https://doi.org/10.56975/ijcrt.v13i8.292468

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Biodiversity Conservation And Sustainable Development: Adressing The Twin Challenges Of Desertification And Climate Change

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ABSTRACT:

The Convention on Biological Diversity 1992 defines biodiversity as 'the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part which includes diversity within species, between species and of ecosystems'

Biodiversity is the living foundation for sustainable development. The totality of genes, species and ecosystems of a region is also called biodiversity. In an ecosystem the community of living organisms live in conjunction with the non-living components of their environment interacting as a system. They live in harmony with one another. This leads to a healthy growth of a community and thus ecological balance is maintained.

Introduction:

USES OF BIODIVERSITY:

Healthy ecosystems and rich biodiversity help to

1. Increase ecosystem productivity.
2. Support rich flora and fauna.
3. Protect various water resources, forest resources, medicinal resources and food resources.
4. Protect the environment through the degradation of pollutants and soil formation.
5. Provide recreation and enhance aesthetic value.
6. Preserve the genetic diversity of plants and animals.

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In the present 21st century the loss of global biological diversity is advancing at an unprecedented pace. About 1,40,000 species are lost each year and it is estimated that 30% of all species will be extinct by 2050. Several species are teetering on the brink of extinction. They are Bornean orangutan (Pongo pygmaeus), giant otter (Pteroneura braziliensis), Amur leopard (Panthera pardus orientalis), Darwins fox (Lycalopex fulvipes) and Sumatran rhinoceros (Dicerorhinus sumatrensis). The world is losing its tropical forests at an alarming rate of almost 42 million acres per year. This means that nearly 1.3 acres of tropical forest disappears every second.

REASONS FOR THE LOSS OF BIODIVERSITY:

I. Increase in population:

When population increases, there is huge consumption of resources which ultimately leads to depletion of valuable resources. In order to accommodate the growing population, encroachments into nearby forest areas occur leading to large scale deforestation. Due to destruction of their natural habitats, flora and fauna of that area is exterminated leading to loss of biodiversity. Population growth also results in increased emission of greenhouse gases such as CO2. Increase in CO2 in the atmosphere leads to greenhouse effect or global warming. Due to increasing temperatures several organisms which are intolerant to high temperatures are killed, the ice caps in the polar regions melt leading to rise in sea levels and submergence of coastal areas, the migration patterns and nesting cycles of birds are disturbed, the ice algae diminishes resulting in the death of organisms in the polar regions.

Development in science and technology has facilitated the use of refrigerators, air conditioners in every household. Due to this there is increased emission of chloro floro carbons or CFCs. CFCs are the major culprits destroying the ozone layer. They react with ozone forming oxygen and release chlorine.

$Cl + O_3 \longrightarrow O_2 + ClO$

$ClO + O_3 \longrightarrow 2O_2 + Cl$

The released chlorine again reacts with more of ozone converting it into oxygen and this is a chain reaction causing the destruction of ozone layer .So CFC is called Ozone eater! Ozone hole was first noticed in 1979 in Antarctica and U.S satellite photos showed that its area is expanding every year. Ozone depletion causes skin cancers and emphysema, a destructive lung disease. Through the hole, ultra violet rays reach the earth directly thereby causing death of micro phytoplankton, causes plant diseases such as ozone flecking in grapes, causes crop loss and damages leaves reducing their photosynthetic rate.

Increase in population results in overconsumption of energy resources such as coal, petrol and diesel. The use of automobiles have increased tremendously resulting in increased vehicular exhaust. The exhaust fumes contain oxides of sulphur and nitrogen. When these oxides are released into the atmosphere they combine with rain water to form acid rains. The acid rains contain H_2SO_4 and HNO_3 acids.

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$S + O_2 \rightarrow SO_2$

$SO_2 + ½O_2 + H_2O \rightarrow H_2SO_4$

$NO_3 + NO_2 \rightarrow N_2O_5$

$N_2O_5 + H_2O \rightarrow HNO_3$

Acid rains have the followings effects:

1. They decrease the variety of species in food chain
2. Lethal to fishes.
3. Due to acidification bacteria and blue green algae are killed disrupting the whole ecological balance.
4. Forest cover is damaged.
5. Crops are destroyed, retards growth of crops.
6. The activity of symbiotic nitrogen fixing bacteria present in the nodules of leguminous family is inhibited thereby destroying fertility of the soil.
7. Root systems are damaged.

