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Environmental Issues and their Possible Solutions for Sustainable Development India: A Review

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Abstract

Human activity has drastically impacted the earth's ecology, resulting in significant changes in the environment over the ages. Developing countries like India have extensive intervention of life form activities has intensified environmental problems, soil degradation, greenhouse effect, global warming, and ecological imbalance. These difficulties have directly impacted the quality and maintenance of the environment. Research and statistics clearly indicate that if current trends continue, situations would worsen in the near future. Sustainable solutions, such as bioremediation for water pollution and microbial decomposition for crop residue waste, are becoming increasingly important and demand huge exposure in order to minimize the negative effects of human activities and assure sustainable development. Microorganisms play a significant part in carbon as well as other nutrient cycling, and their influence on climate change deserves special consideration. If microorganisms and nutrient cycling are connected, they operate as an effective strategy for addressing many environmental issues like soil degradation, global warming, and ecological imbalance. Thus, this paper aimed to close a research and evaluation gap by analyzing environmental challenges and their long-term growth.

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Introduction

Human activities are the main factors in the destruction of Earth's living conditions. Human impact has led to a rise in the amount of greenhouse gas emissions, global warming, soil contamination, natural resource depletion and contamination of the soil, water, and air, species extinction, the build-up of dangerous recalcitrant compounds, and other difficulties. Several conferences have emphasized the influence of environmental challenges in recent decades. However, the depth of understanding in order to define the term "environmental sustainability" is extremely poor, with disparities in the views considering the perspectives of distinct groups or individuals working in different occupations (Vezzoli and Manzini, 2008). The world's expanding environmental concerns are largely associated with increased human activity. The outlook for the availability of land, environmental health, and diversity has been steadily decreasing, with expectations of even worse conditions by 2050. To attain the aims of environmental sustainability that have so far been lacking, it is critical to incorporate the ecological and biological components. To rid the planet of anthropogenic concerns, an integrated strategy is essential on an urgent and ongoing basis. Biological techniques must be at the forefront and used to their full potential in order to accomplish environmental sustainability goals. This study discusses important environmental concerns, followed by remedies incorporating biological techniques to attain sustainable development, which has been researched and forecasted. Environmental challenges are a significant priority for all governments and scholars worldwide. The way things are going, a number of severe environmental concerns may even be dangerous to human civilization. Several significant environmental issues are currently afflicting the world, with grave consequences for living species. This section discusses the most prominent environmental concern (Rockstorm *et al.* 2018).

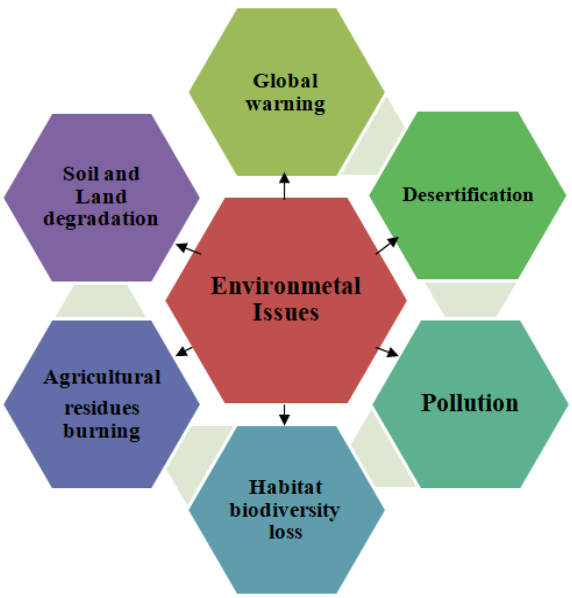

Fig. 1: Environmental issues (https://in.pinterest.com/pin/environmental-problem-environment-problem-and-solution--522206519267336793/)

Environmental deterioration is a global issue that has an impact on the entire world. All types of living things are affected by pollution in some way. Even species that live in the poles or at the bottom of the ocean are affected by pollution. Anthropogenic activity has led to the emergence of numerous pollutants in recent decades, which have a detrimental impact on the ecosystem (Rockström *et al.* 2018). Industrialization, urbanization, and deforestation rates are making conditions in developing countries

worse. Greenhouse gases continuously increasing day by day and adversely impact the environment. Greenhouse gases mainly consist nitrous oxide, chlorofluorocarbon, methane and carbon dioxide.

