

Unveiling the ripple effect: how human activities reshape ecosystems

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Abstract

Ecosystems encompass a dynamic web of interactions between living organisms and their environment. This network includes everything from the smallest microorganisms to the largest mammals, and landscape. Ecosystems provide vital services, such as clean air, water, nutrient, climate regulation and all the related things. However, human activities have significantly affected these systems, leading to habitat destruction, species extinction and disruption in delicate ecological balances. Human population growth increased the conversion of natural ecosystems for agricultural, industrial, and residential purposes, as well as the demand for ecosystem inputs like freshwater, fiber, and soil fertility. It also placed strain on the ability of natural ecosystems to sustain human populations. Growing agricultural, engaging in illicit fishing and hunting, and unplanned activities greatly influenced it. Future generations may face risk of starvation, thirst, illness, and catastrophe if we continue to lose biodiversity. It directly and indirectly contributes to many aspects of human life, such as security, the necessities for a happy life, health, positive social interactions, and the freedom to make decisions and take action. The article focused on effects of human activity on ecosystems and to evaluate how well managed processes contribute to habitat conservation, in order to better understand the importance of ecosystems on living beings in this planet.

Keywords: *ecosystems, agriculture, deforestation, global warming, biodiversity*

INTRODUCTION

The greatest ecosystem that can be studied and partially comprehended is that of planet Earth. A system's overall function and sustenance are provided by a combination of all living and nonliving creatures and habitats, which is known as an ecosystem. This comprises all living things found therein as well as all land, soil, water, and air. The totality of human actions and habits that have an impact on the delicate ecosystem of the Earth's surface, both positively and negatively, is known as the human impact on the environment. To establish an international, United Nations-backed examination of the global ecosystem, 132 nations from around the world gathered in 2019. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) investigation determined that some 1 million species are in danger of going extinct as a result of human activity. According to a Royal Botanic Gardens survey, around 22% of the 380,000 plant species that have been discovered are threatened. According to research by the Zoological Society of London and World Wide Fund for Nature (WWF), changes in the Earth's ecosystem brought on only by human activity have resulted in a 25% decline in land-based species, a 28% decline in marine species, and a 29% decline in freshwater species over the past several decades. Human change is the single biggest threat to biodiversity [1]. Ecosystems worldwide are under threat from increasing human population densities, intensive land use, invasive species, typically connected to changes in habitat heterogeneity, increasing habitat fragmentation, and reduced dispersal abilities. Protected areas are frequently the sole haven for endangered species. Indeed, alterations in the climate have the potential to amplify the consequences of these factors on protected areas [2]. At least 20% of terrestrial ecosystems' vulnerable or endangered species are impacted by extreme weather and climate change, while more than 85% are affected by habitat degradation or destruction

[3, 4]. An effective PAs (protective areas) system is one of the most important plans for the protection of biodiversity in light of the rising pressure that human activity is placing on the planet's resources [5, 6]. Different human causes, such as changes in landscapes, invasive species, overexploitation, and pollution, have an impact on biodiversity reduction [7]. The direct degradation and habitat destruction brought on by land uses are the most pressing and serious threats to biodiversity. Climate change only poses a 7.1% hazard to the extinction of vertebrates, whereas it poses a threat to up to 44.8% of vertebrate populations [8]. Road building, property development, and urbanization have a negative impact on reserves and lessen their effective extent [9]. Despite the fact that environmental management is at the core of every development, researchers have not identified or examined the impact that human activity has had on the environment. If the activities and their effects could be taken into consideration, this could be a useful way to understand environmental management. A review of the literature has shown a relationship between all human activities and the environment [10]. Everything we do as people affects the environment in some way. For instance, pollution is a byproduct of human activity in the environment, with agricultural, water pollution, and air pollution serving as its primary causes. It is a natural or human-induced process that has an adverse influence on the ability of the land to take, store, and recycle water, energy, and nutrients in order for the ecosystem to function properly [11]. The study focused on effects of human activity on ecosystems and to evaluate how well managed protective areas contribute to habitat conservation. In order to better understand the natural system of the biome, future needs, and priorities for ecological study are discussed in this article. This will help to promote conservation and sustainable usage of the biome.

