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अंतरराष्ट्रीय जैवविविधता दिवस
प्रकृति में ही हमारा समाधान

BIODIVERSITY HOLDS THE FUTURE FOR HIMALAYAN PEOPLE

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From the Director's Desk

It gives me pleasure in sharing the special e-Newsletter published by the team of Centre for Biodiversity Conservation and Management



(CBCM) in the institute as part of celebration of International Day for Biological Diversity 2020.

The theme of IDB for this year is 'Our Solutions are in Nature'. This theme, very well coincides with the changing outlook of the world under COVID 19 pandemic scenario. Scientific community and other stakeholders believe that the cure lies within the domains of nature. Therefore, nature based solutions (NBS) are attracting wider attention. Himalaya being biodiversity hotspot, and having experienced harmonious relation of its people with nature, make the region more important. Under changing scenario, we need to think afresh and differently on possibilities of better livelihoods, and the issues of conservation in the region. This e-Newsletter included the views of different experts captured during the webinar(s) and the articles received from the various researchers in the Himalayan region. The Institute is all set to take-up field action to find biodiversity based solutions for improved quality of life in the aftermath of COVID-19.

R.S. Rawal, Ph.D.
Director

Webinar

Himalayan Biodiversity and Future Solutions



Himalaya an important candidate for action both for the sustainable use of biological diversity and its conservation. The Indian Himalayan Region (IHR) constitutes a large part of the Himalayan Biodiversity Hotspot (HBH) and significantly contributes for its biodiversity richness and representativeness. The IHR harbors nearly 50% of the total flowering plants of India, of which 30% are endemic to the region. Moreover, nearly 2000 plant species of medicinal

The Himalaya, one of the 36 global Biodiversity Hotspots, is recognized for its ecological and economic values. However, diversity of representative biodiversity elements and their sensitivity to human and/or climate - induced perturbations, and more importantly the dependence of up-land and downstream communities on its goods and services, makes the

value, about 1000 wild edibles, and over 100 essential oil bearing plants are reported from the region. IHR with only 16.2% of India's land cover, contributes for about one third of forest (32.1%) and 100% of alpine cover. Both these ecosystems are together responsible for much of the biodiversity in the region. The indigenous communities, since millennia, are intensively dependent on this biodiversity for sustenance and income generation. **Cont.....**

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Keeping above in view, and find out post COVID-19 solutions for livelihoods and conservation, G.B. Pant National Institute of Himalayan Environment (GBP-NIHE) organized a webinar on the "Himalayan Biodiversity and Future Solutions". The event was organized to mark the International Day for Biological Diversity, 2020 (IDB 2020). The theme of IDB for this year is 'Our Solutions are in Nature', which very well coincides with the changing outlook of the world under COVID 19 Pandemic scenario. Scientific community and other stakeholders believe that the cure lies within domains of nature. Therefore, nature based solutions have attracted wider attention. The webinar intended to deliberate on solutions providing sustainable use and conservation of Himalayan Biodiversity. Keeping this in view, range of panellists drawn from academicians to policy planners, teachers to grassroots agencies (NGOs/CSOs) working in the Himalayan region were involved (Annexure 1). Panellists were specifically requested to suggest way forward for harnessing benefits of Himalayan biodiversity to: (i) improve life quality of local indigenous communities, (ii) develop local products, markets, and supply chains, (iii) provide alternate options of livelihoods to unemployed rural youth, including the ones compelled to return to villages in Himalayan hills under COVID 19 outbreak situation. The Institute has organized a series of webinars through its HQs, Kosi-Katarmal and the regional centre covering PAN Himalayan region (Kullu, Himachal Pradesh; Itanagar, Arunachal Pradesh, and Pangthang, Sikkim).

