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EDITORIAL



Biological diversity is the key indicator of the healthy ecosystem. Certain species are affected by environmental pollutions and anthropogenic activities, so some species are endangered and extinct day by day. But the extinction of a species may have impacts on entire ecosystems. Biodiversity is declining rapidly due to land use change, climatic impact, invasive species, overexploitation and pollution. Now the emergence of COVID-19 has underscored the mutually-affective relationship between people and nature. Now, we must try to understand and appreciate the limits to which humans can exploit the nature, before the impact is negative. We must try to acquire the knowledge on conservation and development of biodiversity. So, this newsletter highlighted the importance and conservation of biodiversity in this current pandemic situation.



(Kausik Mondal)

INSTRUCTIONS TO CONTRIBUTORS

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Biodiversity: In the light of Corona Pandemic

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Introduction

The Corona pandemic has literally brought the whole world to a standstill and more so at its wits' end. The authors have albeit written this paper with the understanding that it is too early to analyse and comment on the effect of the current pandemic on biodiversity, nevertheless the same was done with the realisation that there definitely are reasons of concern in biodiversity and conservation issues in the light of the present situation. With this in mind, the issues of utmost relevance were decided and the same have been discussed in the present paper. The issues identified include scenario of policies and decision making initiatives, networking during the pandemic and in post pandemic times, flow of fund for conservation, education and research on biodiversity and conservation, environmental adjustments and recovery of ecosystems, wildlife crime, wildlife trade, causes and spread of zoonotic diseases and solutions available in nature to cope with all of this and beyond.

News regarding the COVID 19 started trickling in from Wuhan since December 2019, with a probable inception in November 2019. Since then, down the lane the disease has reached nearly every nook and corner of the worlds' cities, towns and villages. While this paper is being written in its final format, WHO dashboard reports 1,23,22,395 confirmed cases and 5,56,335 deaths across the world due to this pandemic (Fig. 1), with the graphs of new cases, confirmed cases, and deaths still steeply on the rise, worldwide. What makes the situation worse and grimmer is

the fact that the world is yet to find a prophylactic or therapeutic solution that could control the spread of the pandemic. Meanwhile, the disease continues to impact mankind in innumerable ways including health, economy and livelihood options, societal structure and dynamics, education, transport and communication among many others and all of this in a way, that none of the nations across the globe could claim preparedness for the same.

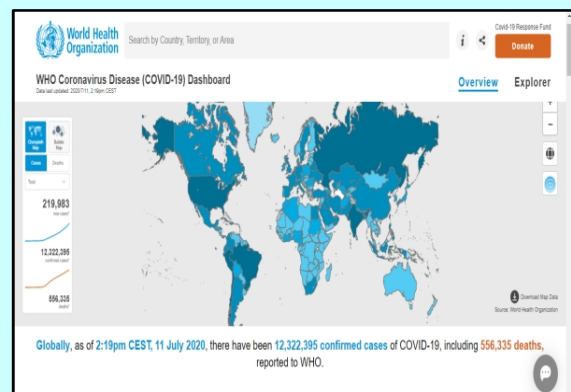


Figure-1. WHO - COVID-19 dashboard; accessed from www.covid19.who.int on 10.07.2020

The governments in various countries, in their effort to control and combat the pandemic and to save its citizens, decided to impose lockdown in different capacities and to different extents. This initiated a sudden complete halt to all activities that people across the world are so used to doing non-stop since ages. Industries, business-houses, tourism, social gatherings, educational institutes, traffic movement, all came to a standstill and that too in the most sudden and impactful way. The authors decided to start from here the present discussion on biodiversity in the light of the Corona pandemic. The first obvious understanding is that it is not only the pandemic that has shown its effect on biodiversity but it is the other way round too, that is both the pandemic and biodiversity *per se* have had effects on each other and continue to do so. Nevertheless, there remain certain very important issues (Fig. 2), which are linked to the discussion on how the pandemic has effected biodiversity during its time of

build-up and what is to be expected in the acceleration period of the pandemic as well as during post-COVID-19 situation.

With the intention of building up an overview of insights into the extent and depth of effects and to highlight the fact to the personnel engaged in and holding responsible positions in the streams of biodiversity and conservation, of course in varied capacities like policy makers, individuals involved in implementation agencies and governance, academicians, researchers, protectors, care givers, NGOs and others, that yes, the world and its ecosystems have once again changed their course and the community involved must make itself equipped to respond well to all the expected and unexpected changes. The most pertinent issues that stand decided include—major setback for biodiversity related policies and programmes owing to status of fund availability and the world wide issue of social distancing; barrier created in terms of education and research in the spheres of biodiversity and conservation; forced ban on wildlife trade leading to spike in wildlife crime *vis-à-vis* zoonotic diseases; and reduced global emissions and marginalised anthropogenic interference in natural systems and nature to the rescue of mankind as nature has solutions as well.

