

ПРОБЛЕМНАЯ СТАТЬЯ

ENVIRONMENTAL IMPACTS OF HUMANITY'S CARELESSNESS PART I: EXTINCTION, CLIMATE CHANGE AND POLLUTION

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ABSTRACT. The process by which the natural environment is compromised in such a way that reduces biological diversity and the general health of the ecosystem is called environmental degradation. This process can occur naturally, or it can be caused by uncontrolled human activities. Many studies consider that environmental degradation, which has been caused by humanity, is one of the greatest threats to our planet. Since the Earth provides a habitat for all living beings, the irreversibly compromised environment could end the existence of human beings. Environmental degradation, if progresses with the current speed, will definitely make life of all the life forms, including human beings extremely terrible. Many studies have revealed that due to the excessive overuse of natural resources, the environment is being deteriorated rapidly. Some examples of the resources are water, air, soil, plants, animals etc. Basically, all living forms of life on the planet are interlinked in such a way that a change in one parameter triggers a domino effect on all the other aspects that depend on it. This could eventually destroy the ecosystem and collapse wildlife.

KEYWORDS: biodiversity, biogeochemistry, biohazard, ecosystem, deforestation, greenhouse, industrial waste.

INTRODUCTION

Although it is hard to exactly quantify how the choices made by an individual affect the environment, it is crystal clear that our modern lifestyles, usage of plastics, the demand for more land and energy are weakening the environment. It has been evaluated that since 1750, more than 571 plants and animals have collapsed from existence due to the sole day-to-day activities of human beings (The Guardian, 2019).

While human beings particularly do not care about extinct animals like the Barbary lion, the St. Helena olive, or the passenger pigeon (Black et al., 2013), other living organisms still depend on them for their survival in the ecosystem. Each aspect of our environment is constructed in such a way that it helps us by purifying water, converting exhaled CO₂ into O₂ that could be inhaled, and growing all the nutrition we consume on the daily basis. In this way, keeping the environment well-functioning is an issue

not only for organisms who live on it but also for human beings who depend upon the environment for several things that they cannot fulfil themselves.

Now, let us dig deeper into how human's actions could affect the ecosystem that is needed for our survival. It has been reiterated several times that tempering with the biosphere could lead to several catastrophes like pollution, global warming, deforestation, desertification, extinction of wildlife and more. However, critics might question their role in pushing the already unstable system beyond their tipping point.

FUNCTIONS OF THE ECOSYSTEM

There are four different functions of the ecosystem which we take for granted. They're the facilities that we human beings can't replicate or work around even with our modern lofty technology.

Firstly, only a healthy ecosystem is capable of performing functions like recycling compounds that are necessary for life. Similarly, for properly running

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the carbon, nitrogen and phosphorus cycles, and for the replenishment of the Earth's biological system, the ecosystem should be intact. Some of the ecosystems are more efficient than others in performing these jobs, but their performance is only as good as their integrity.

Secondly, ecosystems also provide us with a platform by generating the raw materials needed to continue life. For instance, we get fish from the ocean and water from rivers and aquifers. Fibres, that we use for clothing also come at the cost of plants' and animals' life. And most importantly, sources of fuel in the form of wood, hydropower, wind or petrol, are provided by the environment.

In the same way, the ecosystem also governs services and moderates numerous systems of the Earth that can become dangerous if not controlled properly. For instance, the decomposition of dead organisms takes place in presence of fungi. Similarly, the water we drink, and the air we breathe are filtered by the plants. Furthermore, they also influence the climate by absorbing all the CO₂ exhaled by living organisms during respiration (Chinese Academy of Sciences, 2019).

Finally, the last function of the ecosystem is less tangible, nevertheless still an important aspect. A stable ecosystem provides us with a place where we can be inspired by the picturesque view of nature, where we can live and discover things about it. It is just nice to be amid flora and fauna.

In terms of economy, if we calculate the monetary value of the ecosystem provided to humanity, it easily overweighs the global economy. For example, if we had to pay for the services provided by the nature, it would cost humanity \$145 trillion/year (Costanza et al., 2014). Clearly, we will be unable to reduplicate the ecosystem's functions as the global economic output is limited to \$75.59 trillion/year (Worldbank, 2019). Therefore, we must be grateful that we are getting it free of cost and the ecosystem until now does not require reciprocity for its generosity.

IMPORTANCE OF BIODIVERSITY IN AN ECOSYSTEM

Ecosystems can only provide us with required materials provided that every cog of the ecosystem is functioning properly. Or, to be more precise, the biodiversity has to be healthy as they are the building block of the biosphere and the ecosystem, which collaborates with different living and non-living things of nature.

It is crucial for the ecosystem to be resilient against the hindrances that it encounters every day, so it needs its biodiversity to be intact. Ecosystems with diverse organisms are drastically more resilient to the loss of some of their entities than those with low biodiversity. In a high-biodiversity system, the extinction of one species is less likely to cause the whole ecosystem to collapse.

Let us take an example of the Amazonian rainforest. A little patch of 10000 m² of the Amazonian rainforest consists of more diverse flora and fauna than in all of Europe. So, the ecosystem remains unimpaired even if one species goes missing from the system, as there will be other organisms to carry out the pending task done by the missed species. The same thing might not be said in the case of an ecosystem with less bio-diversity like in Sonoran Desert as there might not be enough organisms to compensate for the functions carried out by the lost species (U.S. National Park Service, 2019). This could result in a disturbance of the whole ecosystem.

