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Ecosystem Interactions and Dynamics of the Some Natural Phenomena and Anthropogenic Environmental Processes in the Global Scale and Philippine Setting

Prof. Raymund N. Fantonalgo, RFT, M.Sc.
Asst. Professor of Biochemistry, Chemistry Department
Asst. Professor of Biology, Biology Department
College of Arts and Sciences, Iloilo Doctors' College
West Avenue, Timawa, Molo, 5000, Iloilo City, Philippines
E-mail address: kimodiwa1127@gmail.com

Asst. Professor of Biology, Life Science Department
College of Arts and Sciences, Central Philippine University
Lopez Jaena St., Jaro, 5000, Iloilo City, Philippines
E-mail address: rnfantonalgo@cpu.edu.ph

PhD Science Education (Biology) candidate
College of Education, West Visayas State University
Luna St., La Paz, 5000 Iloilo City, Philippines
E-mail address: raymund.fantonalgo@wvsu.edu.ph

Abstract

The various terrestrial and aquatic ecosystems of the world are interconnected to each other. Both human activities and natural geological and physical processes can greatly affect their evolution, natural dynamics and different operations. In this paper, five natural phenomena and anthropogenic processes occurring in the global scale such as coastal reclamation, acid rain, El Niño phenomenon, climate change, and ocean acidification are considered for discussion and explanation. In the case of Philippine setting, the construction of dams, occurrence of oil spill, excessive quarrying, conversion of farmland to residential areas and commercial uses, and deforestation are taken into consideration for elucidation and discussion. Both positive and negative effects of these phenomena and processes are analyzed through the use of whole system and multi-disciplinary approaches. Each of these phenomena or processes has modified the community level interactions and has altered the dynamics of the ecosystem balance. Anthropogenic activities have been blamed for the making these processes and phenomena more detrimental to animals, plants, and humans. These activities are mainly designed for the aspiration of the human beings for economic development. Mitigation and adaptation strategies for each environmental issue should be considered to produce relevant, responsible, and scientific alternative solutions for environmental planning and management. It is recommended that the vision of the humanities for economic development should be aligned with the concept of sustainable development. Technological advancement and infrastructural development should not compromise the well being of the nature; otherwise, its boomerang and domino effects will be continuously experienced by humanities in the near future.

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Introduction

Geological events and physical phenomena have gargantuan impacts to the dynamics of the various ecosystems around the world. These events and phenomena are natural processes; hence, they shape the shapes of the ecological systems in numerous aspects and mechanisms. It is beyond the capacity of the human beings to stop these events and phenomena to emerge. Emergence of these events and phenomena in the different eras of the history of the human civilizations have affected the interactions of the biotic factors to their fellow biotic components and ate the same time, the abiotic components of the various ecosystems in the planet. The resilience of the people with these physical events serves as the epitome of their strength and intelligence. They have developed adaptive strategies on how to surmount the challenges brought by these phenomena. Besides the natural phenomena, there are environmental processes which have been brought by humans to nature and they are called as anthropogenic processes. Over the course of the history, some scholars have considered industrial development as the agent of the environmental destruction. Several scientific investigations have proven that development stands as the emblem of the ecological imbalance. In this light, proper environment management is

advised avoid extreme alterations of the natural processes. Remember that nature has its counter mechanisms to follow once its natural processes are modified.

In this paper, five natural and anthropogenic processes occurring in the global scale are considered for discussion. These environment events include coastal reclamation, acid rain, El Niño phenomenon, climate change, and ocean acidification. In the case of the local settings, five environment events are also tackled in this article. The events are comprised of construction of dams, oil spill, excessive quarrying, conversion of farmland to residential areas and commercial uses, and deforestation. The causes of these processes are discussed in this paper. The effects of these events in the ecosystems are also elucidated. Both positive and negative effects are openly discussed. Moreover, the explanations as for how these events have intervened and altered the interactions in the communities and dynamics of the ecosystems are also presented in this manuscript. Mitigation and adaptation strategies are also discussed at the end part of each environmental issue so that alternative solutions for the potential environmental adversities created can be entertained.

A. Global Scale

1. Coastal Reclamation

Context and Scenario

As the world's industrialization progresses and the population grows in number, the demand for vast pieces of land increases to accommodate human settlements, commercial establishments, industrial hubs, and tourism sites. Developers and business practitioners have been entertaining the idea of coastal reclamation for more spaces to be allocated for the developmental projects. Technically, coastal reclamation is a prospective land reclamation approach for creating new land or enclosing the sea and tidal flats for multiple uses.The simplest method of coastal reclamation involves simply filling the area with large amounts of heavy rock and/or cement, then filling with clay and soil until the desired height is reached.

One of the world's prominent reclaimed areas is observed in Dubai (Figure 1b), United Arab Emirates. Dubai built the Palm Tree Islands (Figure 1a)to increase the coastline for tourists. Dubai is known for its sunny weather and beaches, but more than 72 km (45 miles) of coastline was needed to accommodate the goal of tripling the number of tourists to 15 million annually; hence seeking for more spaces through reclaiming coastal areas (Subraelu et al., 2022). In Japan, land reclamation has been used since the 16th century, with the purpose of creating more space for development, industry, and other activities in Tokyo City. As of 2012, about 250 square kilometers of land has been reclaimed from the Tokyo Bay (Figure 1c), roughly 15% of the original bay area to generate more spaces for industrial and commercial purposes (Ishikawa and Yasuda, 2020).