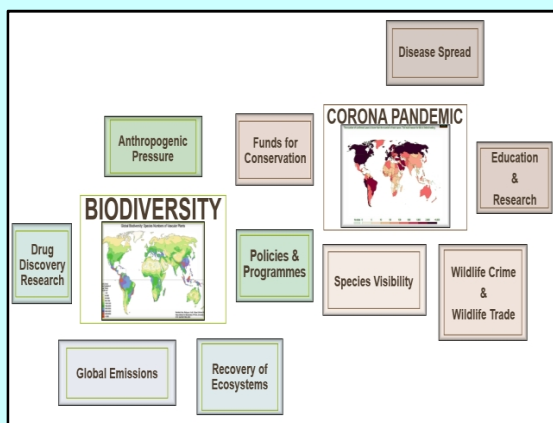


Figure-2. Issues common to the understanding of biodiversity in the light of Corona pandemic

A. Policies and Programmes on biodiversity and Fund availability

The year 2020 was a much awaited year in terms of biodiversity enthusiasts and was

anticipated to be a very fulfilling year for framing global biodiversity policies. The year marks the final year of the United Nation’s Decade on Biodiversity. A programme that was initiated in 2011 to promote the implementation of a strategic plan on biodiversity and its overall vision of living in harmony with nature, famously named as the Aichi Biodiversity Targets. These were 20 strategically planned targets at the global and national levels to achieve the goals set by the Convention on Biological Diversity. The year 2020 had a series of programmes scheduled for discussions and planning, the most important being the preparation of post 2020 global biodiversity framework. The United Nations Environment Programme the UNEP had declared 2020 as the Super Year for Nature and a number of related international meetings and conferences stand cancelled or indefinitely postponed due to the pandemic.

The most unfortunate realization for biodiversity and conservation personnel in this pandemic situation and during the aftermath of the pandemic is that a year stands lost in terms of organizing and scheduling many major international meetings, workshops and negotiations to take decisions regarding the future of Earth’s ecosystems and wildlife. The major Conventions/ Meetings/ Workshops/ that stand either delayed or cancelled include among others:

- The World Conservation Congress, scheduled to be held in June, 2020 in Marseille, France, has been postponed to January, 2021 by the IUCN.
- The Environmental Agenda for 2020, marking the final year of the United Nation’s Decade on Biodiversity was to culminate in October, Kunming, China along with Convention on Biological Diversity’s 15th Conference of Parties, the same has been postponed indefinitely. Delegates from 196 countries were planned to meet to

finalize negotiations on a global biodiversity policy framework to replace the 2010 Aichi Biodiversity Targets expiring at the end of the year.

- The 3rd Meeting of the Open-ended Working Group to frame the post-2020 Global Biodiversity Framework scheduled to be held in Cali, Columbia has been postponed.
- The 3rd Association of Southeast Asian Nations (ASEAN) Conference on Biodiversity scheduled to be convened in Malaysia during March 2020 has been postponed.
- The United Nation Forum on Forests was scheduled in May, 2020 and has been postponed indefinitely.
- The United Nation Ocean Conference was scheduled to be held in Lisbon, Portugal during June, 2020 and stands delayed.

In such a scenario it is obvious concern that the world is set to lose critical time to turn around the alarming trends in climate change and biodiversity loss, and with more resources allocated to fight the pandemic shall in turn spell fewer resources for biodiversity initiatives now and hereafter for many years to come.

Discussions delayed shall show their repercussions in days and years to come. It is extremely important to not only understand but also remember all the time, as our conscience would remind us, that the air, water, climate and the food, things that we can't do without and that makes our planet habitable, all come from nature. Now that we live in exceptional times nature is sending us an important message, that we are on the verge of a breakdown and that it's time to wake up, to take notice, and to reinstate our relationship with nature. Unfortunately, we have been held back with all these delays and disruptions to follow the norms of the pandemic which is social distancing.

In terms of fund availability for biodiversity research and conservation expenditure, it is noted that there has been a total collapse of ecotourism provisions, which has always been a major revenue generating avenue for wildlife conservation and habitat restoration. Furthermore, the inevitable global economic recession that we have already started witnessing shall leave the governments and conservation bodies bereft of funds that could be utilized for conservation and research on biodiversity. So we are most likely to have an economic turmoil and social change all over the world post this pandemic period and we are at loss to understand how these changes are going to change the way things were planned to be done earlier. And thus, it goes without saying that the pandemic has totally disrupted conservation work and funding, with potential repercussions for years to come.