So, the healthiness of biodiversity is directly linked with the way we treat it. But, unfortunately, our activities have been advertently affecting the environment which is putting some of the highest biodiversities of our planet at risk. Some of the activities are directly impacting the organisms whereas some are creating few changes in the ecosystem that eventually create a domino effect and harm all the living things.

NON-NATIVE AND INVASIVE SPECIES

Biodiversity can be affected by human beings when they introduce a non-native species. For instance, kudzu in North America (Blaustein, 2001) and cane toads in Australia (WWF-Australia, 2019) were migrated from their natural habitat by human beings. These invasive species had some specific traits that could out-compete or even eat native species. Such invasive species could jeopardise the existence of an entire ecosystem.

A species is considered to be invasive when it arrives in an area and gets successful in establishing and populating itself by competing with native species. Such flourishing species are capable of impacting an ecosystem much more than other species. Most of the immigrant new species incur no threat to the native species, it is only some of them that turn out to be invasive. But when they have a disproportionate effect, they can have larger impacts on the environment. For example, lots of new garden plants

are introduced in every part of the world, and even if they sometimes grow uncontrollably, they are unable to achieve a big population and threaten the survival of the native species. Such species pose no threat to surroundings, are harmless; so they are named as non-native species. But the species that cause problems are the ones that turn into invasive forms. There are several ways how the invasive species impact native species: modification of habitat, competition with local species for food and resources, predation of native species, herbivory on native plants, the introduction of pathogens and hybridization with natives.

One of the pertinent examples will be the introduction of European Marram Grass (*Ammophila arenaria*) to Samoa Dunes on the coast of California, Oregon and Washington in the 1800s. They were brought to normalize the ever-shifting dunes, which actually worked perfectly. But, European Marram Grass grew into stands of tall and itchy grass which in turn provided an extra cover for predators, preventing them to hunt seabirds and native plants. In this way, it hindered the natural ecosystem (Delgado De La Flor et al., 2020).

Likewise, the eastern side of the USA has been affected by an Asian balsam woolly adelgid (*Adelges piceae*). These insects are used to sucking out the sap off the tree. During the process, it has killed almost 99% of Fraser fir trees in Washington and in the Appalachians (McManamay et al., 2011).

Invasive species can be pathogens as well. *Cryphonectria parasitica* can be taken as one of the examples. The disease that it causes was named "chestnut blight" because it was first reported on American chestnut in New York City in 1904. Since then, it has been wildly spreading and has become a major cause of the decline of European chestnut (Rigling et al., 2018).

And sometimes, when a species mates with closely related species, its genetic materials can be dramatically modified. The modified genetic material can be less adaptive in the given environment. Endemic species, that are reluctant in moving from one place to another are more vulnerable to these changes. An example of this phenomenon is North American mallards (*Anas platyrhynchos*). They have been taken to places like Florida, Hawaii and even to New Zealand and Africa and they were freely allowed to mate with other lock ducks. Hence, North American mallards are on the brink of extinction (Simberloff, 2013).

DEFORESTATION AND DESERTIFICATION

Firstly, let us consider one of the most resilient ecosystems on our planet, i.e. the Amazonian rainforest. Despite being one of the robust ecosystems, human beings are continuing to incur serious damaging effects on it by chopping down the trees at the startling rate of $323 \cdot 10^6$ m² of forest land per day (One Tree Planted, 2020) to gather woods for furniture and to graze cattle for meat. When we cut down a piece of rainforest, the number of inhabitants of the place sharply decrease which triggers different things. For starters, this does not only affect the current ecosystem but also impairs the neighbouring ecosystem. For example, trees help to prevent soil erosion. When the rain falls, trees absorb some of the rainfall which slows down the runoff of the water. In this way, they prevent the rainwater from seeping into the soil before making their journey into the ocean through streams and rivers. If there had not been trees, the rainwater would have directly hit the land, causing soil erosion during the process. Similarly, erosion washes chemicals and minerals to the ocean which is harmful to aquatic life. In this way, one action can have a cascade effect on an entirely different ecosystem. Indeed, environmental degradation is one of the ten threats for human beings as per High-Level Threat Panel of the United Nations (Globalpolicy, 2020), other issues being poverty, terrorism, civil war and so on. This clearly highlights how close we are heading towards the disaster.

Deforestation can cause not only flooding but also desertification, resulting in dry and unproductive land. A simple act of cutting down the trees will not convert a forest into a desert. For desertification to occur, some additional factors have to be accompanied by other processes like overgrazing and over-irrigation. Turning a piece of land into a desert by over-watering initially seems to be counterintuitive, but, when the groundwater is used for irrigation, the natural underground salt slowly builds over the soil and makes the soil so salty that nothing can be grown over there. Actually, this is exactly what China has been suffering for a century. Due to overgrazing and high water demand, the Gobi Desert is growing in size by $36 \cdot 10^8$ m² every year (Johansen E Bruce, 2019).

These two phenomena hamper the biodiversity of a properly functioning ecosystem. Since the function of purifying the air by converting CO₂ into O₂ is disrupted by deforestation, the next domino to fall is the climate.

