



Research Paper

## Ecosystem Degradation and Need for Restoration: Through the Lens of Environment and Human Health

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*“What is the use of a house if you haven't got a tolerable planet to put it on?”*

— Henry David Thoreau

As per World Health Organization Decision making Tool, every minute, 5 children die from malaria or diarrhea in developing countries. Every hour, 100 children die as a result of exposure to indoor smoke from solid fuels. Every day, nearly 1800 people in developing cities die as a result of exposure to urban air pollution. Every month, nearly 19,000 people in developing countries die from unintentional poisonings. Think, is it possible for us to decorate ourselves healthy in so much filthy dirt? The one and only answer to this question is “NO”.

If we have a glance at the pages of ancient records and observe the theory of ‘Sphere’, we will have the postulations visible from Frederic clement’s ‘Biome’ to Kostler’s ‘Holon’. On this basis, no one can deny the image of “Ecosystem”, which was coined by A.G. Tansley, an English botanist in 1935. It is a geographic area where plants, animals and other organisms as well as climate and landscape, work together to form a bubble of life. In other words, an ecosystem is a chain of interaction between organisms and their environment. This chain of interaction have started breaking down when Beaumont et al. talked about few environmental crises such as the release of dioxin after a major chemical explosion of Givaudan’s plant of Roche Holding AG, at Seveso in 1976; A leak of poisonous fumes(MICgas) from Union Carbide’s plant at Bhopal in 1984; the explosion at the Soviet nuclear plant at Chernobyl in 1986; the ‘NIMBY’ syndrome of the 1988 voyage of the polychlorinated biphenyls toxic waste-laden Karin B barge to find suitable treatment capacity; the 1989 oil spills into Prince William Sound off Alaska from the Exxon Valdez; Saddam Hussein’s deliberate oil releases in Kuwait during the Gulf War; the 1993 oil spillage the Bracer along the Shetland Island’s southern coastline; threat to biodiversity and other natural resources from organized terrorism, smuggling, international underworld people etc; the destruction of Russian nuclear submarine in Barrant Sea in the year 2000, resulting in threat of radioactive contamination to marine ecosystem. However the two type of Ecosystem i.e. Terrestrial Ecosystem and Aquatic Ecosystem, are now passing through the top of double edged sword. No doubt we the human being living in the terrestrial ecosystem, we are hurting ourselves by scraping all the ecosystems under this land-based area like Forrest Ecosystem, Grassland Ecosystems, Tundra Ecosystems and Desert Ecosystem. Both biotic and abiotic components are disassembled as a consequences. Both the Holological and Merological methods reveals there is a dispersion in laws of Thermodynamics and rapid transformation of Entropy. Hence the Formal and Informal model of presenting Ecosystem lost their dignity on the basis of ecosystem’s dynamics and productivity. The forcing function including solar radiation is becoming so aggressive that both Intra holonic principal flow pathway and Auxiliary flow pathway are facing complexities in the form of Divergence, Bimodality/Multimodality, Discontinuity and Hysteresis of ecosystem. The scenic beauty of earth is demolished by our misdeeds. All types of Ecosystem present on earth lost the Resistance stability and Resilience stability. There is an imbalance in between earth and ecosystem. This balance may be disturbed due to the introduction of new species(micro-organisms like COVID-19), the sudden death of some species(extinct species like polar bears), natural calamities or man-made disasters.

Ecosystem disruption changes may be driven by many factors including economic growth, population growth, urbanization, intensification of agriculture, rising energy use and transportation.

There are various examples of our violent attitude that have destroyed our Ecosystem. The carpet bombing of the lush green forests during the Vietnam war led to the loss of habitat of many species. Statistics show how population has increased from the industrial age and how it will affect the environment. In the name of development, we are setting trees on fire and cutting down vegetation, we modify how we use land, and keep expanding paved areas. All of this has an impact on not soil ecology as well as water balances. Increased urbanization also necessitates more water to feed the city's population and industry, often requiring deeper and deeper wells to be drilled or water to be moved from even more distant locations. Increase of pavement area not only lessens the amount of water vapour that transpires back from the vegetation but also contributes to groundwater pollution if the salt used to melt road ice were allowed to runoff into the natural drainage system.

“Armenia”: A live example of threatened ecosystems continues to face problems with respect to air, water, soil pollution, and that may bear significant political and economic consequences cannot be erased from our mind. India supports 17 per cent of the world population on just 2.4 per cent of world land area. Its current rate of population growth at 1.85 per cent continues to pose a persistent population challenge. In view of the linkages between population and environment, a vigorous drive for population control need hardly be over emphasized.