II. POLLUTION:

Mixing of undesirable harmful substances or micro-organisms in water so as to alter its natural qualities is called water pollution. Growth of industrialisation has resulted in contamination of major water bodies. The sources of contamination are domestic sewage waste from slaughter houses, sewage, soap production, textile mills, paper mills, pesticides, fungicides, herbicides agricultural waste, industrial waste and runoff from urban areas containing detergents.

The above sources cause increase in nitrate levels which in turn causes methaemoglobinaemia or blue baby disease. Nitrate reacts with haemoglobin and causes methaemoglobin.

Nitrate + Hb → methaemoglobin

It reduces Oxygen carrying capacity and causes blue baby disease.

Agricultural wastes and chemical fertilizers contain high amounts of phosphates and when these are drained into nearby water bodies through surface runoff from agricultural fields, they cause eutrophication. Eutrophication is a slow and steady natural ageing process of any lake. But human activities have speeded up eutrophication and lakes are dying due to asphyxiation. When nutrients enter abundantly it causes algal blooms. These algal blooms do not allow light to penetrate. So the lower algae and aquatic plants start decomposing. As a result dissolved oxygen in water decreases leading to asphyxiation of fish. When fish die the lake's ecosystem is damaged. Sediments increase. Decomposition gives a putrid smell due to formation of organic waste. If waste increases BOD also increases. Aquatic organisms die in large numbers and there is severe loss of biodiversity.

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Industrial effluents cause death of aquatic organisms. For ex: Mercury (Hg) is an industrial effluent. It gets converted to Methyl mercury, the Methyl component coming from methane gas released by bacteria during anaerobic respiration. Methyl mercury is very toxic and also concentrates at high levels in tissues. It causes fatal poisoning by producing crippling disease called Minimata disease. This incident occurred in Japan. Hg came from nearby industry and was absorbed and accumulated in fishes. When humans consumed these fishes they suffered from mental retardation, cerebral palsy and convulsions. Several fish were killed.

Organochlorine pesticides such as Aldrin, Dieldrin, Endrin, DDT, BHC are most dangerous because they are non-biodegradable. These are accumulated by lower organisms and increase in concentration successively up the food chain until toxic concentrations are consumed by higher animals (birds & mammals). This increase in concentration up the food chain is called biological magnification or biological amplification. DDT is highly toxic and kills various organisms in the food chain. Moreover organochlorine pesticides show persistence and their harmful effects remain in the environment for several years.

III. Spread of disease:

Sometimes due to human intervention there are accidental fires in the forests and several plants and animals are killed. Partially burnt carcasses putrefy and result in disease outbreak. Contagious diseases spread and wipe out whole populations. Water pollution also causes diseases due to excessive growth of bacteria and viruses.

IV. Invasive species:

An invasive species is a species that is not native to a particular area but arrives usually with human help, establishes and spreads on its own.

Invasive species have the following deleterious effects:

a) **Habitat modification**: North American beavers (caster canadensis) became invasive in Argentina. In 1940, 50 beavers were introduced for their fur. But these beavers started gnawing down the trunks of Southern Beach trees. As a result of 40 million acres of forest is now transformed into meadows.

b) **Competition for resources**: The invasive species Zebra mussels (Driessen polymorpha) have eradicated native mussels in Great lake region by settling on top of native mussels and killing them. They compete with native mussels for food and space. So the number of native mussels is dwindling

c) **Predation:** The brown tree snake introduced in Guam, an island in the Pacific Ocean wiped out three fourths of the native bird species and two of the eleven native Lizard species.

d) **Herbivory**: The Asean balsam woolly adelgid (Adelges piceae) has killed 90-99% of Fraser fir tress which were dominant in the Appalachians by sucking out the sap of these trees.