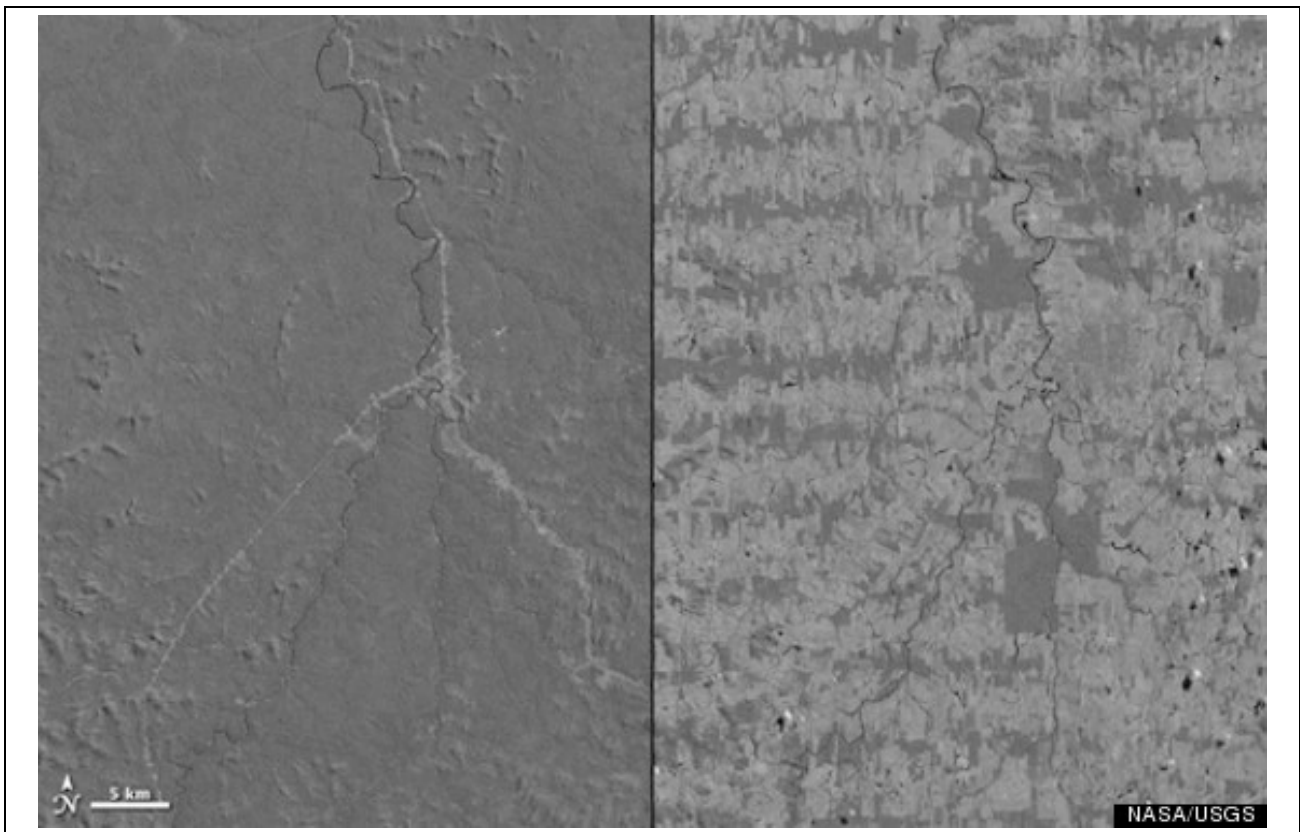


Image 1. Picture of Amazon in 1975 and 2012 (HuffPost, 2017)

GREENHOUSE GASES AND CLIMATE CHANGE

CO₂ is a potent greenhouse gas that covers the Earth (U.S. Environment Protection Agency, 2018). So it is pretty clear that with the increase of this gas in the atmosphere, the temperature of Earth will increase. But unfortunately, we are not only increasing its concentration in the atmosphere by burning fossil fuel but also parallelly cutting down the trees which are responsible for converting this greenhouse gas into oxygen. This creates a double-whammy effect that is currently driving global warming. Global warming is presenting itself as decreased levels of polar sea ice.

This is shrinking the habitat of native animals like polar bears and seals. In the same way, it is causing the migration of animals towards the poles in search of a favourable temperature for their body (Ogilvie, 2016). Similarly, a hotter and drier climate is one of the causes of more bush fires in the forest (Center for Climate and Energy Solutions, 2020). Critics may argue that climate has changed many times in past, but it is to be noted that those climate changes took centuries to occur, providing animals with enough time to adapt or move (Kemp et al., 2015). But the current climate changes are occurring

within our lifetime, which can lead to dire consequences.

Another problem caused by shrinking polar ice is highly unprecedented. The white polar ice is an excellent surface for reflecting incoming solar rays, which indirectly prevents the Earth from “overheating” and checks the temperature of Earth under control (National Snow and Ice Data Center, 2020). The absence of polar ice then adds an additional factor for global warming (Earth observatory, 2007).

Secondly, the melted ice thus changes into water and finally makes its way to the oceans, which consequently increases the sea level. The increased sea level creates havoc on the seashore by causing destructive erosion, eroding habitats of fish, birds, plants and animals; and damaging human infrastructures.