The factors like degradation of land and Soil Erosion, Deforestation, Faulty Utilisation of Water Resources, Environmental Problems from Faulty Mining Practices and Industrial and Atmospheric Pollution are some important points highlighting the ecological imbalance in entire world including India.

The life on earth is kinship in a way that proves that whatever we give in to the earth never simply disappears. Contaminants reach the humans in the form of the food they eat, the air they inhale, and the water that they drink. Everything is interconnected in some way or another. Children and the elderly are the most vulnerable to environmental injury, as their immunity is questioned for a variety of reasons. Pesticides and chemicals like hormones and antibiotics used promoting animal growth are also present in the food we eat.

India has been reported about the serious problem of land degradation and soil erosion. Around 174 million hectares (i.e., 53 per cent of the total land area) of land in India is facing the serious problem of land degradation out of which a 144 million hectares is subjected to soil erosion through water and wind and the rest 30 million hectares is subjected to other problems. In addition, heavy population pressure has led to conversion of forest and permanent pastures into crop lands leading to indiscriminate grazing. Some soils are naturally rich in toxic elements. Nickel rich soils of new Caledonia or serpentine soils to which unique groups of plant species become adopted and become toxic for human health. Human activities have resulted in soil contamination via fallout of air pollutants, discharge of liquid industrial or agricultural waste or dumping of solid waste. Chlorinated hydrocarbon pesticides and PCBs tend to remain unchanged in the soil for many years. Soil particles less than 5 micrometre are likely to reach the alveoli. Other particles may settle on food or water and be ingested.

Large scale deforestation has been progressing since independence due to over-exploitation and mismanagement of forest resources. During the first two decades of planning (i.e., from 1951 to 1972) India lost about 3.4 million hectares of forestland out of which about 70 percent was lost in river valley projects, roads and communications and industries. A hypothetical line called Dampier Hodges line is assumed by the foresters to demarcate Sundarban from northern part of Bengal. Previously it was the roaming ground of famous ‘Royal Bengal Tiger’, spotted deer, fishing cats, wild boar, rhesus monkeys, mongooses, pythons, besides large crocodiles and sharp-toothed sharks in the estuarine water. But now the line lost its importance due to extinction of the species. Coral reefs continue to suffer degradation.

A recent booming of shrimpculture has become a big threat to sundarban’s natural detritus food chain. Thousands of villagers are involved in collecting shrimplings from the tidal waves using small mosquito nets; after bringing the collected material on shore, desirable shrimplings are sorted out for selling to aquaculturists and the remaining infant organisms of other species, larvae-meroplanktons etc. are destroyed instead of returning to the sea. Considering the gradual increasing stress due to depletion of detritus output from vanishing mangroves and the number of people involved in such shrimpling collection activities, their long term effects may be futile. Scanty availability of meiofauna may lead to stoppage of visiting by economically important water fowls of higher trophic levels creating loss to natural fishery.

Industrially polluted water of the Ganges is also a cause of great concern. Accumulation of toxic chemicals and heavy metals may lead to several emergent undesirable consequences including the scanty availability of ‘Hilsa’. A term ‘walking mangrove’ is hardly used for Sundarban by foresters due to trapping of alluvial soil of the river by its elaborate horizontal and vertical network of rhizomes and consequently extending the delta towards sea. This also results in southwardly shifting of mangrove forest itself through vegetative as well as viviparous propagation. Deforestation is still continuing at a rapid scale and the problem has reached to such a proportion that it has totally disturbed the ecosystem of the country.

The National Committee on Environmental Planning has revealed that less than 12 percent of total geographical area of the country is covered by adequate tree. However the official statistics show it as 22 per cent of the total geographical area. The degree of deforestation is maximum in Himalayan ranges from Kashmir to North-East India. All these have led to an ecological collapse in the country.

India, despite being one of the wettest countries on the planet, continues to suffer from floods and droughts as a result of inefficient water management. Since independence, too much emphasis has been placed on the construction of large dams. However, these massive dams have displaced cores of tribal people, drowned millions of hectares of valuable forest, failed to prevent and regulate floods, and often created destructive flash flood in the downstream valley.

The recent available data shows the area affected by floods in India has increased from 20 million hectares in 1971 to 40 million hectares at present. Furthermore, due to continual water logging and increased soil salinity, these massive dams and multi-purpose projects have had an environmental impact in the form of soil degradation in the command regions. The Indo-Genetic plains of Uttar Pradesh, Punjab, and Haryana account for the majority of the areas threatened by rising salinity.

