.8 pH. The last time the ocean pH level was this low was 14-17 million years ago. Major extinctions were occurring while the Earth was several degrees warmer.

Ocean acidification is presently affecting our entire ocean, this includes coastal waterways. Worldwide, billions of people rely on food from the ocean as a primary source of protein and several jobs and economies depend on the organisms living in the ocean.

Major Countries and Organizations Involved

Environmental Protection Agency

EPA (Environmental Protection Agency) is seeking to improve the research center. The EPA teamed up with NOAA (National Ocean and Atmospheric Administration) to see how compound and organic conditions change after some time inside Narragansett Bay (RI). This sort of work investigates

how seawater enhanced with broken up carbon dioxide and supplements influence natural food chains. A different profession inspects how marine creatures react to acidification, including the joined impacts of acidification and oxygen exhaustion brought about by nutrient contamination and how tiny fish networks may change. Such estimations uncover the Bay's ecology to researchers, remembering ecological reactions to late decreases for nutrient contamination.

Part of this work centers around shellfish to perceive how they are reacting to acidification. One key to EPA accomplishing its observing objectives is through its coordinated efforts with the National Estuary Program (NEP). The NEP is sending bleeding-edge observing frameworks in essential estuaries around the United States. These intricate instruments can distinguish pH and break up carbon dioxide in seawater, giving researchers new bits of knowledge into acidification in nearshore waters. Additionally, EPA is joining acidification boundaries into existing PC models that anticipate water quality and shellfish habitat quality.

A different PC model combines components of biology and economics to anticipate how acidification's impact on shellfish will affect the economy due to declining creation by the fishing and hydroponics businesses.

Latin American and Caribbean countries

Research suggests that rising seawater acidity is now affecting the capacity of organisms like shellfish and corals to manufacture shells and skeletons. This could subvert local food security and vocations in Latin America and the Caribbean, the main territorial gathering of the Ocean Acidification International Reference User Group (OaiRUG).

Ocean acidification is a quiet storm that is beginning to affect individuals' lives, along with pressures from overfishing and contamination, exacerbated by seawater warming and diminished oxygen levels. Latin American and Caribbean nations rely upon the ocean for food and occupations. Without significant cuts in carbon dioxide emissions, the impacts of sea acidification on this district could be catastrophic.

Carbon dioxide emissions caused by human activities are modifying sea chemistry, resulting in the rise of acidity in seawater. Caribbean islands have seen diminishing pH levels for the past 20 years, while seawater immersion of calcium carbonate, fundamental for life forms, for, corals and shellfish build skeletons, has declined by around 3% for every decade. In the colder waters of northern Chile, decreased shell calcification has been seen alongside a 25% decrease in the development pace of scallops. In Patagonian waters, researchers indicated that ocean acidification will decrease biomass creation of mussel hydroponics between the range of 20 and 30%.

UNESCO-IOC (United Nations Educational, Scientific and Cultural Organisation-Intergovernmental Oceanographic Commission)

Ocean acidification is a rising issue and researchers are unable to make meaningful predictions of the acidic seawater impacts on marine organisms or fisheries in general or identify how much time we have before it's too late. We need methods to examine the ecosystem to recognise the multiple environmental factors.

UNESCO-IOC and the Scientific Committee on Oceanic Research (SCOR) sponsored the International Ocean Carbon Coordination Project (IOCCP), a monitoring and research programme. The IOCCP focuses on the increasing levels of CO2 and its effect on calcifying organisms and coral growth rates.

UNESCO-IOC is the co-founder of the Ocean Acidification network. It is meant to provide a significant source of information for researchers and scientists for research activities.

The only path to protect the ocean and organisms from the threat of acidic water is to reduce Carbon dioxide (CO2) emissions. By 2100, Businesses can raise their Carbon dioxide emissions up to 150%. A catastrophic issue like ocean acidification needs global effort. UNESCO-IOC is determined to advocate the member states to merge and understand the importance of planning sustainable development strategies to protect our ocean.

Japan

Ocean acidification is a major issue in northern Japan . The produced Carbon (CO2) emissions dissolved in seawater has consequences for marine ecology and biogeochemistry.

Tokyo Institute of Technology and Japan Agency for Marine-Earth Science and Technology (JAMSTEC) studied the ocean off the coast of Japan. Scientists took measurements in the Pacific Ocean between 2013-2016. The result was low pH of water in the Pacific, near Hokkaido and Kuril Islands.