Let us see one of the pertinent and recent examples of global warming. When Australia suffered from a huge bush fire in 2019, the media snubbed another natural disaster, i.e. flooding in East Africa, which is actually intricately interrelated to each other. In 1974, fires burned $3.5 \cdot 10^{10}$ m² of the forest, and in 2003, another $2 \cdot 10^{10}$ m² of the forest was lost to fire. But the fires that started in 2019 was even worse, the inferno engulfed more than $4.9 \cdot 10^{10}$ m² of the forest (The Guardian, 2020).

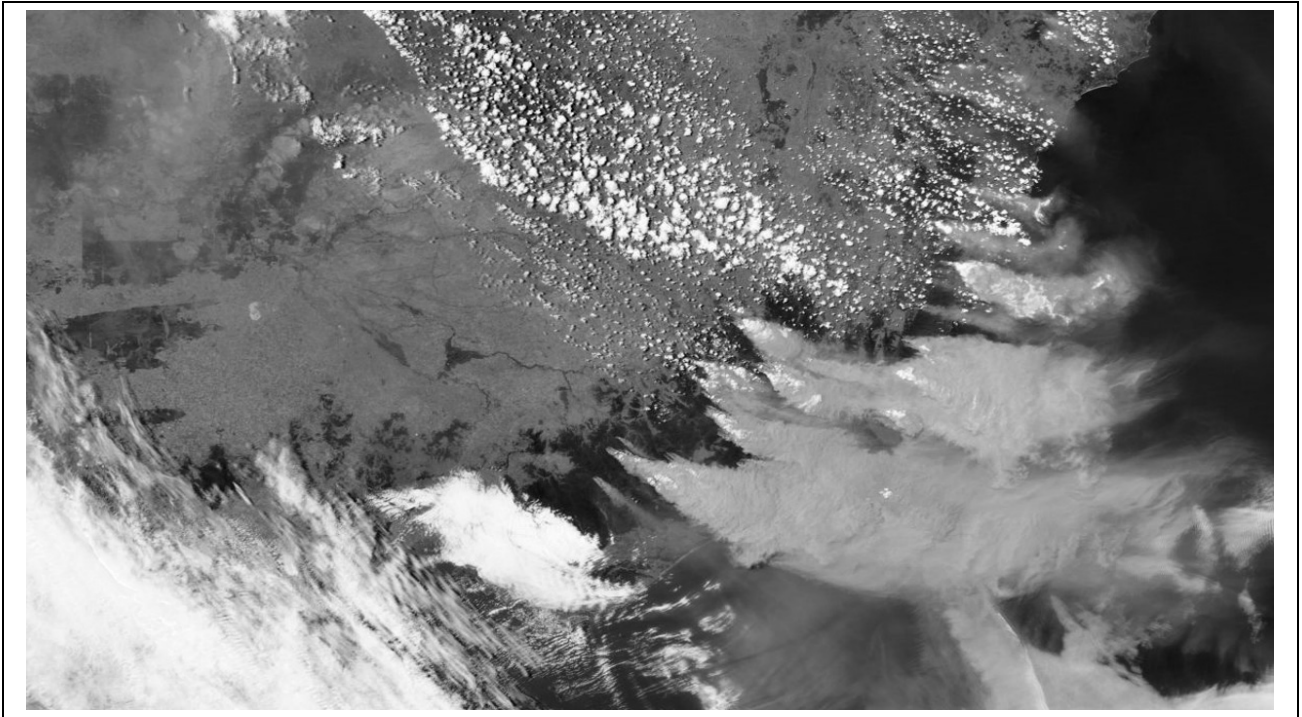


Image 2. This satellite image provided by NASA showing wildfires in Victoria and New South Wales, Australia (Larson, 2020)

