Protecting, Restoring and Promoting Sustainable use of Land to Protect Planet Earth

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Received 08.04.2025 **received in revised form** 03.05.2026, **accepted** 10.05.2025
DOI: 10.47904/IJSKIT.15.1.2025.55-60

Abstract- Desertification and land degradation is occuring at an alarming rate in dry lands of the globe. Over 2 billion hectares of land worldwide are degraded. It is estimated that 12 million hectares of land is lost to degradation affecting 40 per cent of population especially rural population, small farmers and poor people in underdeveloped countries. There are large number of reports that indicate extinction of a sizable number of plant and animal species. Global warming and climate change due to excessive release of green house gases and carbon emissions in the environment and uncontrolled human activities exacerbate desertification and land degradation. Steadily increasing population particularly in the developing countries and the pursuit of better living conditions led to an increasing use of energy which released large amount of green house gases in the atmosphere causing more frequent and intense droughts and prolonged heat waves. This global problem has been recognized by the United Nations as life threatening to millions of people and therefore listed as goal no. 15 under Sustainable Development Goals and it was decided to restore 150 million hectares of the deforested and degraded land of the planet by 2020 and 350 million hectares by 2030, and revive native plant life to the landscape. Forests, mangroves, coral reefs, peat lands and other ecosystems that support life also store a large amount of carbon, hence their protection is equally important for mitigating and reversing climate change, which is essential for stopping of further spread of desertification. In this paper efforts initiated at International and National level to mitigate further land degradation to save Planet Earth are reviewed.

Keywords– Land degradation, Desertification, Climate change, Sustainable development

1. INTRODUCTION

As per the India Meteorological Department, India faced extreme weather situations on 93% of the days during the first nine months of the year 2024. These were marked by heat and cold waves, cyclones, thunder storms, heavy rains, floods, Land slides and droughts in different parts of country. These unprecedented events claimed 3238 lives, affected 3.2 million hectares of crops, destroyed 235862 houses and buildings and killed approximately 9457 domestic animals. In 2024, 27 states and union territories faced rise in extreme weather days as compared to previous year [15].

Jammu and Kashmir, colder region of India also recorded temperature as high as 35.6°C which is highest in the last 25 years. Global temperatures have been rising steadily due to excessive release of greenhouse gases in the atmosphere. According to the Intergovernmental Panel on Climate Change (IPCC) the average global temperature has risen by 1.4°C above pre-industrial level. [8]

Approximately 47 per cent earth's surface is occupied by deserts which include both arid and semi-arid regions. A desert is defined as a region which receives less than 250 mm of rainfall in a year, and also little precipitations. Deserts are classified according to their geographical location, precipitation they receive and temperature conditions. Arctic and Antarctic Deserts are cold deserts, Sahara, Arabia and Syrian Deserts are hot deserts and Thar Desert in India is a Monsoon Desert.

Climate change intensifies desertification and land degradation. Unusual rise in temperatures, intense heat waves due to climate change cause [13] uneven distribution of rainfall, intense droughts, heavy downpour, floods, landslides, wildfires etc.

According to IPCC working Group I heat waves in India are 30 times more likely now than they would be without climate change [16]. March 2025 has, witnessed heavy snowfall, cold waves and land slides in Uttarakhand, Himachal Predesh and Jammu and Kashmir.

Desertification is defined as the severe form of land degradation in arid, semi-arid and sub-humid regions. Desertification and land degradation pose serious threat to the local and global ecosystems. It

reduces land productivity, harm biodiversity and induct negative changes in vegetation properties.

2. HOW SERIOUS IS DESERTIFICATION?

UNCCD compiled data [7] from 126 countries and provided a comprehensive report on global land degradation situation. The report revealed that land degradation worldwide is spreading at a very high rate all across the planet. Between 2015 and 2019 the world lost 100 million hectares of productive land annually. Some regions such as eastern and central Asia, western and southern Asia, Latin America including Carribbean have experienced land degradation faster than world average.

Land degradation and desertification is caused by several factors such as severe and prolonged dry weather along with hot wave conditions. Global warming and human activities that pollute the quality of land and water resources by discharging highly toxic effluent without treating it. Agriculture is also a major contributor to land degradation, Deforestation, that is, cutting of trees for agriculture and urbanization to fulfill the needs of growing population is also a major cause of desertification and land degradation. It also adversely affects biodiversity. It is estimated that 50 per cent of savannahs and 70 per cent of grassland globally have been either destroyed or altered by cultivation [11].