Inaugural remarks, Director, GBP-NIHE, Kosi-Katarmal, Almora



To begin the webinar "Himalayan Biodiversity and Future Solutions", **R.S. Rawal**, Director of the Institute, welcomed the panellists /

participants and informed them that the webinar is envisaged to deliberate on solutions providing potential by Himalayan biodiversity, especially in view of the slogan "Vocal for Local" given by the Honorable Prime Minister of India during his address to the Nation on May 12, 2020. He highlighted global significance of IHR w.r.t. rich biodiversity, ethnic and cultural diversity, and flow of ecosystem goods and services that sustain life of millions of people both upstream and downstream. The Himalayan biodiversity remains a matter of discussion in different forums ranging from local to global, and the recommendations emanating from these discussions often revolve around following understandings: (i) biodiversity has potential to

improve the quality of the life of people, and (ii) people's participation is essential for achieving the target of biodiversity conservation. However, he felt, when it comes to action, in both the areas, not much has been achieved. Need for more concerted efforts for biodiversity conservation and sustainable use by different stakeholders to improve the quality of life of the people was stressed. Dr. Rawal opined if the local communities are provided with diverse livelihood options based on local biodiversity and forest resources, their participation would be forthcoming. In view of this, he mentioned that the post COVID-19 situation provides an opportunity to harness the potential of biodiversity, especially the medicinal plants, wild edibles, traditional crops, etc., to enhance the livelihoods of the local inhabitants. Particularly of those who have returned back from urban centers to their villages. There is an urgent need to use their skills and capacity for harnessing the potential of Himalayan biodiversity. With the formal self introduction of the experts/panelists, Dr. Rawal opened the session.

Panel presentation



Achrya, BK (Sikkim University, Gangtok) highlighted the need for conservation and value addition in agro-biodiversity, particularly of traditional crops.

These crops and cropping systems are unique and resilient in changing situations, including climate change. Providing an example of Sikkim Himalaya, Acharya informed that in Sikkim biodiversity in traditional agro-ecosystems is higher compared to forest patches. Further, promotion of eco-tourism through replication of successful models in Bhutan, was suggested to be good possibility to make positive changes in the livelihoods as well as conservation of biodiversity. He also stressed on need to recognize the value of potential Medicinal and Aromatics Plants (MAPs), and traditional knowledge associated with them, to develop new formulations and drugs. This will motivate local people to cultivate such plants, which is a viable option of livelihood.



Considering the importance of Himalayan biodiversity and its sustainable utilization under the pandemic COVID 19 scenario,

Bhatt, ID (GBP-NIHE, Almora) listed following solutions: (i) strengthen Ayurvedic system of

medicine as the Himalaya has over 1740 medicinal plants, which are the source of different life saving drugs and, therefore, promotion and cultivation of these MAPs is urgently required, (ii) The Himalaya is represented by over 900 species of wild edibles, but only a few species are being used in nutraceuticals and cosmeceutical industries, largely been used as antioxidants and anti-aging agents. Therefore, research on the value and value addition of their produce may help in improving the livelihood of the people in the region, (iii) the Himalaya is a germplasm center of traditional agriculture crops which is eroding due to the introduction of hybrid varieties, therefore, promotion of traditional agriculture crops through mixed cropping is needed to save this germplasm and achieve food security, (iv) the Himalaya is known for the various underutilized crops which are source of nutritious food, therefore, promotion of such underutilized crops like amaranth, buckwheat, minor millets (finger millet, barnyard millet, pros millet and foxtail millet, etc.), in farming system is very much needed, (v) there is a need to have plantation drives (site based and local species) for greening the degraded and abandoned lands so that ecosystems are restored and co-benefits are realized by the people, and (vi) sensitization of diverse stakeholders, especially school students, towards biodiversity conservation and sustainable use is essentially required.



Kotru, Rajan (Lead Strategist, Redefined Sustainable Thinking -REST, Palampur) emphasized on the need for adopting landscape approach

while talking about the nature based solutions (NBS). This approach addresses integration of several inbuilt ecosystems having various life support values (e.g. lakes, ponds, grasslands, etc.) and the local communities can be linked for their livelihoods and entrepreneurship. The approach however requires to keep a good balance between indigenous knowledge and scientific/digital knowledge for planning ahead and for managing sustainability at scale. Biodiversity can be enhanced outside forests where agro-forestry or other farming systems could contribute to conservation of local germplasm and the capacities of local stakeholders to promote ex-situ cultivation of medicinal plants. Mixed cropping and promotion of traditional health crops on degraded lands could open up a new avenue to local youth as well as to returnees who now can be engaged with to build local entrepreneurship.