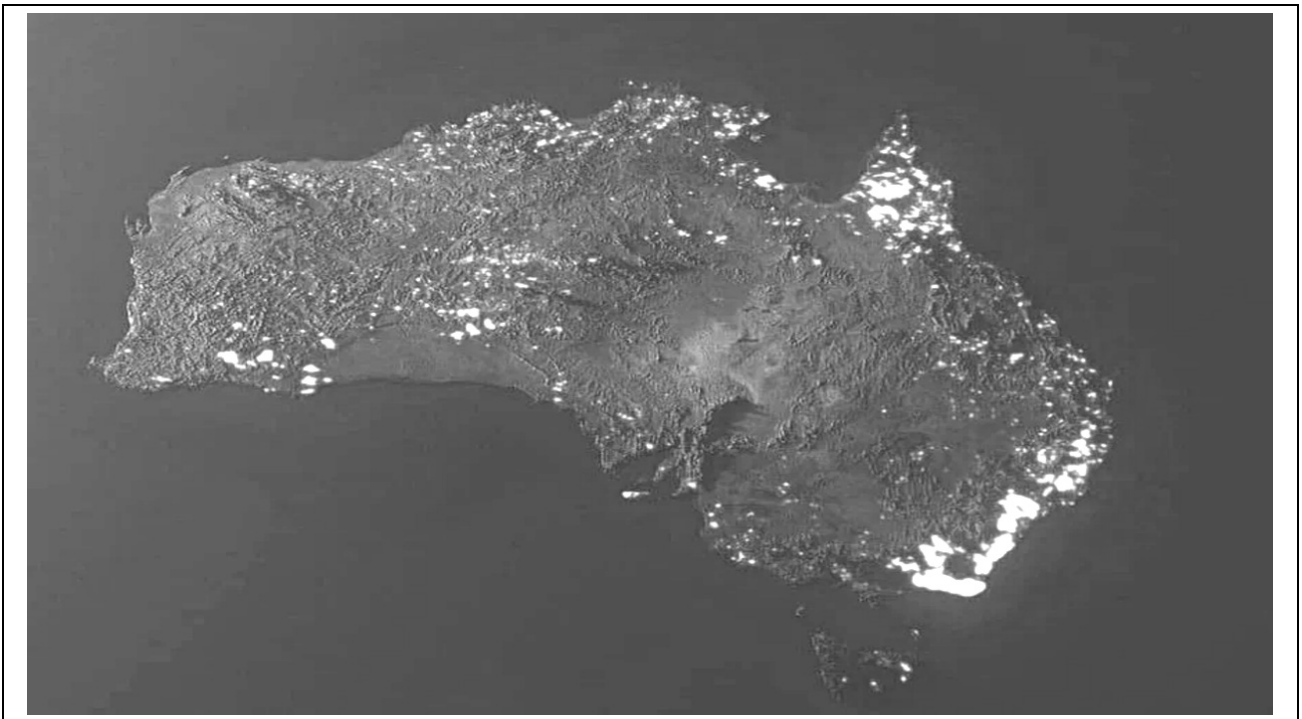


Image 3. A 3D visualization of bush fire of Australia (True scale of bushfires across Australia, 2020)

Initially, due to the effect of global warming, Australia is also getting warmer. It has been recorded that 2019 was its hottest year, as some parts of the country hit up to 45 °C in December (Australian Government - Bureau of Meteorology, 2020a). Analogically, 2019 was also its driest year causing historic droughts in some places of the country. The two conditions were suitable for bushfires to start and spread speedily. Besides them, there are other several factors that drive Australia's weather, and its likeliness to burn. But one of the most significant factors is the Indian Ocean Dipole (IOD). The IOD is a big temperature gradient that affects the temperature of the Indian sea, ranging from the eastern

edge of Africa to the western edge of Australia. Meteorologists have been keeping an eye on those temperature shifts for decades and have found three phases: positive, neutral and negative. IOD is considered to be neutral when the surface water in the Indian Ocean is evenly warm from eastern Africa to western Australia. A negative phase is when strong wind flows from east Africa to west Australia, shifting warmer water towards Australia. Warmer water results in more evaporation, which leads to more rain. So, Australia gets heavy rain, and sometimes even gets flooded. But on the other side, the colder water near East Africa prevents it from getting enough rain, finally resulting in a rough drought.

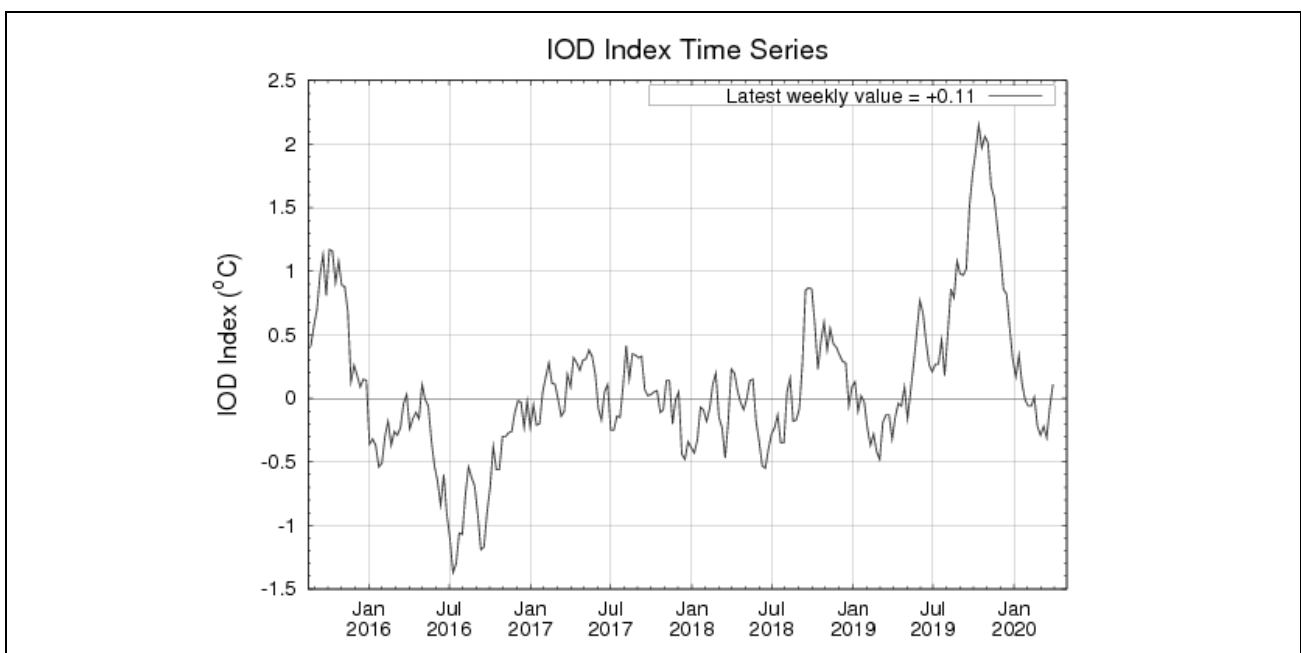


Image 4. IOD from 2016 to 2020
(Australian Government - Bureau of Meteorology, 2020b)