Large-scale mineral extraction in India is causing major environmental concerns, destroying the country's land, water, forest, and air. Mining on a large scale has led in the conversion of agricultural and forest land into stockyards, townships, highways, railway lines, and other structures, as well as the removal of vegetation and top soil.

The disposal of mining waste, as well as mineral dust from mines, pollutes the air and reduces agricultural production. Due to overexploitation, underground mines frequently cause land subsidence. Mining activity also pollutes water resources by allowing rainwater to flow into rivers and streams after passing through mineral wastes. Large-scale deforestation, soil erosion, and different health concerns to humans in the form of respiratory problems have all been associated with mining operations. As a result, measures were made under the revised Mineral Policy of 1993 to keep an eye on the pollution caused by mining operations.

In India, unplanned and uncontrolled growth of industries and poorly-maintained automobiles are creating huge atmospheric pollution regularly leading to huge environmental problems. The main atmospheric pollutants include carbon dioxide, carbon monoxide, oxides of nitrogen, sulphur dioxide, hydrocarbon and metallic traces. Oxides of nitrogen leads to excess ozone formation which causes respiratory illness as well as atherogenesis. Ozone depletion is responsible for perhaps 300,000 additional cases of skin cancer a year and 1.7 million cases of cataracts. Besides some specific pollutants are also being mixed with atmosphere which include lead from automobile emission, urea dust from fertilizer factory, cement and lime dust from cement factories, increasing radiation of nuclear power stations etc.

In the aftermath of 1970s fuel crisis, newly constructed “energy-efficient” office buildings tended to be relatively airtight and fuel conservation programs greatly reduced the amount of fresh air added to air conditioning. This contributed to “sick-building syndrome”. Moreover, industrial wastes coming out of fertiliser factories, paper mills, and leather factories are constantly being discharged in rivers, lakes and seas, creating huge health hazards for the population of the country. Radon, a decay product from naturally occurring uranium in soil, occurs in gaseous form and emits alpha particles that cause lung cancer.

Poverty is said to be both cause and effect of environmental degradation. The circular link between poverty and environment is an extremely complex phenomenon. Inequality may foster unsustainability because the poor, who rely on natural resources more than the rich, deplete natural resources faster as they have no real prospects of gaining access to other types of resources. Moreover, degraded environment can accelerate the process of impoverishment, again because the poor depend directly on natural assets. Although there has been a significant drop in the poverty ratio in the country from 55 percent in 1973 to 36 percent in 1993-94, the absolute number of poor have, however, remained constant at around 320 million over the years. Acceleration in poverty alleviation is imperative to break this link between poverty and the environment.

Beginning from the non-communicable disease to Anti-microbial resistance and climate change; the public health threats are persistently bruise human life in this era. Climate change is one of the “crisis multiplier” in modern era globally due to uncontrolled Global warming. The ramifications of climate change diverge from agricultural damage, imperilled food security, to sea-level rise and the accelerated erosion of coastal zones escalating the intensity of natural catastrophic events, species extinction, and spread of vector-borne diseases. All the public health authorities are daunted by both the direct and indirect effects of climate change.

The term “Deadly Dozen” means set of twelve causing death. First time the public health experts from the Wildlife Conservation Society broadcast a report on October 2008 called “Deadly Dozen: Wildlife diseases in the age of climate change.” This report accounts 12 pathogens that could spread into new geographical area as a result of climate change. All of the 12 pathogens have potential impacts to human and wildlife health as well as global economy. The study depicted the fundamental detrimental effects of climate change on the health of animals and examined the nuts and bolts of deleterious impacts of climate change on the health of wildlife and

the spewing effects on human populations. A broad range of infectious diseases which are threaten human being are enlisted in the “Deadly Dozen”. It is not a comprehensive one because subsequent studies may eliminate pathogens from the list of those enabled by climatic changes. The list includes the micro-organisms which are spread as a result of changing in temperature and precipitation level. Avian influenza, Babesiosis, cholera, Ebola, intestinal and external parasites, Lyme disease, Plague, Rift Valley Fever, trypanosomiasis, tuberculosis and yellow fever are the infectious diseases enlisted in “Deadly Dozen”. It also includes harmful algal blooms that make toxins those are deadly to both humans and wildlife commonly known as “red tides”.

To a large extent, ecosystem degradation is the result of market failure, that is, the non-existent or poorly functioning markets for environmental goods and services. In this context, the degradation is a particular case of consumption or production externalities reflected by divergence between private and social costs (or benefits). Lack of well-defined property rights may be one of the reasons for such market failure. On the other hand, Market distortions created by price controls and subsidies may aggravate the achievement of environmental objectives.

