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AN OVERVIEW OF BIODEGRADATION IN AN ARID ENVIRONMENT

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Abstract: Since the beginning of civilization and man's waking knowledge of his link to his environment, the importance of the soil-water system in nature and man's life has been recognized. Man, just as he was in ancient times, is ultimately reliant on the soil-water system and the plant life it sustains for his survival. Nutrient deficiency and water scarcity, declining soil quality, and unfavorable climate regimes are all characteristics of arid soils. Other underlying abiotic and biotic elements that impact the structure and function of these ecosystems also affect these settings. For this study area of Rajasthan is selected. India is facing serious biological degradation issues if not addressed, it will raise the expense and complexity of future remediation operations, which are already a huge hazard to human health, particularly among the most vulnerable populations.

***Index Terms* - Region, Environment, Soil, Water, System.**

I. INTRODUCTION

Environmental degradation and extensive deforestation are becoming more widespread as a result of global warming-caused floods and droughts, industrialization and urbanization, and conflict. Desertification indicators, both natural and man-made, must be identified and included in the effects of environmental deterioration. Changes in vegetation greenness due to drifting sand, pressure from cattle herds, and weedy invading species are all contributing factors. were produced. Human overexploitation of vulnerable ecosystems, resource system instability, and harsh climatic circumstances as causes of desertification. To effectively measure the degree of deterioration, both natural and manmade factors must be considered. The number of vegetative covers, as well as the quantity of drifting sand, are two factors to consider while planning a project. natural factors that can have a substantial impact on the severity of desertification. Arid regions cover around the 66.7 million km2 of the planet and more than 2 billion people are anticipated to rise in size as a result of climate change. As a result of considerable soil deterioration in dry regions, desertification, or loss of ecosystem production and function, has occurred, is caused by climatic changes and human activities. These areas are characterized by soil degradation and minimal plant cover, which leads to high rates of soil erosion and poor nutrient content. As a result, the livelihoods of those who reside in these places are jeopardized, and many are forced to migrate. Growing aridity is a serious threat to plant productivity because of the fundamentally sluggish dynamics of nutrient accumulation in many regions. Droughts that last for a long time and are extremely dry are a result of climatic changes caused by variations in precipitation patterns and temperature oscillations, which hamper food production and lead to biodiversity loss. Extremely low levels of soil nutrients and organic matter, as well as a lack of water and the accompanying physical instability caused by high winds and ultraviolet radiation, characterize dry and semi-arid environments. Insufficient soil structure and poor organic matter reduce the soil's ability to store water, which is detrimental to the environment connected to decreased fertility and increased greenhouse gas emissions. These constraints result in A decrease in CO_2 absorption from natural vegetation and agricultural production. Constraints like high salinity, increased use of pesticides and fertilizers to increase production, as well as increased land usage, can lead to problems like desertification and the eventual abandonment of farmland, and the need to relocate operations. The pace of soil degradation is accelerated by loosely aggregated coarse soil, which results in a loss of organic carbon, soil erosion, soil fertility loss, and biodiversity loss. Microbial development and activities are hampered in such a nutrient-limited environment, which has an impact on the biogeochemical cycling of nutrients. As a result, the ecosystem is more prone to disturbances, has a lower rate of recovery following disturbance, and is more vulnerable to climate change. In many arid or semi-arid nations, growing agricultural productivity is essentially dependent on irrigation, and thus on water availability. So, let's take a look at the water issue. Our fear stems from a growing global shortage amid apparent abundance. Because, in details of that water occupy about three-quarters of the earth's surface, it is unfortunate that it is not always available when, where, and in the quantity and quality required. Seas and oceans hold up to 97 percent of the world's water, which is too salty to drink or use for agriculture. A further 2% is encased in glaciers and ice caps. The remainder is neither equitably dispersed nor effectively utilized. The world's water consumption will treble in the next two decades as cities develop and industries and agriculture expand globally.

One tone of petroleum still requires twenty tones of water to refine, up to 250 tons of water to make steel, and 500 tons of water to generate grain.