In 2019, a strong positive phase was observed in these countries. The strong winds from west Australia blew the warm water towards eastern Africa. This was the main culprit in causing floods in Africa and drought in Australia simultaneously. The entire process of shifting water temperature from east to west or vice versa is natural, but the gradient was extreme in 2019. The positive IOD was one of the strongest in history, reaching slightly over 2 °C (Australian Government - Bureau of Meteorology, 2020a), which unusually increased the water temperature difference between Africa and Australia. Hence, extreme bush fires in Australia, but also heavy rainfall in Africa, pouring rain more than three times their annual rainfall in just four days. The good news is that IOD finally shifted to neutral,

which brought less of an ordeal to Australia and Africa in early 2020 (Australian Government - Bureau of Meteorology, 2020b). But, as global warming is continuing, scientists have become wary on how that might affect weather phenomena like the IOD. One study predicts positive IODs, like what we recently saw in Australia, could happen more frequently as global temperatures rise and warm the Indian Ocean (Cai et al., 2009). If the global temperature keeps on increasing, these types of bush fires in one place and floods in another place could soon be a new normal.

By now, it is clear to apprehend how a damaged aspect of an ecosystem can take down the whole biodiversity. Even more, it is hard to ignore other immediate impacts that humans are having on the environment.

OVERHARVESTING NATURAL RESOURCES

Probably overharvesting certain organisms has the most influential direct impact on the ecosystem. With the increase of the world's population, people have turned into overfishing to replenish the increasing demand for fish like tuna. On the other hand predators like wolves are being killed on land to save livestock from being hunted. Similarly, people are hunting wild animals for fun or for poaching, taking predators at the point of extinction. As they occupy the apex of the food chain, their disappearance can result in catastrophic failure of the ecosystem down the food chain. This also decreases the diversity of organisms present in the ecosystem, which in turn again hurts the surrounding environment. An example of unregulated commercial fisheries can be found in the western Atlantic ocean, where cod had been fished uncontrollably. 400 years ago, it was a highly productive business. But modern factory trawlers were introduced in the 1980s. With the availability of new modern instruments, the aquatic ecosystem could not bear the toll and it simply collapsed. Later on, political and economical interests were accused for the disaster (Frank et al., 2016).

Next, hunting for recreation and entertainment is popular, especially in Africa and some parts of Asia. But this form of entertainment may come at a great cost as it is threatening a number of species to extinction. Initially, due to poverty, animals were hunted for bushmeat to feed the families. However, due to globalization, the same bushmeat is now increasingly commercially available in grocery stores because it is considered to be tastier and more nutritious than usual meat. Furthermore, agriculture alone is unable to cope with the additional protein demand of the increased population. Therefore, the population of mammals in the Congo basin is getting dangerously below their normal threshold due to the increased demand for bushmeat (Ripple et al., 2016).

AIR AND SOIL POLLUTION

There is a bunch of effects on the ecosystem when certain chemicals or contaminants are introduced into the natural environment that causes adverse change. In short, such chemicals or contaminants are called pollutants and the process is called pollution.

If pollution is currently impalpable, then it is considered to be the most dangerous one because it quietly takes place unnoticed by human beings. And sometimes it is too late to correct ourselves by the time people encounter its effects. While some pollutions are not deadly, some naturally occurring chemicals and some of their synthetic forms can be deadly.

There are several human behaviours that lead to altering concentrations of these naturally occurring compounds. But one of the most significant actions is by tempering with the biogeochemical cycles. The carbon cycle is one of the pertinent examples, where humans are clearly intervening with the naturally occurring processes. The cycle works by transferring carbon from rocks to the atmosphere and through living bodies. The cycle runs at its own pace, with a perfect balance. But the system now is being overloaded by introducing more carbon into it, way more than it can handle safely. Humans are adding more carbon into the atmosphere by burning coal and gas for fueling the energy demand of the 21st century. The extra carbon loiters in the atmosphere as a greenhouse gas, further insulating our planet and increasing the global temperature (Skeptical Science, 2015).

Nitrogen and phosphorus cycles are no exception to it. They are also facing similar effects. Nitrogen and phosphorus are key elements for the growth of plants and animals (Galchenko et al., 2019). But the biosphere could not handle them if produced in an enormous amount.