Causes and Effects

Some literature claimed that the ultimate objective of reclamation is ecosystem restoration, including restoration of any natural vegetation, hydrology, and wildlife habitats affected by surface disturbances from construction and operating activities at an oil and gas site. Other literature emphasized that land reclamation from the sea has become a popular phenomenon in coastal development. It is the most preferred solution to the need for land in coastal areas and has been implemented for various use cases, including flood control and agriculture. In the affirmative side, coastal reclamation has significant economic benefits and promotes regional development. In the negative side, man-made environmental change drivers such as pollution, altered land use, over-exploitation, and ecosystem degradation have negative impacts on the structure and function of coastal ecosystem due to coastal reclamation. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) of the United Nations (UN), invasive alien plant species (IAPS) have threatened 20% of the earth's surface, including biodiversity hotspots because of reclamation (Li et al., 2023). In the case of Dubai, researchers have found that the Palm Jumeirah has contributed to marine destruction, shoreline erosion, higher temperatures, and exacerbated socio-economic disparities. Temperature and erosion effects were felt outside of the Palm Jumeirah region, near local communities, which exacerbates socio-economic disparities. In the Philippines, one of the controversial proposed reclamation projects is the New Manila International Airport which was set to rise in Brgy. Taliptip, Bulakan, Bulacan. The mangrove areas will be covered to address the space need for aerotropolis. Raymund Fantonalgo, a marine scientist, said the area where the aerotropolis will be built is a productive nursery and feeding ground because of the rich mangrove ecosystem in the area. The coastal village is also home to at least three species of mangroves. According to preliminary research by the Advocates of Science and Technology for the People (AGHAM) last April, there are at least five species of fish and at least five species of crustaceans found in the waters of Sitio Kinse in Taliptip (Gabico, 2019).

Figure 1. Famous reclaimed areas in the world. a.) The Palm Islands, UAE (Source: Berman, 2023); b.) The Dubai Islands, UAE (Source: Berman, 2023), and c.) Tokyo Bay eSG Project (Source: Matsuyama and Huang, 2022).

Environmental Management Strategies

In the era of rapid industrialization, coastal reclamation is inevitable as men continue to aspire for the development of the human civilization; however, safety measures should be implemented so that the lives of the inhabitants should not be put into perilous events. Effective flood control system should be put in place so that the residents thriving near the coastal areas will have an assurance for their personal safety and will not put the

safety of their properties at jeopardy. Strategic geological assessment should be conducted to prevent land subsidence over time. Holistic ecosystem approach should also be implemented in order to address the disruption of the ecological balance.

2. Acid Rain

Context and Scenario

Acid rain has been experienced by many countries around the world due to rapid rate of industrialization. Rainwater tastes sour due to the presence of the substances which have very low pH values. Technically, acid rain is made up of highly acidic water droplets due to air emissions, most specifically the disproportionate levels of sulphur and nitrogen emitted by vehicles and manufacturing processes. It is often called acid rain as this concept contains many types of acidic precipitation.

Causes and Effects

Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxides are released into the air. These substances can rise very high into the atmosphere, where they mix and react with water, oxygen, and other chemicals to form more acidic pollutants, known as acid rain.The causes of acid rain are S**ulfur and Nitrogen particles which get mixed with the wet components of rain**. Sulfur and Nitrogen particles which get mixed with water are found in two ways either man-made such as the emissions that are given out from industries or by natural causes like lightning strike in the atmosphere releasing nitrogen oxides and volcanic eruptions releasing sulphur oxide. The fast pacing of industrialization serves as the greatest contributor for the increasing demand of the fossil fuels (Fantonalgo et al., 2018b). Burning of the fossil fuels has generated ample amount of gases that is responsible for the deterioration of air quality for both developed and developing countries (Fantonalgo et al., 2018c) and for the rapid occurrence of acid rain.

Acid rain has brought harmful effects to agriculture, plants, and animals. It washes away all nutrients which are required for the growth and survival of plants (Shi et al., 2021). Acid rain affects agriculture by the way it alters the composition of the soil (Prakash et al., 2023) (Figure 2.). Acid rain has caused the prevalence of the several respiratory diseases among animals and humans. Take note that when acid rain falls down and flows into the rivers and ponds it affects the aquatic ecosystem. It alters the chemical composition of the water, to a form which is actually harmful to the aquatic ecosystem to survive and causes water pollution. It was found out that acid rain also causes the corrosion of water pipes, which further results in leaching of heavy metals such as iron, lead and copper into drinking wate.

Environmental Management Strategies

Some measures which can be applied in order to mitigate the harmful effects of acid rain include strict implementation of the air quality standards and shift to the renewable energy sources. In terms of air quality standards, all countries of the world should ensure that they are adhering to the standards implemented by World Health Organization (WHO) as to the tolerable amounts of sulfur and nitrogen gases. It is also suggested that each country should maximize the use of the renewable energy sources so that to reduce the production of greenhouse gases.