B. Barriers in education and research on biodiversity and conservation

With a worldwide shut down of all academic organisations, universities and research centres, it is of great concern to observe that in a course like biodiversity and conservation where field studies remain as critical as ever, this pandemic situation has forced it to remain suspended or at the most online like all other courses. The online system of curriculum transaction can definitely work well with many courses and is the trend of the day with a whole set of new generation turning out to be well equipped digital learners. But the courses on biodiversity and conservation bereft of its practical components remains hopelessly incomplete with heavily impacted field research comparable to lack of practical in medical courses. Moreover with laboratories and research facilities in a complete shutdown, restrictions on travel, and entry into protected areas, marine locations and similar studies in lesser studied areas, education and research are in for a major set back. According to

Corlett et al. (2020), missed research implies missed opportunities, in terms of missing out issues like identifying conservation priorities, monitoring the health of endangered species, vulnerable ecosystems and potentials of providing solutions that are practical.

C. Wildlife trade and Wildlife crime vis-a-vis zoonotic diseases

Illegal wildlife trafficking practices have resulted in the emergence of zoonotic diseases which refers to a situation where pathogens can jump from one species to a different one and continue to infect the new host. Such illegal actions on wildlife in terms of trade and/ or crime are primarily undertaken with the intention of bushmeat consumption, keeping unconventional exotic pets, making animal skin accessories, home trophy decorations, privately owned zoos, traditional medicine practices, and many such desires of mankind amounting to greed and over consumption.

The corona pandemic has emerged as one of the worst zoonotic disease of recent times that has taken the whole world in its grip. And with the realisation of the same being a zoonotic disease the acting executive secretary of the United Nation's Convention on Biological Diversity called for a global ban on wildlife markets to prevent and control future pandemics. With such a forced ban on wildlife trade in action world over, there has been a spike in wildlife crime and the rate of such crime has increased manifold. Wildlife trade, both legal and illegal are reasons for concern in the context of zoonotic pandemics, their genesis, spread and intensity. A report by the Wildlife Conservation Society gives an overview of wildlife crime in Indian states during the lockdown period April 13th to 30th 2020 based on media reports. Within a span of 16 days, 13 states recorded 25 cases of wildlife crime(WCS-CWT, 2020).

A comparison of species groups that faced such crimes in pre-lockdown and during

lockdown gives a clearer understanding. TRAFFIC (2020) in their report on '*Indian wildlife amidst the COVID-19 crisis: An analysis of status of poaching and illegal wildlife trade*' points out that the highest increase in poaching was reported in ungulates where an astonishing jump from 22% of total during pre-lockdown, soared to a 44% during lockdown. This is understandable since such species are mainly targeted for meat which is usually for self-consumption. The second group of wild animals which were major victims of poaching included the 'small mammals' like monkeys, smaller wild cats, civets, hares, porcupines, giant squirrels, etc. Although some of these are in high demand in international markets, they are also hunted for meat or for local trade in India. Interestingly, cases against this group rose from 17% to 25% between the pre-and lockdown periods. Poaching incidences of big cats (Tiger and Leopard) remained at 20% as a percentage of total incidences reported (TRAFFIC, 2020). The report has also analysed wildlife crime data during the study period and highlighted the fact that there has been a significant increase in overall poaching of wild animals in the entire country during the lockdown period which is not restricted to any geographical or political boundaries and neither to any specific wildlife area. Cases have been reported from both forests located in human dominated landscapes and also from declared Protected Areas such as Tiger Reserves, National Parks, Wildlife Sanctuaries, Bird Sanctuaries and likewise.

D. Reduced global emissions and marginalised anthropogenic interference

A very interesting outcome of the pandemic has been the interpretation of satellite images to show dramatic improvements in air quality in every country affected by the pandemic, with a complete shutdown of industries and transport. This year will probably witness a global decline in greenhouse gas

emissions, as well as large reductions in other drivers of global warming. Reports of reduced human pressure on wild species, in terms of decline in visitors in protected areas, imposition of travel restrictions and park closures have shown positive impact of reduced stress on sensitive animals and trampling pressure on animal trails. News of wild species venturing into areas of normal human interference, which include parks and beaches, areas in which they have not been seen for many years has kept trickling in since the lockdown period, which may be considered a positive fallout for the present but which in all probability is likely to be temporary. It is definite that pollution levels, greenhouse gas emissions, and the many other adverse human impacts on wild nature will rebound, but funds and other infrastructural support for conservation shall have to compete with a wide range of new priorities especially health and specifically drug development research on corona virus, at least in the near future.