Transport activities have a wide variety of effects on the environment such as air pollution, noise from road traffic and oil spills from marine shipping. Transport infrastructure in India has expanded considerably in terms of network and services. Thus, road transport accounts for a major share of air pollution load in cities such as Delhi. Port and harbor projects mainly impact on sensitive coastal eco systems. Their construction affects hydrology, surface water quality, fisheries, coral reefs and mangroves to varying degrees. Habitat fragmentation carries long term environmental impacts some of which can destroy entire ecosystems.

Thus we have to think about the great lines said by Leonardo DiCaprio:

*“Our planet’s alarm is going off, and it is time to wake up and take action!”*

In running Ecosystem, the arrival and nature of such complexities may be unpredictable. So prediction models, management models, future strategic action plan development models need high degree of precision and sufficient information for correct decision making. There is a need to be refinement of Deterministic model including (Dynamic model and matrix model), Stochastic model (ANOVA , Regression model, Distribution model) and Markov models as well as Multivariate model for the Restoration planning and policy making process. The balance between the transformation of resources and the protection of environment must recognize the key macro ecological and economic factors regulating human development: philosophical and cultural, political, financial or investment( economic), societal, technological and environmental.

The key challenges to attain sustainable levels of human health and Ecosystem Restoration are limiting extreme population growth rates; enhancing human capability, skills and employment; ensuring food security through integrated agricultural development; maintaining essential ecological processes and life support systems through the protection of threatened species and ecosystem; discovering safe and sustainable energy pathways; increasing manufacturing output through technological adaptation and diversified use of raw materials; enhancing the capacity to produce and manage urban infrastructure, services and shelter for a growing population.

Unless we change our ways and protect and restore our ecosystems, we will not only destroy the landscapes we love, we will undermine the foundations of our own well-being and bequeath a degraded, inhospitable planet to future generations. By knowing our local ecosystem, understanding the drivers of degradation and by learning the solving process, we can become ambitious for restoration of our ecosystem. Strengthening ourselves in individual level as well as group level like faith groups, teachers, youth groups, workers/ trade unions, civil society organizations, local authorities, farmers, women self-health groups, scientists and Government is most important step towards Ecosystem Restoration project.

The Ministry of Environment & Forests (MOEF) in the Government works in close collaboration with other Ministries, State Governments, Pollution Control Boards and a number of scientific and technical institutions, universities, non-Governmental organizations etc the for protection, restoration and development of ecosystem. Environment (Protection) Act, 1986; Forest (Conservation) Act, 1980 and the Wildlife (Protection) Act, 1972 , The Water (Prevention and Control of Pollution) Act’1974, The Air (Prevention and Control of Pollution) Act’1981,The Prevention of Cruelty of Animals Act’1960,The National Environment Tribunal Act’1995are some key legislation governing ecosystem restoration. The weakness of the existing system lies in the enforcement capabilities of environmental institutions, both at the centre and the state. There is no effective coordination amongst various Ministries/Institutions regarding integration of environmental concerns at the inception/planning stage of the project.

Current policies are also fragmented across several Government agencies with differing policy mandates. Lack of trained personnel and comprehensive database delay many projects. Most of the State Government institutions are relatively small suffering from inadequacy of technical staff and resources. Although overall quality of Environmental Impact Assessment (EIA) studies and the effective implementation



of the EIA process have improved over the years; institutional strengthening measures such as training of key professionals and staffing with proper technical persons are needed to make the EIA procedure a more effective instrument for environment protection and sustainable development.

Because of the interdependency of earth ecosystems international co-operation is paramount to prevent, and when disaster strikes, respond to relieve quickly and effectively the effects of environmental disasters. Thus, Governments, International organizations and communities must work together – at all levels – to lessen the risks associated with environmental degradation and its contributing factors, such as climate change, and ensure that vulnerable people are prepared to survive and adapt. At the same time, companies, organizations and individuals must also ensure that their work is environmentally friendly and sustainable.

Recently, Supreme Court has broadly and liberally interpreted the Article 21 and transgressed into the area of protection of environment and held that the protection of environment and citizen's right to live in eco-friendly atmosphere interpreted as the basic right guaranteed under Article 21. Recently to mitigate the needs of environment related litigation, "Green Benches" had been constituted in many High Courts in the Country. Some of the following decisions of Supreme Court of India has a great ramification towards the protection and safeguarding the environment and maintain the ecological balance.