The main ingredients of the fertilizers are phosphates and nitrates. But besides fertilizers, phosphates are chemical ingredients of detergents as well (Kogawa et al., 2017). Therefore, when wastewater from our houses or waste from farms with those elements mix with rivers, they provide nutrition to the algae. As algae get extra nutrition, they rapidly grow and absorb all the oxygen of the water, choking other plants and animals in the process. But that's not the end of it. After all the phosphorous and nitrogens are consumed, the algae finally die and are decomposed by the bacteria. But the process also requires oxygen which decomposers absorb from the water which is already poor in oxygen. In this way they put a final nail in the coffin, further plummeting the oxygen level in the water and killing every oxygen requiring organism in it. In this way, dead zones are created by the pollution of nitrogen and phosphorous (Chislock et al., 2013). This even can now be visually observed in the Gulf of Mexico. The Dead-Zone in the Gulf of Mexico covers $18 \cdot 10^9$ m² of river delta and coastline, which was created by deoxygenated water influenced by nitrogen and phosphorous rich Mississippi River (Desonie, 2007). It has been noticed that the size of the dead-zone fluctuates seasonally, depending upon farmers' fertilizer usage. So, pollution is not just synthetic compounds but sometimes they are just imbalances of chemicals that are required for our survival.

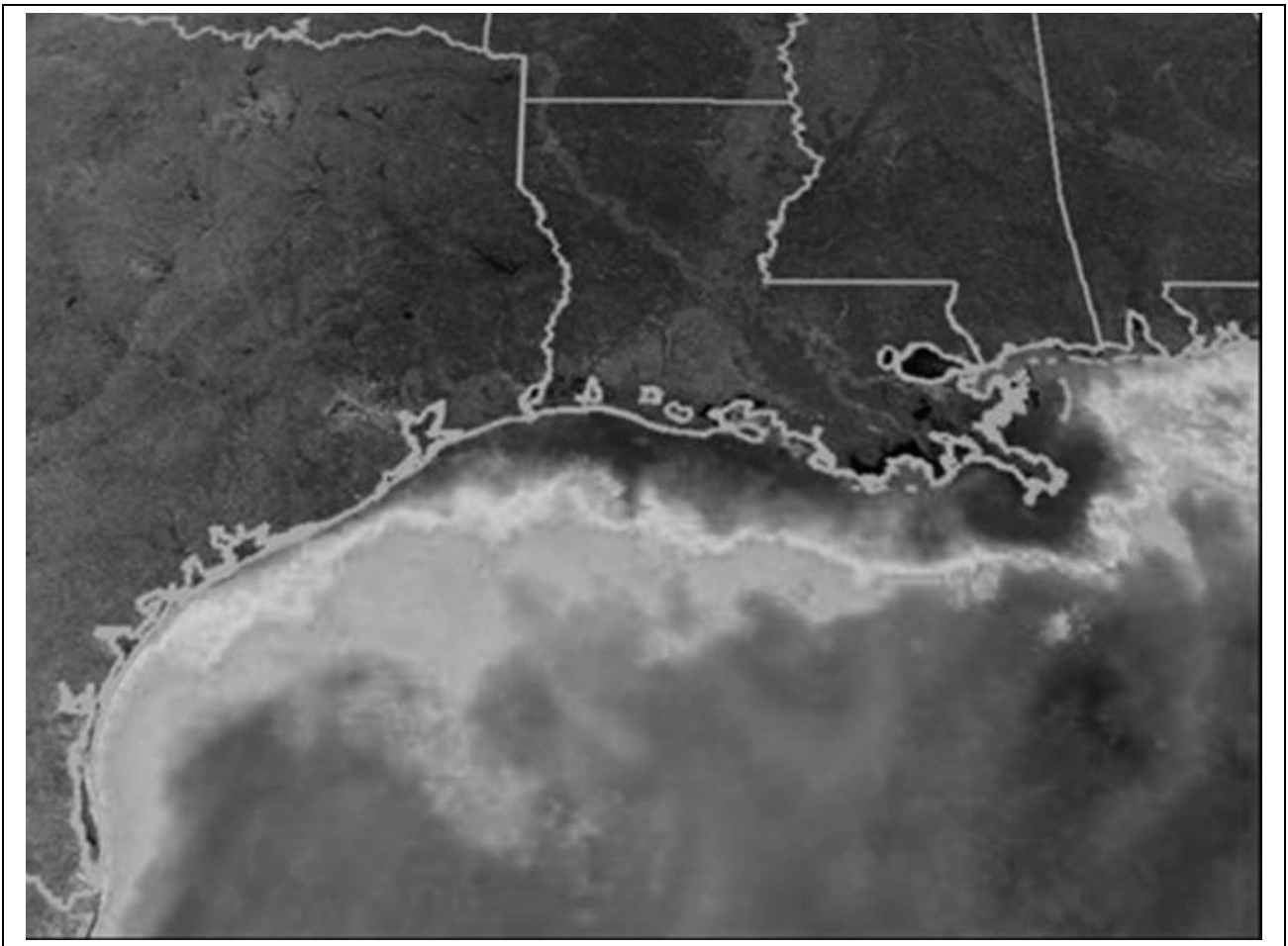


Image 5. The dead zone in the Gulf of Mexico is indicated in red (NOAA, 2011)