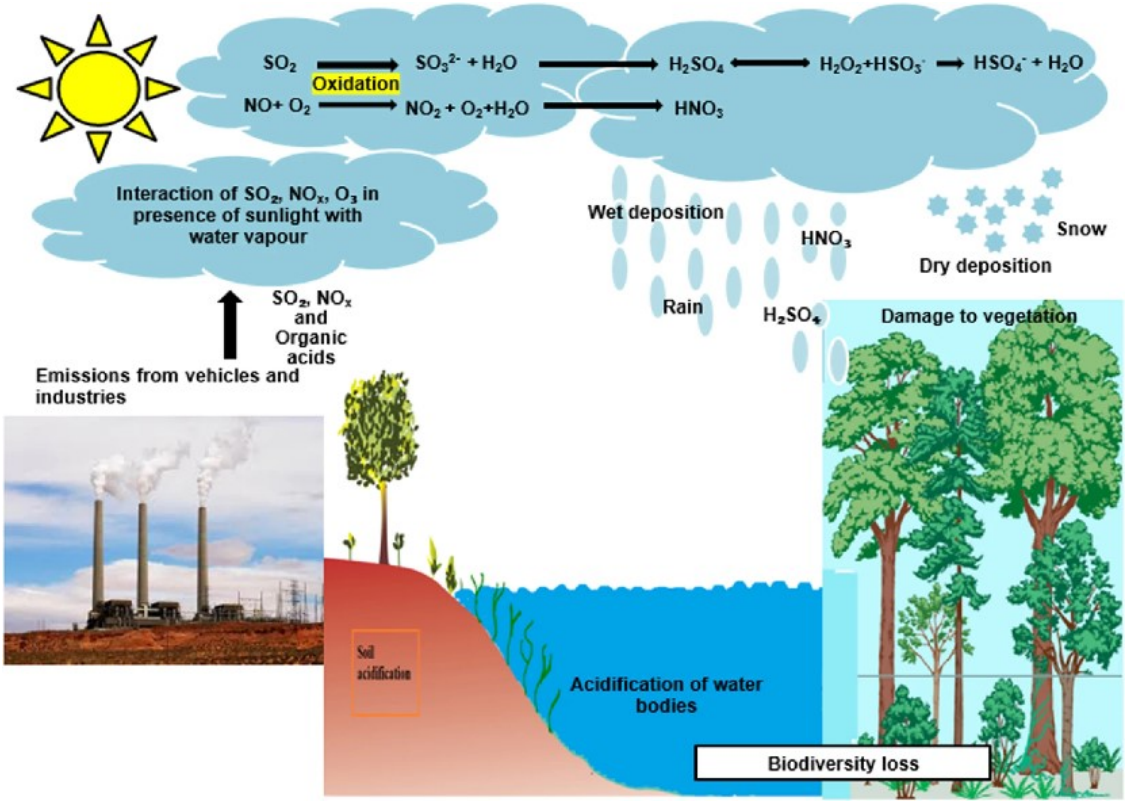

Figure 2. Schematic representation of the pathway of acid rain formation and consequent effects (Source: Prakash et al., 2023).

3. El Niño

Context and Scenario

El Niño means Little Boy in Spanish. South American fishermen first noticed periods of unusually warm water in the Pacific Ocean in the 1600s. The full name they used was El Niño de Navidad, because El Niño typically peaks around December. The development of El Niño events is linked to the trade winds. El Niño occurs when the trade winds are weaker than normal, During El Niño, trade winds weaken. Warm water is pushed back east, toward the west coast of the Americas. El Niño can affect our weather significantly. The warmer waters cause the Pacific jet stream to move south of its neutral position. With this shift, areas in the northern U.S. and Canada are dryer and warmer than usual. But in the U.S. Gulf Coast and Southeast, these periods are wetter than usual and have increased flooding (Ashok and Yamagata, 2009).

Causes and Effects

Weakening of the trade wind has been considered as the main cause of El Niño phenomenon (Figure 3). According to some reports, El Niño has brought some benefits such as fewer hurricanes and other tropical cyclones in the north Atlantic, milder winters in southern Canada and the northern continental United States, replenishment of water supplies in the southwestern U.S., and less disease in some areas due to drier weather (like malaria in southeastern Africa)(Ortiz-Prado et al., 2023). In some places in the tropical region, upwelling of the nutrients is observed during El Niño. The rise of the nutrients to the surface of the ocean waters leads to the greater production of the pelagic marine fishes like tuna and sardines (Rossi and Soares, 2018). On the other hand, a strong El Niño event that took place in some places has brought negative impacts. According to the observations of the scientists, people in Arizona generally welcome the wetter winters brought by El Niño, but in other parts of the world, El Niño can mean droughts, floods, crop failures, and looming food shortages (Ward et al., 2014).

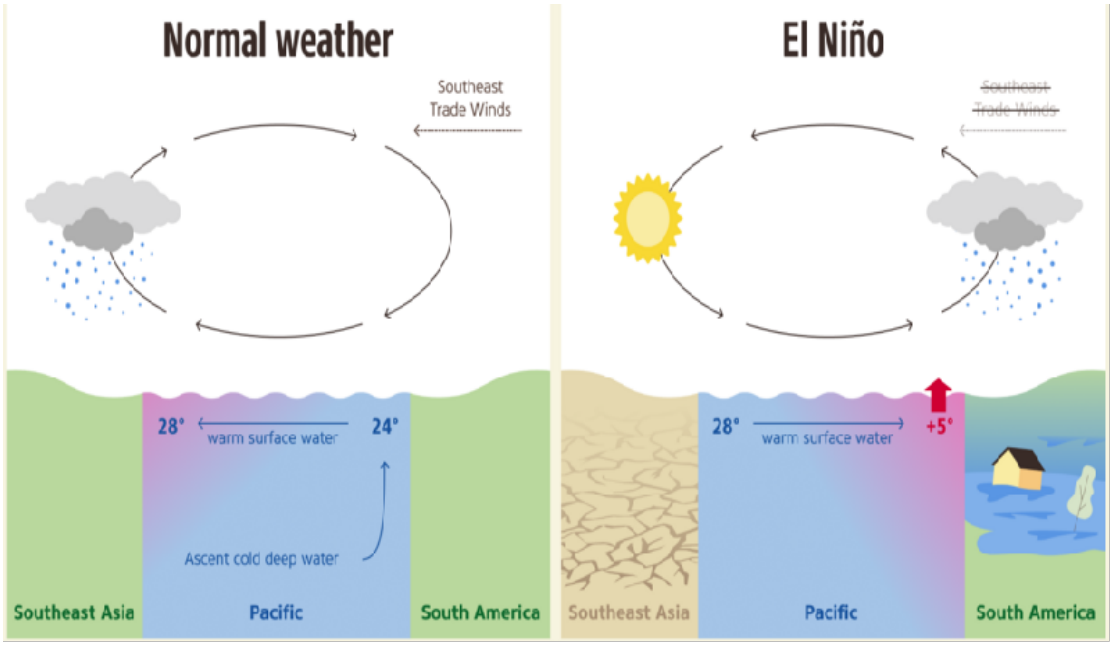

Figure 3. Strong southeast trade winds during normal weather and weak southeast trade winds during El Niño The origin of El Niño: In the Pacific Ocean, ocean and air currents circulation reverse. The sea surface in the east of the ocean warms, and moist air brings rain to the coasts of the Americas. Southeast Asia and Australia experience severe drought.
(Source: https://www.welthungerhilfe.org/our-work/focus-areas/climate-change/el-nino)

