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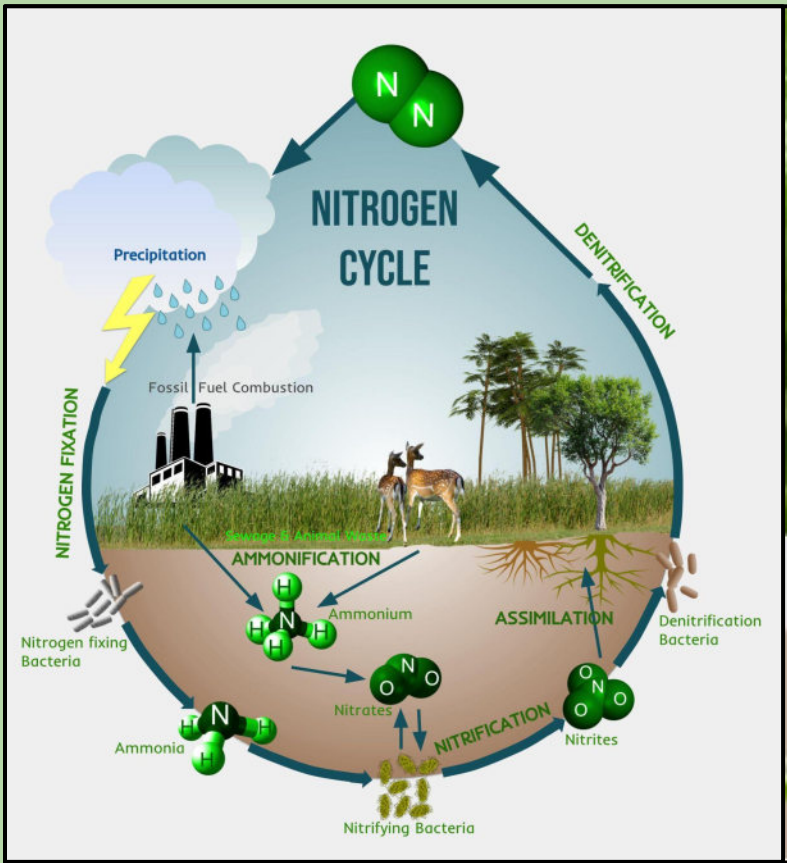
# Reactive Nitrogen



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## Geodiversity & Impact on Environment

Ministry of Environment, Forest & Climate Change, Govt. of India

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Editorial

# Need for Long-Term Systematic Measurements of Reactive Nitrogen in South Asia

**Umesh Kulshrestha**

In the last six decades an increase in the global population, demand for food and energy has risen exponentially. Due to this reason, fertilizer production and combustion of fossil fuels have also increased dramatically. In fact, these are the major factors contributing towards an increase in reactive nitrogen species (Nr) having threats to humans and the environment. Fertilizers are strong sources of $NH_3$ while the fossil fuel combustion is one of the major sources of NOx. Most of the Nr in the atmosphere is contributed by these two compounds. Due to human activities, global production of reactive nitrogen species has doubled during the past century (Sutton et al., 2012) In India too, the fertilizer consumption has remarkable swing from 12.4 kg/ha in 1969 to 175 kg/ha in 2018 for India with a mean growth rate of 5.96% per annum (Knoema Atlas, 2021). Estimates indicate that the consumption of fertilizers in India will be doubled by 2050. But in contrast with fertilizer use, the nitrogen use efficiency (NUE) of crops is decreasing (Abrol and Adhya, 2017).

$NO_X$ which is mostly contributed by automobiles and coal powered industries also has increasing trends. However, there has been a drop in NOx levels during COVID 19 shutdown. $NO_X$ species ($NO_2$ and NO) are the precursors for $HNO_3$ in air. The chemical interaction of $NH_3$ and $HNO_3$ gives rise to $NH_4NO_3$ formation which is scavenged by wet or dry deposition process (Sharma and Kulshrestha, 2020). The deposition of these species is harmful to the ecosystem. The NOx and $NH_3$ in the indoor air have been reported affecting biochemical properties of indoor plants (Katoch and Kulshrestha, 2021). According to reports, the wet deposition fluxes of $NH_4^+$ and $NO_3^-$ have increased remarkably in Delhi due to increasing emissions from petroleum driven vehicles in the city (Singh and Kulshrestha, 2014). However, such findings need to be reconfirmed through very systematic and long-term measurements of NOx, $NH_3$ and their deposition across India and other south Asian countries.

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In this regard, global efforts are on to understand the Nitrogen cycle. The South Asian Nitrogen Hub (SANH) mega project under the UK Global Challenge Research Fund (GCRF) brings together 32 leading research organizations from across South Asian nations and the UK to improve nitrogen management in agriculture and study the flow and impact of nitrogen pollution on the ecosystem led by Center for Ecology and Hydrology, Edinburgh, UK. Recently, during 8th virtual conference of the International Nitrogen Initiative (INI) held on May 31-June 3, 2021, nitrogen community has signed a declaration called ` Berlin Declaration' which emphasizes upon `sustainable management of reactive nitrogen compounds across all sectors of human activity as a crucial step towards achieving the UN Sustainable Development Goals (SDGs) by 2030'.

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# Atmospheric Reactive Nitrogen

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Nitrogen is an important element that exists in the environment in various forms. Reactive nitrogen species (RNS) act as a catalyst in various atmospheric reactions and tropospheric photochemistry. The presence of nitrogen species in the atmosphere affects air pollution levels, the earth's radiation budget, and stratospheric ozone depletion. The deposition of atmospheric nitrogen may affect freshwater eutrophication, drinking water quality (Galloway et al., 2004; Holland et al., 2005). Nr Species like NOx (NO + $NO_2$) and ammonia ($NH_3$) act as contaminants in the ambient air and have a direct impact on regional and global atmospheric chemistry (Mosier et al., 2002). Nitrogen species are emitted in the environment both by natural sources (like volcanic eruptions, forest fires) and anthropogenic sources (like traffic emission). Once emitted into the atmosphere they experience various chemical transformations and transport progressions and lead to various problems such as air pollution, acid deposition and eutrophication (Reis et al., 2009; Tiwari and Kulshrestha, 2017). The residence time of RNS species in the atmosphere is about one week which is similar to that of ambient aerosols. During their residence period, they undergo long-range transport and may undergo various physico-chemical alterations and are finally removed from the atmosphere through dry and wet deposition. The major portion of the nitrogen species is removed from the atmosphere by wet deposition. However, in north India where wet conditions exist only for a limited period, dry removal and dustfall are more important processes (Kulshrestha, 2017). In the atmosphere, $NO_2$ and $NH_3$ are the major precursors of other nitrogen compounds such $N_2O_5$, $HNO_3$, HONO and particulate $NO_3^-$ and $NH_4^+$. Nitrogen is mainly emitted into the atmosphere in the form of NO from primary sources and gets converted into $NO_2$ in the atmosphere through photochemical oxidation. Most of RNS in the atmosphere undergo photochemical oxidation. RNS reacts with other atmospheric pollutants (like OH, $O_3$, $NO_3$, $HO_2$ and Cl) in the atmosphere and undergoes gas-particle partitioning under the influence of meteorological parameters. The atmospheric occurrence, transport and fate of these reactive species from the atmosphere are mainly influenced by the gas-particle partitioning process.

Exposure to N species shows a direct impact on terrestrial and aquatic ecosystems. Indoor exposure to RNS also affects plants (Katoch and Kulshrestha, 2020). N deposition below a critical level can be beneficial to an environment, such as causing an increase in biomass and $CO_2$ uptakes. But beyond the critical limit, N deposition results in serious negative effects, that

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include direct toxicity from dry deposition (Carter et al., 2017). The excess deposition of RNS leads to eutrophication, acidification. It has negative impacts on plant diversity due to changes in the form of accessible N. Long-term exposure to terrestrial ecosystems can cause significant deteriorations in plant cover.

Typical ambient concentrations of selected RNS are given in Table 1.

**Table 1.** Typical Concentrations of RNS in Delhi NCR (Sharma et al., 2017).

| Reactive Nitrogen Species (RNS) | Annual average and SD |
|---|---|
| **$NO_2$** | 18.1 ± 3.2 ppb |
| **$NH_3$** | 17.8 ± 3.4 ppb |
| **NO** | 21.2 ± 2.3 ppb |

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# Nitrogen Chemistry: An Indoor Perspective

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In recent times, chemical interactions which are commonly occurring in the air, surface reservoirs and aerosols of the indoor environments have gained considerable importance. A chemical compound abundant in the indoor air may have several sources and the major sources for reactive nitrogen oxides (NO and $NO_2$) are generally combustion processes such as heating, cooking using gas stoves, smoking etc. Before discussing the chemical interactions of inorganic nitrogenous species in the indoor environment, it is interesting to outline some common indoor elements which influence these reactions.

## Typical Features of Any Indoor Environment

There are certain underlying characteristics in most of the indoor spaces despite the prevalent heterogeneity in structure and function, which have been summarized in the following points-

1. The building structure envelops the interior space such that it acts as a transport barrier to and from external surroundings. However, infiltration of air from windows, leaky passages, doors etc. leads to exchange of air. Pressure gradients play an important role across the buildings during air exchange in the form of wind or differential heating (Abbatt and Wang, 2020).
2. Indoor spaces are characterized by a very high surface area to volume ratio (SA/V) unlike the outdoor atmosphere. In addition to macroscopic surfaces visible to the naked eye, microscopic features such as roughness and porosity of surfaces influence partitioning processes. Building materials, furnishings, paints etc. may have low viscosity or high porosity which enables diffusion of the molecules into them. Due to this, species which are volatile in the outdoor atmosphere behave as semi-volatile compounds indoors and their concentrations are higher on the surface because of partitioning to these static surfaces as compared to their gaseous forms (Wang et al. 2020). There are many surface reservoirs into which gas-phase compounds might partition. For more water-soluble species, a water-rich surface film would increase the uptake of gaseous species from indoor air.
3. The intensity of sunlight penetrating inside, temperature and relative humidity frequently vary in the indoor spaces. Usually, outdoor photon fluxes are higher than indoor photon fluxes and their intensity varies according to the time of the day, geographic locations and seasons which influences indoor chemistry and interactions of various compounds. Overall, the

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light intensity observed indoors is dependent on several factors such as transmission efficiency of sunlight through glass, number of doors and windows (duration and time of the day when they remain open and distance from them), outdoor cloudiness, types of indoor lights used etc.

Thermal conditions are regulated in the indoor spaces as opposed to the outdoor conditions in the airtight modular buildings due to which indoor chemical interactions are different from outdoor surroundings. In case of naturally ventilated built structures, indoor temperature and relative humidity conditions are subjugated to outdoor surroundings (Katoch and Kulshrestha, 2020).

4. Indoor environment is frequently influenced by the anthropogenic activities of inmates which is a dominant feature due to the ubiquitous presence and activities of humans. Chemical processes occurring via skin, breathing, excretion, clothing etc. continuously affect chemical composition of indoor air. In addition to direct emissions from humans, other relevant activities such as cooking, cleaning, heating, smoking, usage of building materials, personal care products, furnishings etc. strongly influence the abundance and interactions of chemical species found indoors (Katoch and Kulshrestha, 2021; Abbatt and Wang, 2020; Wang et al. 2020; Nazaroff and Weschler, 2020).

## Reactive Nitrogen Oxides and their Transformations

In the absence of these indoor activities, the mixing ratios of pollutants could be high due to the infiltration of outdoor polluted air. The indoor concentration of any pollutant depends primarily on the equilibrium between the sources and sinks. As per Spicer et al. (1993), the residence time of gas phase nitrogen oxides in the indoor environment were in the order NO ~ HONO > $NO_2$ > $HNO_3$.

For $NO_2$, the surface water serves as an important sink, following which the water mediated $NO_2$ disproportionation into HONO and $HNO_3$ occurs.

$$NO_2 + H_2O \rightarrow HONO\ (aq) + HNO_3$$

The above reaction is known to be the most dominant contributor to indoor HONO levels in addition to its primary emissions from combustion processes involving natural gas and propane in the households (Abbatt and Wang, 2020). $HNO_3$ concentrations are generally very low in the indoor air due to its high solubility in water but $HNO_3$ can strongly influence pH values in the indoor environment (Nazaroff and Weschler, 2020).

It has been observed that HONO maintains an active partitioning between the indoor surfaces and gaseous phase. The partitioning with $NO_2^-$ in surface reservoirs helps to maintain the gaseous HONO mixing ratios in the indoor air (Wang et al. 2021; Spicer et al. 1993).

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$$HONO\ (aq) \leftrightarrow H^+ + NO_2^-$$

$$HONO\ (aq) \leftrightarrow HONO\ (g)$$

It can be ascertained that multiphase reactions and consequently the equilibrium attained determines the gaseous HONO mixing ratios in the indoor air.

In the presence of sunlight (300 nm ≤ λ ≤ 400 nm), photolysis of HONO occurs to produce highly reactive OH radicals which play a key role in indoor chemistry. From a health point of view, HONO is known to react with nicotine sorbed on indoor surfaces to form nitrosamines which is tobacco specific and potentially carcinogenic.

## Reduced Reactive Nitrogen Indoor Interactions

The most abundant basic species in indoor air is $NH_3$ and it raises the pH of the indoor aqueous surface films which has an impact on the partitioning of various compounds (for e.g. acidic species) between gas phase and indoor surfaces. Indoor $NH_3$ emissions are highly influenced by the presence of occupants as human breath, skin, flatulence, urine, feces etc. are sources of primary $NH_3$ emissions (Nazaroff and Weschler, 2020). Routine activities of humans such as cleaning and cooking also increase indoor $NH_3$ concentrations (Katoch and Kulshrestha, 2020; Ampollini et al. 2019).

It has been observed experimentally that when rapid ventilation is maintained such that outdoor air with low levels of $NH_3$ infiltrates the indoor space, the overall $NH_3$ concentrations do not typically decrease which implies that a large reservoir of $NH_3$ is available on the indoor surfaces which release gaseous $NH_3$ to maintain equilibrium and quickly restore the indoor mixing ratio of $NH_3$ (Ampollini et al. 2019). Chemical reactions in which $NH_3$ is the limiting reagent may speed up in the indoor spaces due to higher $NH_3$ concentrations present indoors. Gas phase mixing ratios of most species (i.e. VOCs, HONO etc.) may decrease following enhanced ventilation if the outdoor air typically has lesser loadings of pollutants than indoor air, and the mixing ratios then rebound to their previous steady state values after closing the doors and windows. This rebound effect indicates that the surface reservoirs are large, with much more compounds absorbed by these reservoirs than in the gas phase (Abbatt and Wang, 2020).

As the indoor environment and associated processes are very different from the outdoor atmosphere hence, it is imperative to study the chemical interactions of nitrogenous compounds in a comprehensive way with emphasis on the prevailing indoor structure and conditions for a better understanding of the fraction of oxidized and reduced nitrogen burden existing in the indoor air.

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# Farm Nitrogen : Pride or Peril ?

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From being a component of DNA, Protein, Chlorophyll to constituting 78% of atmospheric gases Nitrogen is ubiquitous and indispensable . It is as important for agriculture as water is for aquaculture. The Haber's process that enabled artificially synthesizing ammonia, fuelled the green revolution and furthered nutrition justice around the world . Nitrogen in soil is essential for growth , nucleic acid, protein, chlorophyll synthesis and nutrient uptake by plants. However Nitrogen fertilizers are also the most mis-managed resource and its injudicious use has repercussions on environment, economy , health and biodiversity. The key to feeding the projected 9 billion human population by 2050 is through nitrogen management in soil. For which every stakeholder in the food production-consumption ladder from farmers to policy makers, scientists, and citizens have an active role to play.

## Nitrogen Mismanagement - Understanding the Gravity of the Problem

Globally, 70% of all fertilizers used are nitrogen based which contributes 40 % of all food production increase. However nitrogen use efficiency (NUE) in agriculture on an average remains 33% while the remaining 67% is a negative externalities burden on the environment, human health and biodiversity.

Agriculture is the chief contributor of non-carbon greenhouse gases. Augmenting soil with ever increasing levels of nitrogen fertilizers culminates into release of Nitrous oxide, a potent greenhouse gas. Evidently there has been about a 358% increase in nitrous oxide emission since the advent of the green revolution . Also volatile ammonia, nitric oxide emission has been escalated, these also contribute to global warming , climate change, stratospheric ozone depletion, tropospheric photochemical smog formation, acid rain etc.

Excess nitrates and ammonium ions percolate into groundwater and enter rivers, ponds through surface runoff. This contaminates the water body, culminating into accelerated eutrophication, algal bloom, lower dissolved oxygen threatening lives of several aquatic animals, creating dead zones. The groundwater nitrates are responsible for methemoglobin or blue-baby syndrome. Nitrates ($NO_3$-) and nitrites ($NO_2$-) are linked with disorders like diabetes, thyroidism. Once converted to nitroso, compounds can turn carcinogen as well as teratogens.

The nitrate seepage or leaching in ground is also due to an irrational irrigation system , the seepage of negatively charged nitrates leads to electric loss of several positively charged ions like calcium, potassium, rendering them unavailable for soil.

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Urea, ammonia synthesis is highly energy intensive. Fertilizer sector accounts for over 25% of natural gas consumption in India. This along with fertilization effects of nitrates and consequent algal bloom results in excess release of carbon dioxide in the atmosphere furthering global warming climate change.

Nevertheless the importance of Nitrogen optimization of soil for food security and global peace requires no brainer. But its multifaceted repercussions denounce scope of complacency and prolong reliability for sustainable farm production. It is even more important for India which has the largest share of global arable land, second largest human population to feed and stands as third largest consumer of fertilizers but performs dismally when it comes to per hectare cereal yield.

## Overcoming the Hangover

Punjab , Haryana , western Uttar Pradesh were once the poster child of the green revolution in India. These states were forerunners in adapting green revolution high yield crops, land reforms, irrigation and popularising nitrogen use as auxiliary service to soil. But these torchbearers of national food security and farm productivity are now themselves looming in the dark. With decades of near stagnant farm productivity, ever increasing soil sterility/salinity, rising input cost, the farm indebtedness and rural distress is the norm threatening the country's nutrition regime.

The concomitant danger of losing self sufficiency in food is reinforced by the fact that there has been no significant improvement in farm productivity even after dumping ever increasing amounts of nitrogenous fertilizers. Rather deterioration of soil health is becoming more profound in various parts of the country.