We human being need to obey the legislations, step in, and ensure that the damage is curbed, and the balance is attained. Simple measures, such as conservation of electricity, use of alternative energy sources, avoiding the use of things that pollute the environment, soil conservation etc., can help in saving the environment from the threat of degradation. Environmentalists, the world over, are trying their best to save our environment, and we need to do our bit to make sure that they succeed. The need of the hour is to identify the causes of ecosystem degradation, and restore them one by one.

Regarding forest and trees ecosystem, plantation is the simple and best restoration activity. We can add trees to a garden, a public space, a farm, across a landscape or even a whole country. Selective planting can revitalize a forest degraded by overharvesting. But it is not enough to stick seedlings in the ground. Many trees will die if we don't protect or water them. People will help in this task if they are involved in the project – by helping to decide what species are planted and where – and if they expect to benefit. Local fruit trees, for example, come with delicious incentives. Always we have to remember that it is not about simply planting trees but growing them. And it should be the right tree, at the right place and the right time. Planting species that are not adapted to local conditions can lead to problems – for example if "thirsty" species suck out water from dry landscapes. "Assist natural regeneration": This low-cost restoration strategy involves creating the conditions for indigenous trees to germinate or re-sprout naturally. This can mean excluding animals that would eat young shoots and removing other vegetation, especially invasive species, that compete with the young trees for light and water. It can also mean reaching community-level agreements to protect forests and trees, and managing them sustainably so that the new trees are not all cut again later. The concept of "rewilding" is becoming more and more popular in Europe and other places, where there is enough space and opportunity to introduce species that have once been lost. Well-resourced projects can secure bigger restoration gains by looking at a whole landscape. The larger scale can make it easier to balance different interests, for instance by supporting sustainable farming in some areas to reduce pressure on forests and let trees re-grow on marginal land, or striking agreements to protect forests that provide clean water supplies to both people and nature. Forest landscape restoration provides a great opportunity for different decision makers to align – from businesses, to government agencies, to local groups.

In case of Rivers and lake ecosystem, cleaning the water source with proper disposal of garbage is the best method. By creating easy-to-use access points, for instance for animals to drink, boats to land, or people to swim and relax, we can stop the fragile vegetation, bird habitat and fish spawning grounds and reduce erosion at the water's edge. Restoring vegetation can help to restore rich habitats along the banks of rivers and lakes, creating wildlife corridors, and making a buffer zone between the water and sources of pollution, such as nearby industries or farms; remove invasive alien species. Developing fishing and harvesting plans that don't deplete the water, fish or other resources is another way to Restore. We have to Reduce and treat sewage, stop chemical pollutants, industrial waste or other effluent entering the water, Strike agreements or pay incentives to reduce the use of agricultural chemicals on adjacent land. The nitrogen used in fertilizers can pose one of the biggest threats to aquatic ecosystems. We should remove dams or other infrastructure that are no longer needed and restore natural river flow. We can campaign to keep residential development, dredging or mining out of sensitive areas.

In towns and cities we should design and support initiatives to restore waterways and wetlands, plant indigenous trees, and create urban woodland and other wildlife habitats along roads and railways and in public spaces. Rewilding public spaces by mowing grass and cutting down plants less attracts insects, birds, butterflies and even mammals to return to the city. Digital tools, like apps, can support these efforts by tracking and coordinating individual contributions. Managing One micro-ecosystem at a time and togetherly creating a mass movement for micro-restoration can go a long way to enhancing the ecology and liveability of a whole city.

Regarding Farmland and grassland Ecosystem, reducing tillage and use natural pest control and organic fertilizer on arable land to build the health of our soil and the yields of our crops while reducing erosion and the need for farm chemicals. Growing more trees and a greater variety of crops and integrating them with livestock keeping to further boost soil health, diversify our income and provide better wildlife habitat. Planting flowers along the borders of farmlands can provide valuable “feeding stations” for bees and other pollinators.

Restoration of mountain Ecosystem, replanting forests and trees to protect soil, safeguard water flows and guard against natural disasters, such as avalanches, landslides and floods, Limiting extraction and excavation are the best method.

There are so many steps in our hand such as purchasing recycled products, energy conservation, joining in awareness group, participating in health and environmental campaigns, not tossing waste into inappropriate places, advocating in environmental issues, inspecting proper disposal of hazardous waste, not dumping chemicals into the drain, keeping eyes in our water source, monitoring wells inside our house, using nontoxic versions of many popular products. At last the point of discussion is ended with a simple message “Rebuilding ecosystems requires action from everyone, everywhere”. There is still time; we must utilize the most of it before it passes us by.