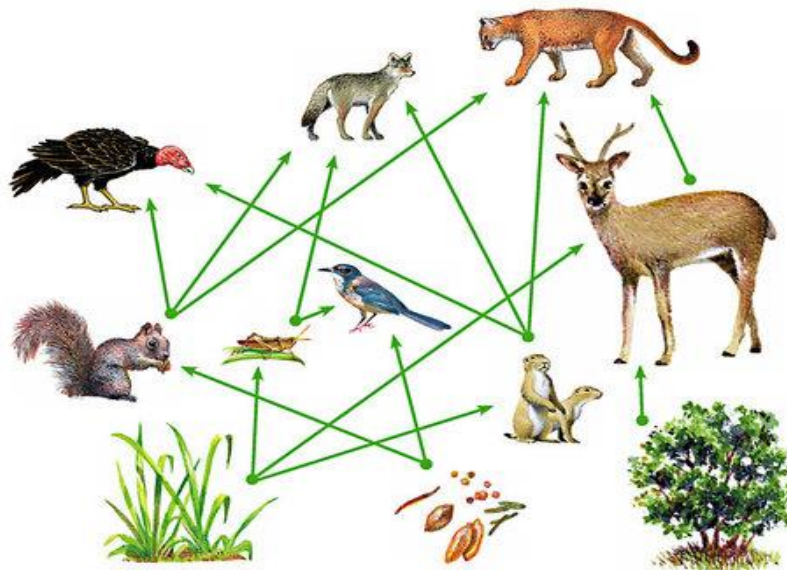


Fig. 1. Depiction of food chain within the ecosystem, Google source

DISCUSSIONS

Major Factors Affecting Human Activity

In the current era of progress, consumerism has greatly expanded along with rising human population and rising needs, raising our standard of living. Here, some significant human activity-related elements are explored.

Economic Growth

Raising the standard of living for people requires economic growth. The modern era's standard of life has increased thanks to technological development that has sped up industrialization and urbanization, but it has also resulted in resource depletion, an energy crisis, and air, water, and soil pollution. The global economy has grown at such a rate that the gap between developed and developing countries is now very vast.