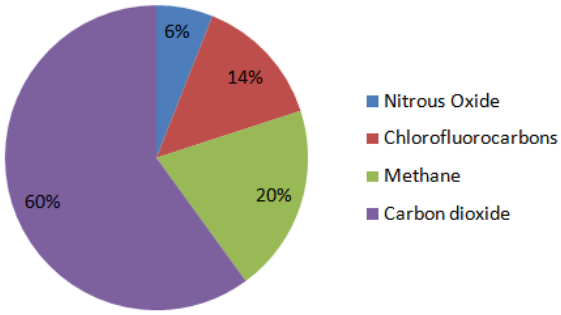

Fig. 2: Relative contribution of various greenhouse gases to total global warming (NCERT, Class 12 biology)

About 92 percent of all pollution-related deaths occur in developing countries (Landrigan *et al.* 2017). Urban pollution has a negative impact on the quality of the land, water, and air (Solé-Ribalta *et al.* 2016). By 2030, the UN predicts that the number of people living in cities will have quadrupled (UN 2014). Different types of pollution can raise the annual health-care budget in low- and high-income countries upto1.7 percent and 7 percent (Landrigan *et al.* 2017) (Table 1).

Table 1: Major air pollutants and their examples (Ileperuma, 2000)

S. No.	Class of Pollutants	Examples
1.	Carbon oxides	CO_2, CO
2.	Nitrogen oxides	NO_2, N_2O
3.	Oxides of sulphur	sulphur dioxide, sulphur trioxide
4.	Particulates	dust, soot
5.	Inorganic compounds	lead
6.	Photochemical smog	ozone, peroxyacyl nitrates
7.	Hydrocarbons	benzo(cx)pyrene, benzene

Meanwhile, the true costs of restoring resources like air, soil, and water have yet to be calculated. Every year, a diverse spectrum of contaminants is discharged into water bodies as a result of industrial emissions. The effect of Chlorofluorocarbons on the depletion of the ozone layer is widely understood. Researchers now assume that chemicals used in the paint industry are to blame for the thinning of the ozone layer in non-polar zones (Carrington 2018). The globe utilizes a staggering amount of fossil fuels to meet its energy needs, which is one of the major contributors to atmospheric pollution. Plastics also have a negative effect on the environment. Wieczorek *et al.* (2018) and Borrelle *et al.* (2017) did similar research, showing the effects of plastic on aquatic vegetation in the seas. Despite the horrifying repercussions of plastics, their manufacturing is expanding and the planet is becoming a dumping ground for these non-biodegradable creatures. Heavy metals have been damaging land and water as a result of rapid urbanization, industrialization, and other human

activities (Yadav, 2010). Although heavy metals are naturally present, dangerous concentrations are being reached due to anthropogenic activity (Mishra *et al.* 2017).

Heavy metals in soil are primarily caused by agricultural and industrial wastewater, household sewage, oil spills, mining, industrial activities like processing of metal, nuclear power, combustion of fossil fuels, metal corrosion, polymers, and fabrics (WHO 2010; Yan *et al.* 2018). Both water and soil have been found to contain heavy metal contamination across the world. Because of lead poisoning in the lake, the supply of water in Michigan, North America, was transferred through the Flint River and Lake Huron in 2014. The issue damaged the water supply further, Moreover, the President of the United States declared an emergency due to serious lead pollution of drinking water (Wendling *et al*. 2018). Over 89 percent of drinking water samples in Karachi, Pakistan, were determined to be lead-polluted. Latin America has some of the most polluted cities in the world, owing to poor heavy metal mining practices. Arctic surface soils have been shown to be contaminated with traces of mercury (Hg) and other elements. Mining activity in parts of the Arctic and Siberia contributes to heavy metal poisoning of soils. The paper's primary goal is to show serious environmental issues and sustainability challenges in the most intensively cultivated nation, such as India. The first half of the article in this review discusses the main environmental problems, and then the remedies, which involve biological methods to attain environmental sustainability, have been investigated and anticipated (Fig. 1).

Location of the Study Area

In this study we try to highlight the environmental issues and there possible solutions in India. The global phenomena of environmental deterioration brought on by development activities are not unique to India. As a result of industrialization, urbanization, transportation, the burning of fossil fuels, and deforestation, which have all contributed to economic growth and development at the expense of environmental degradation, greenhouse gas emissions that have contributed to global warming and climate change have been released. Deforestation has increased significantly as a result of urbanization and a growing human population. Water reservoirs' lifespan is shortened by soil erosion and sedimentation brought on by deforestation. Many plants and animals are in danger of going extinct because of habitat degradation. Environmental degradation, pollution from industrial effluents and vehicle emissions, indoor air pollution and air quality, water pollution from raw sewage, inadequate sanitation, depletion of potable water resources, soil pollution, sound pollution, deforestation, agricultural land degradation, habitat destruction, loss of biodiversity, resource depletion, and others are all a result of India's rapidly growing population and economic development (Kumar, 2019).