II.REVIEW OF RELATED STUDIES

1.Olubukola Oluranti Babalola and Ayansina Segun Ayangbenro (2021) [1] Nutrient insufficiency and water shortages, diminishing soil quality, and climate regimes that are adverse for agricultural development define arid and semi-arid soils. Other underlying biotic and abiotic factors that have an impact on ecosystem structure and function also have an impact on these environments. Numerous factors impact nutrient availability and plant productivity in an arid or semiarid climate. One key component is the soil rhizospheric microbial population, an essential feature of the terrestrial ecosystem. In light of climate change's influence on agricultural yields in drylands, these organisms' potential function in land restoration for improving plant productivity must be examined. Maximizing the roles of rhizospheric microorganisms in arid and semi-arid environments under a range of environmental perturbations is essential for maximizing yield. Plant growth-promoting (PGP) archaea and bacteria are discussed in this study for their role in nutrient solubilization, growth regulator synthesis, carbon sequestration, pathogen competitive exclusion, and arid and semi-arid soil remediation.

2.Vásquez-Dean et al., (2020) [2] Arid habitats are characterized by a scarcity of water, as a result of high amounts of sunlight, which alters the community composition of animals, plants, and the microbiological structure of the soil. This is directly linked to mean annual precipitation (MAP). In recent years, environmental microbiologists have been able to study the full microbial structure because of advances in next-generation sequencing (NGS) technology. PRISMA guidelines were used to identify, characterize, and evaluate the current level of knowledge on bacterial communities in dry soils globally, as well as to examine how certain environmental variables may influence them. Using a combination of keywords, we discovered 66 articles reporting the makeup of the bacterial population in dry soil by 16S rDNA gene high-throughput sequencing, encompassing 327 sample locations. We looked for factors that may affect bacterial populations using geographic, environmental, and physicochemical data. There are wide variations in altitude, mean annual temperature (MAT), soil pH, and electrical conductivity even though each location evaluated was classed as dry. The microbiomes of dry soils are richer in Actinobacteria than those of non-arid soils, with Actinobacteria outnumbering other microorganisms, indicating that microbial structure in arid soils is strongly controlled by MAP and MAT rather than pH. We noticed that environmental and physicochemical characteristics were rarely documented in research; as a result, we propose a reporting standard for further investigation, which will help us to learn more about the interaction between the microbiome and abiotic variables in arid soil. Finally, to better understand the landscape of academic connections, we analyzed the author's network, which revealed a low degree of connectivity and collaborations in this study topic. Given the importance of understanding how microbial activities grow and alter in arid soils, our findings highlight the need for increased collaboration among research groups around the world.

3.Pradip Maurya et al., (2020) [3] Environmental degradation is described as the deterioration of the environment owing to resource decreases, that encompasses all biotic as well as abiotic components that are formed the environment, like soil, air, water, including animals, and all living as well as non-living components present on the Earth. Human (new urbanization, industry, excess population expansion, deforestation, etc.) as well as natural (droughts, floods, typhoons, fires, increasing temperatures, etc.) these agents are the principal reason for environmental degradation. Various types of human activity are now the primary causes of environmental degradation. The number of hazardous gases such as SOx, NOx, CO, and smoke in the environment increases as a result of automobiles and industry. As a result, the government must improve addressing the legal system's gaps to prevent criminal activity. This chapter examines the long-term consequences of environmental degradation, as well as city planners, industry, and resource managers' attempts to alleviate the long-term consequences of progressive environmental degradation.