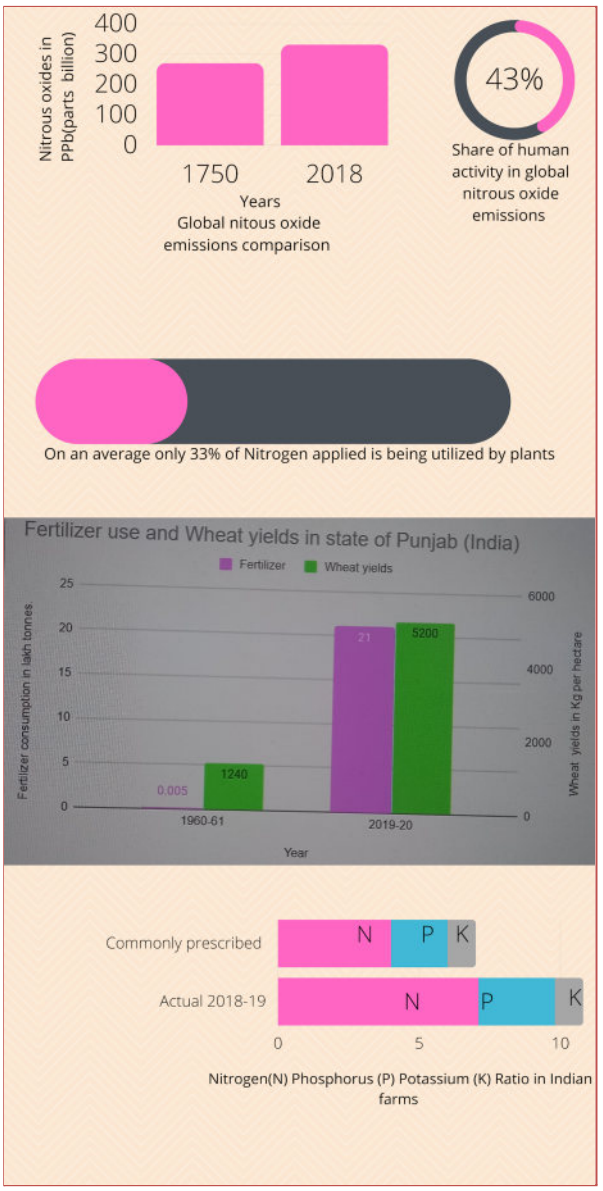


**Figure 1.** Explaining Scale of Nitrogen Mismanagement

It was nitrogen that was in the root of the delicious fruits of the green revolution. However its indiscriminate use have made it villain in socio, economic, environmental malaise that ails Indian farms. Truly resonating with the words of Franklin Roosevelt, “A nation that destroys its soil destroys itself”. However remedies don't lie in sudden and abrupt moratorium on nitrogen fertilizer production and use rather to chalk out sustainable, inclusive, balanced fertilization approaches.

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The ad-hoc arrangement of urea dumping is penny wise pound foolish and needs to be moderated with need based integrated nutrient support. Which is also in concurrence with facts that optimizing soil with micronutrients like zinc, boron, iron, copper etc improves nitrogen use efficiency (NUE).

Inducing Plant growth promoting rhizobium, Bacillus megaterium, Rhizobium, Azotobacter improves soil adaptability to biotic and abiotic stresses, improves nutrient intake on long run. There are several arbuscular mycorrhizal fungi harbouring roots of crops and also improves plants ability to hold and absorb nutrients. To facilitate slow and consistent release of nitrogen in soil, anchoring or coating urea holds merit like Isobutylene Urea, Crotonylidene diurea, sulfur coated urea, neem coated urea, ground rocks etc.

Use of technology for precision farming is becoming important these days. Leaf colour chart, soil health card , drones, Green seeker, satellite imagery, GPS, GIS, real time sensors , canopy mapping are important for spatial and temporal management of soil nitrogen. These technologies help assess nitrogen availability in soil, maintain variable need based rate of nitrogen application in soil.

All such approaches need to be applied at the level of farms. For this extension services need to be inducted to encourage and train farmers for ecologically viable, technologically modern, economically affordable farm nitrogen management practices.

They also need to reconcile faith in traditional knowledge of zero budget farming relying on conservation, circular bioeconomy based permaculture practices. For instance 3786 litres of livestock litter yields 23 Kg Nitrogen and a reasonable amount of other minerals and organic content. The organic content too holds significance for prolonged retention and consistent availability of nitrogen for plants.

Use of biofertilizers based on cyanobacterium, rhizobium needs to be promoted in an incremental manner as a measure towards regenerative agriculture. Crop rotation, mixed cropping, lay farming, mixed farming are the need of the hour. Like rotating legumes and cereals helps maintain soil biota and nitrogen . Irrigation is yet another important area requiring immediate attention. It is judicious to promote fertigation, drip irrigation, mulching so as to avoid nitrogen leaching and ensure optimum management of soil minerals.

The major reason behind the success of the green revolution was the enabling policy framework. However the policy is now moribound and needs overhaul if soil nitrogen and farm prosperity has to last. Rationalising fertilizer subsidy and linking it with productivity concern is the need of the hour to avoid indiscriminate dumping of urea. For which active consideration shall be given to direct benefit transfer (DBT) of fertilizer subsidy to farmers unlike present devolution to fertilizer Industry, as it will encourage more rational balancing of input cost and thus soil nitrogen.

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It will also help prevent leakages and distortion of urea for other purposes. Also subsidy, research and development needs to be promoted for biofertilizers, organic manures etc. The other task in hand is reforming the MSP (Minimum Support Prices ) and procurement policy which is highly skewed in favour of wheat , rice and thus discourages crop rotation and agro-ecology based cropping patterns.

The United Nations (UN) declared 2021-30 as a decade of ecosystem restoration. The importance of balancing farm nitrogen in restoration needs to be emphasised and a mission mode work shall be carried out to maintain balanced amounts of nitrogen for sustainable and inclusive development,climate justice, food security , evergreen revolution, global peace , soil health and biodiversity.

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# Role of Cyanobacteria- The First Oxygen Producing Organisms in Fixation of the Atmospheric Nitrogen

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## Introduction

Cyanobacteria also referred to as Blue-Green Algae (BGA) belongs to Kingdom Protista. Like other Protists they are Prokaryotes meaning their nucleus is not membrane-bound and their DNA is double-stranded and circular spread in the middle of the cell. The Blue-Green Algae is called Cyanobacteria as they contain a bluish pigment known as Phycocyanin which is used to perform photosynthesis by capturing light. Like plants, these organisms can fix carbon in the atmosphere. Not all Cyanobacteria are bluish-green but some also appear to be pinkish or reddish as they contain Phycoerythrin as a pigment. These organisms were first to release oxygen in the atmosphere thereby making primitive reducing atmosphere to oxidizing. Thanks to them as they are the evolvers of the oxygen we breathe today. These organisms are highly diverse as they are widely spread all over the globe. Simultaneously while fixing carbon in the atmosphere, they also fix nitrogen ($N_2$) including their free-living and symbiotic forms. From the Arctic region to the Antarctic, these organisms dominate various environments of the Earth and play a significant role in controlling the global nitrogen cycle. Let's further explore deeply about these beautiful organisms in this article.

## Importance of Nitrogen as a Major Biogeochemical Cycle in the Atmosphere

Atmosphere comprises major gases such as oxygen, carbon dioxide, and nitrogen. But it is nitrogen which is found in abundance (i.e., 78% of the total atmospheric gases). This alone speaks about nitrogen and its importance in controlling the existence of life on this Earth. Nitrogen is a vital constituent of DNA, RNA, and proteins which are building blocks of life. It is present in different forms in the biosphere. For the foremost part, this massive reservoir of nitrogen isn't directly available to living organisms. Utilization of nitrogen from the atmosphere requires a bond breaking of an exceptionally stable triple covalent bond between nitrogen atoms (N-N) to supply $NH_3$ (ammonia) or $NO_3^-$ (nitrate). These reactions are referred to as nitrogen fixation and are often accomplished by both industrial and natural processes. Organic process is the process of conversion of atmospheric $N_2$ (nitrogen) to $NH_3^-$ (ammonia). It plays a crucial role in the flow of nitrogen within the ecosystem. Its importance is understood from the very fact that despite its higher concentration in the atmosphere, almost all living organisms are not capable of directly utilizing free nitrogen for the synthesis of nitrogenous-based biomolecules such as amino acids, purines and pyrimidines, etc.

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Hence there is a requirement of converting this atmospheric nitrogen into an accessible form. This process is called nitrogen fixation. When it is fixed in ammonium or nitrate form, nitrogen enters a biogeochemical cycle and goes through several organic or inorganic forms before it subsequently returns to its molecular form ($N_2$) (Figure 1). The $NH_4^+$ (ammonium) and $NO_3^-$ (nitrate) ions are produced through fixation or liberated through degeneration of organic matter of the soil.

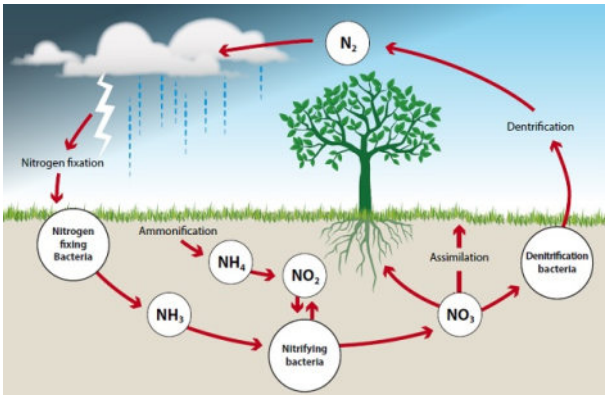


**Figure 1.** Schematic representation of nitrogen cycle (Source: studyacs.com)

## Physiology of Nitrogen Fixation by the Cyanobacteria (BGA)

Cyanobacteria (BGA) are the sole organisms that amalgamate the metabolic capabilities of photosynthetic $O_2$ production and nitrogen fixation. This is often prominent because the nitrogenase enzyme and reaction are highly unstable to $O_2$. Cyanobacteria have advanced strategies to deal with this problem.

In terms of metabolic efficiency and ecological preponderance, the foremost successful one, is that exhibited by the heterocystous Cyanobacteria. These filamentous BGA have developed a specialized cell called heterocyst for nitrogen fixation. Figure 2 demonstrates a biochemical model of heterocyst function. Nitrogenous is protected from the inhibitory effects of $O_2$ by a thick cell wall and active respiratory uptake. The photosynthetic reduction of $CO_2$ and $O_2$ evolution are limited to the vegetative cells which transfer reduced metabolites to the heterocysts, from which they obtain fixed nitrogen. As the vegetative cells divide, heterocysts retract from one another and new heterocysts differentiate from vegetative cells that no longer obtain sufficient nitrogen from the too-isolated heterocysts. Within the heterocysts, reduced ferredoxin and ATP (substrates) for nitrogenase are derived from the degradation of the reductant supplied by the vegetative cells and the cyclic phosphorylation of a partial photosynthetic system. This vegetative cell-the heterocyst system is efficient for synthesizing $NH_3$ and $O_2$ simultaneously, from $H_2O$, air, and sunlight. These BGA have a greater capability in the production of fertilizer than that of non-heterocystous Cyanobacteria (e.g. *Oscillatoria*) which must substitute between photosynthetic periods and nitrogen fixation, reducing the total efficiency of the process.

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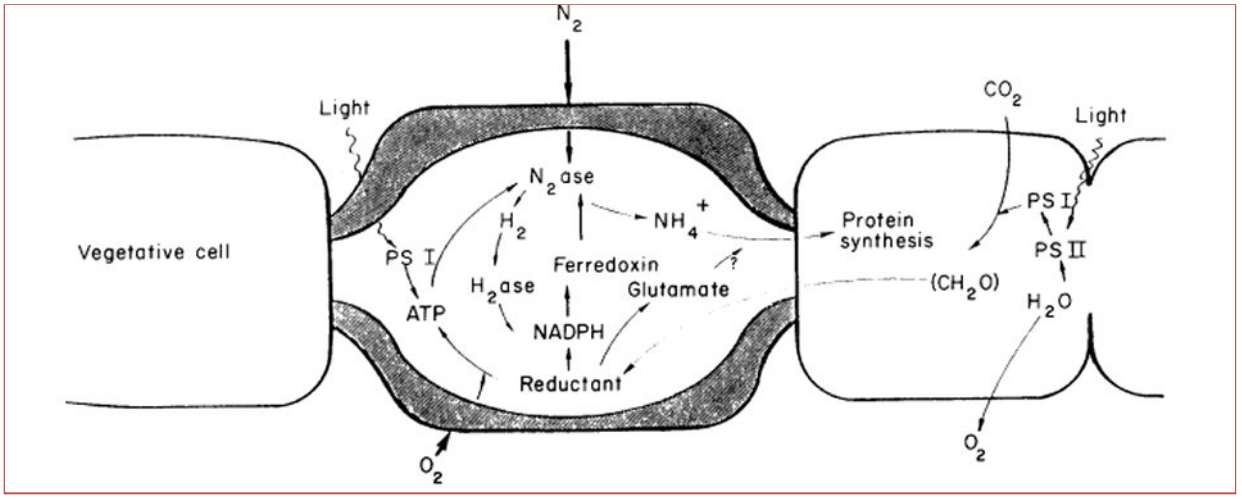


**Figure 2:** Model of heterocyst function
(Source: Enzyme Microb. Technol., 1979, Vol. 1, April. Nitrogen-fixing blue-green algae: John R. Benemann)

## Cyanobacterial Species Responsible for Atmospheric Nitrogen Fixation

There are about 2000 taxa of Cyanobacteria having been recorded on the Earth. Morphologically, they are differentiated into three groups namely, single-celled BGA, non-heterocystous filamentous BGA, and heterocystous filamentous BGA. Generally, nitrogenase is found within the heterocyst, especially distinguished vegetative cells, and each heterocystous form is said to be nitrogen-fixing. But many forms of non-heterocystous filamentous BGA and a few of the unicellular forms also show the capacity to fixation of di-nitrogen in microaerobic or/and anaerobic conditions. Overall, greater than 150 species of 33 genera of Cyanobacteria are reported to fix nitrogen.

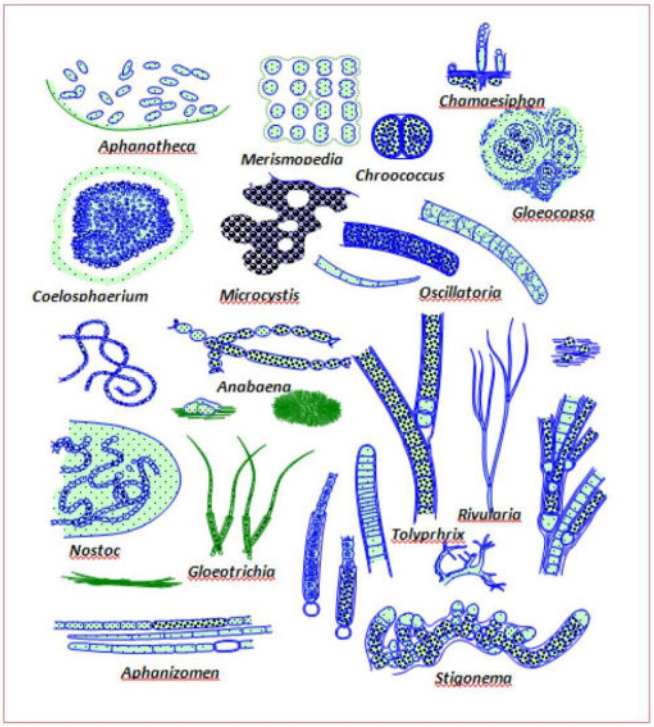


**Figure 3.** Nitrogen-fixing Cyanobacteria (BGA)

(Source: https://www.intechopen.com/books/advances-in-biology-and-ecology-of-nitrogen-fixation/nitrogen-fixing-cyanobacteria-future-prospect)

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## Role of Nitrogenase of Cyanobacteria in Fixation of Molecular Nitrogen

Most of the filamentous and unicellular species of cyanobacteria, synthesize the nitrogenase enzyme and are ready to fix molecular nitrogen. This phenomenon seems to be in contravention with the extreme sensitivity of nitrogenase towards molecular oxygen. Consequently, nitrogen-fixing BGA have set up mechanisms to safeguard nitrogenase from inactivation by oxygen. The enzyme complex nitrogenase (E.C.1.18.6.1) comprises a dimeric Fe-protein i.e., the di-nitrogenase reductase working as an electron carrier to the tetrameric MoFe-protein i.e., the di-nitrogenase which decreases molecular nitrogen to ammonia. These two enzymes are exceptionally oxygen-sensitive. The fundamental anaerobic character of the nitrogenase complex needs exceptional adaptation in cyanobacteria which produce oxygen in plant-type photosynthesis. Filamentous heterocystous cyanobacteria provide a particularly anaerobic environment by making a diffusion barrier for gases, improved respiratory movement, and hence the absence of the oxygenic photosystem-I. Reductant supply of nitrogenase through ferredoxin is given by photosynthates shipped from vegetative cells to the heterocysts and ATP is produced by photosystem-I activity or oxidative phosphorylation inside the heterocysts. Under a light-dark system, most heterocystous strains portrayed so far especially fix nitrogen in the light. Natural Cyanobacterial bloom populated by heterocystous cyanobacteria exhibits higher nitrogenase activity inside the light than in the dark.

## Relationship Between Symbiotic Cyanobacteria, Nitrogen Cycle and Plants

Symbiotically able cyanobacteria have some exemplary characteristics that make them particularly important in the list of $N_2$-fixing symbionts of economic plants, like cereals. Unlike *Rhizobia*, most symbiotic cyanobacteria carry their mechanism for shielding nitrogenase from inactivation by oxygen. Cyanobacteria have an unmatched host range of fungi sponges, protists, and angiosperms), aren't restricted to roots but may form a symbiotic relationship with various plant parts, and don't require to be located intracellularly within the host plant. Cyanobionts usually provide their hosts with fixed nitrogen, in addition, they also provide fixed carbon to non-photosynthetic hosts. The main plant hosts are bryophytes, cycads, the angiosperm *Gunnera*, the water-fern *Azolla*, and mycobiont (to form lichens). The plant cyanobionts are members of the genus *Nostoc*, which is usually free-living in nature.

Nitrogen fixation rates for cyanobacteria are symbiotically related to bryophytes are several-fold higher than the similar free-living cyanobacteria. This rise is because of a greatly elevated heterocyst frequency, which can be 6–10-fold higher than in the free-living state as lesser as 20% of the nitrogen fixed is retained by the cyanobiont, the rest being transferred as ammonia to the host.

Close evaluation of an *Azolla* leaf ascertains that it consists of a thick, reddish, or greenish dorsal lobe and a thinner, translucent ventral lobe immersed in the water. An ovoid central "living quarters" cavity for filaments of *Anabaena* is present in the dorsal lobe.

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The thick-walled heterocysts that have distinctive "polar nodules" at each end of the cell often appear more transparent. The "polar nodules" could also be of similar composition as cyanophycin granules which are the co-polymers of arginine and aspartic acid. Cyanophycin granules occur in many cyanobacteria and function as a nitrogen storage product.

Even though *Azolla* can absorb nitrates from the water, it also can absorb ammonia released by *Anabaena* within the cavities of its leaf. Rice is the single most vital source of food for people and *Azolla* plays an essential role in rice production. For hundreds of years, *Azolla* and its nitrogen-fixing partner, *Anabaena*, are used it as a "green manure" in Asian countries like China to fertilize rice paddies and increase their production. The Republic of China has 3.2 million acres of rice paddies planted with *Azolla*. This provides a minimum of 100,000 tons of nitrogen fertilizer per annum worth greater than $50 million every year. In China, extensive propagation research is being carried out to supply new varieties of *Azolla* which will thrive under different climatic and seasonal conditions.

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# Nitrogen Fixation in Plants

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## Abstract

Nitrogen is present in the atmosphere in large amounts and is an essential nutrient for plants, but plants can't fix nitrogen on their own, microorganisms like bacteria help them in fixing nitrogen. The interaction between bacteria and plants is chemotactic. Plants chemotactically attract bacteria towards its roots as a response nodule formation is activated. Nitrogen is assimilated in the form of nitrate and ammonia. Nitrate reductase reduce nitrate to nitrite and nitrite reductase reduces nitrite into ammonia.

## Introduction

Majority of the atmosphere consists of nitrogen. Nitrogen is an essential nutrient for plants and is the building block for amino acids and also is a part of nucleic acids. Nitrogen moves through the atmosphere, soil, and water in different forms forming a nitrogen cycle. Plants can't fix nitrogen on their own, they need help from microorganisms to fix nitrogen.