Materials and Methods

Based on our recent research and other literatures concerning environmental issues and solutions in India, this review aims to provide an overview of environmental issues and solutions to suggest research trends in future work.

Results

Agricultural Residues Burning

An additional environmental risk in India is the open burning of crop waste in rural areas, especially during the rice harvesting season. The topic of burning agricultural trash in fields makes the front pages of newspapers in Delhi NCR twice a year, in the months of October and December. The region's ambient air quality has deteriorated due to the results of a static atmosphere state above Delhi during the Kharif agricultural harvest time (Kanawade *et al.*, 2019). Due to year-round crop farming, India, the second-largest agrarian economy in the world, produces a substantial amount of agricultural waste, including leftover crops. Many different forms of surplus crop leftovers are burned depending on the agro-climatic zone,particularly in the northern regions of Punjab, Haryana, Uttar Pradesh, and Rajasthan, nonetheless, rice crop residues account for over half of all crop residues burned in the nation. Farmer’s burn crop remnants left in the field after using combine harvesters to prepare the soil for the next crop in the simplest way feasible. There are around 178 million tones of surplus agricultural by products in the nation. The burning of these trashes worsens air quality and raises pollution levels. Burning agricultural wastes significantly increases PM 2.5 concentrations. The amount of residue burned in a short period of time (a few weeks) makes a considerable contribution to pollutant levels like PM 2.5. The following crop

wastes were burned, Maize (11.2), Cotton (9.8), Rice (9.3), Wheat (8.5), and Sugarcane (12.0%). According to several studies, the concentration of organic carbon and its fertility are negatively impacted by open burning of agricultural waste (Hesammi *et al.* 2014).

Water Pollution

Another significant issue in India is water contamination. About 60% of sewage in urban areas is untreated sewage, which regularly enters various bodies of water. As a result, the water becomes contaminated and unfit for human consumption. Farmers also routinely use contaminated river water to cultivate their crops, endangering their health and compromising the food supply in India. Numerous waterways have high levels of heavy metal pollution, including the Ganges, the country's main river and a holy river to Hindus, where thousands of people wash daily and congregate for the Kumbh Mela, the biggest religious festival in the world.

According to a NITI Aayog assessment (2018), India has witnessed the worst water problem, with 600 million Indians enduring severe water deficit stress and more than 100000 people dying each year due to a lack of safe drinking water. According to the report, India ranks at the bottom of the water quality index. The government intends to reroute 30 rivers to alleviate the country's catastrophic water problem, raising environmental worries. The Central Water Commission (CWC) investigated 67 rivers throughout 20 river basins. The results of the third edition of an exercise undertaken by the Central Water Commission (CWC) from May 2014 to April 2018 revealed that just one-third of water quality stations' samples were safe. Heavy metals contaminated the remaining 287 (65%) of the samples collected. Two metals contaminated samples from 101 stations, and three metals contaminated samples from six stations. Heavy metals like Pb, Ni, Cr, Cd, and Cu were among the other main pollutants discovered in the samples and Contamination from Pb, Cd, Ni, Cr, and Cu was more common during non-monsoon seasons, whereas Fe, Pb, Cr, and Cu often exceeded 'tolerance levels' during monsoon periods. Ar and Zn are metals whose concentrations were always within the study's limitations.

Desertification

India is the second-largest manufacturer of agricultural goods in the global despite having a little amount of land. Agriculture, forestry, and fisheries make for 17% of the country's GDP and employ around 50% of the entire labour force. Soil deterioration is caused by both natural and man-made factors (Bhattacharyya *et al.*, 2015). Anthropogenically induced soil degradation outcomes from land clearing and forest destruction, inappropriate farming techniques, inefficient management of industrial wastes and over-grazing (Osman, 2014). Excessive tillage and machinery use, use of inorganic fertilizers, pesticide usage and organic carbon inputs are examples of inappropriate agricultural practices (Karlen and Rice, 2015).