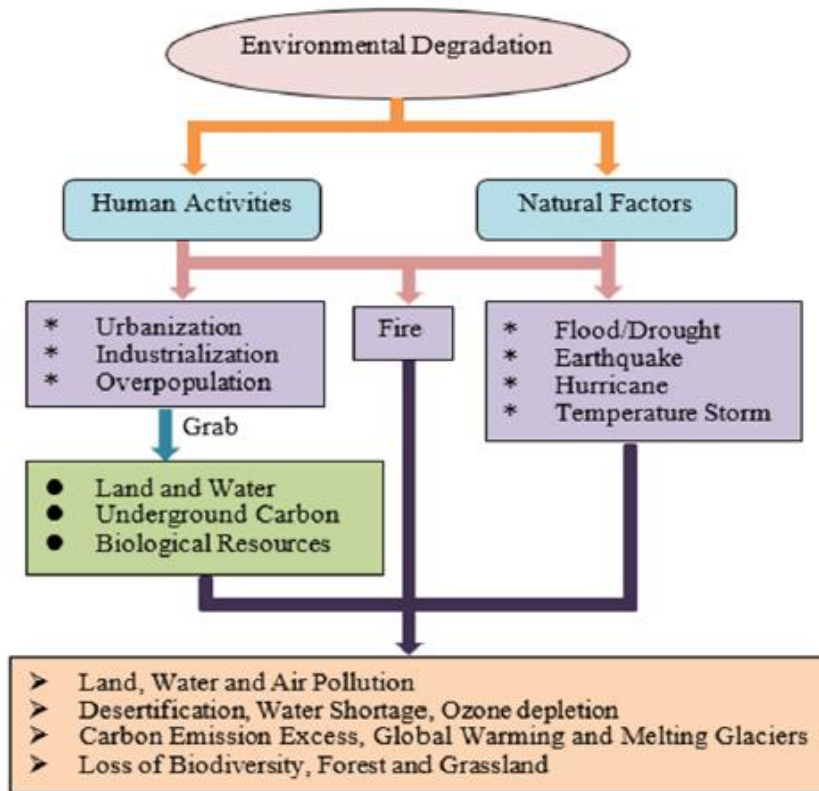


Fig. 2. Different causes of environmental degradation [12]

Human activities are progressively threatening biodiversity as well as other ecosystem services, which are the advantages that humans receive from ecosystems [13]. Ecosystems and biodiversity conservation face significant obstacles as a result of economic development. None of the threatened by human activity biodiversity hotspots, which are home to many endemic species, still have more than one-third of their original habitat. Historically, they occupied 12% of the land's surface, but today only 1.5% of it is covered by their natural habitat [14].

Agriculture

The demand for enough food is rising in parallel with the world population's ever-increasing size. Thus, in order to make more space for agriculture, the globe is being forced by the rate of population growth to remove forests. More than 42% of the earth's surface now supports agriculture, according to data from the UN Food and Agriculture Organization (FAO), and a larger portion of these lands were originally covered by forests. Forests are important wildlife habitats and have been negatively impacted by cultivation practices because they are ecosystems that sustain the complex interactions between living and non-living objects. For instance, a bigger portion of Europe was heavily covered with temperate woods, but through time, this land was destroyed to create way for farms [15]. Due to the enormous quantities of phosphorous and nitrogen nutrients introduced by fertilizer use into natural soils, lands, and water systems, ecosystems have been transformed, and aquatic dead zones have been fast expanding.

Shelter

Finite land resources are under more strain to provide dwellings as the population grows. More than half of the world's population is supported by the development of habitat or housing within 5% of the planet's land area. We have been obliged to reconsider the construction and design of buildings by adding an environmental approach to buildings as a result of the rapid depletion of natural resources, diminishing land, rising pollution levels, and related health issues. Applying sustainable concepts to the "built environment" is urgently needed [16].

Plastic production

One of the most serious environmental issues ever seen on earth was brought about by the invention of plastic. Even in the waters, there is waste plastic all over the planet. Plastic pollution affects the delicate ecosystems and regulatory cycles for thousands of years once it enters the environment. The chemicals found in plastics are released into the environment, affecting the endocrine systems of animals and altering their reproductive habits. They may also result in tumours since they can speed up cell division. Above all, since plastics persist in the oceans for a very long time, they have the potential to destroy ecosystems, causing an estimated 13 billion US dollars in compromise annually. The most afflicted animals are wildlife, some of whom have even killed after ingesting unusually large amounts of plastic. For instance, a whale found dead in Scotland in June 2017 had ingested nine pounds of plastic, which led to a blockage in its digestive track. To make matters worse, over 4,000 instances of fish with plastic in their bodies have been documented globally [15].



Fig. 3. Plastic waste, Google source

Carbon dioxide and other greenhouse gas emissions

Carbon dioxide and other greenhouse gases, such as methane and hydrofluorocarbons (HFCs), are caused by human activity, specifically the burning of fossil fuels and the consumption of manufactured goods. The world has continued to rely on carbon-rich fossil fuels like gas, oil, and coal to provide energy. 400 billion tonnes of carbon dioxide were released into the atmosphere between 1870 and 2013 as a result of the combustion of these fossil fuels for energy. According to reports, carbon dioxide concentrations are surprisingly greater than they have ever been. Global temperatures are increasing as a result, which contributes to the rise in sea level and extreme weather phenomena like heatwaves, flooding, tsunamis, and droughts. Extreme weather and sea level rise have each had a cascading effect on ecosystems on land and in the ocean, affecting food chains, biodiversity, and the rate of desertification [15].