He emphasized on a strong resonance found for payment for environment services (PES) narrative that can be linked to fulfillment of national commitments. Such institutional mechanism can

be linked to fulfillment of national commitments. Such institutional mechanism can be further developed and scaled up based on performance (e.g. biodiversity markers these Biodiversity makes as indicators against a baseline (based on PBR and bioculture protocols) could be then used for quantification on PES by the local community. However, there is a need of good research, so that findings are applied in practice and policy.

He further mentioned, sufficient enabling framework exists to test innovations or value-addition of existing NBS. In this context for scaling up there could be the use of New Working Plan Code that activates the instrument of forest management "Working Plan" which now mandatorily consists of forest ecosystem services and preparation of Micro Plans with local communities with MoUs. Close to nature based forestry could then promote broader planning of biodiversity conservation in forest, aquatic, and rangelands systems. On cumulative basis in a landscape this could be way forward as forest department normally (barring few states of Northeast) is largest state landowner.

Dr. Kotru felt a strong need of using the narrative of cultural services where local social principles that have developed between dependent human communities and nature over thousands of years. Even from the spiritual angle we can use such principles of solidarity, reciprocity and simplicity of our lifestyles bringing back the old collectivism plank amongst communities/community members to promote NBS.

He viewed a solid case for promoting green entrepreneurship and in the post COVID situation with substantial number of returnees with their skills and capital, several key public programmes available, and key ideas already known, we could further identify key context-specific green economic avenues and work on them. However, capacity building, updated technologies, branding and marketing will need to complement each other to ensure that NBS in practice are supported and sustainability principles maintained. There is a need to revisit national commitments (SDGs, AICHI targets, INDC) and already NBSAP is a major plan to be implemented for NBS. We may further put focus on rare species or identify the new ones and look for preservation techniques/management options.

While building the capacities of stakeholders for future, it is important that apart from socio-technical, skills for entrepreneurship, technological and marketing capacities etc., stress is put on improving aptitude and attitude of the key stakeholders to share and commit their engagement. This also applies CBNRM, as lot is done under this but local communities still are not empowered to take favorable decisions on NBS.

Post COVID also has opened up discussion on what will happen to biodiversity in general (i.e., wild animals, insects, birds, etc.); if such a viral crisis also

hits wildlife, domestic livestock or birds, it will further degrade biodiversity. In this context we are also aware that several local races (in crops) could be further promoted, and landscape elements could be pro-actively connected while planning to get a holistic result for NBS.



Negi, GCS (GBP-NIHE, Almora) briefly mentioned about the Earth Summit 1992 (Agenda 21) in which importance of biodiversity conservation was

realized by the World community.

As a follow-up, in India, the Biodiversity Conservation Act (2002) and biodiversity conservation rule (2004) were enacted. The National Biodiversity Authority of India (NBA) and through the State Biodiversity Boards (SBBs) the BD act is being implemented across the nation. But often we are confronted with a question why should we conserve the biodiversity. Therefore, the concept of biodiversity vis-a-vis ecosystem services is gaining importance worldwide. The biodiversity rich communities are more resilient and stable to climate and anthropogenic perturbations. Therefore, losing biodiversity of this pristine ecosystem of IHR will result into downgrading the magnitude of ecosystem services that will directly affect the wellbeing of the mountain communities. The need for applying the carrying capacity and sustainable harvesting practices concept was emphasized. He also mentioned that rural people can play a big role in biodiversity conservation through BMCs provided Access Benefit Sharing (ABS) mechanism of bioresource is soon realized. Also, there is a need to build the capacity of various stakeholders in realizing the dream of functionality of BMCs and preparation and maintenance of PBRs. He emphasized on some of the potential nature based solutions i.e., eco-tourism, bird watching, bee keeping, poultry, fish farming, mushroom cultivation, preparation of bio-briquettes from pine needles, protected cultivation of cash crops in the mountains as alternative source of income and livelihood for the returning youths under the COVID 19 scenario.