## Process

Plants secrete chemicals like Flavonoids, isoflavonoids, and betains to attract bacteria towards its roots. This attraction is chemotactic. In bacteria NodD (gene) is activated as a result for nodule formation. The process of nodule formation can be divided into:

- Recognition by the host
- Infection
- Infection thread formation
- Development of infection thread
- Nodule formation

When nodule formation occurs, nitrogenase enzymes come into play. Nitrogenase enzyme is sensitive to oxygen. The nitrogenase enzyme is encoded by nif genes. Nitrogen is fixed in two forms, ammonia and nitrate. Plants can store high levels of nitrates, animals can't. Ammonia is toxic to both plants and animals. In Nitrate assimilation by plants, nitrate is transported across the plasma membrane followed by two step reductions to form ammonia. Most nitrates are assimilated into organic compounds. First step is reduction of nitrate to nitrite which takes place in cytosol with the help of enzyme nitrate reductase. Second step is conversion of nitrite into ammonia. Nitrite is a highly reactive and toxic ion; it is immediately transported from the cytoplasm with the help of enzyme nitrite reductase.

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Plant Physiology, third edition by Lincoln Taiz and Eduardo Zeiger, Chapter 12; page 259- 282.

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# An Overview on Nitrogen

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## Abstract

Many significant and important elements are found in the earth's atmosphere in which Nitrogen is the most abundant one. Approximately 78% of the earth's atmosphere consists of Nitrogen by volume. From the key building blocks of most of the micro and macromolecules (including DNAs, RNAs, amino acids, vitamins, lipids, etc.,) to the wider aspects of our environment, Nitrogen is found. Whether it is the air we breathe, the water we drink, the soil on which the plants and other organisms grow and survive and the nutrition we take up, Nitrogen plays a crucial role in the lives of living organisms and also helps in balancing the environment. In this article, an effort has been made to cover some of the major aspects of Nitrogen including its occurrence and distribution, properties, regulation in the environment *(The Nitrogen Cycle)* and Detrimental effect of excess Nitrogen.

## Nitrogen – Historical Perspective

During early investigations of the air Nitrogen was recognized and isolated. In 1772, the Swedish chemist, *Carl Wihelm* showed that air is a mixture of two gases - *'fire air'* and *'foul air'*. The one which supported combustion, he called it as *'fire air'* and the one which was left after the utilisation of fire air and which did not support combustion, he called it as *'foul air'*. Later on, according to this view point, the fire air was considered to be Oxygen and the foul air to be Nitrogen, although these terms of *'Oxygen'* and *'Nitrogen'* were not being used at that time when Carl Wihelm did his experiments. It was *Jean-Antoine Claude Chaptel*, the French chemist who gave the name *'Nitrogen'* in 1790. He originally named it *'nitrogène'*, a reference to nitre (potassium nitrate), which was known to contain nitrogen. Although the official credit for the discovery of Nitrogen goes to the Scottish botanist, *Daniel Rutherford* who was the first to publish his work in 1772.

Due to the inertness and inability of Nitrogen to support life, *Antoine Laurent Lavoisier* called it as *azote*, meaning *'no-life'* and it was him only who considered Nitrogen as *'chemical element'*.

## Nitrogen- Occurrence and Distribution

The atmosphere consists of about 78% of Nitrogen by volume. Nitrogen also occurs in the form of ammonia, ammonium salts, oxides of nitrogen and nitric acids in the atmosphere but in varying and lesser quantities. *(The world's top five producers of nitrogen (in the form of ammonia) in the early 21$^{st}$ century includes India, Russia, USA, Trinidad and Tobago and Ukraine.)* Nitrogen also occurs in the mineral deposits of Nitre (Potassium Nitrate) and Chile saltpetre (Sodium Nitrate). Being the key component, Nitrogen is found in most of the micro and macro molecules such as lipids, amino acids, vitamins, and of the genetic material (Nucleic acids including DNAs and RNAs) of various living organisms.

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## Nitrogen – A Chemical Overview

Nitrogen is placed in the p-block of the *'Modern Periodic Table of Elements'* and belongs to *period number 02* of *group number 15*. The alphabet 'N' is used to symbolise the elemental form of Nitrogen. It has two stable isotopes: $^{14}N$ and $^{15}N$. Some important atomic and physical properties of the Nitrogen element are given in Table **1**.

| S. No. | Property | Value |
|---|---|---|
| 1. | Atomic Number | 07 |
| 2. | Atomic Mass | 14.0067 *g mol*$^{1}$ |
| 3. | Electronic configuration | $1s^2 2s^2 2p^3$ |
| 4 (a) | Ionization Enthalpy I | 1402 *kJ mol*$^{-1}$ |
| 4 (b) | Ionization Enthalpy II | 2856 *kJ mol*$^{-1}$ |
| 4 (c) | Ionization Enthalpy III | 4578 *kJ mol*$^{-1}$ |
| 5. | Electronegativity | 3.0 |
| 6. | Covalent Radius | 70 *pm*[a] |
| 7. | Ionic Radius | 171[b] |
| 8. | Melting Point | 63 *K* |
| 9. | Boiling Point | 77.2 *K* |
| 10. | Density | 0.879 *g cm*$^{-3}$ * |

**at 63 K.*

**Table 1.** Atomic and physical properties of Nitrogen *(Source: National Council of Educational Research and training)*

Nitrogen is classified as non-metal and exists in many forms in the nature either in combination with other Nitrogen element such as dinitrogen ($N_2$) or in combination with other distinct elements such as Hydrogen (H), Oxygen (O), Potassium(K), etc., and thereby, forming various compounds of ecological and economical importance such as oxides of nitrogen (NOx), ammonia ($NH_3$), ammonium ($NH_4^+$), etc.

## Regulation of Nitrogen- The Nitrogen Cycle

Depending on the nature of the element, there is a specific route through which the transportation and transformation of the element occurs among ecosystems, i.e., incorporation of elements by living organisms and its subsequent release back to the environment *(via decomposition).* This movement of elements occurs through various spheres of the earth *(namely biosphere, hydrosphere, lithosphere and atmosphere)* and is commonly termed as biogeochemical *cycle*. On the basis of the primary source of element input to the ecosystem, biogeochemical cycle is of two types: *gaseous cycle (in which the atmosphere acts as the major reservoir of elements such as Carbon and Nitrogen)* and *sedimentary cycle (in which the lithosphere acts as the major reservoir of elements such as Phosphorus, sulphur, etc.)*.

We have, now, the basic idea regarding regulation of elements among and within ecosystems. Now, let us see about the cycling of nitrogen, *the gaseous type of biogeochemical cycle*.

The chief reservoir of Nitrogen is the atmosphere which has about 78% of the gaseous form of Nitrogen ($N_2$). The other reservoirs include soils; sediments of lakes, rivers and oceans; surface and groundwater; and the biomass of living organisms. Both biological and non-biological processes carry out the transformation of nitrogen into its various chemical forms in the Nitrogen cycle.

The important processes in the nitrogen cycle include *nitrogen fixation*, *ammonification*, *nitrification* and *denitrification*.

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Nitrogen Fixation- Nitrogen fixation is a reductive biosynthetic process. Natural processes of nitrogen fixation include *Biological Nitrogen fixation* and *Non biological nitrogen fixation (which is done by various photochemical reactions)*. About 90% of the fixation of nitrogen done is the biological nitrogen fixation in which prokaryotic organisms play an important role and hence, these organisms are termed as *diazotroph* meaning *'the nitrogen-fixing organisms'.* Eukaryotic organisms are unable to fix nitrogen.

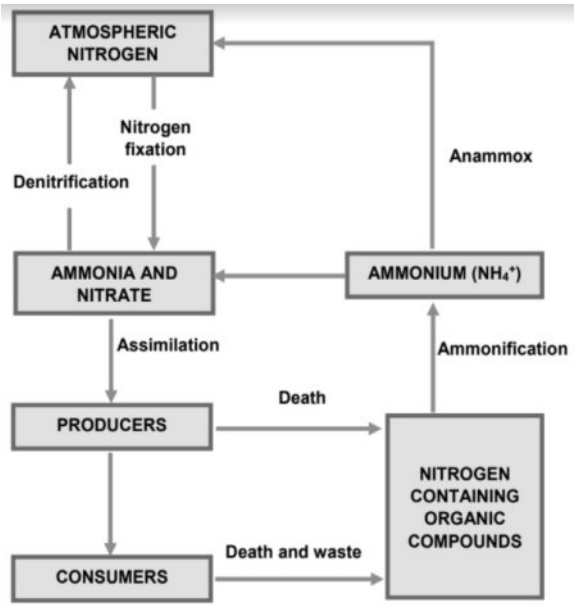
Ammonification- The conversion of organic nitrogen, present in soil, into ammonium ions by the action of bacteria and fungi, is termed as ammonification.

Nitrification- The oxidation of ammonium ions to nitrite exclusively carried out by nitrifying bacteria such as *ammonia-oxidizers* of genera *Nitrosococcus*, *Nitrosospira*, *Nitrosomonas* and subsequent oxidation of nitrite to nitrate exclusively by nitrifying bacteria such as *nitrite-oxidizers* of genera *Nitrobacter*, *Nitrococcus* and *Nitrospira* is referred to as nitrification.

Denitrification- The process of conversion of nitrate ($NO_3^-$) into dinitrogen ($N_2$) by the action of anaerobic denitrifying bacteria is called denitrification. The successive steps involved in this conversion process is mentioned below:

$$2NO_3^- \rightarrow 2NO_2^- \rightarrow 2NO \rightarrow N_2O \rightarrow N_2$$

*Another significant step called Anaerobic Ammonium Oxidation (abbreviated as Anammox) is a recently discovered bacterial process usually done by Anammox bacteria which is mediated by a specialized group of planctomycete-like bacteria which has the features of both nitrification (ammonium oxidation) and denitrification (reduction of nitrate and production of $N_2$) in a single process.*




NITROGEN CYCLE

## Detrimental effects of excess Nitrogen

Now, a major concern is the adverse effects of too much nitrogen- "a too much of a good thing" situation.

Production and use of fertilizers, legume crops, and worldwide burning of fossil fuels, deposit approximately 140 Tg/year *(1 Tg = $10^{12}$ grams or 1 million metric tons)* of new nitrogen into soil, water, and air- about equal to the estimated nitrogen fixed naturally. Human sewage and domestic animal manure contribute perhaps half again as much. Very few of these inputs are recycled because they escape into soils or streams, or are mixed with heavy metals or other toxins (Eugene P. Odum, Gray W. Barrett).

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Based on extensive field evidence, Tilman et al. (1997) predicted that nitrogen deposition is likely to strongly affect ecosystem processes. Annual inputs of nitrogen in fertilizer and municipal sludge applied to old-field communities in Ohio also significantly reduced plant diversity on a long-term basis compared to control plots (Brewer et al. 1994).

Anything that is detrimental to the natural ecosystem eventually becomes detrimental to humans. Excess nitrogen compounds in drinking water, in food, especially in the air, pose threats to human health. excess nitrogen enrichment is

reducing, biodiversity and increasing the number of pests and diseases globally, and is also the beginning to adversely affect human health (Eugene P. Odum, Gray W. Barrett).

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# Introduction to the Nitrogen Cycle

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## Introduction

Discovery of nitrogen is credited to de Saussure, he recognized nitrogen as a vital constituent of plants and it was obtained from soil in the year 1804. Element nitrogen has symbol N ,atomic number 7 and it belongs to group 15 in the periodic table. It is the most common element found in the atmosphere with concentration of approximately 78% of the total atmospheric gases. It is not abundant in the earth crust. Nitrogen exists in many different forms and is an essential component of building blocks of life that is DNA, RNA and Protein.There are many forms of nitrogen which moves or cycles between the atmosphere, hydrosphere and biosphere.The process which involves the transfer of different forms of nitrogen among these spheres is called the Nitrogen cycle. Among different forms di-nitrogen or ($N_2$) comprises 78% of all the gases in the atmosphere and is relatively non-reactive and not directly usable by higher forms of life.The strong triple bond between nitrogen atoms in the nitrogen gas makes it unreactive.In the year 2003, Galloway et.al found that total amount of nitrogen in the earth (atmosphere, water and soil) is $4\times10^{21}$ g which is far more than combined value of all the four essential elements– Carbon, Phosphorus, Oxygen and Sulfur.

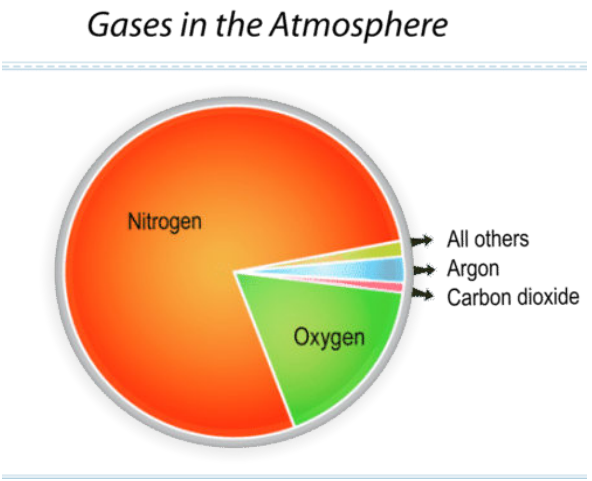


**Figure 1.** Gases in the Atmosphere.

Source: https://www.ck12.org/book/ck-12-earth-science-for-middle-school/section/15.1/ ©Hana Zavadska

## Significance of Nitrogen

Fortunately, there are some microorganisms that can fix the atmospheric nitrogen in the soil and convert nitrogen gas to inorganic nitrogen forms like ammonia and nitrate which can be used by the plants and hence helps in sustenance of life on this Earth. This process is referred to as Biological Nitrogen Fixation (BNF). BNF accounts for approximately 90% of transformation of the atmospheric nitrogen to usable forms by certain bacteria of Genus –*Rhizobium* and Blue- Green Algae (Cynobacteria). Nitrogen is also found in chlorophyll which is the green pigment found in the plants and is essential for photosynthesis.

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Small amount of nitrogen fixation can also occur by high temperature processes like lightning and ultraviolet radiation by breaking strong triple bonds in the molecule nitrogen. Denitrification is another important process in which a microorganism converts nitrate into a reduced form that is nitrogen which goes back to the atmosphere as nitrogen gas. Plants which do not get enough nitrogen become yellowish and give small flowers and fruits.Scientists have estimated that we would lose about one third of our total crops without nitrogen fertilizers.

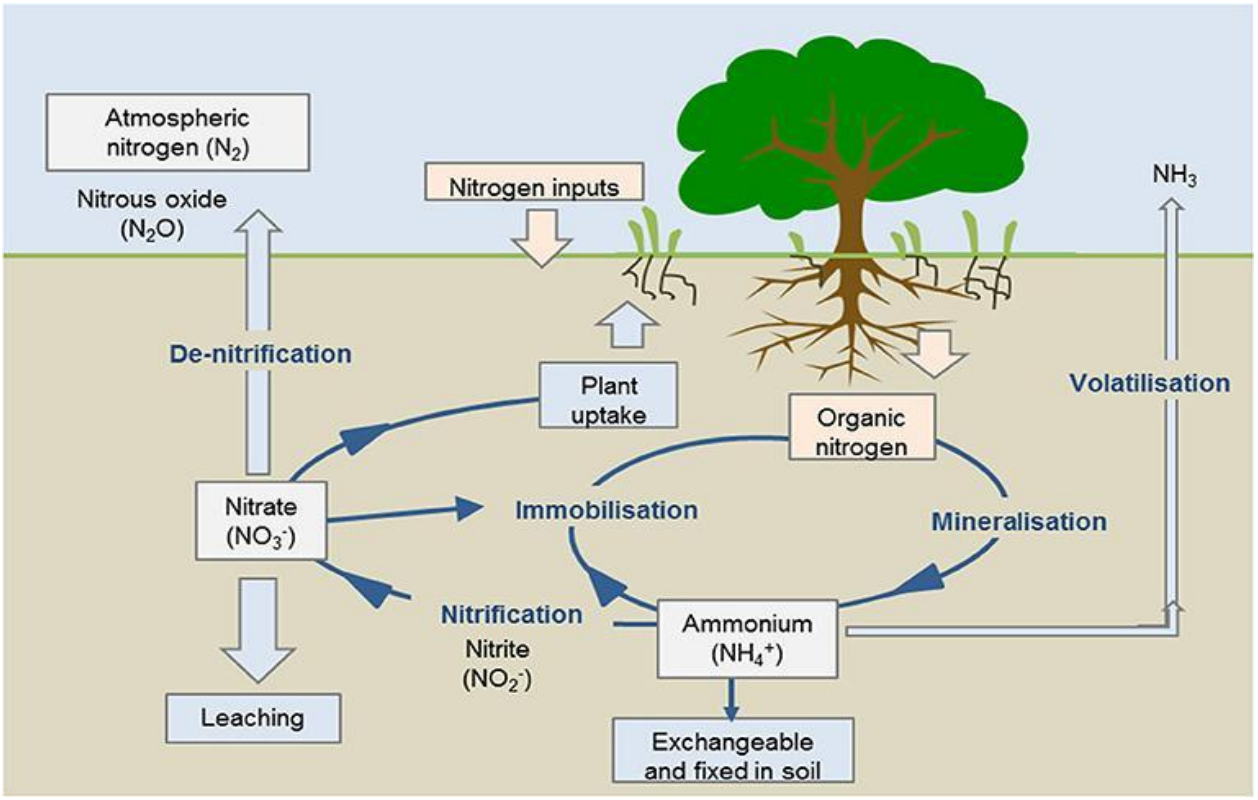


**Figure 2.** The Nitrogen Cycle determines the amount of nitrogen available for plants to uptake. (©2021 DPIRD)
Source: https://www.agric.wa.gov.au/soil-carbon/immobilisation-soil-nitrogen-heavy-stubble-loads

## Nitrogen Cycle

Nitrogen cycle is a repeating cycle of different processes during which nitrogen moves through abiotic and biotic stages which includes atmosphere, plants, soil, water, animals and bacteria. In order to exist in different parts of the cycle, nitrogen exists in different forms like in air it exists as nitrogen gas, in soil it exists as nitrogen oxide and as fertilizers it exists as ammonia.

There are five stages in the nitrogen cycle:

### 1) Nitrogen Fixation

It is the stage where nitrogen from the atmosphere is absorbed into the soil.This process is called nitrogen fixation. Small amount is fixed by lightning whereas a majority portion is

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fixed by biological processes. Lightning provides enough energy for $N_2$ to react with oxygen producing nitrogen oxide (NO) and nitrogen dioxide ($NO_2$). Biological nitrogen fixation involves bacteria, some bacteria remains attached to plant roots have a symbiotic (beneficial for both plant and bacteria) relation with the plant. These bacteria get energy through photosynthesis and in return fix nitrogen for the plants.There are also other groups of bacteria which can fix nitrogen without this symbiotic relation like Genus Bacillus and Azotobacter.

### 2) Mineralization

This stage takes place in the soil, nitrogen moves from organic form (plants/manure ) to inorganic form. This inorganic form is eventually used by plants and is returned to soil when the plant dies. Mineralization takes place with the help of bacteria which acts upon dead plants and animals by the process called decomposition. The first form of nitrogen after mineralization is ammonia which reacts with the water and forms ammonium in the soil.

### 3) Nitrification

The third stage also takes place in soil. During this stage the ammonia produced is converted into nitrate and nitrites. This process is done with the help of bacteria. Plants can directly use nitrates while nitrites are converted into nitrates so that they may be used by the plant community. Here the specific groups of bacteria are called Nitrosomonas and Nitrobacter. Both types of bacteria can work only if there is availability of oxygen.

### 4) Immobilization

This process is the reverse of mineralization.These two processes control the amount of nitrogen in the soil. Microorganisms in soil also require nitrogen for energy sources and hence they reduce the availability of nitrogen to plants. Hence, immobilization ties up nitrogen with microorganism and helps to regulate the amount of nitrogen in soil.