E. Nature has solutions

Just like the pandemic came upon us as nature's fury, so does nature hold solutions too for the same. Biodiversity is a natural repository for most medicines that we develop. As per estimates by the World Economic Forum (WEF), over 50% of modern drugs are developed from natural plant extracts. So, clearly, biodiversity is essential not only for the ecosphere, but also for human health and medicine. Natural world contains pathogens, but these pathogens are in ecosystemic stability and we humans have disturbed the stability. Now with millions of people quarantined under lockdown, but still people getting infected in thousands, and a few dying because of the infection, it is imperative that a single or multiple drug for treatment and vaccine be discovered for prophylactic use.

Now with millions of people quarantined under lockdown, but still people getting infected in thousands, and considerable

deaths too because of the infection, it is imperative that a single or multiple drug for treatment and vaccine be discovered for prophylactic use.

The urgency of research concerning finding a suitable candidate for drug development and vaccine discovery has grown in leaps and bounds and the last few months have seen many screening and simulation experiments with plants with the idea of developing new drugs and vaccines. The most convincing candidates from multiple research include *Withania somnifera* (ashwagandha), *Artemisia annua* (Naagdana), *Aloe vera*, Neem and *Cinchona*.

Thinking beyond the misgivings more optimistically, Corletta et al. (2020) emphasise that education and research in ecology, conservation, and environmental studies may appear more attractive and meaningful to young people who have been alerted to the global environmental crisis by this pandemic and made aware of the links between biodiversity conservation and human well-being.

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Care to Biodiversity for Sustainable Future

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Introduction

Biodiversity is the scientific term for the variety of all living things on Earth comprising of plants, animals, microorganisms, and different ecosystems, such as grassland, aquatic, marine, forests, deserts, etc. It includes all terrestrial, marine and other aquatic organisms. It also covers diversity within species, between species as well as variations among ecosystems. Most ecosystem services depend on the presence of sufficient numbers of individuals of each species.

Biodiversity is the pillar that allows ecosystem to function and human to thrive, foundation of life on earth. It benefits to the society include contributions to drugs and agriculture, and the provision of ecosystem goods & services. It also includes the total of all the genetically based variation in all organisms in the biosphere.

Biodiversity are many categorized into three types

1. Genetic diversity: The genetic difference or variability among individuals of a species expresses with specific characteristics e.g. each human being or animals differ widely from all others (fig.1).

2. Species diversity: The varieties of species in a specific area which is seen in natural and agricultural systems. The tropical forests are rich in species diversity than any other area (fig.2).

3. Ecosystem diversity: The varieties of habitats or ecosystems in a specific region. Each region varies structurally and functionally from other systems with distinctive inter linked species (fig.3).



Figure 1. Genetic diversity



Figure 2. Species diversity

(Source: Gauliya, K., 16014011, www.slideshare.net)



Figure 3. Ecosystem diversity

(Source: <https://www.qsstudy.com/geology/ecosystem-diversity>)

The value of biodiversity

- The importance of biodiversity benefits to human society includes contributions to food, shelter, medicine and the provision of ecosystem goods and services.
- Biodiversity richness sustain the ecosystem health and protect our environment through clean water, clean air, retain soil health, regulate climate, recycling nutrients and maintain biogeochemical cycles.
- The different biodiversity resources offer different value to the societies including

genetic, species and ecosystem variations.

The other utilities of biodiversity are-

- ✓ Livelihood development & food security
- ✓ Natural resource generation
- ✓ Maintain ecosystem and support wildlife and human health.
- ✓ Biodiversity can solve the global warming and climate change impact.
- ✓ Retention of culture and identity through healthy Biodiversity.

Threats to Biodiversity

- Greedy Human activities in modernization era are the main threats to biodiversity.
- The biodiversity reduced day by day through anthropogenic activities by altering habitats and ecosystem, poaching, introducing invasive species, releasing pollutants to environment and contributing to climate change.
- The extinction of species increasing many folds in recent days due to human activities.
- As species disappear, the potential contribution to human knowledge that is carried in their genes is lost.

Causes for the loss of Biodiversity

- **Habitat destruction and Fragmentation:** The habitat loss threats to 85% of all species treated as threatened or endangered. The natural habitat depleted through anthropogenic activities, i.e. Urbanization, industries, agriculture, housing, mining activities, road & railway construction, dam and canal system etc.
- **Overexploitation of resources:** Unscientific excessive utilization of biological resources in a particular area more than their regeneration/reproduction leads to exhausted that biological resources which is a big threat to biodiversity.
- **Exotic species and GMO:** Introduction of non native species and Genetic modified organisms in a particular area can affect on the species diversity of the

natural native habitat and leads to imbalance in the ecological equilibrium.