The Food and Agriculture Organization [FAO] in its report of July 2024 stated that between 1990 and 2020 about 420 million hectares of forest land were converted to other land uses [4]. However annual deforestation rates fell from 15.8 to 10.2 million hectares between [1990-2002] and [2015-2020] periods. As of 2020 forest covered land is 4.1 billion hectares which is about 31 per cent of the total land area of the Earth. Degradation of land adversely affect water sources and reduce food production. It is estimated that if desertification and land degradation is not controlled and reversed it may lead to 12 per cent decrease in global food production and 30 per cent increase in food prices by 2040.

3. INCREASED WILDFIRES AND LAND DEGRADATION

Rising temperatures and low rainfall has resulted in wildfires in several parts of the world. The dry conditions, combined with naturally occuring winds, can produce fast-spreading and dangerous fire out breaks. Recent wildfire in Califorina [18] is an example of it which has resulted in an estimated loss of 135 billion U.S. dollars. It is one of the costliest wildfire disasters in modern U.S. history. According to California Department of Forestry and Fire Protection the fire started on January 22, 2025 killing 10 people, displacing tens of thousands of people and destroying 18000 structures.

In Australia bush fires are widespread and occur regularly. Eastern Australia is one of the most fire prone region of the world. The fires destroy significant property and also result in the loss of both human and animal life. Between August 2023 and June 2024 bush fires are responsible for killing 10 people, destroying 171 homes, 10200 km of fencing, farmers' crops and killed approximately 57000 farm animals. Significantly dry and warm winter over much Australia during 2023-2024 considerably increased the fire risks.

According to NASA Earth Observatory [19] largest wildfire in the eastern part of Japan broke out on February 26, 2025. Due to dry and windy conditions the fire destroyed 2100 hectares of forest land near Ofunato, a small port city 400 km north of Tokyo. In addition to burning through forest land, the fire destroyed dozens of structures and more than 4500 people were evacuated.

On March 21, 2025 unprecedented wildfire broke out in the south eastern region of South Korea, which later on spread to the several neighbouring countries. Apart from destroying 17000 hectares of forest, killed 24 people and gutted 1300 year old historic Buddhist Temple in Uiseong city.

Uttarakhand state of India also experienced widespread forest fires [20], with a large number of incidents spread over 11 out of 13 districts during November 2023 and June 2024. In the Garhwal region forest fires were reported from Uttarkashi, Pauri, Rudraprayag, Chamoli and Dehradun whereas in the Kumaon region, such incidents occurred in Almora, Bageshwar, Pithoragarh and Udham Singh Nagar. Forest fires have destroyed forests, damaged biodiversity and natural water resources. During this period 910 incidents of wildfires were reported killing 5 people and destroying 1000 hectares of forest. In 2020 Uttarakhand had 1.66 million hectares of natural forests spreading over 31% of its land area. Since then, it has lost significant area of natural forests.

The factors which have contributed to the sudden increase in wildfire in Uttarakhand include decline in rainfall during rainy season, rising temperatures in both plains and hilly areas and irregular rain and snowfall due to active El Niño. Apart from these reasons several cases have come to the light that several parts of the forests near proposed government projects and main roads were burnt deliberately. After clearing the forests efforts are being made to change the land use of those parts from forests to agriculture or commercial activities.

4. AI BOOM AFFECTS BADLY THE ENVIRONMENT

Construction of giant data centres badly affect environment. Under Paris Protocol it was resolved that all nations including U.S. and China will reduce carbon emissions so as to keep the rise in global average temperature below 2°C above pre-industrial levels. In the process all nations are expected to reduce carbon emissions by 33 to 35 per cent by 2030 from 2005 level.

According to Berkeley Earth the global average temperature rise has already crossed 1.5°C in January 2024. In spite of the commitment made by companies like Google, Meta and Microsoft to be carbon neutral by 2030 and Amazon by 2040, these are now moving in the wrong direction. They are constructing giant data centres in support of AI. These data centres are like huge bunkers and require great amount of concrete and electricity to house, secure, power to cool hardware of AI. The U.S. is currently having 5000 data centres and it is expected that their number will grow around 450 per year till 2030. Worldwide the current-number of data centres in 10,000 which consume thousands of MW of electricity. To construct these data centres millions of tonnes of cement concrete is required [14]. Manufacturing of concrete especially cement and steel within it is a major contributor to climate change, accounting for about 6 per cent global green house gas emissions. China is not behind; it consumes more than half of the concrete produced and used in the world. Morgan Stanley has projected that these data centres in U.S. alone will release about 2.5 billion tonnes of CO2 each year by 2030 which is about 40 per cent of what the U.S. currently emits from all sources. Similar data from China are not available but it can easily be understood that the green house gases released by China will in any way not less that released by the U.S.