Discussion

Sustainable Solutions

The aforementioned environmental concerns generated debate over what actions should be done to prevent further environmental damage. Regardless of the fact that scientists have been researching the extent and significance of these environmental challenges for years, little progress was made in fulfilling the objectives. Aside from that, environmentally friendly solutions are sometimes overlooked in favour of technical solutions. As a result, in order to build a sustainable ecosystem, a repair plan that incorporates biological treatments or more environmentally friendly methods must be implemented (Fig. 3). This section explores long-term remedies, mostly biological methods, to the problems caused by man-made activity.

Achieving Environmental Sustainability Through Microbes

Microbes are ubiquitous and may be found in all parts of the environment. Microbes in nature are exceedingly varied, and their vast dispersion implies that they might play a vital role in ecosystem preservation. Because of their adaptability microbes can be exploited because of their genetic makeup and diverse metabolic capabilities to solve a wide range of environmental issues (Ahmad *et al.* 2011, Mishra *et al.* 2017, Akinsemolu, 2018). According to Khatoon *et al.* (2017), biodegradation is a critical method for eliminating different polymeric pollutants employing microbial applications. Microorganisms can be used

to solve problems in a straightforward and cost-effective manner, with few inputs and complications. Microbes can be an important instrument in the fight against pollution. Microorganisms are outstanding cleaners (Gupta *et al.* 2018). The process of eliminating toxins from the environment by biological processes, mostly microorganisms, is known as biodegradation. Microbial treatments are used as acceptable replacements for many traditional waste disposal procedures. To detoxify a broad variety of microorganisms can be utilized. Microorganisms or other biological systems are used in bioremediation to convert contaminants into less dangerous ones (Coelho *et al.* 2015). Positive, environmentally responsible, and successful technique for removing dangerous pollutants from the surroundings is bioremediation (Lal *et al.* 2018, Abhilash *et al.* 2016, Kotoky *et al.* 2018). Human health is put at risk by contaminated soil, which also causes numerous environmental issues such as nutrient loss and groundwater contamination (Fredua 2014, Panagos *et al.* 2018). Long-term tools for removing contaminants from agricultural areas and assisting in soil repair include microbes (Verma *et al.* 2017). A cheap method for decontaminating places that have been affected by pollutants is microbial bioremediation. Because of the increasing severity of pollutants, ocean and coastal region pollution is a significant issue on a global scale. Both Sakthipriya *et al.* (2015) and Parthipan *et al.* (2017) successfully used microorganisms that develop bio-surfactants to bio-remediate petroleum pollutants. An article on the microorganisms used in the oil spill bioremediation in saltwater and along the coast was published in 2016 by Tanzadeh and Ghasemi. In order to maintain environmental sustainability, microbes recycle thermal, agricultural, and industrial waste and remediate wastewater (Sharma *et al.* 2013). A significant worry is the release of industrial effluents.

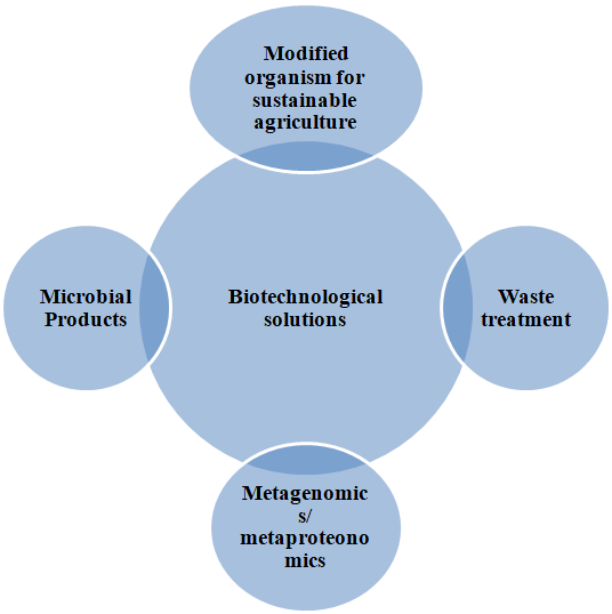

Fig. 3: Biotechnological solutions for environmental issues (Arora *et al.*, 2018)