- **Alternation of ecosystems:** Introduction of hybrid and high yielding varieties can destroy the local ecosystem in agricultural sector.
- **Environmental Pollution:** The natural environment and species diversity affected due to environmental pollution (Physical, chemical, biological) and climate change.
- **Developmental activities:** Urbanization, industrialization, Construction, Mining activities, Agriculture, Forest based activities etc. change the land use and land cover of an area which leads to depletion of biodiversity.
- **Natural calamities:** Cyclone, Floods, Forest fires, Landslides, Earthquakes etc. affects the biodiversity.

Conservation of Biodiversity

Biodiversity conservation defined as the taking action of protecting and preserving the biological resources in terms of variety of species, habitats, ecosystems, and genetic diversity on the planet Earth for sustaining our life through health, wealth, food, fuel, and ecosystem services. Biodiversity conservation is integral part of the economic growth and poverty reduction. The human exploits the present biodiversity as biological resources, so the maintenance of biological diversity ultimately supports the human life long term in the earth.

Biodiversity can be conserved in the In-situ and Ex-situ ways. *In-situ* conservation of biodiversity is the conservation of plant and animal species within their natural habitat through National parks, Wildlife sanctuaries and Biosphere reserves etc. *Ex-situ* conservation of biodiversity is the breeding and maintenance of endangered species in artificial environment e.g. Zoological parks, botanical gardens, nurseries, gene banks, etc.

The Conservation of biodiversity can be promoted through development of Intellectual Property Right (IPR) regimes, as well as new regimes of management of

biodiversity resources, embodied in the Trade Related Intellectual Property Right (TRIPs) - component of GATT, and the Convention on Biological Diversity (CBD).

Biodiversity essential for a sustainable future

Biodiversity is the pillar of human civilization. The biodiversity gets disturbed due to unprecedented anthropogenic developmental activities without caring for the biodiversity resulted huge loss to the planet in the form of land, water and air pollution, habitat change, climate change and land degradation. Along with habitat loss, the shifting climate change is compelling animals to migrate to newer place to live in. The local species are not coping with the new changed habitats and become vulnerability to that environment. Also in this process many plants and animals gets endangered or critically endangered.

There is intrinsic value of the natural world and the need to preserve the biodiversity and ecosystems for future generations. Respecting and caring for biodiversity is the prime responsibility of human civilization as consumers to conserve and manage environmental resources and cultural ethnicity for utilization of both present and future generations. Through scientific and sustainable utilization of natural resources the conservation of biodiversity and environmental sustainability can established.

In recent the COVID19 pandemic crisis has deep roots in how we interact with, manage, and conserve the nature. Human engagement in activities that interfere with ecological and environmental conditions continues, thereby increasing the risk of emergence with new pathogens. The emergence of COVID-19 has underscored the mutually-affective relationship between people and nature. Now, we must try to understand and appreciate the limits to which humans can push nature, before the impact is negative. So there needs parallel arrangement of planting more of these plants along with the development process

so that the problem can be tackled in a proper manner. So biodiversity conservation is a major aspect which we need to look for post COVID 19 era so that we can hand over a healthy planet to the upcoming generations.

Conclusion

The earth gifted to the human civilization a beautiful healthy environment and natural resources with luxuriant biodiversity for foundation of all civilization and sustains our economies. But our greedy nature overexploit our natural and biological resources and diminishing our future. To satisfy human's mad greed in the name of lifestyle development we are continuously destroying the flora and the fauna, the forests and the mountains, the over ground and underground water and polluting the air, water and soil.

The concept of deep ecology should maintain by the human race. Restoration of environment is the scientific study of repairing disturbed ecosystems through human intervention and conservation is often focused on preventing ongoing degradation and restoration ecology. Conservation of biodiversity and environment is as important at the personal level as well as the social level. Simple lifestyle with think locally and act globally is the present call of our mother earth. Together we can challenge the threats to nature, and help ensure its ability to provide suitable environment for the sake of every living thing, including ourselves.

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Tools of Biotechnology for the Conservation of Biodiversity

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Introduction

As per the spirit of definition, in the Article-2 of the United Nations “Convention on Biological Diversity”, the umbrella of the term Biodiversity includes variability of species, genes, flora, fauna, microorganisms, agriculture, domesticated animals and the diversity of & in ecosystems like wetland, marine, deep ocean, estuary, lagoon, lake, island, sea shore, sand dune, river, forest, mountain, dry land, desert, snow covered ecosystem (like tundra) and urban ecosystems. The biological diversity we witness today and those have gone yesterday are the evolutionary outcome of billions of years of interactions among the living creatures, their ecosystem which includes the soil, water and air around them forming a community, mostly interfered, influenced and induced by the human beings. Economic and societal wellbeing of human life is an integral part of the web of biodiversity and biological resources of the earth upon which human civilizations have been built. We get food, fiber, clothing, medicines, housing and industrial raw materials like rubber, oil, building materials, timbers and paper pulp from biodiversity. Numerous ecological services such as photosynthesis, water and air purification, nutrients recycling, prevention of soil erosion and pollination are also provided by various components of biodiversity. Biodiversity none the less plays very vital role in human health, culture diversity, traditional knowledge, medicine system, aesthetic and spiritual values. However, a significant decline of biological diversity has been observed in the last few decades due to the emergence of various threats mostly introduced by