5. INTERNATIONAL EFFORTS TO COMBAT DESERTIFICATION AND LAND DEGRADATION [7]

In 1991 United Nations Environment Programme (UNEP) recognized seriousness of the problem of desertification and land degradation in arid, semi-arid and sub-humid areas and concluded that degraded land areas are on an increase and it is a problem of major economic, social and environmental concerns to many countries. On the recommendations of the Earth Summit held in 1992 at Rio de Janeiro UNCCD [United Nations Convention to Combat Desertification] was established in 1994. The European Union and 197 counties including India are Parties to the Convention. UNCCD holds Conferences of Parties at regular intervals in different parts of the world. The last conference was scheduled from October 21 to November 1, 2024 at Colombia. The main focus is on protection of planet's biodiversity as global biodiversity is declining at an alarming rate.

The protection of planet's biodiversity is as important as controlling and reversing global warming and climate change. Nearly half of the global GDP depends on natural ecosystem, that is forests, grasslands, mangroves coral reafs, peatlands etc. They also hold large amount of carbon and provide shelter to a large number of animal and plant species. If these are not protected nearly 25 percent of them may get extinct. Stopping and reversing land degradation can restore the land as it can act as a carbon sink by holding stocks of carbon in soils and vegetation.

Under United Nations Environment Programme some Countries have shown progress in combating land degradation. For example, in Sub-Sahara Africa, Botswana curtained land degradation from 36. per cent to 17 per cent, The Dominican Republic curtailed degraded land from 49 per cent to 31 per cent between 2015 and 2019, Uzbekistance curtailed degraded land by 26.1 per cent and also Central Asia region curtailed degraded land from 30 per cent to 26 per cent.

A number of UN conventions and fora such as UNFF, UNCBD, UNCCD, UNDP, UNEP, RAMSAR, UNCITES etc. at international level provide support for the achievement of SDG-15. However, conservation efforts to protect wild life, migratory birds etc. are continuously hampered by wildlife poaching and illicit trafficking. To stop it stringent rules within the countries and cooperation across regions and continents are required.

In India various government organizations such as Ministry of Environment and Forests (MoEF) Defence Research and Development Organization (DRDO), Department of Science and Technology (DST), National Mission for sustaining the Himalayan Ecosystems (NMSHE) and several other research organizations are working towards achieving goals of SDG-15. Due to serious efforts made by these organizations an increase in forest cover of 1540 km square has been observed in 2021 as compared to 2019. To achieve targets of SDG-15, the Government of India has initiated several important schemes through policies such as National Environmental Policy, National River Conservation Policy, Natural Resources and Ecosystem Conservation, National Biodiversity Conservation etc.

Sustainable development goal-15 related with a stopping and reversing land degradation and desertification to save planet earth cannot be

achieved by the efforts of governments alone. Every human being will have to be involved in "green works" and other activities related with them. Research organizations and institutes of higher learning must involve local population by educating them for the conservation, restoration and sustainable use of different ecosystems.

6. CURRENT STATE OF LAND DESERTIFICATION IN INDIA

Recently a document published by Indian Space Research Organization [ISRO] named Desertification and Land Atlas [6], shows that desertification and land degradation has increased significantly in recent years. The Atlas provides a state wise area of degraded lands for the duration of 15 year, that is, from 2003-05 to 2018-19. Around 23.79 per cent of the area underwent desertification and land degradation with respect to total geographical area of the country. It occurred mainly in the states of Rajasthan, Maharashtra, Gujarat, Karnataka, Ladakh, Jharkhand, Odisha Madhya Pradesh and Telangana. Climate change conditions are responsible for the spread of arid regions. Surface runoff caused by heavy downpour over short durations erode soil cover causing degradation and adversely affect the ecology. On the other hand, prolonged droughts or unevenly distributed monsoon rain reduces the recharging of underground water table. Water table further goes down due to drawing of more water by farmers for irrigation. Satellite data have revealed that about 6 to 20 per cent ground water get depleted due to 10 to 15 per cent reduction in summer monsoon with a rise in average winter temperature from 1°C to 4°C. This reduction in the level of water table also causes water contamination. [9].

7. THE LAND DEGRADATION AND ITS RESTORATION IN THAR DESERT [19]

The Thar Desert also called the Great Indian Desert lies in the North-Western part of India and is the world's nineth largest hot subtropical desert/monsoon desert. About 91 per cent of the desert lies in the state of Rajasthan. The rest part lies in the states of Punjab and Haryana in the north and in the state of Gujarat in the south. Among all the deserts on the earth, Thar desert Is the most densely populated desert. It is expanding gradually towards Delhi and NCR region due to change in rainfall pattern, unchecked mining activities in the region of Aravali Hills, human activities and unscientific plantation drives etc. Unchecked human activities such as application of new agriculture techniques, overgrazing by animals, excessive extraction of ground water, human settlement in the river basin area etc. have resulted in destruction of ecological system and loss of biodiversity, Banni grassland [10] which lies in Kutch area of Gujarat is the southern part of Thar desert. Once it used to be fine natural grassland has been completely degraded due to overgrazing. Also change in land use of around 18000 hectares of land in Kutch has destroyed the soil property to such an extent that its revival has become a challenge to restore it. In 1960-61 the wrong decision to plant foreign plants in large spaces to stop the advancement of Rann of Kutch has done more harm than good to local species [10].