4.Pereira et al., (2020) [4] Climate change is hastening, exacerbating a slew of human consequences. Several reports have stated that human activities have had an unparalleled impact on all ecological components. The Anthropocene, a new epoch, has begun. Soil and water resources are under immense strain in this new period, and human survival mainly depends on them. Soils, as well as water environments (e.g., freshwater, marine including coastal), give a variety of direct as well as indirect ecosystem services, including climate regulation, flood retention, carbon sequestration, water purification, and storage, as well as providing (e.g., food, fiber, timber) (ES). As a result, soils and water are essential components of human life. Through a series of complicated processes and feedbacks, soils, as well as water ecosystems, connect to the continuous manner. Agriculture activities, for example, have an impact on land degradation, eutrophication of water bodies, and pollution. In present several studies that look at how land abandonment, urbanization, agriculture intensification, mining, and warfare action that is associated with land degradation as well as climate change are speeding up the degradation of soil as well as water resources, decreasing their ability to give ES in both quality with quantity. At different spatiotemporal scales, these change drivers interact independently or in pairs.

5.Andrey Smagin et al (2018) [5] It is inevitable that the decomposition of polymeric materials such as peat, strongly swelling hydrogels, biochar, as well as other soil conditioners, will hurt the structure, water retention, absorption ability, as well as fertility of artificial soil formation in urbanized ecosystems including agro landscapes (constructors). Field including laboratory incubation experiments, along with mathematical modeling, was used to conduct a quantitative study of the biodegradation process, and the results showed that constructozem organic matter loss might reach 30–50 percent each year, with a commensurate decline in soil quality. Under certain thermodynamic conditions, incubation studies that quantify the carbon dioxide emission rates of polymeric materials can be used to estimate breakdown rates and investigate how microbial inhibitors affect these rates. nomographs can assist in maximizing the long-term effectiveness of amendments in soil formations by determining the best depths to apply them make sure to stable functioning for the specified service periods. It is anticipated that the outcomes of this study will be of use to geotechnicians and landscape architects.

6.Samir Eskander and Hosam Saleh (2017) [6] Contamination from numerous human activities, such as the petroleum industry, petrochemical sector, agriculture sector, and nuclear technology, is one of today's significant environmental issues. The release of wastes created as a result of those activities is of special environmental importance. In nature, most of these pollutants, if not all, are hydrocarbons. Components of hydrocarbons have long been recognized as carcinogenic and neurotoxic organic contaminants. In addition to radioactive wastes, there is the risk of damaging irradiation. After treatment of these pollutants, currently recognized disposal techniques such as direct burial in an unsecured landfill can become prohibitively expensive. Mechanical and chemical procedures are commonly utilized to treat these pollutants, but they are ineffective and expensive. Biotechnology can play a significant role in the formation of hazardous waste treatment processes. Bioprocesses for treating dangerous wastes are a good technology since they are cost-efficient and can result in total hazard elimination and mineralization. Nature's process of recycling wastes, or degradation of organic material into the nutrients that may be utilized by other species, is called biodegradation. Few kinds of environmental toxins can be decreased or entirely eradicated by utilizing these natural forces of biodegradation. This article provides an updated description of the biodegradation process for a variety of hazardous wastes, including oil, plastics, pesticides, and radioactive waste.

7.Zia-ur-Rehman et al., (2016) [7] Because of many natural environmental and anthropogenic processes, cultivated lands are continuously breaking down and their expanse is rising. Soil degradation through salinization, erosion, and waterlogging, among other factors, makes it difficult for plants to thrive, resulting in lower agricultural output. Hydraulic conductivity, Osmo-deregulation, bulk density, inadequate aeration, including specific ion toxicities all affect soil physical, chemical, as well as biological properties. To address this issue, a variety of management and reclamation methods are available, but the main aim is to optimize the most cost-effective and environmentally friendly approaches. Different halophyte species and contemporary irrigation technologies can be used to cultivate saline soils. In saline soils, appropriate leaching of soluble salts is aided by conservation and effective as well as adequate use of good quality water. Different additions that offer soluble calcium to alter exchangeable salt adsorbed on clay surfaces that are being used to rehabilitate saline-sodic including sodic soils. Different additions can deliver calcium to the soil directly as well as indirectly by dissolving native calcium from calcium carbonate previously present. Giving appropriate soil surface cover, either in the form of mulching or vegetative cover by fodder including wild shrubs, can help to restore degraded soils. Various studies show that in bad conditions in which chemical treatments are uneconomical, tree plants produce good net returns on investment as well as a crucial net benefit as well as societal consequences from these sites. These data imply that versatile approaches to afforesting abandoned degraded soils offer a significant return on investment. This chapter provides an overview of degraded soils, including their origins, extent, and sources, as well as management and reclamation strategies.