human beings. Destruction of wild habitats, poaching & wildlife trafficking, forest fire, introduction of invasive alien species, introduction of hybrid and high yielding crop varieties, pollution of air, water & soil, non judicious application of agrochemicals, ever increasing population, over exploitation of nature & natural resources and climatic changes are some of the reasons of biodiversity loss. Never the less, people around the world have taken numerous efforts to stop the loss by enacting several laws and Acts. The biggest of them was the United Nations “Convention on Biological Diversity (CBD)” taken place at Rio de Janeiro in 1992. The Biological Diversity Act being implemented in India since 2002 was the upshot of the convention (Wilson, 1988: www.cbd.int; Sharma and Sharma, 2013; Kannaiyan, 2007). On the other hand, humans have also developed many scientific methods, technologies and tools collectively known as ‘Biotechnology’ through which conservation of biological diversity could be achieved to sustain the function of earth. Some of such breakthrough and widely used technologies are brought to the table in the current discussion.

Biotechnology and its relevance to biodiversity

"Biotechnology" as defined by the CBD means “Any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use” (<https://www.cbd.int/convention/articles/?a=cbd-02>). In this broad discipline of modern science, biological processes, cells & cellular components and organisms, are put upon to develop new technologies, new tools and products which are useful in research, agriculture, industry and in the clinic for the betterment of our lives and the health of our planet (Pathak and Abido, 2014). Biotechnology and biodiversity have been traditionally considered to be two opposite poles of science, especially in the last decade, this perception has been

developed that biotechnology has untoward effects on biodiversity. At the same time, if exploited in a safe and responsible manner this paradigm could be changed and new means of strategies could be developed for saving and improving individuals, countries and biological diversity (Isaac, 2018).

Conservation of plants and animals may be carried out as live materials *in vivo* and in laboratory conditions *in vitro*. Live plants and animals may be conserved in their natural ecosystem as *in situ* or in artificial environments like zoos, laboratories, green house as *ex situ*. The “International Union for Conservation of Nature & Natural Resource (IUCN)” has adopted in their guidelines to implement both *ex situ* and *in situ* methods for the conservation of ‘Red listed’ plants (www.iucn.org). Biotechnological tools are mostly applied in *ex situ* and *in vitro* conservation methods and have been specifically useful for the restoration and reintroduction of very rare, endangered and threatened species of plants and animals in wild. Some of the widely used and breakthrough technologies for conservation of biodiversity like cryopreservation, tissue and organ culture, molecular marker assisted tools are discussed in this section.

Cryopreservation and Gene bank

It is a method of long term preservation of plant and animal materials in ultra low temperatures either by freeze induced dehydration or by vitrification. In classical freezing method, first the samples are pre-grown followed by cry-protection and then cooling slowly to pre-freezing temperature (usually -40°C). Samples are then immersed rapidly in liquid nitrogen (-196°C) for storage and maintenance. Cryopreservation technique is instrumental in the conservation of rare, endangered, threatened (RET) plant and animal species by preserving live plants and animals or their parts like pollens, seeds, propagules, meristematic cells, semen, oocytes, embryos and DNA in low and ultra low temperatures with the genetic makeup

intact (Zhao et al., 2008). Preservation of semen of indigenous breeds of domestic animals is required for future breeding programmes. Preservation of genetic material of wild animals which are on the verge of extinction would be required for its restoration. Preservation of pollens of plants which undergo vegetative propagation (like tuber crops) helps in the breeding programmes for the development of new crop varieties. A physical module or repository where all the above genetic resource or germplasm or DNA are preserved is known as genebank. Numbers of such types of Gene Bank modules are available for plant and animals throughout the world.

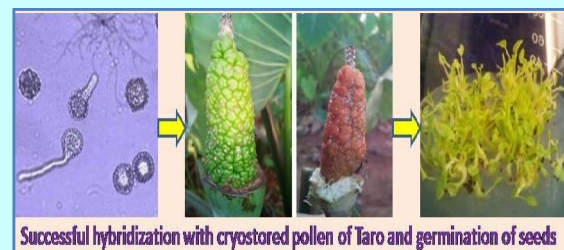


Figure-1: Successful hybridization with cryostored pollen of Taro and germination of seeds.