4. Climate Change

Context and Scenario

Nature is a dynamic system in which its interaction with chemical factors and geological events are constantly changing. Nature is not a callous reservoir of devastating activities of human being; hence, whatever harmful anthropogenic activities are done to nature, the latter has always the capacity to return it back to the ones who are responsible for doing the said actions. It was reported that concentration of carbon dioxide in Earth's atmosphere now exceeds 380 ppm. The value is more than 80 ppm above the maximum values of the past 740,000 years. This increasing concentration of CO_2 has contributed to an increase in the global oceans' average temperature by 0.74°C and sea level by 17 cm during the 20th century. This also depleted seawater carbonate concentrations by ~30 mmol kg−1 seawater and acidity by 0.1 pH unit. The values of the above mentioned parameters are the indications of climate change. Climate change refers to long-term shifts in temperatures and weather patterns of the world. Such shifts can be natural, due to changes in the sun's activity and large volcanic eruptions or anthropogenic due to various human activities contributing to the rise of the average global temperature (Fantonalgo et al., 2018c).

Causes and Effects

According to the results some scientific studies, burning of the fossil fuels, cutting down trees and excessive farming of the livestock are increasingly influencing the climate and the earth's temperature. These activities have added to the enormous amounts of greenhouse gases aside from those which are naturally occurring in the atmosphere thereby increasing the impacts of greenhouse effect and thus, aggravating the global warming. The climate change has proven to have affected the biological, geological, and physical aspects of the world. In terms of biological aspect, the biodiversity and agricultural yield have declined due to climate change. Climate change also affects the geology of the world manifested by long and heavy flooding events due sea level rise (Reguero and Griggs, 2022). Physically, the occurrence of the strong typhoons has been brought by climate change. The continuous existence of climate change in many countries can pose serious threat to the water resources and coastal communities in the near future (Tan et al., 2023). The over all effects of climate change is depicted on Figure 4.

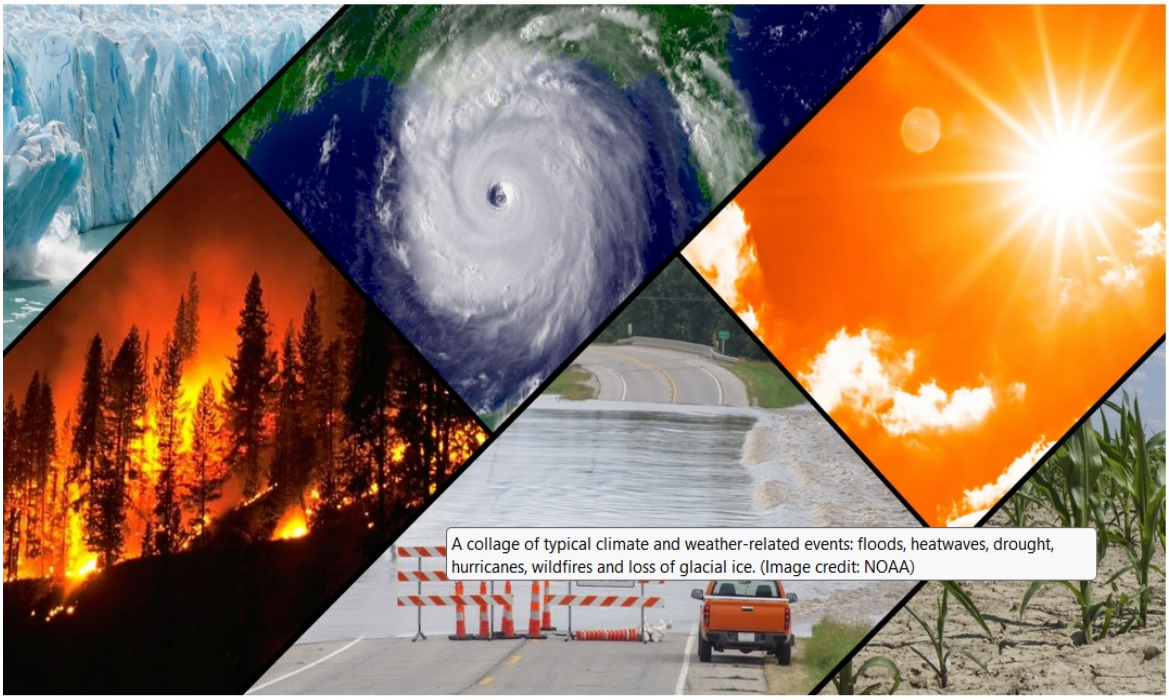

Figure 4. A collage of typical climate and weather-related events: floods, heatwaves, drought, hurricanes, wildfires and loss of glacial ice.
(https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts)

Environmental Management Strategies

The harmful effects of climate change can be reduced by adopting the program "think globally, act locally", developing adaptation actions, and implementing sound and Science-based policies. The success of the collective action can only be materialized if each country of the world is willing take initiative of doing its local roles of mitigating greenhouse gas emissions. Each country should pledge to cooperate in reducing the greenhouse gases. They should seriously adhere to the various signed agreements of the world pertaining on the control of the greenhouse and other harmful gases such as Montreal Agreement and Kyoto Protocol. Within their countries, they should have concrete programs and projects in order to reduce the carbon dioxide emissions in the atmosphere. The process of responding to the impacts of climate change at the end of the chain which is called as adaptation should be put in place. There two types of adaptation- proactive and reactive. The measures that are taken in advance for the purpose of limiting the ultimate damages of climate change or to reduce the extent of reactive adaptation required when climate change impacts are materialized is known as proactive adaptation. This is sometimes called as anticipative action. Several examples of this type of adaptation comprise modification of the zoning laws on coasts in anticipation of stronger sea surges and construction of the flood control infrastructures in the flood-prone areas. Constructing the seawalls in Tacloban City coastal areas after Typhoon Haiyan, creating Climate Change Commission in some countries after series of devastating effects of climate change, producing drought resistant varieties of rice after El Nino incident, and evacuating people from a flood-hit area are several examples of reactive adaptation. This type of adaptation refers to the actions that are done after experiencing the serious effects of climate change. Implementation of the comprehensive and Science-based policies is a necessary weapon in fighting the harmful effects of climate change. This should be comprehensive in a sense that these have the capacity to address the issues and problems of all sectors of the society. Science-based in which all policies to be implemented should derive from Science- the results of the empirical and case studies (Fantonalgo et al., 2018c).