III.PROPOSED METHOD

Vegetation degradation, sandy desertification loss of wetlands, urbanization, as well as secondary salinization were identifying as five significant biological degradation processes in the current study. Table 1 provides a more detailed description of these processes.

Table 1 Description of the prominent environmental

Main processes and land-use subtypes	Explanation of degradation processes
Sandy desertification • Sand • Bare land • Infertile land • Tundra	Desertification refers to the change of land resources into bare land, sand, bare rock as well as wasteland. Many hectares of land is predicted to be tolerated from desertification
Secondary salinization • Salty land • Wasteland • Swampland • Unused land	Secondary salinization is referred to the collection of electrolytes in the surface soil of arable land, converting the later resources into the salinized land. Secondary salinization due to human activity, more generally from poorly-controlled irrigation
Urbanization • Cities and towns • Industrial land • Military regions • Mining land • Docks	Extension of non-agricultural land rise the pressure on agricultural land somewhere, probably prompting reclamation of marginal land areas and/or rising environmental destruction. In that manner, this extension is an indirect land degradation process that is affecting food security
Vegetation degradation • Date Palm • Orchard • Vegetable plots • Natural grassland	Vegetation degradation that is occurred due to consists of several reasons, such as excess grazing, inadequate land reclamation as well as insufficient use of limited water resources. Vegetation degradation is changed grassland to wasteland, and also brings about undesirable pressure on adjacent regions.
Loss of wetlands • Marsh • Lake • Reservoir and pond • Beach	Loss of marshland takes place at which wetlands are converted into bare land. Areas that are marsh are ecological resources; that is fragile and required to be conserved. The marshlands have been decreasing for few times; in a few cases, they have been altered by arable lands, in another, they are converted into the desiccated salinized land

IV.RESULTS OF BIOLOGICAL DEGRADATION ASSESSMENT

The five abovementioned degradations of organic processes and conversion rates have been incorporated for a comprehensive evaluation of biological degradation in Rajasthan Province based on predicted land-use changes. The following table shows how ecologically sensitive locations are distributed throughout the research region. In Rajasthan Province, where soil quality, climate, and land management are poor, these data reveal that the west of the province is the most prone to biological deterioration.

Table 2: Accuracy assessment of change detection

Class	Area (km2)	%
Very low biological degradation	2,521.9	10.42
Low biological degradation	3,140.6	12.98
Moderate biological degradation	4,705.3	19.45
High biological degradation	7,455.7	30.82
Severe biological degradation	6,368.8	26.33
Total	24,192.30	100