Fig. 4. Carbon dioxide gas emission, Google source

Invasive species

Transporting organisms from other either parts of the world— knowingly or unknowingly— leads to the emergence of invasive species. As invasive species are introduced on a timetable much faster than would generally happen with evolution over longer time periods, this can be disastrous to existing species. This can involve invasive species outcompeting local species in the ecosystem, which can cause local species to become extinct or decline, as well as overcrowding since these invasive species might not have any natural predators in this new ecosystem. They may also have significant financial costs.

More quickly and widely than ever, humans have changed ecosystems, mostly to meet the world's expanding need for resources and to support economic growth. These requirements have been identified as significant contributors to ecological deterioration and biodiversity loss. Because of this, policies and programmes for both economic development and ecosystem/biodiversity protection should be developed and implemented in the context of both economic development and the growing reliance of humans on ecosystem services [17].

In addition to "traditional" businesses like fisheries and transportation, increased human activity at sea, such as offshore wind generation and aquaculture, may place more strain on ecosystems, leading to cumulative ecological consequences and the risk of losing ecosystem services [18].

Bad impact of human activities that reshape ecosystems

There is no denying that human activity has a negative impact on the environment. How we live our lives, what we produce and consume, and how we move around impact Earth. The effects of people on our environment are extensive, affecting both terrestrial and aquatic ecosystems, and range from ozone depletion to acid rain, human-induced soil degradation through deforestation, pollution, and loss of species.

Land degradation

Deforestation, desalination, desertification due to waterlogging, wasteland formation, and soil erosion. According to an FAO estimate, around 2 billion people—or approximately 3/4 of the population of developing nations at the time—relied on biomass for their daily energy needs [19]. An area of productive land equal to around 12 million hectares, or about the size of Greece, is lost each year. This occurs as a result of land exploitation without environmental protection [20, 21]. Sensitivity and resilience are indicators of how susceptible a landscape is to damage. The degree of susceptibility is explained by the interaction of these two components [22]. Land damage affects 3.2 billion people worldwide, primarily rural communities, smallholder farmers, and the extremely poor. The anticipated increase in global population to 9.7 billion people in 2050 would result in a rise in the demand for agricultural products such as food, feed, fibre, and fuel. The loss of biodiversity has made agricultural production systems less resilient, and other natural factors like climatic variability and extreme weather events are adding to the burden on the world's land resource. Agro-ecosystem resilience and the stability of food production systems are threatened by the escalating differences in agricultural yields and revenue brought on by climate change [23].

Ozone depletion

A thin layer of gas called the ozone layer encircles the planet and shields humans from the sun's dangerous UV radiation. Without it, life on Earth would be significantly affected and possibly impossible. Human activities has significantly reduced the ozone layer's size during the last few decades. This issue has been greatly exacerbated by the manufacture of chemicals like halons, hydro chlorofluorocarbons, and chlorofluorocarbons (CFCs). These substances, which are used in spray cans, air conditioners, refrigerators, and many other devices, destroy ozone molecules when they are released into the atmosphere [24].

Pollution

When dangerous contaminants (chemicals, toxic gases, particles, biological molecules, etc.) are released into the atmosphere of the planet, this is referred to as air pollution. These pollutants are quite harmful and can occasionally present major health risks. When harmful contaminants and particle matter are added to water sources including lakes, rivers, and seas, water pollution is said to occur. Typically, human activities like faulty sewage treatment and oil spills release these toxins into the environment. A particularly important issue on a global scale is pollution, which has caused the quality of biotic and abiotic natural resources to decline [25]. Water contamination is a major issue, particularly in developing nations. About 71% of the earth's surface and groundwater were submerged in water. Particularly in the world's emerging nations, groundwater is scarce [26]. The flora and fauna of the rivers change and become less prevalent as a result of suffocation deaths. Monitoring of water quality has become necessary due to the growing issue of contamination of the river ecology [27]. Worldwide, industry and automobiles are the main and secondary sources of air pollution [28]. Every gallon of petrol generated, distributed, and then consumed in a vehicle results in the production of carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulate matter, all of which contribute to the increase in global warming.