Pathak, Bhawana (Central University Gujrat) highlighted value of indigenous knowledge associated with medicinal plants for pharmacological development at commercial scale. She said that lot of research is

available in the context of indigenous knowledge but translation of much of this knowledge into practice is real need of the hour. She underlined the potential of wild edibles for food security, nutrition and alternative options of livelihoods, and explained as to how value addition in wild edibles would play an important role in entrepreneurship development and source of livelihood in the Himalayan states. She also felt the need of inclusion of research finding in policy and programme implementation. Bioresource based small scale entrepreneurship needs to be promoted for income generation.



Rastogi, Ajay (Foundation for Nature Contemplation, Majkhali) stressed on including both social and natural ecosystems while thinking

of landscape approach. Drawing attention to 4 social principles like solidarity and reciprocity (in sync with spirituality), respect to nature, (in sync with ecological process), collectivism (balance life style). While in general terms, existence of such values is recognised among human beings. Most of the indigenous and traditional cultures see this value between man and nature, and sometimes even beyond into the spiritual sphere. Another principle is 'Equilibrium', maintaining balance and harmony. Farming in agro-ecological way is an example. This is a nature based solution unlike the modern ways of farming that is being promoted.

He mentioned that nutrition and food security is one of the biggest needs of humanity at the moment under COVID 19 outbreak. Malnutrition is really an acute issue that can be solved through local nature based solutions. He opined that market based sourcing of food can never meet the quality and diversity of what can be produced in homesteads and collected from forests. Above all, dependence on markets alone is unaffordable for large sections of society. Research and interventions on improving dietary diversity and nutrition levels of poor rural communities have shown promise in agro-ecological system. We need to revisit the principles of equilibrium, reciprocity and solidarity to fight the challenge of food insecurity and sovereignty using biological diversity.

'Collectivism' forms the 4th principle, which is about doing things together. Say it be development of land, sharing of livestock for tilling, or making/repairing a house, we know the value of communitarian ways. Inaccessibility and other challenges in mountains make collective ways even more critical for any successful endeavour. The 'collectively' concept today is more relevant. There are functionaries of the Government line departments, Panchayati Raj Institutions, people's

institutions such as self help groups and civil society actors, a strong convergence is therefore required among these organisations to make planning and implementation of various programmes a success. The Government with its various programmes such as MGNREGA, National and State Rural Livelihood Missions is today the biggest investor in the villages for the benefit of the most vulnerable.

The strategies are required to be reframed at the local level to engage the youth who have returned post COVID 19 epidemic in the mainstream process of decision making. Engaging them effectively to benefit from this convergence of several schemes through the democratic decision making process of GPDP (Gram Panchayat Development Plan) and other levels up at block and district levels. It would not only ensure more sustainability but also social equity and including the most vulnerable in decision making. In this process we need to revisit the fundamental social ecosystem values of reciprocity, solidarity, equilibrium and collectivism, not only among humans but also human beings as part of nature; remain as fundamental to future growth today as in the earlier times. Actions that nurture 'health, beauty and permanence' is what Schumacher said in 'Small is Beautiful' 40 years ago, and COVID 19 has given us a reminder specially in the Himalayan context.



Ramola, Sushil
(President, Integrated Mountain Initiatives, New Delhi)

emphasized on the need for adopting an integrated

approach, using a larger canvas, considering the resources and the wealth of biodiversity available in the Himalayan region. How to utilize ecosystem goods and services as a productive service for economic security needs to be taken note of. He also urged to synergize the efforts carried out at local and regional level to make them an integrated system to ensure the participation and livelihood of local people. Using the work of MEA, he explained the linkages between biodiversity, ecosystem

services and human well being (Figure 1).