### 5) Denitrification

In the fifth stage of the nitrogen cycle nitrogen returns to the atmosphere as nitrates are converted back to nitrogen with the help of bacteria. The process is called denitrification.The overall result is loss of nitrogen from the soil but gain to the atmosphere from where the cycle has started.

Too much nitrogen and phosphorus in water leads to overgrowth of free-floating plants such as duckweed and filamentous algae, resulting in dense layers of scum in the water. This damages the aquatic plants, fish, and other lake organisms by depriving them of the oxygen and sunlight which they need to survive.

There are dire consequences for the environment all over the world due to excess reactive nitrogen. As we have seen earlier only a small proportion of earth's biota can convert atmospheric nitrogen into usable forms. Therefore, usable form of nitrogen is a limiting factor for many ecosystems including the agricultural ecosystem. Increased amount of nitrogen has led to decrease in the diversity of species, decrease in water transparency in the

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water bodies, habitat degradation, increase biomass of benthic and epiphytic algae, eutrophication, changes in food-web process of terrestrial and coastal ecosystems. Eutrophication is a process by which a water body becomes over rich with nutrients leading to plentiful growth of simple plant life like planktons and algae. Their excessive growth limits the availability of oxygen to the fishes and other aquatic life below. The above mentioned effects are more prevalent in areas like central and western Europe, Southern Asia, parts of Africa and South America, according to a study conducted by Erisman et.al in 2015. The severe consequence of excessive amounts of reactive nitrogen is a decrease in the amount of oxygen, called hypoxia, which leads to development of dead zones in the water bodies.

## Human Health Impact

The alteration of the natural nitrogen cycle due to anthropogenic activities mainly due to excessive production of synthetic nitrogen fertilizers has both positive and negative impacts to human health.The significant contribution of nitrogen fertilizers in the surplus production of food grain is huge. But there is also a negative impact due to an increase in the reactive nitrogen compounds in the atmosphere and water bodies. Urban areas have increased emission of nitrogen oxides due to excessive use of fossil fuel.

The elevated level of nitrogen oxides increase the amount of tropospheric ozone (bad ozone) and aerosols, which is responsible for increased cases of coughs, asthma, other airways disease and mortality. At higher altitude in the stratospheric region ozone destruction takes place due to catalyst activity of NO as $N_2O$ is broken down by UV rays. It is responsible for an increase in the number of skin cancers. $N_2O$ is also a potent greenhouse gas with a very long residence time of 120 years, hence its effects are very long lasting. Elevated nitrate levels in drinking water leads to a condition called methemoglobinemia (elevated level of methemoglobin in blood which leads to decreased oxygen availability to tissues) mostly affecting babies.

## Future Scope

Many people including students, policy makers, teachers, environmentalists are not aware of the extensive ecological, economical, human health, of the excess amount of reactive nitrogen present in the environment. For over 40 years several national and international studies have taken place to publish reports on damaging effects of reactive nitrogen. Effective ways to reduce nitrogen footprint both locally and globally from anthropogenic activities should be done. Practical strategies and recommendations for restoring water quality and terrestrial and aquatic ecosystems should be developed. Studies should focus on increasing the nitrogen use efficiency and sustainability in the agricultural ecosystem, reducing per capita consumption of animal protein, decreasing the fossil fuel combustion, and searching alternative sources of energy.

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Sudeepa Kumari

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Holistic Environment

# Webinar Report

# International Yoga Day 2021

*Organised by:*

JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences, Jawaharlal Nehru University
New Delhi - 110 067

June 21, 2021

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# International Yoga Day 2021

The School of Environmental Sciences celebrated International Yoga Day, on 21st June, 2021. On this occasion, a webinar was organized on the theme 'Yoga for Wellness' in collaboration with the JNU-ENVIS Resource Partner and the Young Holistic (YoHo) group, SES, Jawaharlal Nehru University, New Delhi.

The panel included eminent **Yoga Guru Dr. Pooran Chand ji**, Founder Director, Sivananda Yoga International School, New Delhi, **Prof. U.C. Kulshrestha** (Dean SES & JNU ENVIS Coordinator), **Dr. Usha Mina,** (Associate Professor & ENVIS Co-coordinator, SES, JNU), **Ms. Ankita Katoch,** YoHo lead SES, JNU, **Ms. Shipra Lakshmi,** YoHo lead SES, JNU and **Ms. Swati Singh,** Programme Officer ENVIS, SES executed the programme.

It was attended by more than 60 participants, through Google-Meet and Facebook Live platforms. The participants included university students, researchers, faculty members and common citizens from different parts of the country.

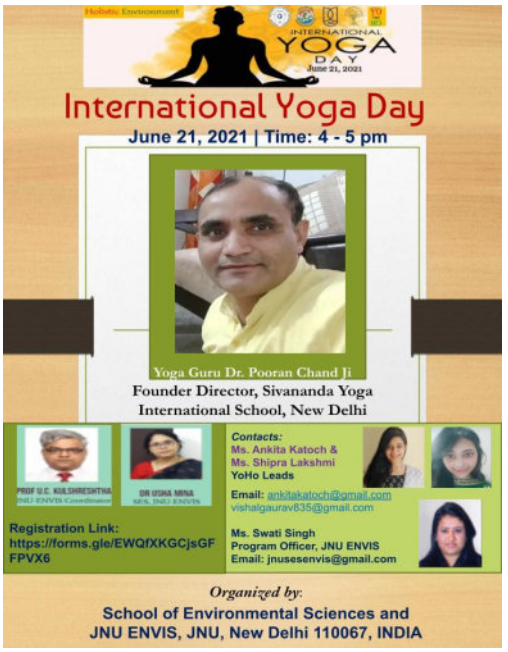



Fig.1: Poster and Schedule of the Webinar widely circulated on the social media platform.

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**Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU -** Welcomed all the speakers and the participants. He talked about the importance of Yoga Day and how practice by local gurus has now reached International audience and the UN decided to celebrate June 21 as International Yoga Day every year. He mentioned that each government or private organization celebrates Yoga Day as a routine as it has multiple benefits. Residential associations also organize Yoga Day camps. He emphasized that everyone should perform Yoga for good health.

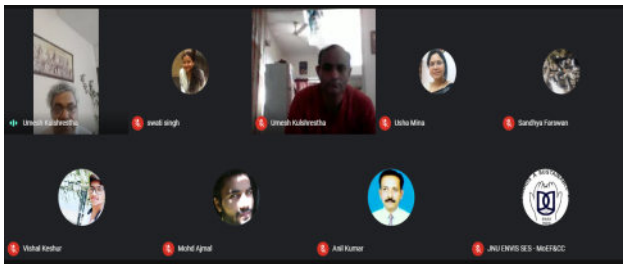

Fig.2: Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU

**Dr. Usha Mina, ENVIS Co-coordinator, SES, JNU -** She talked about benefits of yoga and how health benefits are accrued by regular practice of yoga. She also highlighted the importance of International Yoga Day.

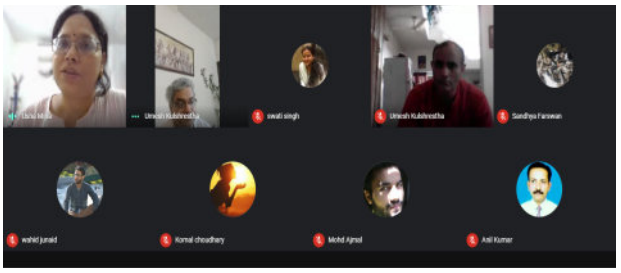

Fig.3: Dr. Usha Mina, Associate Professor & ENVIS Co-coordinator, SES,JNU

**Ms. Ankita Katoch, YoHo Lead , SES, JNU -** She introduced the Common Yoga Protocol and explained about various yoga exercises conducted during the session.

**<u>Asanas in different positions:</u>**

1. **Standing**- Tadasana, Katichakrasana, Padhastasana, Konasana, Surya namaskar.

*Benefits***-** Stretches body, muscle toning and development, correcting posture, spinal agility.

2. **Lying down on spine** - Pawanamuktasana, markatasana, setubandhasana

*Benefits*- Weight loss, flexibility, improves digestion, relieving back pain

3. **Lying down on abdomen**- Bhujangasana, Ardhadhanurasana, salabhasana

*Benefits*- Shoulder and chest stretching, improved circulation, abdominal disorders

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**4. Other asanas :-** Marjariasana - Cat pose, Shashankasana - Rabbit pose, Mandukasana - Frog pose.

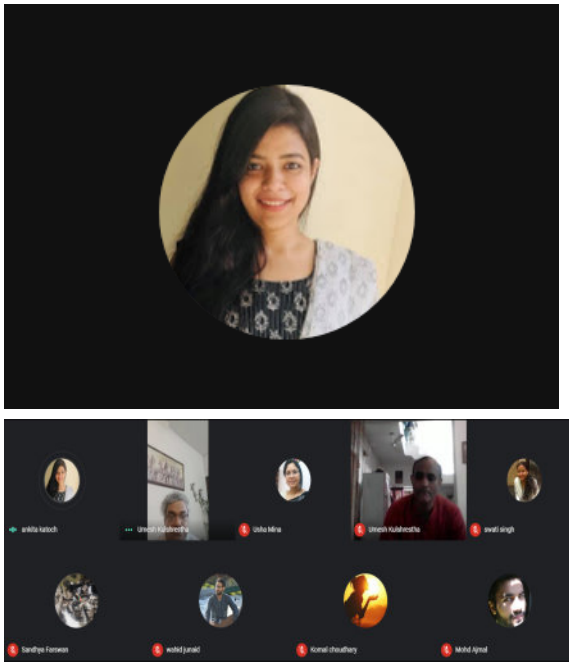

**Fig.4: Ms. Ankita Katoch, YoHo Lead, SES, JNU**

**Yoga Guru Shri Pooran Chand Ji, Founder Director, Sivananda Yoga International School, New Delhi –** He demonstrated Common Yoga Protocol, which was followed by all the participants. All the above (S.Nos. 1-4) asanas were performed by the Yoga Guru.

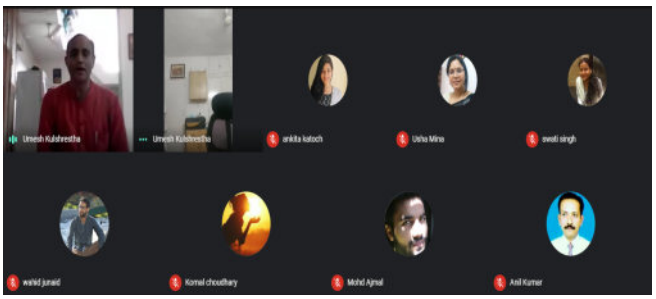

Fig.5: Yoga Guru Shri Pooran Chand Ji, Founder Director, Sivananda Yoga International School, New Delhi

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**Ms. Shipra Lakshmi, YoHo Lead , SES, JNU -** She deliberated the Question & Answer session after the compilation of Common Yoga Protocol. The students and other participants asked very interesting and thought provoking questions which were suitably replied by Yoga guru Shri Pooran Chandji.

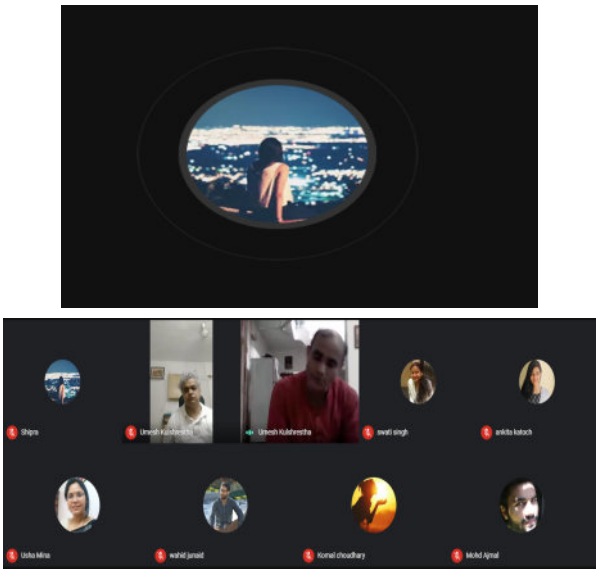


Fig.6: Ms. Shipra Lakshmi, YoHo Lead, SES, JNU

**Vote of Thanks** was extended by **Ms. Swati Singh, Programme Officer, JNU ENVIS.**

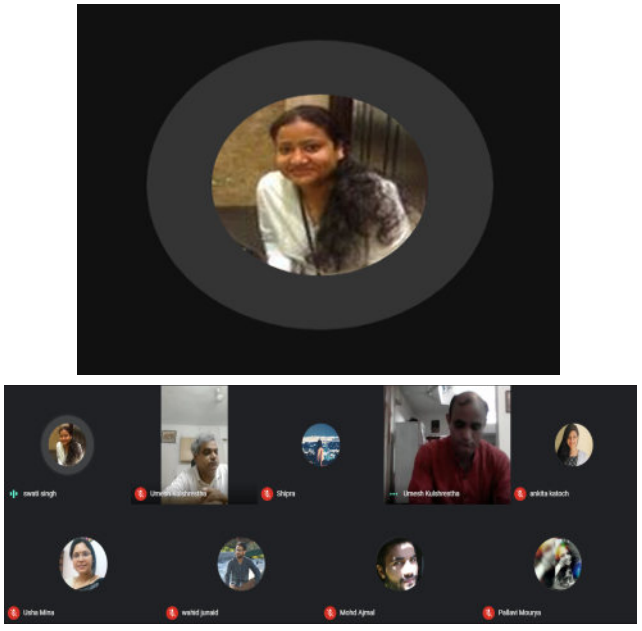


Fig.7: Ms. Swati Singh, Programme Officer, JNU ENVIS RP

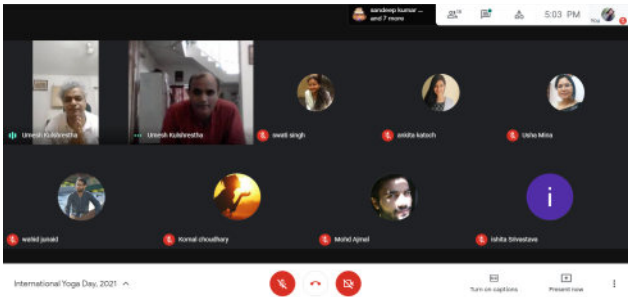
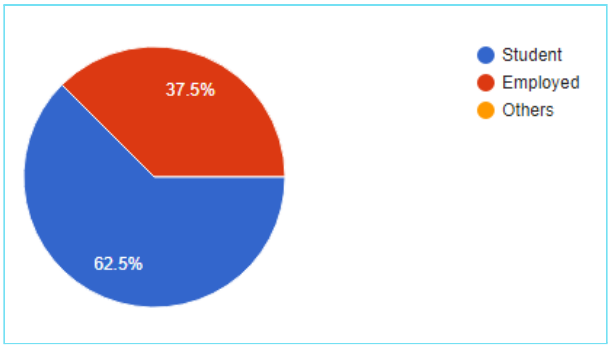
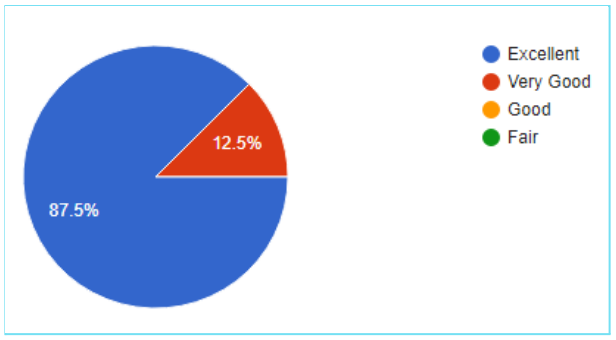


Fig.8: Panelists & Participants of the Panel Discussion

The session came to an end with the distribution of e-certificate to the participants.

## Feedback:




**Video Link on YouTube Channel:**
https://www.youtube.com/watch?v=zlw7g6bis48

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Holistic Environment

# Panel Discussion Report

# International Day of the Tropics

## Theme: 'The Digital Divide in the Tropics'

June 29, 2021

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# International Day of the Tropics 2021

## Theme: 'The Digital Divide in the Tropics'

The School of Environmental Sciences (SES) celebrated the International Day of the Tropics on June 29, 2021. On this occasion, a webinar was organized on the theme 'The Digital Divide in the Tropics' by the JNU ENVIS Resource Partner in collaboration with ENVIS RP on Ecotourism, SCS&T, Sikkim and the Young Holistic (YoHo) group, SES, Jawaharlal Nehru University (JNU), New Delhi.

The panel included very eminent International and National academicians and scientists viz., **Prof. C K Varshney** (Emeritus Professor, JNU, India), **Prof. Marta L Fischer** (University of Parana, Brazil), **Dr. Wilkister N Moturi,** (Egerton University, Kenya), **Dr. E Makaya** (Hanell International London, UK), **Dr. R Balasubramanian** (Singapore University, Singapore), **Dr. Manish Dabhade,** (School of International Studies, JNU, India), and **Prof. P K Joshi,** (SES, JNU, India). **Mr. Manjul Panwar** represented budding researchers as a Young Holistic leader, and **Ms. Swati Singh,** Programme Officer, JNU ENVIS RP, SES, India executed the programme under the supervision of **Prof. U C Kulshrestha** (Dean SES & JNU ENVIS Coordinator). The event was attended by more than 123 participants through Google-Meet and Facebook Live platforms.

The participants included university students, researchers, faculty members and other stakeholders both nationally and internationally.


**Webinar Schedule: International Day of the Tropics**
**Date : June 29, 2021 | Time: 04:30 pm - 06:30 pm IST**

| Speakers | Time |
|---|---|
| Welcome Address by **Prof. U.C. Kulshrestha** ENVIS Coordinator/Dean, SES, JNU, India | 04:30 PM - 04:40 PM |
| **Prof. C. K. Varshney**, Emeritus Professor, JNU, India | 04:40 PM - 04:50 PM |
| **Prof. Marta L. Fischer,** FNA, University of Parana, Brazil | 04:50 PM - 05:00 PM |
| **Dr. Wilkister N. Moturi,** Egerton University, Kenya | 05:00 PM - 05:10 PM |
| **Dr. E. Makaya,** Hanell International, London, UK | 05:10 PM - 05:20 PM |
| **Dr. R. Balasubramaniam,** Singapore University, Singapore | 05:20 PM - 05:30 PM |
| **Dr. Manish Dabhade,** School of International Studies, JNU, India | 05:30 PM - 05:40 PM |
| **Prof. P. K. Joshi**, SES, JNU, India | 05:40 PM - 05:50 PM |
| **Shri D. T. Bhutia,** Director, Department of S&T, Sikkim ENVIS Coordinator, India | 05:50 PM - 06:00 PM |
| **Mr. Manjul Panwar,** YoHo Lead, SES, JNU, India | 06:00 PM - 06:10 PM |
| **Question & Answer Session** | 06:10 PM - 06:20 PM |
| Vote of thanks by **Ms. Swati Singh,** Programme Officer, JNU ENVIS RP | 06:20 PM - 06:30 PM |

*Organized by:*
JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences,
Jawaharlal Nehru University, New Delhi, INDIA

*In Collaboration with:*
ENVIS Resource Partner on Ecotourism, Sikkim State Council of Science & Technology
Department of Science & Technology, Vigyan Bhawan, Deorali, Gangtok, Sikkim, INDIA

Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi

Fig.1: Poster and of the Webinar widely circulated on the social media platform.

**Prof. U C Kulshrestha**, **Dean SES & JNU ENVIS Coordinator –** Prof. Kulshrestha welcomed all the speakers, participants, students and guests while briefly introducing all the speakers. He highlighted the importance of the International Day of the Tropics and how conservation and preservation of the tropics is important. He highlighted that in spite of the richness of all types of resources, the innovative research in tropics is lacking, and it should be promoted. He specifically mentioned that research journals originating from the region need to be promoted. He referred to a research paper published in 1908 which suggested how the tropics should be developed.