However, not every natural chemical has a positive impact on growth and development. In fact, our ecosystem sometimes comes up with some of the most toxic chemicals humanity has ever seen. Cyanide is one of the chemicals. We do not much come in contact with this chemical in everyday life. A small amount of cyanide is contained in lima beans, spinach and seed of apples (Taylor, 2010). Cyanide in plants works as a primitive form of insecticide because it causes molecular asphyxiation. This prevents the bug's cells from using oxygen and finally deters them. It is obvious that an apple seed would not kill a person as it would need a lot more cyanide to finish off a human, but people have found a way to accumulate a lot of cyanides because they are useful in the extraction of gold. Cyanide is useful in separating gold, silver and other precious metals from ore (Rubo et al., 2006). In the process of metal extraction, the ground-up ore is mixed with cyanide solution to dissolve all the metals contained in the ore. Then the solution is filtered out from the slag. The solution then underscores a series of processes for extracting the metals dissolved on it. After all the

metals have been extracted, a huge pile of economically invaluable cyanide-laced powder is formed which is hazardous to the environment. Mines do their best to reduce the concentration of cyanide in these byproducts by using a process called tailings, which converts toxic cyanide into a less-toxic form – cyanate. However, even after the conversion, the toxin is never fully eliminated from the ecosystem (Franks et al., 2011; Nagaraj, 2005). Hence, it keeps leaking into the groundwater supply.

Finally, sulphur dioxide and nitrogen dioxide are two more naturally occurring compounds that we keep releasing into the environment inappropriately. Naturally, they occur in volcanic eruptions and as a waste of some algae and bacteria (Air pollution, 2020). But burning coal and other fossil fuels have a major contribution in releasing them into the environment. Once they are released, they become part of the earth's atmosphere and begin to react with water vapours. The chemical reaction produces acids like sulphuric acid and nitric acid which falls back into the Earth's surface through acid rain (United States Environment Protection Agency, 2020).



Image 6. A forest in the Black Triangle in Europe after acid rain (Lovecz, 2006).

The acids then can have a number of effects depending upon where they fall. These acids can react with soil and release aluminium. They also reduce the fertility of the soil. Similarly, they change the pH of the water and poison aquatic life. Furthermore, they can prevent animals' eggs to hatch, and absorb nutrients out of the plants (United States Environment Protection Agency, 2020).

That's how human beings are responsible for increasing natural chemicals to the level where it begins to be toxic. But we are also producing chemicals that naturally do not occur, and they wreak their own set of havoc. Endocrine disruptors are a separate class of chemicals that are found in a variety of products, ranging from plastics to pesticides and drugs. They have even penetrated the agricultural and industrial sectors. Endocrine disruptors, like 4,4'-Isopropylidenediphenol, which is also known as bisphenol A (BPA), is present in plastics. As bottled waters are packed in plastic bottles, they continue to release themselves into the drinks we drink. Similarly, the same chemicals are found to be present in some pharmaceuticals as well (Facts about BPA, 2018). Eventually, they get mixed with water sources and enter into animals' bodies when they drink the contaminated water. Endocrine disruptors, as the name suggests, go after the endocrine system, which controls different functions of the organism via hormonal control. And as the level of endocrine disruptors has increased, malfunction of the repro-

ductive organs of fish has been spotted (Faheem et al., 2017). Unfortunately, people are also drinking the same water. Actually, people of all ages groups are vulnerable to endocrine disruptors, but the studies so far have indicated that infants are at higher risk as their immune system is still immature. It is paramount to deeply study the reproductive and developmental consequences of these chemicals on human beings.

CONCLUSION

Overall, without any forestall, the action of uncontrolled chopping down of trees leads to deforestation, abtaining the ecosystem from recuperating the damage caused by humans, and leading to the brink of extinction of living things. Several consequences of global warming, one being extreme climate change can also impede human's prosperity. Demanding more than nature can provide might as well result in the disbalance of the ecosystem, which ultimately has the potential to eradicate human beings.

Foundation

The research was carried out by the Federal State Budgetary Institution of Nutrition, Biotechnology and Food Safety with the support of subsidy for accomplishing the governmental assignment.

Conflict of interest

Authors declare no conflicts of interest.

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ЭКОЛОГИЧЕСКИЕ ПОСЛЕДСТВИЯ ЧЕЛОВЕЧЕСКОЙ БЕЗОТВЕТСТВЕННОСТИ ЧАСТЬ I. ВЫМИРАНИЕ, ИЗМЕНЕНИЕ КЛИМАТА И ЗАГРЯЗНЕНИЕ

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РЕЗЮМЕ. Деградация окружающей среды - это процесс, в результате которого природа различными путями угнетается, что приводит к уменьшению биоразнообразия и ухудшению общего состояния экосистем. Происхождение этих процессов может быть естественным, а может быть вызванным или ускоренным человеческой деятельностью. Многочисленные исследования показывают, что угнетение окружающей среды под влиянием человека – это одна из самых больших угроз, с которой когда-либо сталкивалась наша планета. Разрушение окружающей среды неизбежно отразится на всех формах жизни, включая людей. Крупные исследования показывают, что деградация окружающей среды происходит с угрожающей скоростью. Существование многих видов растений и животных на Земле уже стало невозможным. Человек эксплуатирует все аспекты природы – воду, воздух, флору, фауну, почву и др. Но жизнь на Земле настолько сильно зависит от огромного множества мелочей, что даже незначительное, с точки зрения человека, воздействие может вызвать и вызывает эффект домино, что приводит к разрушению экосистем и исчезновению дикой природы.

КЛЮЧЕВЫЕ СЛОВА: биоразнообразие, биогеохимия, биологические угрозы, экосистемы, вырубка, парниковый, промышленные отходы.