Mr. Ramola underlined the urgency for mapping of skills and capacity of persons who have returned back to their villages under present pandemic situation. This exercise will enable us to assign them livelihood options. He further emphasized that the endemic strength of local people needs to be made national and global converting all their ideas into action. We need to realize the potential of rich biodiversity in IHR. This wealth lead to services and all these services can be utilized in a productive way. This way we can contribute to the SDG goals also like SDG 15.1 and 15.9 where it is said by 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

He said, developing plan is an important aspect. Efforts have been made at individual level, but have not been synergized in an integrated way. Therefore, multi-sectoral and multi-stakeholder approaches are essential, and need to be build on specificity. Jobs are no way out in the hills, entrepreneurship development is the only way. Need for a quick survey on what basically the returnee want and accordingly connect them with agencies working on livelihood and skills, and build their capacity so that we can focus on the local possibility (e.g., Bamboo based enterprise). Finally he suggested for documenting the success stories on nature based solution for livelihoods which would mutual benefit others in the region. This is the time to go to local that will help us to develop value chain and finally lead to the prosperity.



Rawat, Gopal
(Former Dean, WI Dehradun) stated that the COVID-19 situation provides us great

opportunity to look back on our resources, capacity and traditional

ecological knowledge for developing the bioresource/ biodiversity based livelihood options.

There exists tremendous scope for NBS in this region. He stressed upon adopting balanced ecosystem approach by integrating social and natural ecosystems. There is a great asylum value of this region in the context of global warming. Despite all

odds, Himalayan region provides ecosystem services and socio-economic values. These include biodiversity used by local ethnic communities on day to day basis. They are the real custodians of traditional knowledge on the sustainable use of biodiversity and its conservation. Citing the example of Indian part of Kailash Sacred Landscape (KSL), Dr. Rawat mentioned Van Raji tribes in this landscape have rich knowledge of many unique high value MAPs and wild edibles that could be developed as source of livelihood. He gave an example of multiple uses of *Bohemeria rugulosa* and *Ougenia oogenensis* in wood carving as well as good and quality fodder. He felt that MoEFCC could initiate such programmes in IHR to identify and conserve bioculturally important species under the green India mission and other restoration programmes. This could be an opportunity for "vocal for local" species. He showed his concern about unemployment of rural youth and those returned back and suggested the need of careful screening of their skills and make sure that such youth should be engaged in works of water conservation, restoration, and forestry related work with the proper guidance of government institutes and credible civil society organizations. He emphasized upon capacity building and channelizing the energy of younger generation which will go a long way in conserving the Himalayan biodiversity.



Chandran, Manoj (CEO, Uttarakhand Bamboo and Fiber Development Board) was of the opinion that biodiversity

should not be taken as diversity of the so called "living things", but should also include the "living world".

Landscape and ecosystem diversity is as important, especially to know the interactions of the "living things" with the "living world". As such, there is nothing called "non-living". Everything has a life. It is only the time-frame we are in and our limited brain capacities make us differentiate non-living and living. The atoms and its sub-atomic particles are also living and have a "life" which we have not yet understood. Without the transfer of electrons when one "life" touches another "life" no communication is complete. He further suggested that while studying species, study of its obligatory and facultative associates is very much necessary. For example, while studying an orchid species, we need to know the host tree or host habitat, the mycorrhizae helping the germination of seeds, the



mucilage producing bacteria, the pollinators, predators, pests, other organisms which the orchid plant harbours or gives shelter knowingly or unknowingly and many such infinite life forms that in one way or the other influence the life of that orchid species. He said that one species of organism as the word "organism" suggests is a organisation of several life forms, each interdependent on the other and having consented to live together from birth to death. The coliform bacteria in our stomach, the mitochondria of each cell (being blue green algae, which are capable of independent existence as well), the ribosomes (which are actually bacteria), the trillions of viruses (which are just genetic material) stocked to be used on demand, etc., are only a few of the infinite examples. Therefore, equilibrium of various life forms is of utmost importance. The disruption of balance will trigger a chain of reactions to restore the balance. Epidemics are a result of such imbalance, when an intruder microbe affects the existing microbial load and the domino effect ultimately resulting in accepting the intruder as one among us having accepted the principles of co-existence and living with mutual respect.