Tissue culture technology

This technology has been a boon for plants which have been threatened due to their slow growth rate, slow or reduced germination of seeds or vulnerability to environmental and climatic changes. Aseptic and disease free stocks of large number of endangered plants having agricultural, horticultural, floricultural and pharmaceutical importance have been regenerated from a single somatic cell or tissue by “Somatic Embryogenesis” and “Organogenesis”. Further, with the help of “Micro-propagation and Cloning” techniques, rapid and mass production of ‘true to the type’ plant propagules could be achieved from many plant parts or cells. Some important Indian medicinal plants which have been successfully developed, propagated and conserved by these methods include *Picorrhiza kurroa*, *Saussaurea lappa*, *Swertia chirata*, *Ginkgo biloba*, *Tinospora cordifolia*, *Gymnema sylvestre*, *Holostemma*, *Salaca oblonga*,

Oroxylum indicum, Celastrus paniculata, Tylophora indica, Bacopa mooniera, Glycyrrhiza glabra, Rauwolfia serpentine, etc. (Sharma et al., 2010).

Reproductive Biotechnology

Since the generation of first domestic cat by somatic cell nuclear transfer (SCNT) technology, scientists have been trying to conserve endangered or threatened wildlife by adopting modern ‘Reproductive Biotechnologies’ or ‘assisted reproductive techniques’ (ART) which include artificial insemination (AI), *in vitro* fertilization (IVF), embryo transfer (ET), semen or embryo sexing, gamete/embryo micromanipulation and genome resource banking (GRB) and Intra-cytoplasmic sperm injection (ICSI) (Veraguas et al., 2017). The best example of utilisation of this method is the development of embryos by ICSI technique containing DNA of the kind of last northern white rhino, hoping to save the subspecies from extinction. In case of the iconic and almost extinct animal northern white rhinoceros (NWR), ART have been proved to a viable and efficient strategy for gene rescue. This strategy may also have broader impact and acceptability if applied with similar success rate to other endangered and threatened large mammalian species (Hildebrandt et al., 2018).

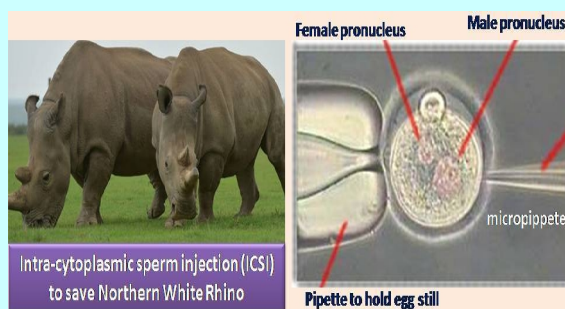


Figure-2: Intra-cytoplasmic sperm injection (ICSI) to save Northern White Rhino: (http://www.kiran.nic.in/pdf/publications/Endangered_Animal_species.pdf).

Molecular Biology Techniques

Molecular markers are widely used in the genetic characterisation of germplasm and for marker-assisted breeding and selection in plants and animal. These are short

stretch of DNA segments present close to a gene or specific regions within the genome there by they act as flag posts for the genes of interest. Molecular markers are also used for ‘Allele Mining’ which is an approach to dissect naturally occurring allelic variations or suitable alleles of a candidate gene controlling key agronomic traits which has potential in crop improvement (Kumar et al., 2010). Molecular markers have also been used for sex differentiation in dioecious plants such as *Silene latifolia, Pistacia vera, Cannabis sativa, Humulus lupulus, Actinidia chinensis, Atriplex garrettii, Carica papaya, Salix viminalis, Rumex acetosa, Mercurialis annua, Eucommia ulmoides, Phoenix dactylifera, Calamus guruba* etc. Identification of male and female plants at seedling stage is very helpful for the strategic planning for conservation of endangered plant species (Al-Qurainy et al., 2018). In case of wildlife conservation, molecular markers have been employed in the development of DNA barcodes which is very useful in the fight against wildlife poaching, trafficking and genetic monitoring of source populations of threatened animals like tigers (Yang et al., 2018).



Figure 3: Genetic characterisation by molecular markers brings new insights of various genes

Genetic Modification or Transgenic Technology

It is the process of altering the structure or expression of specific genes and traits by the use of recombinant DNA and asexual

transfer genes. A genetically modified organism or transgenic, is one that has been obtained by the insertion of one or more genes from another organism. In modern times, we are now able to incorporate new genes or traits from one species into a completely unrelated species through genetic engineering due to which agricultural performance have been optimized and production of valuable pharmaceutical substances have been enhanced. Organisms that have been experimented for genetic engineering include farm/domesticated animals, soil bacteria and mostly crop/vegetable plants. Though transgenic crops are more likely to increase agricultural biodiversity and help maintain native biodiversity, the practical benefits and risks of the crops need to be assayed in the field and their products need to be scrutinized (Sharma and Sharma, 2013; Prashanth et al., 2008).