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e) **Pathogens:** In eastern U.S due to chestnut blight, a fungus the chest nut trees which were once dominant were replaced by Oak trees. As a result several species of moths became extinct.

f) **Hybridization**: Endemic species are those species which live only in one place and are not found any where else. These species when hybridised with closely related species, become extinct. For ex: Endemic ducks in Florida and New Zealand are on the brink of extinction because of mating with North American mallard (Anas platyrhynchos) an invasive species.

V) Destruction of habitats: Clearing of forests for agricultural purposes, for construction of dams, for mining, logging and urban sprawl destroys natural habitats and reduces biodiversity.

VI) Over harvesting:

Over harvesting or over exploitation leads to resource depletion. Common resources such as fisheries are subject to over exploitation because the area is not owned by the harvester and hence he overfishes without restraint. Due to overexploitation if a habitat loses its top predator, the prey number increases to such an extent that they start exploiting their own food resources till their numbers decrease and they become extinct.

VII) Genetic pollution:

The flow of contaminated altered genes from genetically engineered organisms to natural organisms through cross breeding or cross pollination is called genetic pollution. Invasive species cause extinction of small populations in islands which have very low genetic diversity. For ex: Cercocarpus traskiae of the Catalina island near California is on the verge of extinction with only a single population remaining due to hybridization with Cercocarpus betuloides.

VIII) Poaching and illegal wild life trade:

The illegal hunting or capturing wild animals is called poaching. Some animals are poached because their body parts have medicinal value. For Ex: bear gall bladders and big horned sheep antlers. Elephants are killed for their tusks. The Sumatran tiger is a critically endangered species at present because its body parts such as skin, teeth, bones and claws are sold for thousands of dollars. Illegal poaching is leading to mass extinction of some species of animals. The price of Rhino horn is very high in the far East as it is used in alternative medicine to cure everything. In the beginning of 20^{th} century the Asian elephants were 1 lakh in number. But now their number has dwindled to 35000-40000.

In the present scenario there is an imperative need to conserve biodiversity. Conservation includes methods and policies adopted for long term retention of naturally occurring plants and animals and devising various measures to protect them from adverse factors that may terminate their existence.

The following steps should be taken to conserve biodiversity:

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1) **Use of Bio energy resources instead of fossil resources:**

If forests disappear there is decline of rain fall, soil erosion occurs leading to desertification, ground water level decreases and floods may occur in some parts. Over exploitation of fossil fuels will lead to shortage which in turn may lead to collapse of economy and natural systems. Hence there is every need to search for some renewable and eco-friendly resources that can replace the existing non-renewable fossil resources. Some of the bioresources used for energy generation are bio-fuels such as biogas, bio ethanol, biodiesel, green diesel, bio fuel gasoline, bio ethers and algal bio fuels.

a) **Biogas:** Biogas is produced by the anaerobic digestion with anaerobic bacteria or fermentation of biodegradable materials such as manure, sewage municipal waste, green waste, plant material and crops. Biogas comprises primarily of methane and Co_2. It can be used for cooking and generating electricity. Biogas powered train named Biogastaget Amanda is common in Sweden.

b) **Bioethenol:** Bioethenol is an alcohol made by fermentation mostly from carbohydrates produced in sugar or starch crops such as corn or sugarcane. Bioethanol is widely used in USA and Brazil. It can be used in petrol engines as a replacement for gasoline.

c) **Biodiesel:** Biodiesel is the most common bio fuel in Europe. It is produced from vegetable oils or animal fats using transesterification. It is similar in composition to fossil diesel.

d) **Green diesel:** It is produced through hydro cracking of vegetable oils and animal fats. It is being developed in Singapore.

Apart from these, other renewable resources such as solar energy, wind energy and tidal energy also can be used. They reduce pollution and protect biodiversity.

2. Use of Biofertilizers instead of chemical fertilizers:

Modern agriculture is relying heavily on chemical fertilisers and pesticides which are having several deleterious effects. Excessive use of chemical fertilisers is disrupting the entire natural aquatic ecosystem through the process of eutrophication. Hence the safer option is to develop biofertilizers which are eco-friendly and beneficial. Rhizobium, Azotobactor, Azospirillum and Blue green algae are good biofertilizers. Rhizobium inoculant is used for leguminous crops. Azotobactor can be used with crops like wheat, maize, mustard, cotton etc. Anabaena in association with water fern Azolla contributes nitrogen up to 60 Kg/ha/season and also enriches soil with organic matter. Phosphate solubilizing bacteria such as Pantora agglomerans strain P_5 or Pseudomonas putida strain P_{13} are able to solubilize the insoluble phosphate from organic and inorganic phosphate sources, Biofertilizers protect the water bodies from degradation and protect flora and fauna.