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He highlighted the problems such as superstitions and lack of self motivation in the tropics as mentioned in the century old paper, and the same problems still persist. He mentioned that there is a need to attend to the issues of climate change and environmental pollution in the tropics.




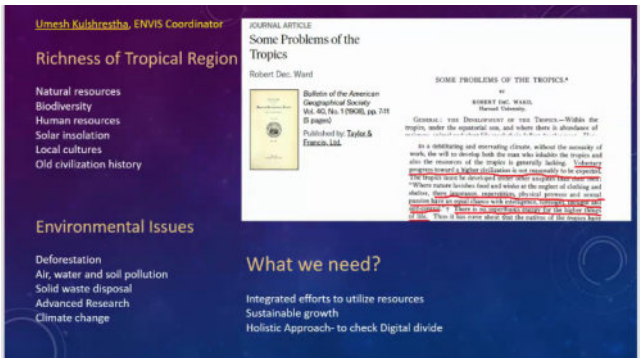


Fig.2: Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU

**Prof. C K Varshney, Emeritus Professor, JNU, India –** Prof Varshney started with the history of this day. In 2014 on June 29, Nobel Laureate Aung San Suu Kyi had produced the 'State of the Tropics Report' that suggested a very distinct point of view on the tropical regions. The report was the outcome of the collaborative efforts of top 12 tropical research institutions.

In 2016 the United Nations (UN) declared June 29 as the 'International Day of Tropis' to celebrate the extraordinary and astounding diversity of the tropics. International Day of the Tropics was inaugurated by the UN General Assembly to raise awareness, at all levels, about the issues that affect the tropical zone, as well as the far-reaching implications of such issues. The day also aims to emphasize the important role that countries in the tropics will play in achieving the sustainable development goals.

According to him the day also highlights the opportunities offered and the challenges faced by tropical nations. He mentioned that the tropics are a region of the Earth surrounding the equator. They are located between the Tropic of Capricorn in the Southern Hemisphere and the Tropic of Cancer in the Northern Hemisphere.

The Tropics cover approximately 40% of the land area on the Earth and are host to about 80% of our planet's biodiversity. The region has over 100 countries spread over North America, South America, Africa, Asia, and Australia. The region supports 40% of the world's population living in the tropical area as of 2014. It is estimated that 50% of the world's population will reside in the tropics by the late 2030s.

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It also exhibits about 80% of biodiversity, as well as maximum diversity in cultures and languages. He said that the Tropics Drive the Global Climate. Tropical climate is characterized by hot weather as temperature remains relatively constant throughout the year. The recent research, particularly around the El Nino - Southern Oscillation (ENSO) phenomenon has altered our view of global climate. ENSO is the largest single source of global climate variability.

Prof Varshney mentioned the environmental issues faced by tropical regions. He said that this region has most of the global population, for example out of global numbers, most children are present in this region. The region has extremely rich biodiversity and also rapid loss of biodiversity. The greatest biodiversity of cultures, languages and religions growing trade and investment are there in the tropics. The tropics are in close proximity to active deep oceans; high risk of damage from cyclones, hurricanes and tsunamis etc.

He highlighted the challenges of the tropics including the high rate of deforestation and loss of biodiversity, growing impact of climate change, increasing forests, bush and peat fire, water shortage, poverty, hunger, malnutrition in all its forms, social inequalities, poor health care, high risk from extreme events, hurricane and tsunami and the Digital Divide in the Tropics. He believes that closing the digital divide is inevitable. This year's theme aims to promote advocacy, awareness and action with speed. He suggested the way forward such as the halting of deforestation (both legal and illegal) and restoration of damaged or degraded ecosystems, and going for net–zero by replacing fossil fuels with renewable sources of energy are important.

He further emphasised on conserving mangroves, wetlands and biodiversity and conserving water resources to solve water shortage. He urged to stop land use changes involving expansion of commercial crop cultivation, and export of cattle meat.

He said there is a need to evolve a new paradigm of economic growth that is climate resilient, tropics centric and that avoids aping the north. Also, he felt that there is a need to expand education and healthcare facilities to all.

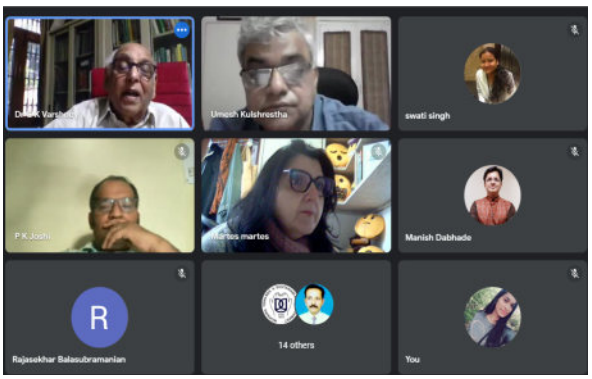


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Fig.3: Prof. C K Varshney, Emeritus Professor, JNU, India

**Prof. Marta L Fischer, University of Parana Brazil –** Prof. Marta L Fischer talked about tropics and her work in the tropics. Her talk focused upon Bioethics. She mentioned that bioethics was consolidated as the field of ethics applied to moral conflicts of biological and life sciences. Potter (1971) was one of the disseminators of bioethics terminology and proposed bioethics as a field of knowledge focused on the study of the survival of human civilization in the context of the survival of the planet. He proposed building a bridge among biological sciences and the humanities in order to balance cultural and physiological needs with public policies.

Although Potter was concerned with issues such as - DNA decoding; increasing urbanization; agriculture production, water and energy consumption, but the political and economic moment did not allow his voice. But his ideas were very well accepted in technology and health issues.

She briefed about bioethics development which took in three stages:-

**1. Micro - Bioethics (1970 - 1980) -** Focus on the patient's autonomy regarding medical decisions in view of technological innovations applied in medicine.

**2. Meso - Bioethics (1980 - 1990) -** Focus on institutional decisions and their impact on society. At this stage, the deliberative and normative spaces of the ethics committees were created.

**3. Macro - Bioethics (1990) -** Decisions were no longer individual or institutional, but global and timeless. It allowed the retaking of the perspective of environmental bioethics idealized by Potter.

She mentioned that the issues have become complex, plural and global in nature. She defined these as below-

1. **Complex -** Actors can assume the role of moral agent, and the role of vulnerable patients depending on the hierarchical decision scale.
2. **Plural -** So many actors involved.
3. **Global -** Impact of the decisions of moral agents even at the local levels have global repercussions.

Prof Fischer suggested the following solutions of the associated problems- **1.** Need to apply a tool to consider the argument of each actor,

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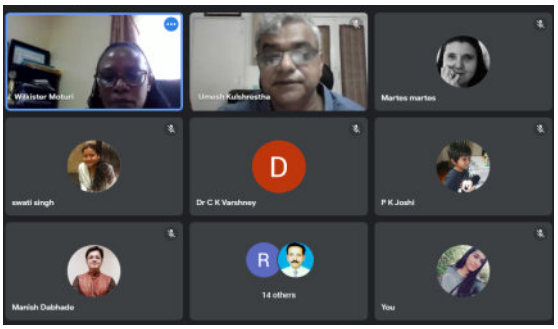
**2.** Applications of local moral or legal values are unable, **3.** To consider the needs and vulnerabilities through participatory management worldwide between these actors.

Prof Fischer mentioned the structure to build and consolidate local environmental bioethics committees in research on humans and animals. We understand the whole environment interaction space: nature, cities, work environment at local and global scales, so members must be composed of a multidisciplinary team. As with all environmental issues, we are talking about processes that are essential to quality biopsychosocial. They may be even up protected by the state, but this should not have absolute autonomy in decisions. We look at participatory management and to this end information and education are important.


Fig.4:Prof. Marta L Fischer, University of Parana Brazil

Thus, an 'environmental bioethics' is required which brings together the relationship of man - environment in a wider range to answer key questions that include interpersonal, social, economic and political dimensions of moral conflicts. This way, these committees would contribute to the public sphere deliberation spaces.

**Dr. Wilkister N Moturi, Egerton University, Kenya** - Dr Moturi discussed environmental problems faced by tropical regions with special focus on African nations. She mentioned that the environmental issues in the tropics are diverse. There are several factors that influence them and these factors lead to unsustainable practices and development activities. Population increase and related issues have exacerbated some of them. Consequently, they lead to a wide range of outcomes. She highlighted some key environmental issues of Kenya.




She was very much concerned with the poor municipal solid waste disposal problem which is a major problem of the tropics. She highlighted different forms of water pollution in Kenya. She mentioned some of the problems in the tropics namely, deforestation, soil erosion and land degradation. Due to industrialization and urbanization, the problem of air pollution is very severe in most of the cities, affecting human health.

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Dr Moturi informed about severe droughts in Kenya. She also mentioned flooding and displacement of people in Rift Valley lakes in Kenya.


Fig.5 Dr. Wilkister N Moturi, Egerton University, Kenya

**Dr. E Makaya, Hanell International London, UK –** Dr Makaya delivered his talk on 'Dynamics of Environmental Anthropology: Local Actions & Global Consequences'. He emphasized upon Tropical Environmental Changes including climate variability, and change for which local actions impacting on the climate and global actions impacting local climate are needed. He briefly mentioned selected tools for impact projection. He mentioned the following tools for modeling and simulation-

- *TRACE (Transport sector climate action co - benefit evaluation tool) -*
- *Climate Action Aggregation Tool (CAAT) -* Climate Action Aggregation Tool (CAAT) is an Excel based tool to aggregate non - state actors climate policy efforts.
- *SCAN Tool -* The SDG Climate Action Nexus (SCAN) tool provides high - level guidance on how climate mitigation actions can impact the achievement of the Sustainable Development Goals (SDGs).
- *Climate Opportunity Dashboard -* The climate opportunity 2030 dashboard provides an interface to interactively compare scenarios for different co - benefits of climate action.
- *GIS and remote sensing -*

Dr Makaya suggested that in order to solve International challenges that go with climate change, we can come up with several tools. Making also happening at the lowest possible. International protocols like the Kyoto Protocol, are very important. It is at the International level where agreements are entered into challenges that go with climate change.

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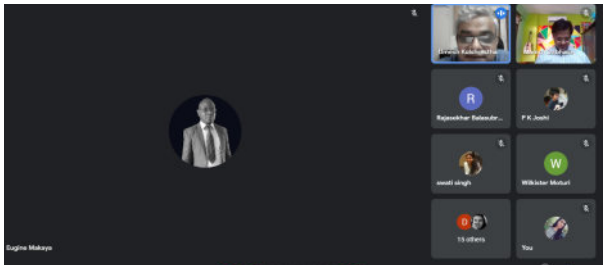
We can come up with several tools. Project climate impacts are normally people who use modelling and simulation tools, such as the trace. The climate action, aggregation through the scan to the climate opportunity dashboard. We also find that GIS in remote sensing could also be used. While concluding his talk, Dr Makaya mentioned that local actions have global implications and vice versa. Anthropogenic activities transcend beyond political boundaries.Tropical climate conditions worsens the situation.



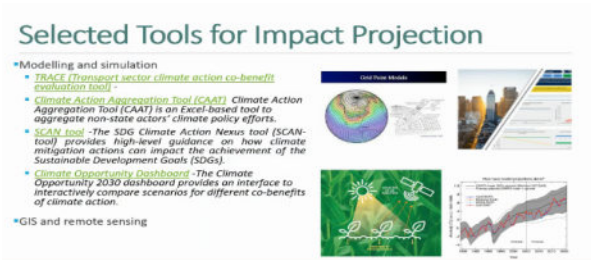
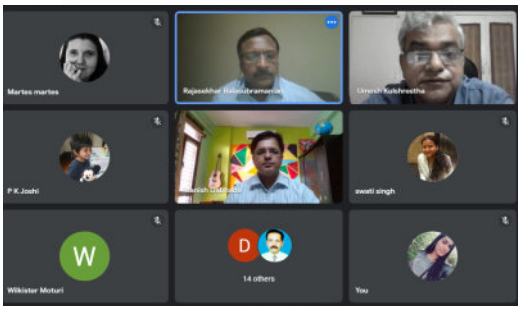



Fig.6 Dr. E Makaya, Hanell International London, UK

**Dr. R Balasubramanian, Singapore University, Singapore –** Prof Bala talked about Challenges & Environmental Problems to tackle in the Tropics. He mentioned outdoor air quality (OAQ) and the impact of COVID - 19 lockdown on urban air quality. He said that the the COVID - 19 pandemic caused by SARS - CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), and subsequent lockdown measures (e.g. Travel restrictions, telecommuting and social distancing) Implemented in countries worldwide in 2020 provided an unprecedented opportunity to examine how human activities influence air quality in urban environments.

He discussed the impact of COVID - 19 lockdowns on urban air quality of Singapore. He emphasized that we need to find out the factors affecting increased O3 concentrations during pandemic. He suggested conducting further studies on $PM_{2.5}$ reduction leading to enhanced photochemistry during the pandemic. Further, more vigorous studies are needed on the role of fine particles in scavenging of OH and $HO_2$. He mentioned that the lesson from the natural experiment conducted during the CB period is that emission trends of primary air pollutants, meteorology and atmospheric chemistry should be considered holistically while making air pollution control policies.Citizen behavioural changes such as switching from motorised urban passenger to active mobility and/or public transport would make urban air cleaner and healthier. He also expressed his worries about indoor air pollution as people spend about 90% of their time indoors.



3.8 millions people every year die prematurely from illness attributable to the Indoor Air Pollution**.** Prof Bala concluded his discussion by citing a case of indoor air quality suggesting a combination of ventilation followed by air distribution, filtration of air and disinfection in order to protect the people who remain indoors.

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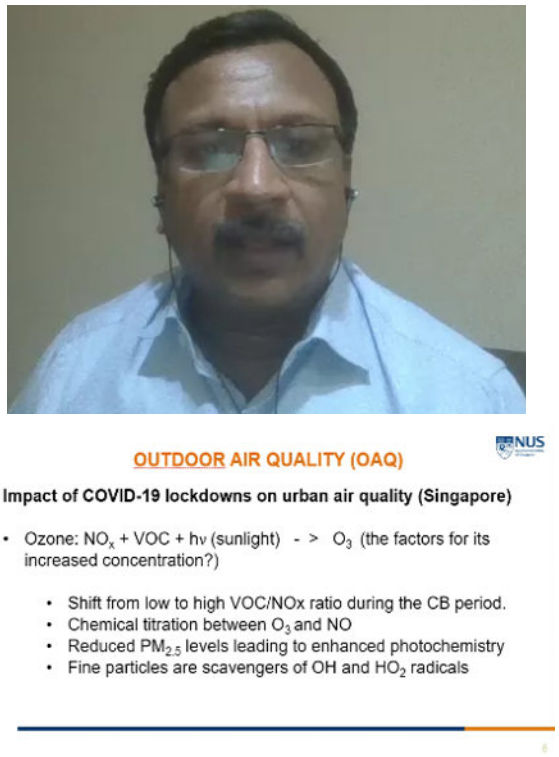


Fig.7: Dr. R Balasubramanian, Singapore University, Singapore

**Dr. Manish Dabhade, School of International Studies JNU, India –** Dr Manish initiated his talk by emphasising on the digital landscape in the Tropics, as per the theme of the International Day of the Tropics is `the digital divide'. The second, very important point which he brought out was the geographic importance of a country.

He said that according to estimates just 37.1% of the people use the internet in the tropics, and in the rest of the world it is around 54% indicating the gap between the tropics and the rest of the world. He mentioned that in fact, the UN development program has seen a lot of activities with its partners including governments asking how to bridge the existing gap of the internet divide in those countries. In fact, an increase in online social activities and increased crossbody collaboration by governments and academics have contributed towards some progress.

In fact, today's reliance on digital solutions has also added urgency to concerns about very importantly, and look at what's happening. He also said that this digital divide is not sudden but seen since the dawn of the internet age, and today, the digital inequality is the reality. It has appeared like a flash exposing to all of us.


Fig.7: Dr. Manish Dabhade, School of International Studies JNU, India

Dr Manish mentioned that the UN also, suddenly started using the terms like digital gap, digital inequality, digital access about the quantity and the quality, both digital literacy. He emphasized that the connectivity and the quality of connectivity both are very important. The access to mobile phones has increased dramatically since the turn of the century, but the reality is that it's still trails behind the rest of the world. So, in 2000, while there were fewer than five mobile forces, just five 400 people in the tropics by 2019. This number had gone up.

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In fact, the 2021 report will be launched today which is titled **'The digital divide in the tropics'.** Dr Manish mentioned that the voices of concern are heard in Europe or even in North America. In fact, there was a high level thematic debate on digital cooperation and connectivity convened by the president of the UN General Assembly. The UN high level panel on digital cooperation which provided recommendations was also mentioned. There were very important recommendations that led to the release of the organization's roadmap for digital cooperation last year in June about an alliance for affordable internet.

**Prof. P K Joshi, SES, JNU, India -** Prof Joshi highlighted the importance of Universal internet with a concern to operationalize it; not only across the ages but also across the genders. He mentioned that the idea of technology revolution has captured the minds of the entire world, but when we actually look at it, we see that we are still in the process of securing it. At the ground level, such kinds of mechanisms are missing to ensure accessibility and usage. If one sees the coverage of mobile services, one finds that when the entire world is heading towards 5G, the majority of the tropics are still with 2G or 3G, and that too in some very selected pockets. Indeed ICT or ICT enabled solutions are must, but for the tropics the right kind of capacity, building skill, transfer of technology, digital literacy, cultural, appropriateness of these services and also the agencies to use these services are needed. Funds are needed; those should carry out hand holding so that everybody can be benefited from this. He said that we all know about Google's room and about SpaceX.

What is needed is impact on the ground so that it enables the community for the purpose. We need to figure out why technology is more important and why technology is very important for the tropics?.

Prof Joshi mentioned that there are certain assumptions that we are going to be able to target everyone with the technology and everyone is going to be able to benefit. But the reality, and the truth is, there are huge gaps and perhaps that is the reason International day of the Tropics 2021 has identified this theme of 'digital divide in tropics'. Tropics are actually to their maximum stretch and there should be a scalable solution. The affordability of using the instruments, the tools for this should be there. We need to develop a newer business model to enable communities in this region.

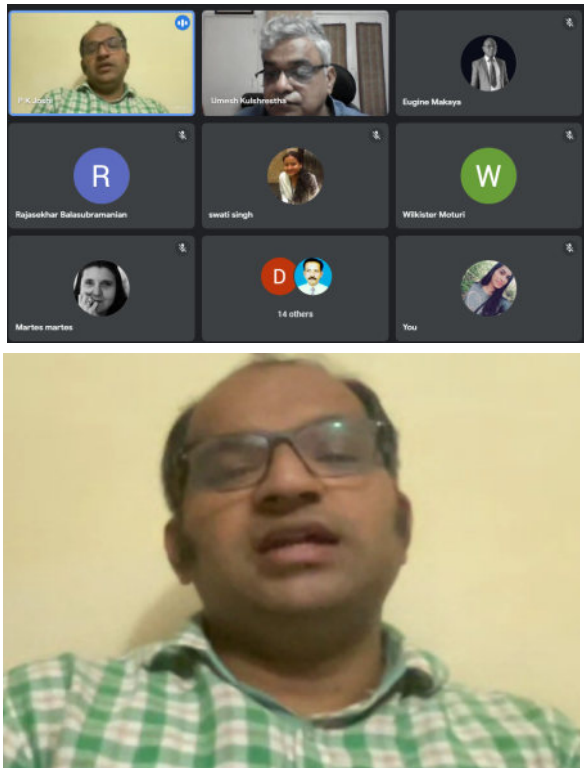


Fig.8: Prof. P K Joshi, SES, JNU, India

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**Mr. Manjul Panwar YoHo Gyan Lead & Student, SES, JNU –** The YoHo which stands for Young Holistic program of the school is contributing towards student leadership. It is an outreach program having around 30 activities such as Quiz, Debates, Seminars, Yoga, Euphoria etc. Mr Manjul, the YoHo leader, talked about YoHo activities of SES and competition that was conducted under the programme. He mentioned that YoHo is really a wonderful program for the overall development of students.