Rasaily, SS (Member Secretary, Uttarakhand Biodiversity Board) stressed on the need for assessing the attitude and aptitude of the returnees to their villages before

assigning any work or job to them. He briefly described how both attitude and aptitude are important in this pandemic situation for providing them with new opportunities suited to their skills and capabilities. He underlined the need of enhancing the aptitude of the returnees for providing them with nature based solutions. Also, there is a need for change in the attitude of the people so that returnees can work happily.

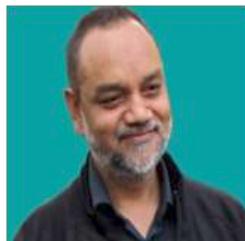


Rawat, RBS (Former PCCF, Govt of Uttarakhand) mentioned that the Covid-19 pandemic crisis has brought us an opportunity, which can be utilized with suitable interventions and solutions considering the

potential of Himalayan people.

COVID 19 has taught us how to live in harmony of nature. Following was highlighted by him: (i) Whatever traditional knowledge based approach we had in the past that needs to be revived, biodiversity need to be harnessed and conserved; (ii) promotion of organic products whether MAPs or

wild edible, which can increase our immunity against any epidemics. Indian Himalaya has 2000 MAPS which are in great demand and that is the basis of developing product and putting them in marketing mechanism. There is a need of value chain development and marketing for potential MAP species in the IHR, and (iii) involve the youth in different aspects of biodiversity conservation and first develop the database of their skills and involve them in small enterprises such as bird watching, eco-tourism, restoration programme, etc. Dr Rawat also suggested for involvement of youths in the preparation of People's Biodiversity Register (PBR) under the guidance of Uttarakhand Biodiversity Board. This will provide them immediate livelihood as well enhance their awareness on biodiversity conservation.



Rathore, BMS (Chief Policy Advisor, ICIMOD) said two things are very much relevant to this webinar, one is nature based

solutions and another is decade of ecosystem restoration.

There is a need to keep two things in backdrop, one is significant change in land use and land cover in the mountains leading to degradation and migration. We have lost two-third endemic species from the mountains and also losing the ecosystem services. Second is illegal trade in wildlife and 23 billion \$ worth trade happens every year throughout the world and this trade is very dangerous for spread of zoonotic diseases i.e. COVID 19. Many of these trading systems share cross border value chain. He highlighted the problem of illegal trade in biodiversity at district to national level, and stressed on the need to prevent the loss of biodiversity. This is possible through transboundary cooperation and programmes. He suggested for joint patrolling, monitoring, conservation, etc. of biodiversity loss and illegal trade. He also suggested for mapping of land use and land cover changes over the years for ecosystem restoration considering the goals of decade of restoration. He further highlighted the value of traditional crops/ varieties in nutrition and also as medicine, needs to be considered for value addition as done in case of finger millet.



Nautiyal, Amrita (Teacher, GIC Taila, Rudraparyag, Uttarakhand) stated that we have enough biodiversity in the

Himalayan region but the real need is its sustainable utilization and management for enhancing the livelihood of locals.

She suggested that there is need to involve the youths, who have returned in their home, in suitable ongoing Govt. schemes like MNREGA. She also emphasized that involving the youth in restoration of degraded lands in the mountain villages can be a good option. Promotion of local handicrafts products and traditional recipe, which may become a means of providing livelihood opportunities at village level, was highlighted by Ms Amrita Nautiyal.



Tiwari, JP (Teacher G.I.C. Batulia, Dwarahat, Uttarakhand) expressed his concern on the issue of human wildlife conflicts in the mountains.

He pointed out that how crop raiding by wildlife has created loss in crop production and income of the local people in the villages. He urged the planners to make such policies or programmes which can help minimize wild life depredation and the loss of farm produce. He also pointed out for the need to use key R&D outputs/ findings in biodiversity conservation and livelihood enhancement. Further cultural value of biodiversity should be promoted and maximum participation of local inhabitants in conservation programmes should be ensured.