3. **Use of Bioremediation to remove pollutants:**

Bioremediation is a biological method of removing pollutants. The bacterium Deinococcus radiodurans has been genetically modified to consume and digest toluene and ionic mercury from highly radioactive nuclear waste. Mycoremediation is a form of bioremediation in which fungi are used to decontaminate the area. Two species of the Ecuadorian fungus Pestalotiopsis are capable of consuming

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Polyurethane in aerobic and anaerobic conditions such as found at the bottom of landfills. Mycofiltration is a similar process using fungal mycelia to filter toxic waste and micro organisms from water in soil.

4. **Use of biodegradable plastic:**

Biodegradable plastic is plastic that has been treated to be easily broken down by microorganisms and returned to nature. Biomedical applications include the use of bio degradable implant materials. As a result implants can now fit in through small incisions, doctors can easily perform complex operations using implants that can naturally biodegrade after a completed surgery.

5. **Using Vermiculture and vermicomposting to reduce the negative impacts of chemical fertilizers:**

Rearing of earthworms and using earthworms to increase soil fertility is called vermiculture. A major advantage of earthworm activity is that they work as living ploughs, open up the soil for greater aeration, retention and root development and hence promote water and nutrient absorption.

6. **Establishing protected areas and promoting in-situ and ex-situ conservation.**

In-situ conservation is the conservation of wildlife in natural habitat. It includes establishment of national parks, wildlife sanctuaries, biosphere reserves, heritage sites and other protected areas. Ex-situ conservation is the conservation done outside the natural habitat. They can be Zoo, biological parks, gene banks, tissue culture banks, seed banks etc. Breeding is done in controlled environment and helps to increase genetic diversity. After the off springs grow to a particular age they are released into their natural habitat. Some of the national parks are Corbett National park in Uttar Pradesh which protects tigers, Gir National park in Gujarat which protects gibbons and Indian Lion. Some of the important wild life sanctuaries are Pakala in Andhra Pradesh and Madhumalai in Tamil Nadu.

Biosphere reserves help in restoration of degraded ecosystems, conservation of genetic resources, species and ecosystems. They also help to attain sustainable development.

7. **Promoting afforestation programmes**

Afforestation programmes such as Vana Mahotsav and Vanam Manam are helping in developing a green belt and increasing the green cover

8. **Water conservation methods such as rainwater harvesting, construction of check dams and water shed management:**

Rainwater harvesting is done by digging small shallow pits in any open area where rain water can accumulate. Check dams regulate the flow of water and help water to seep into deeper layers of soil and the level of ground water increases. Water shed management is done successfully by using drip irrigation and sprinkler irrigation which prevents wastage of water.

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9. Conducting awareness campaigns to educate the public:

Seminars, Workshops, Symposiums, and Conventions should be organised to enlighten the public on the importance of conservation of biodiversity, deleterious effects of pollution, sustainable use of biological resources etc.

10. Legislation and enforcement of strict laws to curb poaching, illegal wild life trade and encroachments.

11. Taking special measures to protect endangered forms, vulnerable forms and rare species mentioned in the red data books.

12. Protecting biodiversity hotspots especially the western Ghats and the Himalayan region.

13. Controlling oil spills in seas.

14. Controlling the introduction of alien species and promoting endemic species.

15. Establishing training and research programmes on biodiversity conservation.

16. Promoting technical and scientific co-operation between countries.

17. Granting other countries access to genetic resources for environmentally safe processes.

18. Encouraging technology and biotechnology transfer between developed and developing countries.

Conclusion:

Ecosystems are paradises of valuable genes but are inching towards the status of ‘paradise lost’. Hence let us strive collectively to regain the paradises. Save biodiversity, save planet Earth!