If the pH levels of the Pacific Ocean keep decreasing at a fast rate, the production of N2O (Nitrous Oxide) would increase at a speedy rate by 185% to 491% by the year 2100. And the effect of Nitrous oxide on greenhouse gas is 298 times greater than Carbon dioxide. The ammonium present in the ocean test measurements would decrease due to the conversion to nitrate that leads to increased production of N2O.

Relevant UN Treaties and Events

- Oceans and the law of the sea, 23 December 2015 **(A/RES/70/235)**

Previous Attempts to solve the Issue

Attempts like geoengineering solutions were proposed to be used for the oceans to reduce atmospheric carbon emissions. geoengineering methods aimed to reduce global temperatures without reducing global carbon dioxide emissions, for example filling the atmosphere with sulfur will not solve the issue of ocean acidification. This program can cause severe issues in an already fragile ecosystem and could cause several unpredictable consequences.

During this time, the only effective way to stop and end ocean acidification is by significantly reducing unnecessary human-caused carbon dioxide emissions.

Possible Solutions

Ocean acidification is a quiet yet catastrophic issue that needs quick actions taken. To protect the coral reefs from the continuous rise of Carbon Dioxide (CO2) scientists need to determine that the CO2 levels will have to be stabilized at 350 parts per million or below.

To achieve this global emissions have to be reduced by at least 85%, below 2000 levels by 2050. To make this work, nations must reduce their greenhouse gas emissions by 25-40% below 1990 levels by 2050.

To prevent future ocean acidification alternative measures are to add chemicals in ocean water to decrease acidity and to address the seriousness of ocean acidification.

International organizations and governments can come up with programs and platforms where they educate the citizens on the risks posed by climate change and ocean acidification. These solutions can instill some self-triggered discipline that guides the citizens to the goal of environmental conservation. Education is necessary because it gives theoretical tips that would be needed for understanding policies while applying it in the real context.

Reduce, reuse and recycle! This old but useful method helps in conserving energy and reducing pollution as well as CO2 emissions from extraction, manufacturing and disposal.

A lot of energy is wasted when water is pumped, treated and heated so we can use it. This is why conserving water can reduce greenhouse gas emissions. It would be a better option to use eco-friendly products as much as you can and avoid plastic.

Guiding Questions

1. How is your delegation affected by this?
2. Why is ocean acidification an issue?
3. What were the previous solutions taken to solve this issue? Did it work?
4. Does your delegation support negatively impact organizations/countries?
5. Has your delegation endorsed any resolutions?
6. What measures is your country taking to solve the issue of ocean acidification?
7. What are the benefits of ocean acidification on climate change?
8. What are the factors that can increase ocean acidification?
9. How can we end ocean acidification to help us achieve a sustainable future?
10. Is there any hope for pteropods to survive and overcome the challenge of ocean acidification or will it diminish? explain.

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Appendix or Appendices

I. https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification **(Ocean acidification impact on ocean life)**

This website is descriptive and useful as it outlines all of the issues Carbon Dioxide (CO2) has caused to the living organisms in the ocean worldwide.

II. https://www.whoi.edu/know-your-ocean/ocean-topics/ocean-chemistry/ocean-acidification/the-ph-scale/ **(The pH Scale)**

This website is important as it briefly explains the issue of the pH levels in the ocean.

III. http://onesharedocean.org/open_ocean/ecosystems/pteropods_at_risk#:~:text=Ocean%20acidification%20is%20likely%20to,as%20pteropod%20shells%20more%20challenging.&text=Importantly%2C%20changes%20in%20pteropod%20abundance,whales%20and%20other%20zooplanktonic%20organisms. **(The Pteropods are at risk)**

This website elaborates the Pteropods' life and its role in the food chain and its importance and the risks caused by the human production of ocean acidification can affect the entire marine system.

IV. https://www.scientificamerican.com/article/ocean-acidification-threatens-global-fisheries/#:~:text=Ocean%20acidification%20is%20likely%20to,Environment%20Programme%20said%20Friday.&text=If%20ocean%20water%20becomes%20too,than%20creatures%20can%20rebuild%20them.
(Fisheries affected by Ocean Acidification in U.S)

This website is useful in acknowledging the affects ocean acidity has on fisheries that can affect people who depend on it and economic activity.