Role in Sustainable Agriculture

Soil fertility is a term that refers to the availability of nutrients as well as the microbial communities that thrive in the soil (Lazcano *et al.* 2013). Soil bacteria make agro-ecosystems fertile and crop productivity high by maintaining ecological equilibrium. However, as a result of high chemical input into agricultural ecosystems, many of these useful bacteria are becoming reduced or extinct in the soil. Aside from that, as previously said, there are a number of other downsides of using chemical fertilizers and pesticides (Helsel, 1992, Popp *et al,* 2013). As a result, beneficial soil bacteria must be introduced into both impacted and unaffected agro-ecosystems

in order to increase yields in an environmentally friendly way. The rhizosphere is an elevated zone that contains a wide diversity of microorganisms that are primarily mutualistic with the host organism and provide assistance in several ways (Hartmann *et al.* 2008). Among the many microbes that inhabit the rhizosphere, are the most efficient contributors to sustaining agro-ecosystem production. PGPR are crucial plant root colonizers that may be found in huge numbers in the rhizosphere (Spaepen *et al.* 2008). The capacity of microbe's boosts their levels in plants makes them great candidates for eco-friendly crop biofortification (Vessey, 2003). Microbes have successfully chelated micronutrients. Biofortified crops are becoming more popular in order to satisfy the population's dietary needs (Nooria *et al.* 2014).

Table 2: Examples of substantial contaminated site remediation employing microorganisms

S.No.	Positive outcomes at significant polluted sites	Microbes used	References
1.	France removes sulphate and zinc (Zn)	bacterial consortium that reduces sulphate	Bruschi and Goulhen (2006)
2.	Chlorinated solvent removal, UK.	Microbes that are naturally biostimulants	Schaffner (2004)
3.	Oil spill in the USA, shoreline cleanup in Alaska.	Native microorganisms are damaged by oil	Boopathy (2000); Das and Chandran (2011)
4.	Oil spill cleanup in Gulf of Mexico.	Native microorganisms are damaged by oil	Atlas and Hazen (2011)
5.	PAH bioremediation of soil contamination, Spain	*Pseudomonas*	Pelaez *et al.* (2013)
6.	Soil bioremediation, California	Glycerine-diammonium phosphate and perchlorate-reducing bacteria (DAP)	Evans *et al.* (2008)
7.	Indian oil refinery's filthy muck is being cleaned up.	*Pseudomonas aeruginosa*	Mishra *et al.* (2001)
8.	European electrolysis factories' cleanup	Mercury-resistant microorganisms	Leonhäuser *et al.* (2013)
9.	Remediation of diesel-contaminated soil at Austria.	Microbial group *(Pseudomonas species* and *Pantoea species*)	Hussain (2016)
10.	Fuel oil contamination, Florida	Commercial fertiliser and microbial inoculum	Jones and Greenfield (1991)
11.	treatment of the former Budelco, Netherlands, zinc refining site	microorganisms that reduce sulphates	Hockin and Gadd (2007)
12.	Amoco Cadiz leak cleanup, French	microorganisms that break down hydrocarbons	Atlas (1981)
13.	Cleaning up the Bay of Campeche, Mexico, after being contaminated by the IXTOC I.	microorganisms that break down hydrocarbons	Atlas (1981)
14.	removing hydrocarbons from a West African oil refinery site	*Bacillus subtilis*, and *Aspergillus* sp.	Nkeng *et al.* (2012)
15.	Wastewater treatment for azo dyes from the textile and dye industries in Hong Kong	*Acetobacter liquefaciens*	Sharma (2010)
16.	Petroleum hydrocarbon degradation, Nigeria	*Pseudomonas aeruginosa,* and *Corynebacterium* sp	Adebusoye *et al.* (2007)

Conclusion

The long-term sustainability of the environment is vital to humanity's survival. In any event, we must conserve our ecosystem and habitats in order to sustain life on the blue planet, particularly human life. The current pace of the amount of destruction is substantially greater than the ability of ecosystems to recover or heal, and this must be reversed as quickly as feasible. We should switch to green substitutes if we want to rehabilitate the environment and deliver things ahead to normal since anthropogenic activities are destabilizing the globe. Microorganisms and plants, among other biological tools and entities, can aid in the restoration of polluted ecosystems and the reduction of the effects of global warming and climate change. Sustainability is the buzzword of the day, and if we don't get to work and start paying attention immediately, things can get out of hand. Using environmentally friendly and low-input biotechnological technologies, many of the issues highlighted and discovered in this study can be resolved. We have only begun to scrape the surface, further work and study are necessary. The Earth is diverse and, despite tremendous destruction, the majority of it is still undamaged, making it possible to solve environmental challenges with cutting-edge biotechnology technologies and methodologies.

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Conflict of Interest

The authors do not have any conflicts of interest.

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