5. Ocean Acidification

Context and Scenario

Ocean acidification has been affecting the entire world's oceans, including the coastal estuaries and various waterways.Ocean acidification is a condition in the ocean in which there is a reduction in the pH of the marine waters over an extended period of time. This ocean phenomenon is dubbed as the "osteoporosis of the sea" because of the depletion of the mineral calcium as result of decline in pH. The average pH for sea water is

8.2 but can range between 7.5 and 8.5 depending on the local conditions. Values falling below the average ocean pH values are considered acidic.

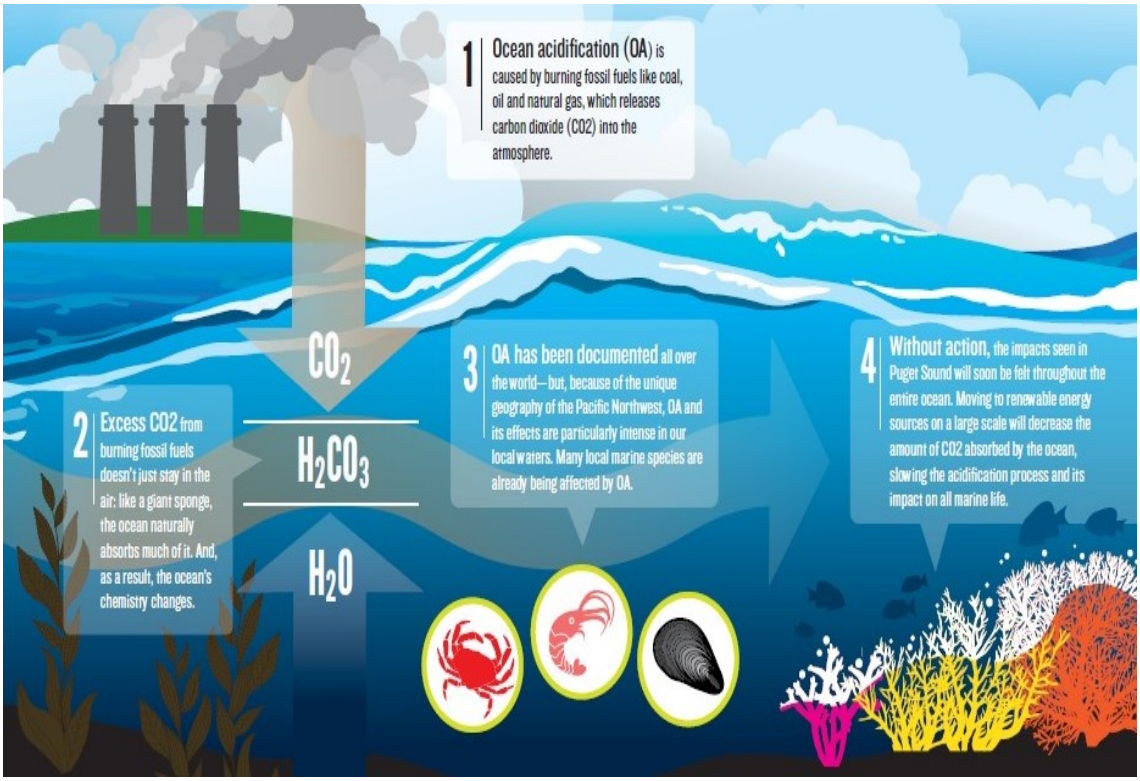

Figure 5. Causes, mechanisms, and effects of ocean acidification to various organisms.
(Source:https://smea.uw.edu/currents/falling-ph-and-rising-momentum-taking-action-on-ocean-acidificatn/)

Causes and Effects

Ocean acidification is mainly caused by carbon dioxide gas in the atmosphere (Figure 5) dissolving into the ocean. This leads to a lowering of the water's pH, making the ocean more acidic. Carbon dioxide is being produced faster than nature can remove it, so increasing amounts are being absorbed by the ocean. Rapid industrialization serves as the primary contributor of carbon dioxide in the atmosphere. The burning of fossil fuels to provide energy for the growing factories and industries are observed as the leading cause of the carbon dioxide rise.

The calcifying organisms and calcareous plankton in the ocean such as shellfishes and corals are drastically affected by this phenomenon. When CO_2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions. This increase causes the seawater to become more acidic and causes carbonate ions to be relatively less abundant. Carbonate ions are an important building block of structures such as sea shells and coral skeletons. Decreases in carbonate ions can make building and maintaining shells and other calcium carbonate structures difficult for calcifying organisms and calcareous plankton (Hofmann and Bischof, 2014). There are studies showing that various species of corals become vulnerable to diseases and coral bleaching due to the ocean acidification. Seaweeds and seagrasses' growth and survival are also affected continuous souring of the sea water (Koch et al., 2013).

Environmental Management Strategies

To manage the ill-effects of ocean acidification, mitigating actions are very significant aspects to consider in dealing with the harmful effects of the said marine phenomenon. The process of reducing emissions or removing greenhouse gases out of the atmosphere at the onset of the chain for the purpose of minimizing the climate change in the first place is called mitigation. Examples of the mitigation actions include reducing deforestation, shifting from coal- to gas-fired power plants, and developing renewable energy.

B. Local Scale

1.Construction of Dams

Context and Scenario

The barrier that stops or restricts the flow of surface water or underground streams is called dam. Dams were constructed in the various areas in the Philippines for the purpose of attaining agricultural, industrial, and economic benefits. Reservoirs created by dams not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability. Hydropower is often used in conjunction with dams to generate electricity. A dam can also be used to collect or store water which can be evenly distributed between locations. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (dikes) are used to manage or prevent water flow into specific land regions.