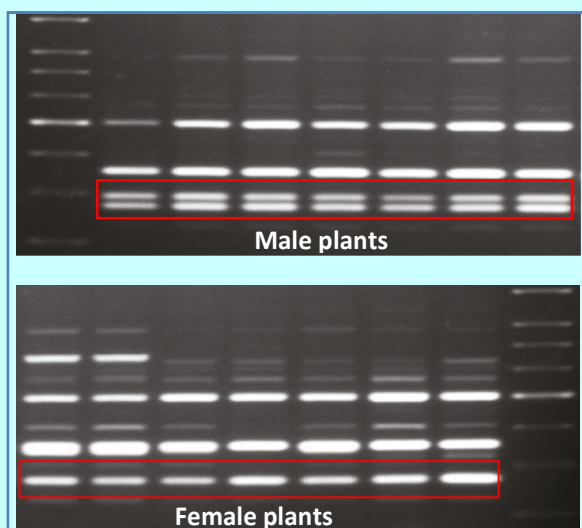


Figure 4: Distinction between male and female date palm plants by RAPD markers.

Biotechnology Indirectly Promotes Biodiversity Conservation

With the help of various biotechnological tools and methods, lots of information has been generated on the genetic pools possessed by the indigenous flora, fauna and microorganisms. Genes and quantitative trait loci (QTL) of crop landraces and wild relatives have been mapped and identified and is being incorporated in cultivars to increase crop

yield and to mitigate biotic and abiotic stress tolerance. Consequently, the rights and benefits of the owners of such landraces, farmers' varieties of crops, plants and local breeds of domesticated animals are being protected by various Acts and laws such as the Biological Diversity Act 2002, Protection of Plant Varieties and farmers' Right Act 2001. In this way, people and communities get motivated towards conservation of indigenous biodiversity.

Conclusion

Introduction of technological interventions have boosted biodiversity conservation but products like transgenic or GMOs are facing criticism. Cryopreservation and tissue culture techniques with somatic cells cannot maintain or increase evolution. Low cost production of tissue cultured plants is still being worked out. However, biotechnological input for biodiversity conservation is the next big thing.

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Report of Webinar on 'Care to Biodiversity'

The Web seminar on Care to Biodiversity was organized on the occasion of World Environment Day-2020. As this year the Environment day theme is Biodiversity.

Due to COVID-19 pandemic the DESKU ENVIS Resource Partner on Environmental Biotechnology, University of Kalyani, Supported by Ministry of Environment, Forest and Climate Change (MoEF & CC), Govt. of India, was organized the WEBINAR on CARE to BIODIVERSITY on the occasion of World Environment Day, 5th June, 2020.

The Webinar on Care to Biodiversity was inaugurated by our Hon'ble Vice Chancellor, University of Kalyani Prof. Sankar Kumar Ghosh, with the eminent resource persons, Prof. A. K. Panigrahi, Coordinator ENVIS Centre, Head, Dept. of Zoology, Dr. A. K. Sanyal, Chairman, West Bengal Biodiversity Board, Dr. Dr. Anant Pande, Scientist, Wildlife Institute of India, Dr. Neera Sen Sarkar, Dept. of Botany, K.U., Dr. Punarbasu Chaudhuri, Dept. of Environmental Science, University of Calcutta and Dr. Shubhransu Nayak, Odisha Biodiversity Board. On the occasion Hon'ble Vice Chancellor released ENVIS news letter on Biotechnological and Environmental Aspects of COVID-19.

A total of 1870 registered participants were selected for participation. In the webinar 3,737 participants were viewed live in **YouTube** and over 125 participants viewed in **Facebook** simultaneously. The participants were comprise of students, academicians, scientists, doctors, administrative persons all over the world, majorities from Asian countries and some are from USA, Europe and Australia were actively participated in the seminar.

FORTHCOMING EVENTS		
Events	Date	Place & Correspondence
Webinar on Environmental Sustainable for Global Pollution	October 12-13, 2020	London,UK https://pollution.earthscienceconferences.com/
Webinar on Biodiversity and Conservation	October 12-13, 2020	Sydney, Australia https://biodiversity-ecosystem.conferenceseries.com/
Webinar on Microbial Biotechnology and Future Bio-industries	October 25, 2020	Paris, France https://www.longdom.com/webinars/microbialbiotech
Webinar on Environmental Impact Assessment (IVC-EIA)	26th and 27th November 2020	Karnataka, India https://www.emprienvis-ivceia2020.com/
Webinar on Biodiversity and Ecosystem Services in a Climate Change Perspective (IVC-BES)	10th and 11th December 2020	Karnataka, India https://www.emprienvis-ivceia2020.com/

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