Acid rain

One of the most obvious and well-known adverse effects of human activity on the environment is acid rain. It happens when air pollution from factories or power plants combine with the environment to create acid, which then falls to the ground as rain, snow, or fog. Burning fossil fuels like coal and oil is the main source of acid rain. Sulphur dioxide and nitrogen oxides are released into the air when these materials burn. As they ascend into the atmosphere, these gases combine with water vapour to produce nitric and sulfuric acids. The environment may suffer when the acids return to Earth as precipitation. While a few natural factors, such as wildfires, rotting vegetation, and other environmental biological processes might contribute to acid rain, most of it is brought on by human pollution, especially from power plants that burn fuel to generate electricity. When it occurs, acid rain can be incredibly harmful to humans, animals, and even plants [24].

Global warming

The gradual increase in the planet's surface temperature is known as global warming. Although this warming trend has been around for a while, the burning of fossil fuels has greatly accelerated its pace over the past century. The amount of fossil fuels burned has increased along with the size of the human population. Burning fossil fuels such as coal, oil, and natural gas results in the phenomenon known as the "greenhouse effect" in the atmosphere of Earth. Climate change is a problem brought on by global warming. Although these expressions are occasionally used interchangeably, they are not the same. Changes in global weather patterns and growing seasons are referred to as climate change. It also refers to the rise in sea level brought on by melting ice sheets and glaciers and the expansion of warmer oceans. Climate change brought on by global warming poses a severe threat to life on Earth in the form of catastrophic weather events and extensive flooding. Scientists are still researching global warming and how it affects the planet [29].

Deforestation

The primary component of the terrestrial eco-system, the forest, is a vast "green wealth" that belongs to humans and is crucial to maintaining the planet's life support system. However, as human industrial civilization has progressed, additional phenomena such as uncontrolled mining of wild flora, indiscriminate cultivation and occupation of forest area, and industrial pollution have grown more severe [30]. Around the world, deforestation has significantly changed the terrain. Approximately 2,000 years ago, Western Europe was 80 percent forested; today, it is only 34 percent. Between the 1600s and the 1870s, almost half of the woods in eastern North America were cleared for agriculture and logging. Over the previous 4,000 years, large areas of China's woods have been lost, and only slightly more than 20% of the country is today covered in trees. Earth's

cropland was previously largely covered in trees. Tropical rainforests are currently experiencing the highest destruction, which is facilitated by massive road construction into formerly virtually inaccessible areas. Forests become more accessible for exploitation when roads are built or upgraded. Tropical deforestation is largely attributed to slash-and-burn agriculture. In order to fertilize the soil for crops, farmers use this agricultural practice to burn enormous tracts of forest. However, the land is only productive for a short while before the farmers leave to carry on their work elsewhere. In order to make room for logging, livestock ranching, oil palm and rubber tree plantations, tropical forests are also destroyed [31].

Natural consequences

Avalanches, earthquakes, tidal waves, hurricanes, and fires can completely destroy local animal and plant populations to the point where they are unable to thrive there. This can happen physically as a result of a singular calamity, or it can result in long-term asset degradation due to the introduction of an invasive foreign species into the environment. Obviously, humans aren't entirely responsible for this entire situation, but the latter typically occurs following tidal waves, when reptiles and bugs are washed ashore. Earth itself also causes ecological problems. The truth is that the environment is always changing, even though environmental degradation is typically linked to human activity. Some biological systems deteriorate to the point where they can no longer support the life that is designed to reside there, whether or not human exercise has this effect [32].