8. ACTIONS REQUIRED TO CHECK SPREAD OF THAR DESERT [19]

In order to stop spread of desertification and land degradation towards eastern part of Rajasthan and towards Delhi and NCR Region the Central and State Governments must frame appropriate rules to curb unlawful mining activities in the hilly area of Aravali ranges, restrict excessive use of ground water, encourage recharging of ground water table, restore local ecological system and biodiversity by planting native plants like Khejri, Rohida, Neem, etc. Native plants will not only support desert ecosystem but also provide valuable products like desert fruits, wood for furniture, fodder etc. The State Government should provide training to public and private agencies, rural and tribal communities regarding afforestation, reforestation and soil conservation tools and techniques. Central Government should develop and adopt new polices for sustainable development of landscape by making use of remote sensing data and cloud computing and also guide farmers to make optimal use of water and neutriants required for dry farming.

9. NATIONAL EFFORTS TO COMBAT DESERTIFICATION AND LAND DEGRADATION IN INDIA

The Indian arid zones cover an area of 320,000 km^2 [4] and is and under steep pressure of population rise and increasing dependency on limited resources. Government of India is determined to reverse climate change and further spread of desertification. Various research institutes like CAZRI and AFRI in Rajasthan and Gujarat Institute of Desert Ecology [GUIDE] were established which have been working on various sustainable projects for improvement of dry lands and their communities. Apart from establishing research institutes the Government of India launched and implemented since 2000 National Afforestation Programme with the purpose to do afforestion of degraded forest lands. It also prepared

in 2001 National Action Programme to Combat Desertification [2].

In 2014 It also launched National Mission for Green India or Green India Mission [GIM] [5] with the objective of promoting, restoring and enhancing India's decreasing forest cover with a deadline of 10 years. It is one of the eight missions launched under National Action Plan on Climate Change [NAPCC] with the objective to safeguard the biological resources by protecting forestry and at the same time to provide food-water-and livelihood security to forest dependent communities, GIM focuses on multiple ecosystem services.

Recently to manage forests and to combat desertification, the Government of India increased the number of indicators from six to fourteen [5], to check the performance on different aspects of SDG 15 such as percentage change in forest cover, tree cover, per capita income of Himalayan States, biodiversity target etc. The Government of India also initiated steps for Conservation of natural resources and restoration of ecosystems, prevent pollution of rivers, development of river fronts etc.

10. CONCLUSIONS

Our life on the planet earth depends upon preserving the ecosystem of natural environment. Deforestation, land degradation and loss of natural habitats have caused a serve damage to ecosystem. Forests are natural homes to a large number of species of plants, animals and insects. The livelihood of large number of human population depends upon forests. Deforestation and land degradation worldwide has affected adversely human population especially poor people in the underdeveloped countries.

Any activity performed by human beings disturbs natural environment. If the disturbance is within limits the nature restores the system. But due to massive requirement of food products and excessive demand of energy to satisfy the needs of increasing population the forest area worldwide is declining at an alarming rate due to change in land use. Apart from conversion of land use, increased greenhouse gas emissions, wildlife trafficking and poaching of wild animals. are also of great concern. Now looking at the current scenario, it is not only necessary to protect and preserve life on the planet but to reverse the trend by promoting sustainable use of the ecosystem.

United Nations under its sustainable development goal 15 has set 18 targets some of which were required to be achieved by 2020 and some by 2030[5]. But unfortunately, the progress in achieving these targets is either very slow or almost nil. According to Global Forest Resources Assessment report [7] around 31% of the world's land area was under forest cover in 2020 which has recently declined in tropical regions and rain forest regions. Biodiversity has also found to decline in all regions of the world according to the report published by Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services. However, in some countries namely Botswana, Dominical Republic land degradation has reduced due to efforts made by them.

Digital technologies such as AI, remote sensing GIS can be effectively employed for tracking land use, deforestation, habitate loss, illegal human settlement and cultivation of crops on forest land, excessive use of ground water, illegal mining, poaching of wild animals, forest fires, land slides etc. and accordingly sustainable management practices can be employed effectively. Digital techniques can also be used for educating masses about efficient and sustainable use of green energy, preserving natural ecosystem by controlling carbon emission into the atmosphere. To save planet earth it is not only essential to stop further land degradation and desertification but also to restore the already degraded land.

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