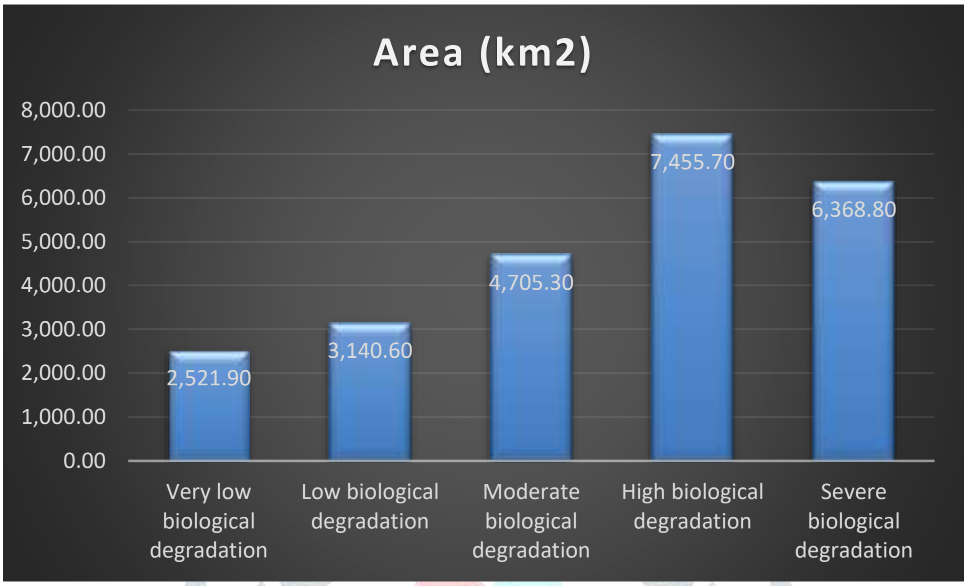

Figure 1: Graph showing Accuracy assessment of change detection

More than a quarter of the research area (26.33 percent) (6,368.8 km2) falls into one or more of the biological degradation categories shown in the table above. Areas with large to moderate sensitivity are concentrated in the west, accounting for 50.27 percent (12.161.0 km2) of the total area. Only 10.42 and 12.98 percent (5,662.50 km2) of the study area's total area, respectively, is highly or moderately sensitive to biological deterioration in the northern regions. The lower susceptibility is most likely because of the presence of enough vegetation as well as good soil quality. Biological deterioration in Rajasthan Province is caused by both natural and man-made factors, according to the conclusions of this study. According to a GIS overlay of biological break down process layers produced from multi-temporal remotely sensed images combined with the field investigation, the area of sandy decertified land in the area has grown significantly over the past 13 years. Anthropogenic (land-use change) and natural (soil index, vegetative index, climate index, drifting sand) factors were taken into account while analyzing biological deterioration. Biodegradation was found to be widespread in most of the places investigated. A greater proportion of the territory's land area was deteriorated in 2003, making the region more vulnerable to environmental change overall. For all of the province's western regions, the danger increased by 40% on average from 1990 to 2003, with a clear northwest-southeast trend in degrading conditions. Locations that had not previously been considered to be particularly vulnerable to deterioration saw a rise in degradation risk. It has resulted in a reduction in the disparity in biological degradation risk between the research locations. As the population grows and land becomes scarcer, the already fragile ecosystems of the region become even more vulnerable to conflicting (human) interests. Overuse of natural resources and poor land management are only two examples of human inaction that have led to the current state of affairs.

V.CONCLUSION

Encroachment on the ecosystem is an arduous undertaking. These three metrics were used to monitor the soil's biological degradation process by tracking vegetation shifts on the surface and the movement of sand grains in the top layer of the soil. Data from a land-use variation survey was utilized in this study to explore if the hypothesized link between land use/cover variations and biological degradation in India's southern states could be investigated. When the GIS was utilized to link together multiple databases, it was able to provide a realistic picture of biological deterioration within the research region. In the southern part of India, land use patterns are fast-shifting, which has a negative influence on the environment, according to a study. According to the latest data, the rate of land degradation appears to be increasing, particularly in Rajasthan Province. These undesirable LUCCs may have been exacerbated by insufficient government policies that fostered land deterioration. Real estate, economic development zones, as well as high-tech industrial parks, have fueled a huge increase in demand for cultivated land that has been taken over by non-agricultural uses. It is clear to the Indian government, however, that land degradation will stifle long-term growth. Land degradation has indeed been addressed through certain basic and practical techniques, but it is far from sufficient given mounting population pressures and the need for natural resources for rapid economic growth. Strategies for controlling and restoring adverse vegetation cover changes should be implemented. Because of this, it is imperative that environmental monitoring and regional planning in this area take priority. To deal with a wide range of environmental challenges in the southern part of India, a professional arid environment center has to be established, according to this study. It's also important to compare Rajasthan Province's position to that of other big cities in emerging nations that are undergoing similar degradation processes, such as Mumbai and Delhi. Remote sensing and Geographic Information

Systems (GIS) tools may open up a new field of comparative environmental research, providing a comprehensive picture of how land-use patterns and processes in India have changed as the result of biological deterioration.

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