Fig. 5. Arbitrary cutting down trees, Google source

Drought, desertification, and water scarcity

The third primary effect of climate change that could have a large impact on migration due to climate change is drought and water scarcity. Due to global warming, droughts, desertification, and water scarcity are projected to get worse. According to projections, nearly one-third of the world's population will be impacted by these occurrences. Millions of people could be forced to relocate due to droughts around the world, which will impact human livelihoods and food shortages. The availability of freshwater for people and ecosystems in coastal locations will decline as a result of sea level rise because salinization of groundwater and estuaries will spread into more areas. Additionally, the supply of clean water sources is under pressure due to shifting precipitation patterns [32].

Water resources degradation

Among the most serious hazards are high nutrient concentrations in marine and coastal waters caused by agricultural runoff and microbe contamination of groundwater caused by sewage outfalls

[33]. Acute and delayed dangers to human health can result from contact with contaminated bathing or drinking water. While tap water is subject to treatment, testing, and purity requirements, it is not always sanitized of microorganisms that cause diarrhea, as evidenced by waterborne disease outbreaks like the one brought on by *Cryptosporidium* in Milwaukee in 1993, which affected over 400,000 people. Additionally, the presence of faecal coliforms in bottled water is not restricted [34]. Currently, 40% of waters are unsafe for swimming or fishing, and fish in 40 states contain high amounts of mercury. The Clean Water Act of 1972 requires the states to set pollution limits and reduce pollution in watersheds until criteria are met, although compliance is minimal and enforcement is poor. It also mandates the publication of a list of all bodies of water that do not satisfy water quality standards. The most significant factor contributing to the contamination of surface and groundwater in India is the discharge of untreated sewage [35]. Effluents are another by-product of industries that endanger the environment. The leather and tanning, petroleum, and chemical manufacturing sectors all produce significant amounts of waste that are released untreated into nearby streams, polluting the water and endangering aquatic life. Due to bad management, absentee workers, faulty design, poor maintenance, and a lack of dependable electrical supply, the majority of government-owned sewage treatment plants are frequently closed.



Fig. 6. Water level downgrading, Google source

Health effects on people

Environmental degradation may have an adverse effect on human health. Respiratory issues like pneumonia and asthma can be brought on by areas where harmful air pollutants are present. The indirect impacts of air pollution are known to have caused the deaths of millions of people [36].

Loss for the tourism industry

The tourism industry, which depends on visitors for a living, may suffer greatly as a result of environmental degradation. Most tourists may be greatly turned off by environmental devastation in the form of less greenery, diminished biodiversity, massive landfills, elevated air and water pollution, and more [32].

Loss of biodiversity

The loss of biological diversity is caused by both the global extinction of many species and the local decline or extinction of species in a particular region. Depending on whether the environmental deterioration that causes the loss is practically permanent (for example, through land loss) or reversible through ecological restoration or ecological resilience, the latter phenomenon can be

either temporary or permanent. Due to human actions that go beyond the limits of the earth, the current global extinction, also known as the sixth mass extinction or the Anthropocene extinction, has caused a biodiversity crisis that has so far shown to be irreversible [37, 38]. Particularly in connection to the degradation of tropical forests, habitat destruction has been a major factor in extinctions. On the surface of the globe, freshwater habitats like swamps, deltas, and rivers account for 1% of the total area. Freshwater ecosystems are significant despite making up a small section of the planet since about one-third of all vertebrate species call these types of habitats home [39]. Terrestrial [40] and marine [41] habitats, including tundra, [42] mangroves, coral reefs, and caverns, have been negatively impacted by climate change. Excessive use of a resource can cause its destruction, including extinction. As will be covered in the section on fisheries below, overexploitation can also be viable. As with overgrazing in stock management, over logging in forest management, over-drafting in aquifer management, and endangered species in species monitoring, overfishing can be used in place of overexploitation in the context of fishing. Overexploitation is not just a human behavior. For instance, introduced predators and herbivores may overuse local flora and animals.