In the Philippines, the most prominent dams are Angat Dam and La Mesa Dam. Angat Dam is located within the Angat Watershed Forest Reserve in Barangay San Lorenzo (Hilltop), Norzagaray, Bulacan. It supplies potable water to Metro Manila and powers a hydro-electric power plant.The La Mesa Dam is part of the Angat-Ipo-La Mesa water system which supplies water to the population of Metro Manila and surrounding provinces. The La Mesa Reservoir has a maximum capacity of about 50.5 million cubic meters (1,780 million cubic feet). Water from the reservoir spills into the Tullahan River which transports the water to Manila Bay.

Few years back, the proposed Kaliwa Dam project new centennial water source which will traverse from Sitio Cablao, Brgy. Pagsangahan, General Nakar, Quezon or Sitio Queborosa, Brgy. Magsaysay, Infanta, Quezon to Teresa, Rizal gained a controversies because the said project covered the ancestral domain of the Dumagat Remontado tribe (Roco et al., 2023). The Dumagat Remontado are an indigenous people, descendants of lowlanders who fled from Spanish colonizers and chose to live in the mountain ranges of Sierra Madre. The same scenario took place in Iloilo in the case of Jalaur Dam project which would possible displaced the Panay Bukidnon tribe in their ancestral domain. The rights of the indigenous people to their ancestral domain should be put into consideration (Morales-Fernholz, 2017).

Causes and Effects

In spite of the positive impacts of dams to society, some geologists and environmentalists have noticed negative impacts of construction of dams (Bungabong et al., 2023). The major disadvantages of dams include impact on relocation of nearby populations, negative impact on reproduction and migration of aquatic animals, soil erosion, geological imbalance in water bodies due to stagnation of sediments, reduction in groundwater, habitat destruction and biodiversity loss. Dams change the way rivers function. They can trap sediment, burying rock riverbeds where fish spawn. Gravel, logs, and other important food and habitat features can also become trapped behind dams.

Environmental Management Strategies

In the light of dam construction in the Philippines, proper geological safety measures should be implemented to ensure the welfare of the affected people. The proponents should properly consider the Indigenous Peoples' Rights Act of 1997 (IPRA). IPRA is officially designated as Republic Act No. 8371, is a Philippine law that recognizes and promotes the rights of indigenous cultural communities and indigenous peoples in the Philippines.

2. Oil Spill

Context and Scenario

Oil spill refers to the release of a liquid petroleum hydrocarbon into the environment, especially in the marine areas, due to human activity. The term is usually applied to marine oil spills, where oil is released into the ocean or coastal waters, but spills may also occur on land. Oil spills into rivers, bays, and the ocean most often are caused by accidents involving tankers, barges, pipelines, refineries, drilling rigs, and storage facilities. Spills can be caused by: people making mistakes or being careless.

In the Philippines, the biggest oil spill took place in Guimaras on August 2006. This event in the ocean was dubbed as the worst oil spill ever in the Philippines. The oil tanker M/T Solar 1, carrying more than two million liters of bunker fuel, sank on August 11, 2006 at the Guimaras Strait off the coast of the Guimaras and Negros Occidental provinces, causing some 500,000 liters of oil to pour into the strait. In 2005, oil spill also took place in Semirara Island in Antique. The oil spill was caused by a power barge of the National Power Corporation that ran aground off the coast of Semirara Island in Antique province, spilling some 220,000 liters of oil.

Causes and Effects

Negligence is considered as the main cause of oil in the Philippines. Oil spills have negative impacts to the biodiversity, groundwater, and the environment (Baleña, 2015). Aquatic organisms are suffering from the harmful effects of oil itself during oil spill event. Toxic substances from crude oil have threaten the aquatic plants and animals. Once oil percolated the groundwater, it affected the safety of the drinking water supply of the locality. Oil pollution can have a devastating effect on the water environment because it spreads over the surface in a thin layer that stops oxygen getting to the plants and animals that live in the water. Oil pollution can harm animals and insects, prevent photosynthesis in plants, and disrupt the food chain. Wildfowls are particularly vulnerable, both through damage to the waterproofing of their plumage and through eating the oil as they preen. In the ground and soil oils coat or kill the organisms which are necessary to maintain the environmental balance (Alea et al., 2022). Humans are not also exempted from the ill effects of oil spills. The fumes of the oil can cause respiratory diseases among residents and sometimes can cause death in extreme cases.

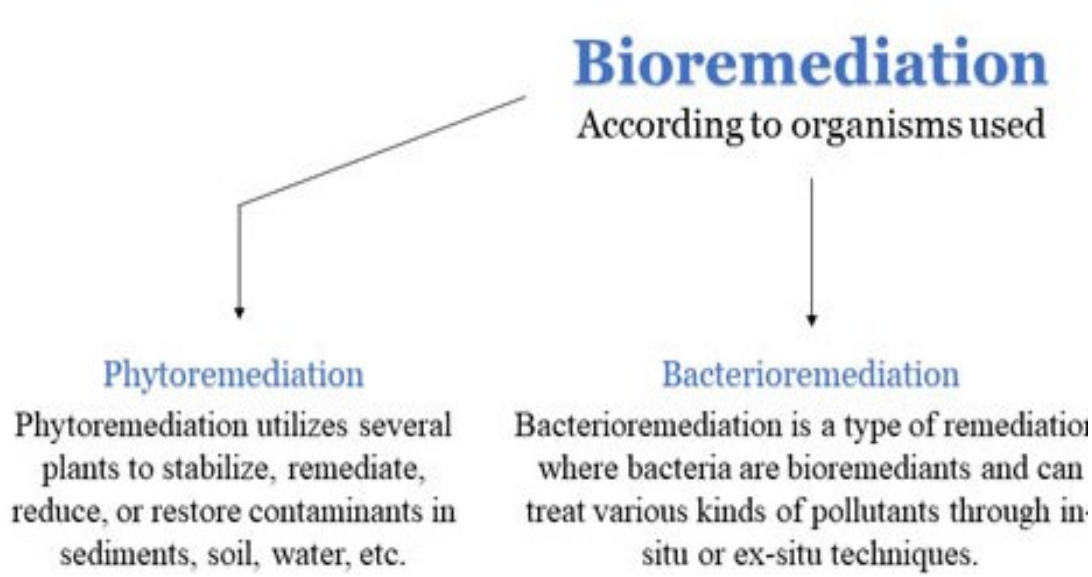

Figure 6. Types of bioremediation according to the organisms utilized. (Earth Reminder for Everyone, 2021).