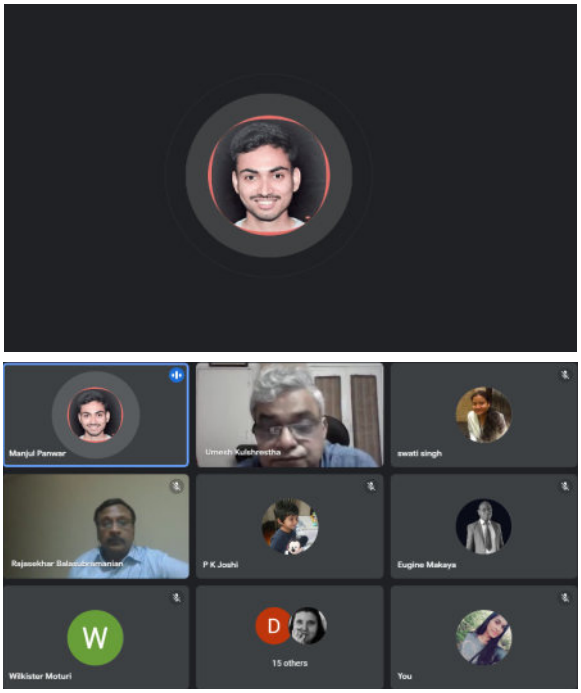
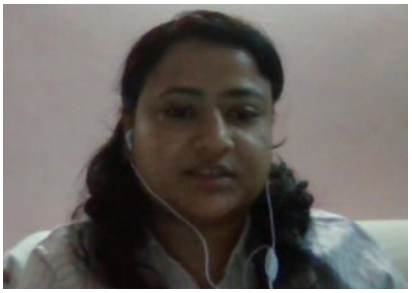



Fig.10:Mr. Manjul Panwar YoHo Gyan Lead & Student, SES, JNU

**Vote of Thanks** was extended by **Ms. Swati Singh, Programme Officer, JNU ENVIS and** she declared the result of Online Short Essay Competition conducted on this occasion.



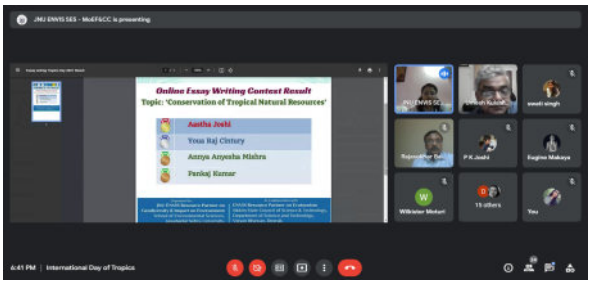



Fig.11: Ms. Swati Singh, Programme Officer, JNU ENVIS RP


Fig.12: Panelists & Participants of the Panel Discussion

The session came to an end with the distribution of e-certificate to all the participants. Feedback was collected from the participants. This is to mention that a very positive feedback was received from the participants about the event.

## Recommendations:

1. Halt deforestation (both legal and illegal), plant trees and restore damaged or degraded ecosystems.
2. Net-zero emission, replace fossil fuels by renewable sources of energy.
3. Conserve mangroves, wetlands and biodiversity.
4. Conserve water resources to solve water shortage.
5. Stop land use changes involving expansion of commercial crop cultivation, and of cattle farms for meat export.
6. Evolve and involve new and transformative technologies.

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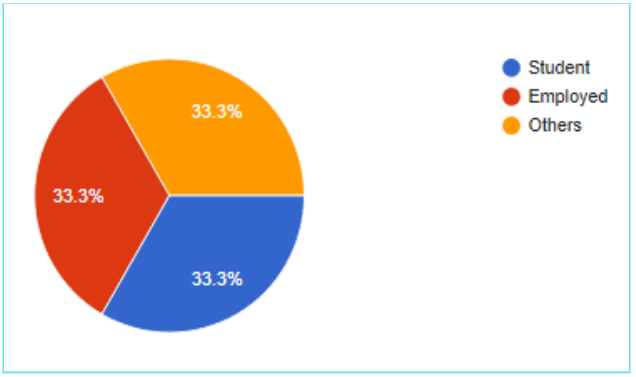
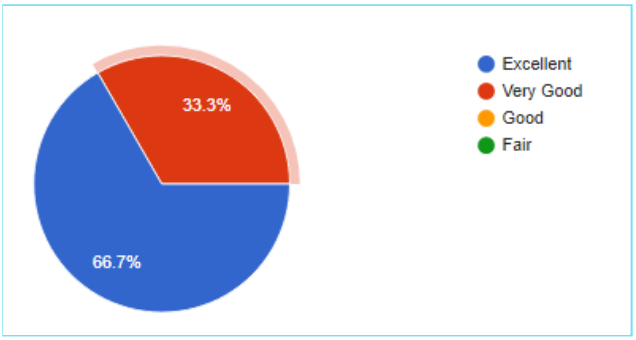
7. New paradigm of economic growth that is climate resilient, and tropic centric, and avoids aping the north.
8. Expand education and healthcare facilities to all.
9. Constitute a bio-environmental ethic body.
10. Develop food security and drought control plans.
11. Need to develop the impact projection tools.
12. Need to conduct more studies on $PM_{2.5}$ reduction leading to enhanced photochemistry during the pandemic.
13. More investigations are needed on the role of fine particles in scavenging of OH and $HO_{2..}$
14. Need actions to fill the digital gap between the tropics and the rest of the world
15. Strengthen the ground level mechanisms for technology usage.
16. Need to encourage more young researchers and need to promote research journals which are focusing on the tropics.

## Feedback:




At the end I was happy to be Winner

It is an innovative approach to share the details about the tropics

Very nice and enthusiastic

**Video link on the official YouTube Channel:**
https://www.youtube.com/watch?v=wXhP9_7CqCs

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# Webinar Report

## World Nature Conservation Day, 2021

### Theme: Nature Conservation Approach for Sustainable Future

*Organised by:*

JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences, Jawaharlal Nehru University
New Delhi - 110 067

July 28, 2021

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# World Nature Conservation Day

## Theme : ' Nature Conservation Approach for Sustainable Future'

The School of Environmental Sciences celebrated the World Nature Conservation Day on 28th July, 2021. On the occasion, an International webinar was organized on the theme '**Nature Conservation Approach for Sustainable Future**' in collaboration with the JNU-ENVIS Resource Partner and the Young Holistic (YoHo) group, SES, Jawaharlal Nehru University, New Delhi.

The panel included very eminent national and International researchers such as **Prof. Himanshu Pathak** (Director, ICAR, NIASM, Pune, India), **Dr. Beachley Gregory** (Co-chair TDep - NADP USEPA, USA), **Prof. Govind Chakrapani** (VC, Berhampur University, Odisha, India), **Prof. Narpat Singh Shekhawat** (Retd. JNVU, Jodhpur, India), **Dr. Neha Sinha** (Bombay Natural History Society, India), **Prof. U.C. Kulshrestha**, Dean SES & JNU ENVIS Coordinator, **Dr. Usha Mina** (ENVIS Co-coordinator SES/JNU), **Ms. Shipra Lakshmi,** YoHo lead SES, JNU, The Young Holistic leader YoHo **Ms. Saham Ansari** represented the student group, **Ms. Swati Singh,** Programme Officer ENVIS, SES executed the management of the programme.

Professor U.C. Kulshrestha, moderated the panel discussion. It was attended by more than 153 participants, through Google-Meet and Facebook Live platforms. The participants included university students, researchers, faculty members and common citizens from different parts of the country.


**Webinar Schedule: World Nature Conservation Day 2021**
**THEME: NATURE CONSERVATION APPROACH FOR SUSTAINABLE FUTURE**
**DATE : JULY 28, 2021 | TIME: 05:00 PM - 07:00 PM IST**

| Speakers | Time |
|---|---|
| Welcome Address by **Prof. U.C. Kulshrestha** ENVIS Coordinator/Dean, SES, JNU, India | 05:00 PM - 05:10 PM |
| **Prof. Himanshu Pathak**, Director, ICAR, NIASM, Pune, India | 05:10 PM - 05:25 PM |
| **Dr. Beachley Gregory,** Co-chair TDep - NADP, USEPA, USA | 05:25 PM - 05:40 PM |
| **Prof. Govind Chakrapani,** VC, Berhampur University, Odisha, India | 05:40 PM - 05:55 PM |
| **Prof. Narpat Singh Shekhawat,** Retd. JNVU, Jodhpur, India | 05:55 PM - 06:10 PM |
| **Dr. Neha Sinha,** Bombay Natural History Society, India | 06:10 PM - 06:25 PM |
| **Dr. Usha Mina,** SES, JNU ENVIS Co-coordinator, India | 06:25 PM - 06:40 PM |
| **Ms. Shipra Lakshmi**, YoHo Lead & Student, SES, JNU | 06:40 PM - 06:45 PM |
| **Ms. Saham Ansari**, YoHo Lead & Student, SES, JNU | 06:45 PM - 06:50 PM |
| Vote of thanks by **Ms. Swati Singh** Programme Officer, JNU ENVIS RP | 06:50 PM - 07:00 PM |

Organized by:
JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi

Fig.1: Poster and Schedule of the Webinar widely circulated on the social media platform

**Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU -** He welcomed all the speakers and the participants. He highlighted the importance of World Nature Conservation Day. He mentioned the major findings of the IPCC about sources of carbon dioxide. He discussed the effect of COVID 19 shutdown on CO2 levels at Mauna Loa observatory. He also discussed air quality improvement in the National Capital Region of Delhi due to reduction of pollutants, especially the particulate matter. He introduced the panelists of the day and invited the first speaker to deliver his talk.

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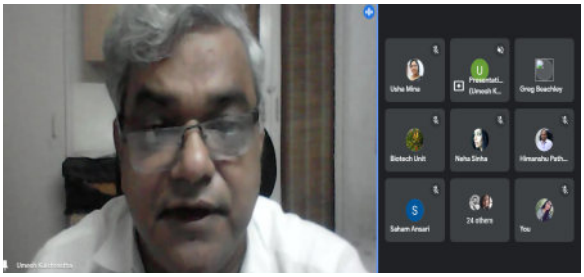


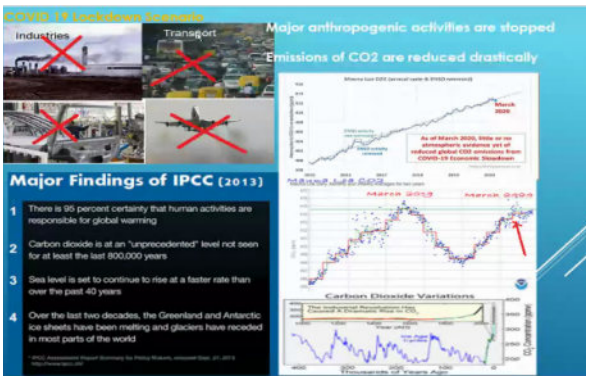


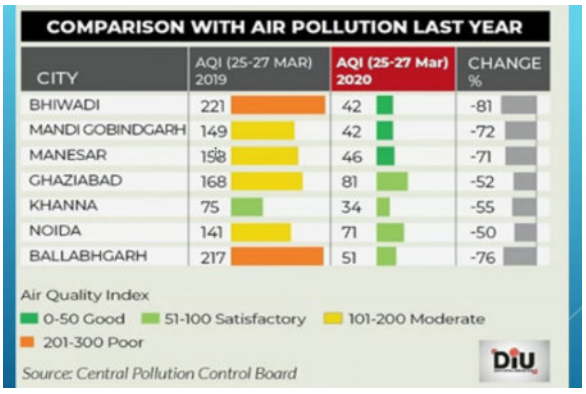


Fig.2: Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU, India

**Prof. Himanshu Pathak, Director ICAR, NIASM, Pune India –** He commenced his talk by contradictory approaches of Economy Vs. Environment. He said the environment is in minority, at times marginalized.

He mentioned that th agriculture started 10,000 years back, initially it was subsistence agriculture with low productivity. Various Agricultural Revolutions are the following:-

1. Green (crop) Revolutions
2. White (milk) Revolutions
3. Blue (fish) Revolutions
4. Yellow (oil) Revolutions
5. Golden (honey & short.) Revolutions
6. Silver (egg) Revolutions
7. Brown (coffee) Revolutions
8. Grey (wool) Revolutions

India faced food scarcity till 1950, food shortage from 1950 - 1970, from 1970 - 2010 we are food sufficient and 2010 onwards food is in surplus.

The Indian economy has grown to 2800 billion US$ in 2019 from ~30 billion US$ in 1950 i.e., 90 times increase. Per capita GDP has grown by 7 times since 1950.Since 1950, the growth has been ~5% annually. Global economy has grown nearly 10-fold since 1950. Economists project 3% annual growth. Illustrious economic past is extrapolated into a promising future.

Water availability in India is reducing with current per capita availability of about 1500 $m^3$, India is already a water - stress country. The global Living Planet Index (LPI), has declined by more than 30% since 1970. The Tropical LPI has declined by almost 60%. The Temperate LPI showed an increase of 15%, reflecting the recovery of some species populations in temperate regions. Global mean temperature to increase by 3.7 to 4.8°C by 2100, Sea level to rise ~ 50 cm by 2100, Cyclones are fiercer & frequent: Tauktae, Yaas, Amphan, Nisarga, Fani, Biotic stresses are more aggressive: Locust.

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Poor people are the worst sufferers as they are more dependent on nature. Though they contribute least to its degradation. Global hunger fell for decades, but it's rising again, globally there are almost 60 million more undernourished people now than in 2014. COVID has increased the number of hungry people many fold. The Global Hunger Index of 2020 ranks India 94th among 107 countries.

**Sustainable development includes the following:**

1. **Eco - regional Agriculture Planning :-** Growing crops in suitable eco-regions and without degrading natural resources.
2. **Reducing Food Loss:-** Global Grain Crop production ~2700 million tons (2018-19), 36% to feed animals, 47% to feed people, 5% for biofuels, 12% for others, 1/3rd of the Food Produced is lost.
3. **Choosing Local and Seasonal Food :-** Buying produce that's in season, Riper, tastier and more nutritious, Sustain local farmers, Preserve local variety, Season:Nature adaptation, Fresh & anti - oxidant rich, Food selection: locality choice, Reduces carbon footprint, Influences diversity.
4. **Going Vegetarian and Growing Food at Home :-** Greenspace at home, Access to a garden, A balcony with space for plant pots, Grow your own food, Use of space time, Fresh food items, Reduces anxiety, Improved bondage, Choice of item is yours.
5. **Using Emerging Sciences and Technology :-** Integrated high - tech farming, High - Yielding, stress tolerant crop, Automation and mechanization, Efficient need based input use, Integrated livestock and fisheries.

He Concluded his talk by saying the conflicts and environment will continue. But nature is the timekeeper to decide how long it will last. 'Business as usual' is not working. It's time for an alternate approach. 'Sustainability' is the solution and needs scientific implementation. Ecosystem restoration is the key for sustainability. Let us reimagine, recreate and restore.


Fig.3: Presentation by Prof. Himanshu Pathak, Director ICAR, NIASM, Pune India

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**Dr. Beachley Gregory, Co-chair TDep - NADP USEPA, USA -** He mentioned his study on Monitoring efforts to assess ecosystem effects and restoration due to emission reductions strategies in the United States. He talked about Acid Rain Legislation and National Monitoring Networks. Major legislation was Title IV of the 1990 clean Air Act Amendments, Acid Deposition Control: focused on negative effects of $SO_2$ and NOx emission on ecosystem health.

Monitoring networks provide accountability for emission reduction programs:-

1. **Clean Air Status and Trends Network (CASTNET) -** Weekly air concentrations of N,S species, base cations & chloride & dry deposition.
2. **National Atmospheric Deposition Network (NADP) -** Weekly wet deposition samples (precipitation, pH, dissolved N, S species, base cations & choice).
3. **Long Term surface Water Quality Monitoring Program (LTM) -** Network of lake and streams samples (30+ Chemical and physical parameters).

CASTNET was established in 1987. 41 sites operating 30+years providing valuable data for long - term trends. Currently ~ 100 rural monitoring sites, Ambient gases and particles concentrations ($SO_2$, $HNO_3$, $PNO_3$, $PSO_4$, $PNH_4$, base cations, pCl) measured weekly on filters and used to estimate dry deposition fluxes (TDep Measurement Model Fusion method).

He said that the sites are located away from known emission sources and often in ecologically important locations including 31 National Park.Consistent measurement with a robust quality assurance program provides valuable data. Also measures Ozone concentrations.

**NADP** was established in 1978 to measure pollutants in precipitation (acid rain). National Trends Network (NTN): measures weekly wet deposition of $SO_4^{2-}$, $NO_3^-$, $NH_4^+$, pH, cations, $Cl^-$ at more than 200 sites. Nearly all CASTNET sites are co-located with or near an NTS site. Consistent measurements with a robust quality assurance program provides valuable data.

**Ammonia Monitoring Network (AMoN) :** Radiello $^{1M}$ passive samplers provide bi weekly concentrations of ambient $NH_3$. Network was established in 2007 and has grown to more than 100 sites. Over 60 AMoN sites co-located with CASTNET.

**Current LTM Network :-**

- Data Published through science Hub
- 170 locations, ~1200 samples annually
- 220 peer - reviewed publications (and counting)
- Accomplished cooperatively through network partners

**Following are major measurement sites: Vermont Lakes** - 12 lakes, VT Department of Environmental Protection. **Maine/High Elevation Lakes -** 32 lakes, US Geological Survey (USGS) and the University of New Hampshire and University of Maine.

**Adirondack Lakes -** 50 lakes, USGS, Adirondacks Lakes Survey Corporation (ALSC), the New York State Department of Environmental Conservation (NYSDEC), & New York State Energy and Research Development Authority (NYSERDA), **Catskills Streams -** 4 streams, USGS, **Ridge and Blue Ridge (VA) stramsm -** 72 streams, Shenandoah National Park and the University of Virginia.

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He concluded by discussing the result of his study that is Effectiveness of EGU NOx Reductions & Improved water quality in lakes and streams.

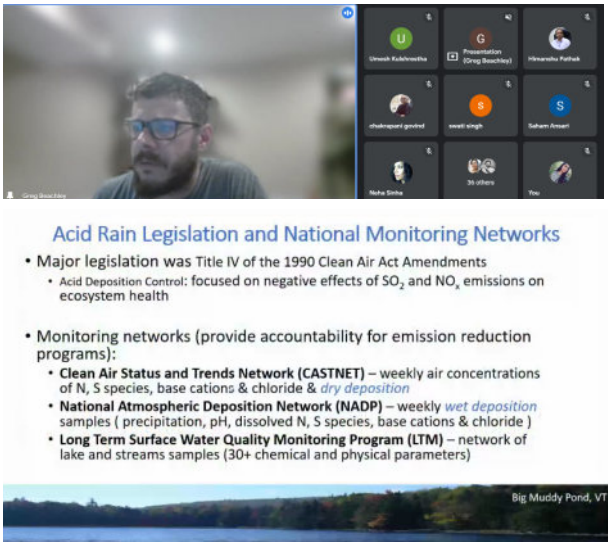

Fig.4: Dr. Beachley Gregory, Co-chair TDep - NADP USEPA, USA

**Prof. Govind Chakrapani, VC, Berhampur University, Odisha, India–** He talked about cruelty on our food before it comes to our plate. Humans are miniscule in the universe but are trying to reverse what was there on the earth. In the last century we have been consuming natural resources which are finite. Human population has doubled from 1940 -50 to recent times. This exponential rise in population has put pressure on natural resources.