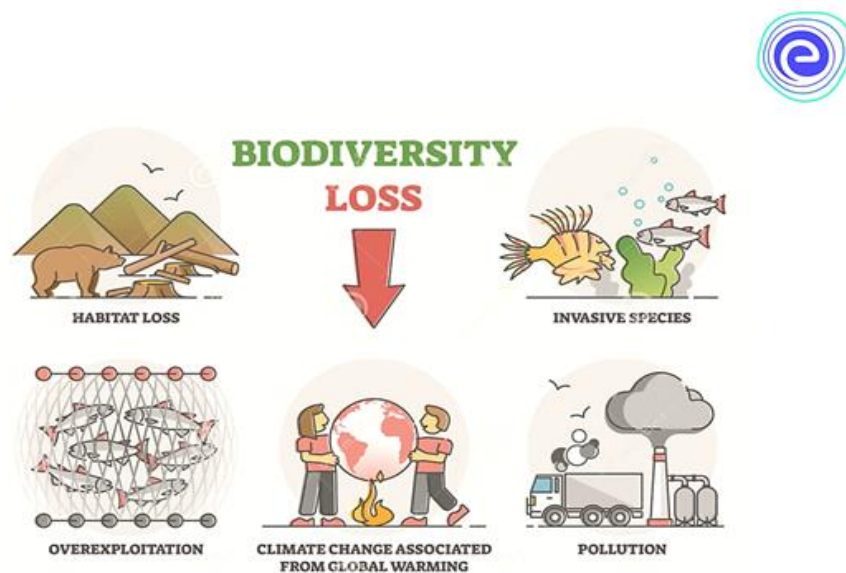


Fig. 7. Loss of biodiversity

The loss of biodiversity affects human health in a number of ways. One such effect is the extinction of therapeutic plants. Around 70 to 80% of people globally rely completely on plant-based medicine as their major source of healthcare, demonstrating how widely used plants are as medication [43].

Some possible ways to prevent loss of biodiversity

Loss of habitat is one of the main risks to biodiversity. This can be done by destroying trees, polluting the oceans, or doing anything else that changes the natural environment. The concept of green chemistry may aid in the creation of innovative, practical, and affordable methods for producing the intended product, which will ultimately help in the preservation of the environment [44]. We use a lot of natural resources, and when we don't do so responsibly, the results can be terrible. Despite the fact that many environments' biodiversity is now in danger, there are numerous things we can do to lessen this risk. These are some outlines that can be taken to protect biodiversity [44].

- i. Government legislation
- ii. Nature preserves
- iii. Reducing invasive species
- iv. Habitat restoration
- v. Captive breeding and seed banks

- vi. Research
- vii. Reduce climate change
- viii. Purchase sustainable products
- ix. Sustainable living
- x. Education
- xi. Conservation of energy
- xii. Improve hygiene
- xiii. Safety measures to be implemented to prevent oil spillage.
- xiv. By making people be aware of the causes and dangers of air pollution

There are methods that may help in slowing down the environmental damage. The legislative structure must be finalized for pollution and depletion to be effectively controlled. The current state of the international law has some flaws that subtly favor wrongdoing. In order to prevent criminal acts, the government must improve how the legal system is filled in. Since overexploitation is the primary cause of the loss of biodiversity, amendments to laws governing the exploitation of natural resources are urgently needed.

CONCLUSIONS

Human life is made both possible and worthwhile by ecosystems. The primary cause of environmental degradation is human activity. Because to the effects of human-induced climate change, the ecosystem is seriously threatened. The satisfaction of humanity's fundamental needs and aspirations is threatened by its disappearance. Future generations risk suffering from hunger, thirst, sickness, and tragedy if we continue to lose biodiversity. In order to examine the progress, issues, and goals to achieve ecologically sound utilization in any region, scientific study is required to improve conservation based on scientific methodologies. Our awareness of the extent of biodiversity and land use is improved by scientific research, which also helps to lessen the negative effects of land use. An essential step in the adaptive management process is the incorporation of research findings into an action plan for the preservation of biodiversity. The majority of the practical steps taken to slow down biodiversity loss are under the purview of the policy-making processes undertaken by governments and civil society. The scientific community must still close significant knowledge gaps, nevertheless.

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