Environmental Management Strategies

Proper checking up of the condition of the tankers should be implemented prior to voyage to prevent the accident to happen. In worst case scenario if oil spill will take place, physical, chemical, and biological cleaning methods can be applied. As far as physical method is concerned, two boats will tow a collection boom, allowing oil to concentrate within the boom, where it is then picked up by a "skimmer." From whirring disks to floating drums, skimmers come in various designs but all basically work by removing the oil layer from the surface of the water. For chemical methods, chemical dispersion and burning are suggested. Chemical dispersion is achieved by applying chemicals designed to remove oil from the water surface by breaking the oil into small droplets. On the other hand, burning refers to as "in situ burning" method. This is the method of setting fire to freshly spilled oil, usually while still floating on the water surface. Biological method involves bioremediation. Bioremediation refers to the use of living organisms to remove contaminants, pollutants, or unwanted substances from soil or water. This technology mainly utilizes microbes (Figure 7), although the cultivation of plants (Figure 6) and can accelerate bioremediation since the rhizosphere provides a favorable environment for microbial proliferation. Macrofungi can also be used in the bioremediation process (Figure 6).

3. Excessive Quarrying

Context and Scenario

The modern world requires mineral resources serving as raw materials for industrial application and constructing various infrastructures. The address this demand, quarrying becomes a popular economic activity. By technical definition, quarrying refers to the process of removing rock, sand, gravel or other minerals from the ground in order to use them to produce materials for construction or other uses. With this concept, a quarry is any such working on the surface of the earth where minerals are extracted. Quarries are also known by other names around the world such as surface mine, pit, open pit, or opencast mine.

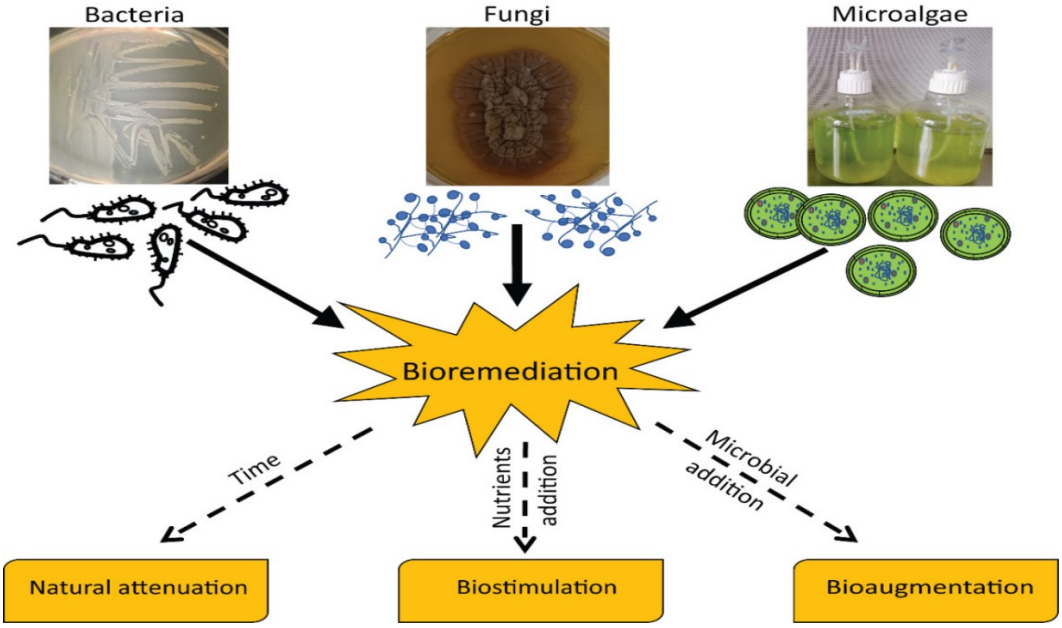

Figure 7. General scheme of bioremediation strategies involving different microbial taxa. (Source: Dell' Anno et al., 2021)

One of the manifestations of the excessive quarrying was the landslide case in Naga City, Cebu in 2018. The trial court in Cebu City issued a temporary environmental protection order (TEPO) against the quarry operations of Apo Land and Quarry Corp. (ALQC) in the mentioned city. The issuance of the TEPO is part of the P4.5 billion class suit lodged by some of the victims of the fatal September 2018 landslide in Barangay Tinaan that claimed the lives of over 70 people. According to the veteran environmental lawyer Benjamin Cabrido Jr., the massive landslide was a product of the quarry operations in the mountains of Naga City. In the case of Iloilo Province, some residents living along Tumagboc River in Miagao, Iloilo allegedly considered excessive quarrying as one of the reasons for the destruction of the river banks. In response to this clamor, there was a dump truck which was apprehended (Figure 8) in violation of Provincial Ordinance 2017-145 for transporting quarry materials without an official receipt.The local executive order to the MENRO and the PNP to intensify the campaign against illegal quarry operations in Miagao, Iloilo, Philippines in order to protect the natural resources of the municipality (Municipality of Miagao, 2023).

Causes and Effects

Quarrying has some economic benefits that is why this activity has been practiced. This activity provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. In terms of employment and investment, reports depicted that quarries stimulate local communities through investment and provision of jobs. In fact, the quarrying industry creates over 10,000 jobs directly and supports another 80,000 indirectly, often in rural and regional locations.