Healthy environment is the foundation of healthy life and healthy society. We should not leave earth in bad condition for our future generation, that is sustainability. Eight billion people are eating 77 billion animals every year. These animals should also be part of conservation. Commercial animal farming has changed our fooding habits. However ethical means should be used, like licenced slaughterhouses have the right to kill animals. In India & many South East Asian countries animals are killed in open shops in front of their own kind.

He proposed to change the concept of animal husbandry to animal welfare. Also talked about animal waste and how they are dumped in landfills and how it affects ecology of that area, how it affects other biota and problems of groundwater contamination and land degradation. He emphasized that cruelty against animals should stop, like firecrackers being fed to them hidden in food so that they do not enter the agriculture fields. Plants and animals all have emotions and we should respect them.

He concluded by quoting Lord Budha “Be Humanly Human to Animals”.

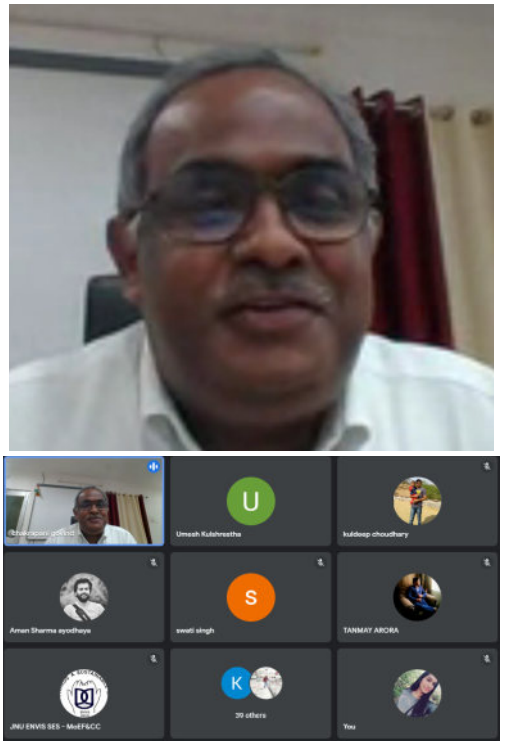
Fig.5: Prof. Govind Chakrapani, VC, Berhampur University, Odisha, India

**Prof. Narpat Singh Shekhawat, Retd. JNVU, Jodhpur, India–** He talked about desert natural resources. Bioresources of Indian desert. It has four unique features:- i) Aravali hills ii) Sand dunes iii) Canal coming from Punjab and Haryana iv) Water coming from Gujarat.

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He mentioned issues like polluting the water of the canal coming from Punjab and Haryana, this may create problems for the future. Reason for no suicide in Rajasthan farmers like with mother nature, conservation pratices, like Khejari movement, traditional conservation practices, sacred grooves all villages, some jungles. *Calligonum polygonoides are lush* green trees but have disappeared now.

Prof Shekhawat mentioned that many trees are now disappearing due to the introduction of tractors, development activities and development. Population pollution, micro plastics, preparation for war due to Jodhpur border with Pakistan, construction of roads all are affecting natural resources of the desert area. No biosphere reserve for desert due to economic & political issues. Traditional agricultural practices should be promoted. Across the roads, conservatory plantation medicinal plants should be promoted. He said development should take place but it should be sustainable and our natural resources should not be destroyed.

He concluded by emphasizing that the natural plants should be promoted at administrative and policy level.

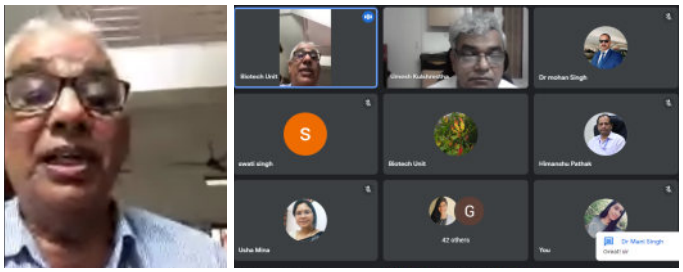

Fig.6: Prof. Narpat Singh Shekhawat, Retd. JNVU, Jodhpur, India

**Dr. Neha Sinha, Bombay Natural History Society, India–** Her discussion focused on Contemporary conservation. She said the biggest challenge is taking away chunks of land. She talked about the ecology of the area and how once a flowering tree and habitat provides various birds & animals. Wildlife is ignored in planning. Biggest challenge is that we are not able to protect land; major chunks of habitats are lost. Most habitats are fragmented. Talked about trends in forest diversion and land use changes in 2020. Linear project biggest diverted to forest land. Hydel power may not be as green as it looks.

She talked about the Great Indian Bustard birds which use agro - grasslands, scrub lands and deserts as their habitat. The birds use agro - vegetation mixture, grassland, high fruit abundance and intermediate grazing density. They avoid prosopis thickets for foraging. In the day, they are observed to use moderately tall sward and grasses for resting but shorter sward and less prosopis for roosting. Nesting females preferred grasslands with relatively tall sward and abundant insects, while displaying males preferred grasslands with shorter sward, far from settlements. India's green energy goals have a serious problem for the great Indian bustard.She raised a concern that the solar parks in Rajasthan, Gujarat are causing problems for the Great Indian Bustard.

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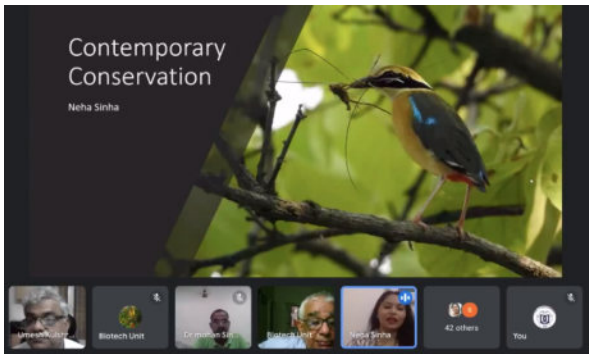



Fig.7: Dr. Neha Sinha, Bombay Natural History Society, India

She also talked about EIA and the difficulties related to the newly proposed post - facto clearances. She discussed the issue of Lakshadweep Development Authority Regulation, 2021 and issues related to it.

**Dr. Usha Mina, ENVIS Co-coordinator, SES/JNU, India–** She talked about creating awareness about the need to preserve the environment and natural resources in order to keep the world healthy. We know that a healthy environment is a foundation for a stable and healthy human society and it is also a reminder to preserve our natural resources. Connecting the link between us and nature? Panchtatva or Panchamahabhutas - The five elements Space, Air, Earth, Water, Fire are the foundation of an interconnected web of life. The entire cosmos is formed by these dynamic five elements and the composition and mix of these elements in each form - animate or inanimate - varies in degrees depending upon the structure, nature and function of the created object.

She talked about Nature's connectedness and "Natural - Deficit Disorder" and their effects. She suggested the following way forward: options- i) The current deplorable environmental crisis demands a spiritual response ii) A fundamental reorientation of human consciousness, accompanied by action that is born out of inner commitment, is very much needed. We cannot conserve nature without forging an emotional bond between ourselves and nature as well - for we will not fight to save what we do not love. Sustainability and resilience will be achieved much faster the majority of the earth's population understand the value and needs of our increasingly fragile earth.

She proposed some **Nature based solutions in order to h**arness the power and sophistication of nature to turn environmental, social and economic challenges into innovation opportunities. They can address a variety of societal challenges in sustainable ways, with the potential to contribute to green growth, 'future-proofing' society, fostering citizen well-being, and providing business opportunities.

She suggested following the principle of 5 R's i..e. Reduce, Reuse, Recycle, Respect and Reconnect. She concluded by emphasizing protection for mountains, forests and pastures for the sustainable Earth.

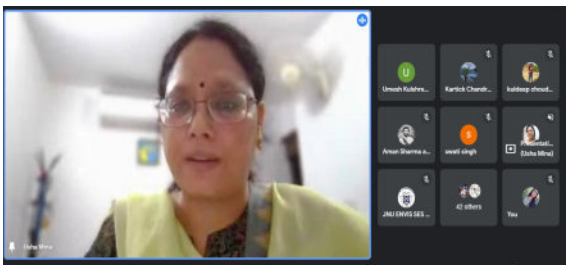

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Fig.8: Dr. Usha Mina, ENVIS Co-coordinator, SES/JNU, India

**Ms. Shipra Lakshmi, YoHo lead, SES, JNU –** Ms. Shipra Lakshmi provided a description of the quiz organized by the YoHo group. She also announced the result of quiz contest winners. The quiz result has been uploaded on the JNU ENVIS website: http://jnuenvis.nic.in/img/ResultQuizNCD2021.jpg

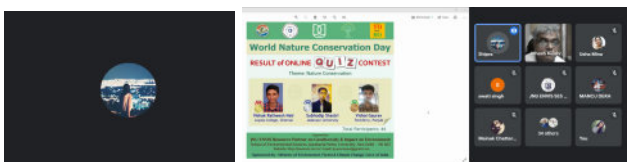



Fig.9: Ms. Shipra Lakshmi, YoHo Gyan Lead, SES, JNU announced results online.

**Ms. Saham Ansari, YoHo lead, SES, JNU –** She provided details of the Essay Competition and declared the result of an online essay writing contest conducted during this session. The Essay competition result is uploaded on the JNU ENVIS website: http://jnuenvis.nic.in/img/ResultEssayNCD2021.jpg

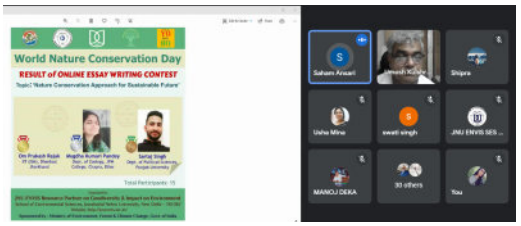
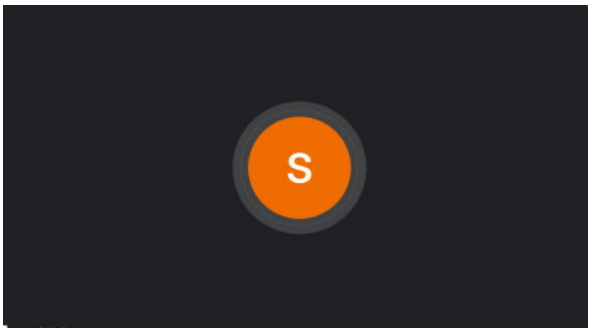



Fig.9: Ms. Saham Ansari, YoHo Gyan Lead, SES, JNU

**Vote of Thanks** was extended by **Ms. Swati Singh, Programme Officer, JNU ENVIS -** She thanked all the speakers, participants, students and the faculty for making the event successful.



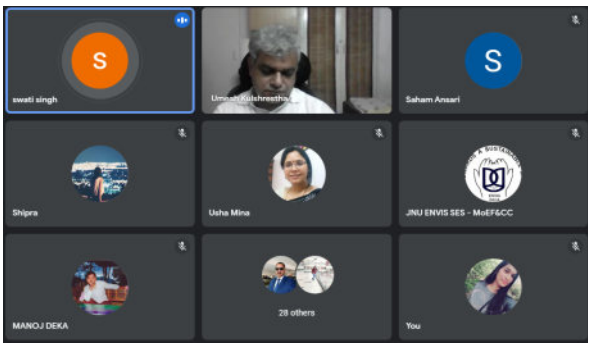




Fig.9: Ms. Swati Singh, Programme Officer, JNU ENVIS

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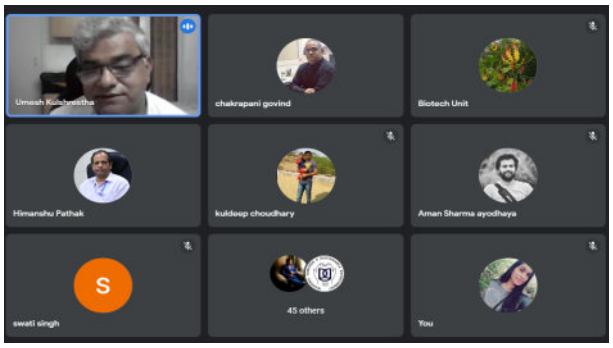


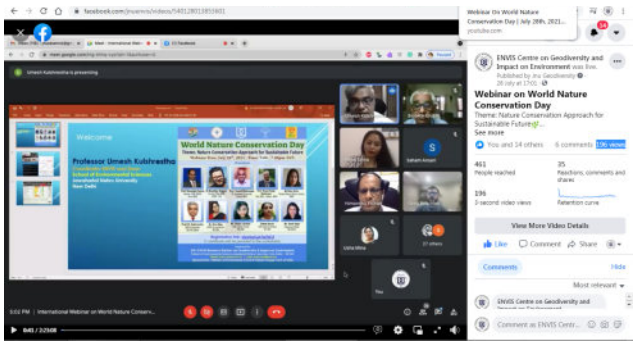



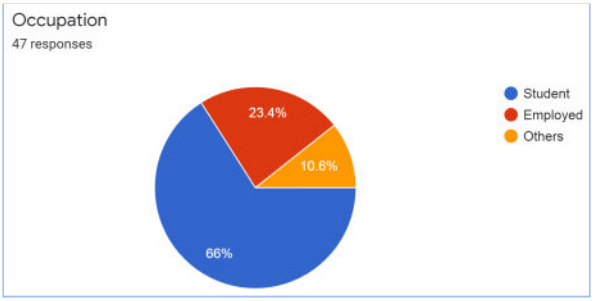

Fig.10 : Panelists & Participants of the Panel Discussion

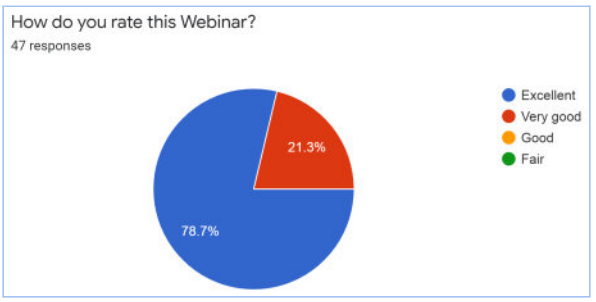
The session came to an end with the distribution of e-certificate to all the participants. Very positive feedback was received from the participants.

## Recommendations:

1. This is high time to change from business as usual to a sustainability approach.
2. Need to revise the background standards using new normals of COVID 19 shutdown values.
3. This is time to Reimagine, Recreate and Restore Natural resources.
4. Native Plants should be promoted, organic farming be promoted.
5. Planning should be done to establish a biosphere reserve in the desert ecosystem.
6. Cruelty towards animals should stop and the concept of animal husbandry should be changed to Animal Welfare.

## Feedback:




Your Short Line Feedback
42 responses

THe session was ecellent and the thoughts shared and issues raised are inevitable. We need to act now. wonderful session.Thank you

Informative one!

Excellent

very insightful

Nice, informative and enthusiastic

Very informative webinar thanks looking forward for more knowledgeable webinars

Very informative

This webinar meeting on World Nature Conservation Day 2021 was excellent and gives us latest position in the present era of the world. These types of seminar should be going at every institution. Thanks for this nice and informative seminar. Excellent job.

The webinar was very informative.

may be included in new emission norms challenges, nature conservervation plans, Environment SD etc in Thermal Power Plants

Excellent webinar , I have ever heard, thanks

Nice information

Truly speaking, this webinar/event is a very informative one. It created a greatest emphasis amongst all of us to protect our natural resources in order to conserve the nature. I would really thank the honourable professors in this event for sharing their valuable insights and suggestions for protecting and conserving the nature. Thank you.

Very Good And Knowledgefull Webinar. Thanks to Organising Team

Wonderful Session

**Webinar Video on the Official Youtube Channel:**
https://www.youtube.com/watch?v=Z9kcRx0G2v8

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# Webinar Report

# International Youth Day, 2021

## Theme: Transforming Food System: Youth Innovation for Human and Planetary Health

*Organised by:*

**JNU ENVIS Resource Partner on Geodiversity & Impact on Environment**
**School of Environmental Sciences, Jawaharlal Nehru University**
New Delhi – 110 067

August 12, 2021

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# International Youth Day 2021

## THEME: TRANSFORMING FOOD SYSTEM: YOUTH INNOVATION FOR HUMAN AND PLANETARY HEALTH

The School of Environmental Sciences celebrated the International Youth Day on 12th August, 2021. On the occasion, a webinar was organized on theme '**Transforming Food System: Youth Innovation for Human and Planetary Health**' in collaboration with the JNU-ENVIS Resource Partner and the Young Holistic (YoHo) group, SES, Jawaharlal Nehru University, New Delhi.

The panel included very active young researchers such as **Dr. Usha Singh Gaharwar** (Assistant Professor, Swami Shraddhanand College, Delhi University), **Mr. Yogendra Singh** (PhD Student, SES, JNU), **Ms. Swati Pandey** (BA LLB, Ram Manohar Lohia Awadh University, UP), **Mr. Rafi Ahmed** (PhD Student, SES, JNU), **Ms. Shruti** (PhD Student, SCIS, JNU), **Ms. Sandhya Singh** (PhD Student, SES, JNU), **Ms. Shruti Pandey** (YoHo lead & M.Sc student, SES, JNU), **Mr. Manjul Panwar,** YoHo lead SES, JNU, **Ms. Swati Singh,** Programme Officer ENVIS, SES executed the management of the programme

Ms. Swati Singh, moderated the panel discussion. It was attended by more than 60 participants, through Google-Meet and Facebook Live platforms. The participants included university students, young researchers, faculty members and youth from different parts of the country.


**Webinar Schedule: International Youth Day 2021**

**THEME: TRANSFORMING FOOD SYSTEM: YOUTH INNOVATION FOR HUMAN AND PLANETARY HEALTH**

**DATE : AUGUST 12, 2021 | TIME: 05:00 - 06:30 PM IST**

| Speakers | Time |
|---|---|
| Welcome Address by **Ms. Swati Singh** Programme Officer, JNU ENVIS RP | 05:00 - 05:10 PM |
| **Dr. Usha Singh Gaharwar,** Asst. Professor, Swami Shraddhanand College, DU | 05:10 - 05:20 PM |
| **Mr. Yogendra Singh,** Ph D student, SES, JNU | 05:20 - 05:30 PM |
| **Ms. Swati Pandey,** BA LLB, Ram Manohar Lohia Awadh University, U.P. | 05:30 - 05:40 PM |
| **Mr. Rafi Ahmed,** Ph D student, SES, JNU | 05:40 - 05:50 PM |
| **Ms. Shruti,** Ph D student, School of Computational & Integrative Sciences, JNU | 05:50 - 06:00 PM |
| **Ms. Sandhya Singh,** PhD student, SES, JNU | 06:00 - 06:10 PM |
| **Ms. Shruti Pandey**, YoHo Lead & M Sc Student, SES, JNU | 06:10 - 06:20 PM |
| Vote of thanks by **Mr. Manjul Panwar,** YoHo Lead & Ph D Student, SES, JNU | 06:20 - 06:30 PM |

*Organized by:*
JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi

Fig.1: Poster and Schedule of the Webinar widely circulated on the social media platform.

**Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU informally welcomed the panelists and participants -** He mentioned the importance of youth awareness and the International Youth Day. He shared his views on how youth is playing an important role in the society as well as in research and development.