Like many other man-made activities, quarrying causes a significant impact on the environment. In particular, it is often necessary to blast rocks with explosives in order to extract material for processing but this method of extraction gives rise to including noise pollution, air pollution, damage to biodiversity and habitat destruction (Tajolosa and Tajolosa, 2022). Several serious environmental impacts related to quarrying activities on and near the river such as vibrations, land degradation, land subsidence and landslides, water pollution, occupational noise pollution, and air pollution, will lead to health-related problems and loss of biodiversity (Placino and Rugkhapan, 2023).

Environmental Management Strategies

It is recommended that the concerned government agencies should properly conduct regular site inspection to ensure that standard protocols are implemented by the operators in an accordance to the existing ordinances, policies, and laws governing such activity. Regular monitoring of the volume quarried by the operators should be done to see to it that maximum allowable volume limit has not been violated.

4. Conversion of Farmland to Residential Areas and Commercial Uses

Context and Scenario

Massive land use conversion has been observed in the major cities and sub urban areas in the Philippines since 1990s. The possible explanations for this scenario include the fast growing urban sprawling and industrial expansion. By technically, the land use conversion refers to act or process of changing the current physical use of a piece of agricultural land into some other use or for another agricultural use other than the cultivation of the soil, planting crops, growing trees including harvesting of produce therefrom, as approved by DAR such as residential and commercial uses.

Causes and Effects

On the positive side, land use conversion in the Philippines can facilitate the improvement of infrastructure and the expansion of urban services such as transportation, utilities, and healthcare. Urban services can lead to enhanced quality of life and increased access to essential services for the local population. On the other hand, looking at the negative side of the activity, land use conversion could result in reduced food production, increased food prices, and reduced food security (Arceo-Dumlao, 2021). Furthermore, the conversion of agricultural land to residential use can have social and economic consequences, such as displacement of farmers and rural communities (Factura et al., 2022), increased urbanization, and changes in the local economy.

Figure 8. Apprehension of the dump truck in violation of Provincial Ordinance 2017-145 for transporting quarry materials without an official receipt (Source: https://www.miagao.gov.ph/about-miagao/news/on-anti-illegal-quarry-operations-transporting-without-official-receipt/).

Environmental Management Strategies

Recently, massive urban sprawling has been observed in some areas of Bulacan, Laguna, Cavite, and Rizal due to over congestion in National Capital Region. In Iloilo, this is noticed among the municipalities of Oton, Pavia, Santa Barbara, Leganes, and Zarraga. Vast pieces of farmlands were converted to residential areas to provide settlements for the people and industrial sites to give employment opportunities for the migrating people. To manage this issue properly, the Department of Agrarian Reform (DAR) should limit the agricultural land areas for the said conversion purposes. Developers should implement stringent pollution controlling measures to ensure lower amount of pollutants generation in the converted land areas.

5. Deforestation

Context and Scenario

Deforestation refers to the decrease in forest areas in the many places that are lost for various uses such as agricultural croplands, urbanization, or mining activities. Greatly accelerated by human activities since 1960, deforestation has been negatively affecting natural ecosystems, biodiversity, and the climate.

Palawan being tagged as the thickest covered forest in the Philippines three to four decades ago has been devastated due to the threats of mining activities in the province. Many forested areas in the country have been converted into agricultural sites through “Kaingin System” due to the higher demand of food items for the increasing population. Some local residents are engaging on massive charcoal making due to lack of job opportunities.

Causes and Effects

Urbanization, mining, and destructive livelihood activities are the drivers of deforestation in the country. Deforestation has negatively affected the environment such as loss of habitat, increased greenhouse gases, and

soil erosion and flooding. One of the most dangerous and unsettling effects of deforestation is the loss of animal and plant species due to their loss of habitat (Gabriel et al., 2023). Take that 70% of land animals and plant species live in forests. Not only does deforestation threaten species known to us, but also those unknown.The trees of the rainforest that provide shelter for some species also provide the canopy that regulates the temperature. Deforestation results in a more drastic temperature variation from day to night, much like a desert, which could prove fatal for many inhabitants.In addition to the loss of habitat, the lack of trees also allows a greater amount of greenhouse gases to be released into the atmosphere. Healthy forests absorb carbon dioxide from the atmosphere, acting as valuable carbon sinks. Deforested areas lose that ability and release more carbon (Chen et al., 2023). Further harmful effects of deforestation include soil erosion and coastal flooding. Trees help the land to retain water and topsoil, which provides the rich nutrients to sustain additional forest life.

Environmental Management Strategies

Alternative livelihood programs for the rural people should be implemented by the government agencies and non-government organizations (NGOs) so that residents will no longer engage on excessive charcoal making activity and "Kaingin System". Strict implementation of the policies and laws should be done in order to reduce the rate of deforestation in the Philippines. Responsible mining activities are also recommended so that forested areas will not heavily destructed while digging the minerals from the soil. Effective reforestation project of DENR will be institutionalized.

Conclusion

Natural phenomena are inevitable to take place in the global scale. These are governed by some natural physical and geological processes. These phenomena are very difficult to predict. The occurrence of these phenomena have greatly affected the natural landscape of the environment and in some points have interfered the ecological system balance. People needs to adapt on these events; hence, they need to adopt the most effective and responsive environmental management strategies.

There are anthropogenic activities both in global and local scales that have modified the dynamics of the environment. These activities have altered the natural environmental processes that have resulted to intensified disruption of the natural balance of the various ecosystems. In this way, the processes in the ecosystems have proceeded in a rough manner. Smooth facilitation of the natural processes is no longer observed.

Recommendations

It is suggested that the local government units in all countries of the world should adopt policies and programs in response to the deteriorating quality of the environment and the dwindling environmental resources. Once the programs and policies are implemented, proper validation, monitoring, and audit should be conducted to properly assess and evaluate their effectiveness and responsiveness of the implementation. Other geological and environmental processes should be considered in the future articles for wider discussion of the ideas.

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