He also talked about the conception of the YoHo programme in the School of Environmental Sciences and the role of YoHo activities and activity leaders in achieving the objectives of the theme of the day.

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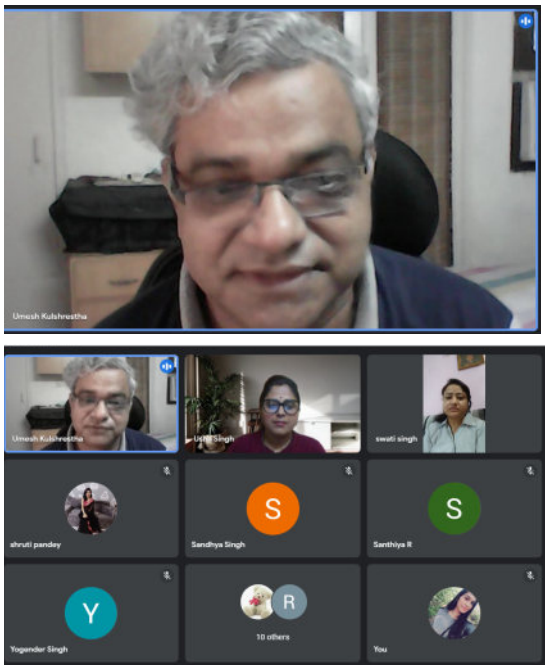

Fig.2: Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU, India

**Ms. Swati Singh, Programme Officer, SES, JNU** - Formally welcomed all the speakers and the participants. She talked about the importance of this day and how we as youth can make a change. She also highlighted the importance the voice of youth holds in the present time, which is also perceived by the UN as the Internationalyouth day. She then introduced the first speaker Dr. Usha Singh Gaharwar.

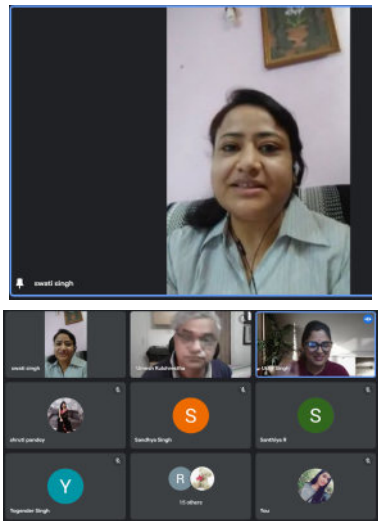

Fig.3: Ms. Swati Singh, Programme Officer, JNU ENVIS

**Dr. Usha Singh Gaharwar, Asst. Professor, Swami Shraddhanand College, Delhi University** – She said that age can't decide how young you are, it is your energy. On the inside, it is your will, it is your commitment for betterment towards the society as well as for yourself that defines that you are youth. Youth involvement and contribution is the pillar of the sustainable goal of any Nation or the World. She mentioned that success is not related to how young you are or how old you are.

She said that the food system has gone to the boundary level. Agriculture is biggested (21%) GHG emitter. Deforestation due to agriculture is the maximum biodiversity loss. A balanced and nutritious diet is required for all of us. Today's youth has the greatest responsibility to correct food choices. We need ways to realize the earth's potential.

She emphasized that the voice of farmers should be heard before the introduction of hybrids etc, their voice should be integral in policy making. Changing mindset of youth food choices, greater consumer awareness, impact of food, food packaging and nutritional diet etc. Youth which are actively involved in policy making, as a food expert, farmer, government, everybody have to come together, so that we can address what kind of food transformation is acceptable & what kind of a sustainable future as well. Half of the population is facing the hunger problem. We are not having a good diet. We can also support the smallest food producers, those who produce good quality food.

She urged small scale food producers to produce nutritional food. Also, seasonal food and local grown along with smart cooking should be promoted. Youth is crucial because it is associated with two generations. She Concluded her talk by saying- Youth has all the power to achieve the goal so you can do it.

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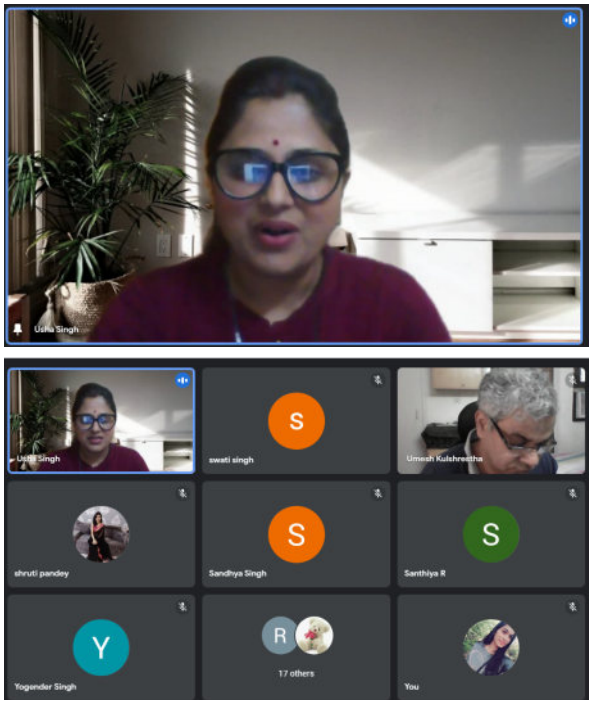


Fig.4: Dr. Usha Singh Gaharwar, Asst. Professor, Swami Shraddhanand College, DU

**Mr. Yogender Singh, PhD Student, SES, JNU -** He talked about the theme of the day being the youth. It is our moral duty to fulfill these objectives to take care of decreasing land availability, population, pollution, etc.

He mentioned that food security exists when all people at all times have physical and economic access to sufficient, safe & nutritions food that meets their dietary and nutritional needs. According to FAO, close to 800 million people have no access to food. 60% in low in countries are food insecure.Food insecurity negatively affects physical, mental health. Social emotional & cognitive development throughout life. Food security is related to sustainable development goals. Sustainable solution by their group is under Prof. UC Kulshrestha development of modern community farming.

He mentioned community development as `cillas' (village in city) where land is earmarked for various activities like multistorey green buildings, parks, hanging gardens, community farming. This helps to build socialism, environment education and health benefits.Household waste is used as compost in these farms.

He concluded by saying that young people will get in touch with agricultural experiences and children will get attached to their values. Healthy food helps us save on our medicines.

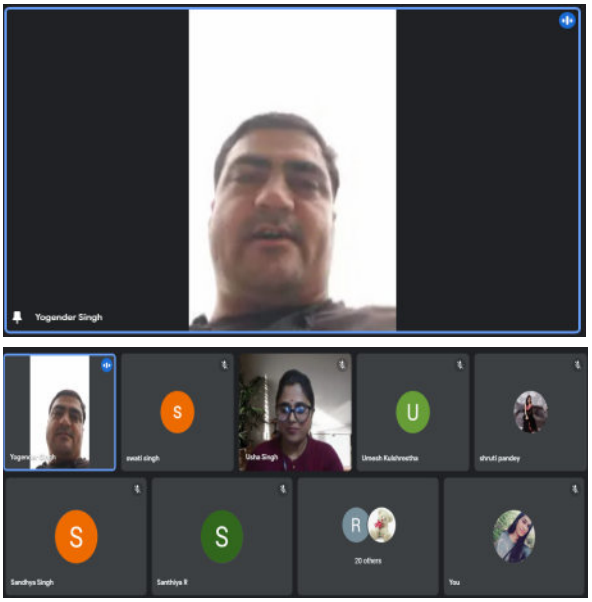


Fig.5: Mr. Yogender Singh, PhD Student, SES, JNU

**Ms. Swati Pandey, BA LLB, Ram Manohar Lohia Awadh University, U.P. –** She talked about the role of youth in fulfilling the theme of youth day. She mentioned that global efforts are needed to fulfill these objectives. She talked about Ms. Basu and her work in agriculture. Highlighting the importance of innovation and science and technology development in agriculture.

She concluded by emphasising that the development in agriculture needs to be customized for the local needs and solutions should be problem specific.

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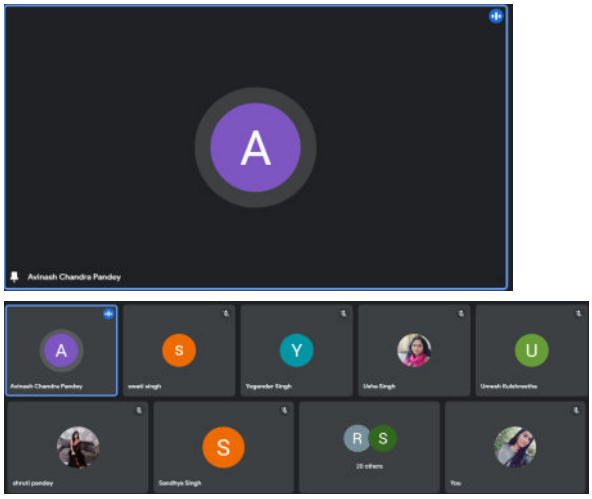
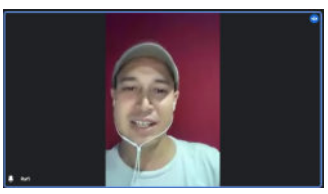



Fig.6: Ms. Swati Pandey, BA LLB, Ram Manohar Lohia Awadh University, U.P.

**Mr. Rafi Ahmed, PhD Student, SES, JNU –** He defined youth as per UN. He said that one in six people in the World is a youth. World is the youngest at present time. Full and active participation of youth around the globe is must for achieving SD Goals in 2030. According to him this day gives an opportunity to hear views and voices of youth at global level.

Youth have expressed their views on Covid - 19 its impact on environment, health etc. Working toward an equitable food system, which will be most sustainable and healthy. Resilience of the food system, especially after ongoing pandemic and after maths.

He said that many food systems are fragile and about to collapse. If this happens poor and marginal people will be more affected. Youth engagement is crucial for a sustainable food system, consumption of youth is important.He concluded by saying let's dedicate more time, support, more commitment as a youth.



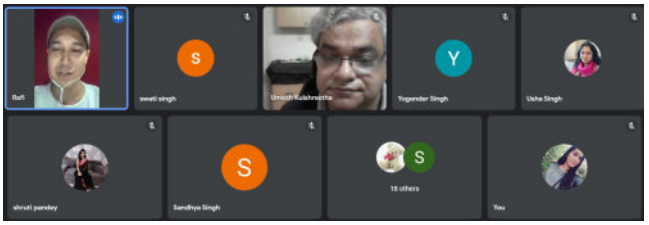


Fig. 7: Mr. Rafi Ahmed, PhD student, SES, JNU

**Ms. Shruti, PhD Student, SCIS, JNU –** Her discussion focused on International Opportunities and Collaborations: Bioinformatics and Agrifood industry.

She talked about Bioinformatics and Food Studying impacts of microorganisms on food, genomics and proteomics study to meet the prerequisites food manufacturing, food handling, improving the quality and nutritive worth of food sources, may provide possibilities for food and beverage companies focusing to expedite ingredient discovery, studying associations between potential ingredients and their effects on human health, storing and maintaining biological data and other resources required for food and nutritional sciences, help in detection of allergens and ensuring the quality of flavours while maintaining its safety.

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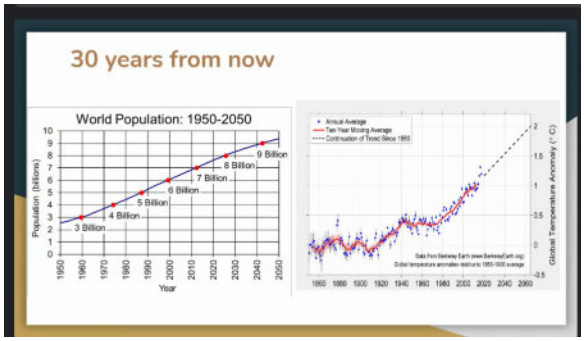
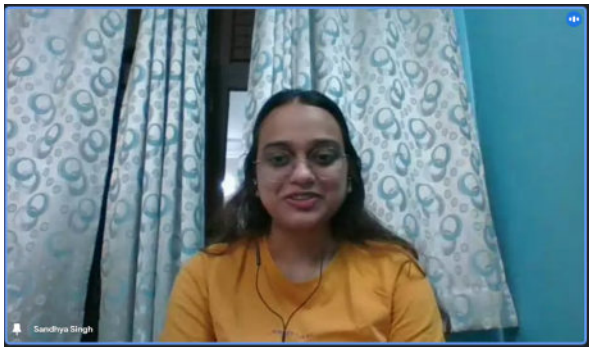



Fig.8: Ms. shruti, PhD Student, SCIS, JNU

**Ms. Sandhya Singh, PhD Student, SES, JNU –** She talked about youth day being celebrated to recognise the efforts of the global youth in enhancing the global society and achieve the sustainable development goals. The youth plays a significant role in achieving the sustainable development goals. Youth plays a role in different conditions.

She said that youth can affect two generations. Youth Plays a significant role in different conditions and society. She said that Indian youth continue to contribute to the global society and enhance the global society in all the ways we can. Youth does play a significant role. Parents need to focus on the youth and we are focusing on the youth's development for a great achievement. This can help achieve a good nation, a progressive society.



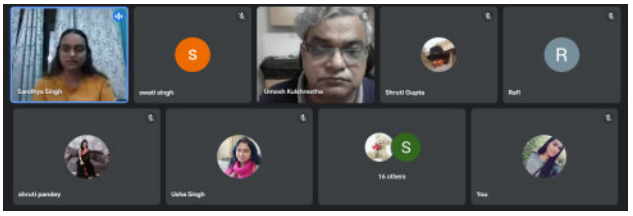



Fig.9: Ms. Sandhya Singh, PhD Student, SES, JNU

**Ms. Shruti Pandey, YoHo Lead, SES, JNU –** She talked about how the food system affects everyone and encrypts everything. Food is produced and distributed to how it is consumed. As youth leaders and politicians we know that the role of young people in transformation is critical. She said that her generation's youth is the largest in history and has a valuable role to play in making our food system more suitable. Ms. Shruti Pandey provided a description of the Quiz, and Extempore competitions organized by the YoHo group. She also announced the result of the Quiz Contest and Extempore competitions winners.


Fig.10: Ms. Shruti Pandey, YoHo Gyan Lead, SES, JNU announced results online.

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**Dr. Usha Mina, ENVIS Co- coordinator & Associate Prof. SES, JNU** appreciated the efforts of all the youth panelists. She said sustainability of food security needs sustainability of natural resources. She thanked all the panelists, participants.

Fig.11: Dr. Usha Mina, ENVIS Co - coordinator & Associate Prof, SES, JNU

**Vote of Thanks** was extended by **Mr. Manjul Panwar, YoHo lead, SES, JNU –** He thanked all the speakers, participants, students and the faculty for making the event successful.

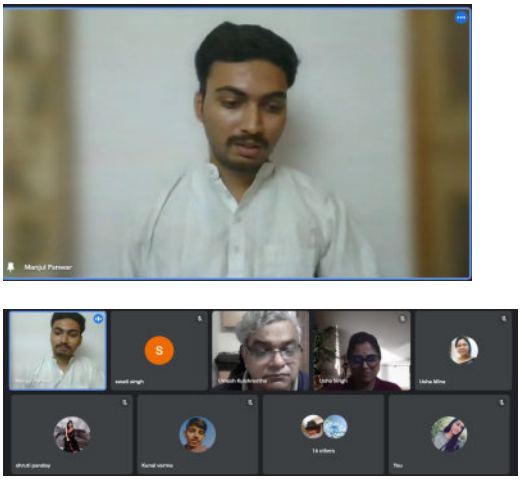

Fig.12: Mr. Manjul Panwar, YoHo Gyan Lead, SES, JNU.

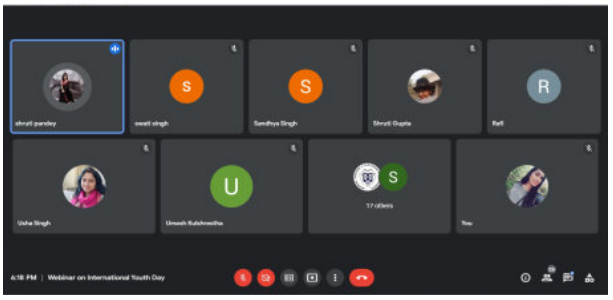

Fig.13 : Panelists & Participants of the Panel Discussion.

The session came to an end with the distribution of e-certificate to all the participants. Very positive feedback was received from the participants.

## Recommendations:

1. Youth should be encouraged to make correct food choices which are nutritious, healthy and sustainable for the food ecosystem.
2. Farmers should be involved in all decision support and policy making in the agriculture sector.
3. Youth should be encouraged to dedicate more time, support, efforts and commitment.
4. Innovative and holistic approaches like modern community farming and sustainable goal achievement should be encouraged in all the metropolitan cities and other towns.

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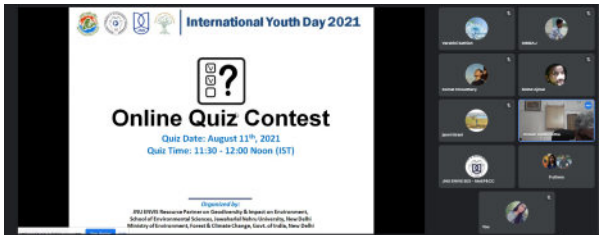
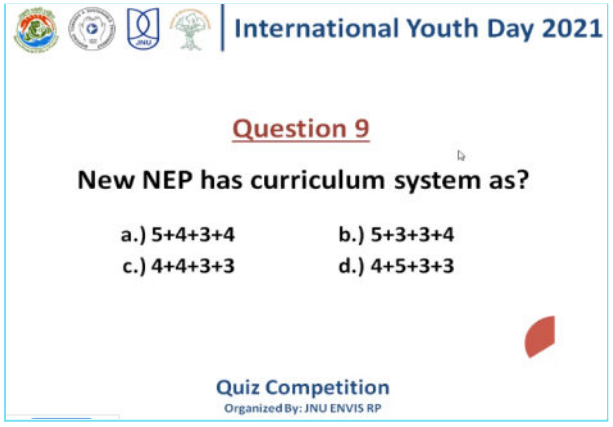
## Competitions:

### Online Quiz Competition:-

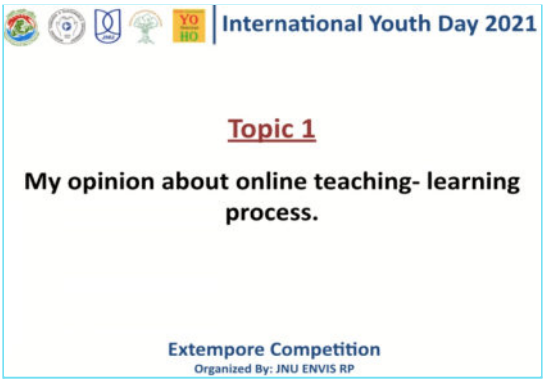







### Quiz Competition Result:


### Online Extempore Competition:-



### Extempore Competition Result:


**Webinar Video on the Official Youtube Channel:**
https://www.youtube.com/watch?v=W2-XmeLte6w

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JNU-ENVIS RP organized Van Mahotsav 2021 (1st - 7th July) on the theme: 'Plant Where You Are'. 14 tree saplings of following species were planted at the Parth Sarathy Rocks (PSR) in the JNU Campus.:

**1.** *Psidium guajava* (Guava) **2.** *Ficus benghalensis* (Banyan Fig) **3.** *Ficus religiosa* (Peepal/sacred fig) **4.** *Azadirachta indica* (Neem) **5.** *Aegle marmelos* (Bael) **6.** *Terminalia arjuna* (Arjun) **7.** *Dalbergia sissoo* (Shisham/Indian Rosewood)

*******

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