Tewari, Pankaj (Aarohi, Satoli, Nainital) emphasized on richness of biodiversity and bioresources in Himalayan villages.

However, question is how to harness this potential sustainably? He mentioned value chain development of bioresources is urgently required to engage people at different level. Also there is a need of promoting e-commerce to sell farm products through various channels that will reduce the involvement of middle man. This will create opportunity for entrepreneurship development and livelihood enhancement at local to national level. In the COVID 19 scenario, he narrated, the situation of village life in his area of operation in District Nainital and informed that the returnees have already started cultivating their land at notable scale for the summer season crops. This is an indication that agriculture should get larger focus. Therefore, appropriate material and technological support to them from Govt. departments would boost their moral to strengthen their survival strategy in these days of uncertainty.

Close and way forward

Before closing the webinar, Dr. R.S Rawal, Director thanked all the panellists and participants. He informed that the Institute shall come-up with the Proceedings and Key Messages emerged from the webinar and share the draft with all the panellist for their inputs. Once it is agreed by the panellists, same will be shared with various stakeholders, including field level executing agencies. He also informed that in the next five year (2020-2025), the Institute has initiated four transformative projects and out of these four, three are well fitting to the present topic. These include, (i) developing eco-model villages, (ii) fostering climate smart communities, and (iii) mainstreaming value chain of the medicinal plants and wild edibles for rural development.

Therefore, the recommendations/messages of webinar will be appropriately included in these projects of the Institute. However, all the panellists/participants are urged to push the messages of this webinar, on their personal and Institutional capacity, so as to realize the benefits for wellbeing of the Himalayan people in post COVID-19 time.

GBP-NIHE, North East Regional Center



The North-East Regional Centre (NERC) of the Institute, Itanagar, Arunachal Pradesh celebrated the IDB on the theme “Our Solutions are in Nature” through virtual platform. In addition, an on-line Photo competition on the Biodiversity of the Eastern Himalayan region was also organized for all the participants.

Er. M.S. Lodhi, Regional Head of NERC welcomed all the participants and highlighted the importance of IDB and moderated the entire discussion during the webinar.

Dr. Wishfully, briefed about the importance of the IDB and mentioned that the year 2011-2020 has been declared as the UN International Decade on Biodiversity to 'promote the implementation of a strategic plan on biodiversity and its overall vision of living in harmony with nature'.

The resource persons of the Webinar, Dr. B.B. Bhatt, Environment & Forest Department, Govt. of Arunachal Pradesh talked about Biodiversity of Eastern Himalaya and its importance. He highlighted the significance of the biodiversity of Eastern Himalaya which is the result of an admixture of biodiversity elements from three regions, viz., the Oriental, Chinese and Malayan elements. He also emphasized the importance of animals as agents of seed dispersal and their role in regeneration of forests. He further stressed on the need to change the mind-set of local people from being exploiters to conservators of nature and wildlife.

Dr. Temjenmongla, Scientist-C Zoological Survey of India, Arunachal Pradesh Regional Centre talked about Traditional Knowledge: its importance and implications, talked about the importance and implications of traditional knowledge (TK). She mentioned that TK is important not only for daily life of indigenous people but also in modern science related to agriculture, natural resource management, and medicine. She pointed out some of the implications of TK in the field of biotechnology, medicine, climate change, etc. She cited an example of the Government of Kerala which has advised its people to go back to Ayurveda to mitigate the Corona virus. A total of 16 participants attended the Webinar from different institutes including NERIST, Spice Board Itanagar, Uttar Banga Krishi Vishwavidyalaya, West Bengal and all the faculty and research scholars of GBPNIHE-NERC.

Some of the important points emerged out of the discussion can be summarized as:

1. It was realized that developmental activities in the Himalaya has a cost of biodiversity loss.
2. Local village institutions and influential people among the community can play an active role in spreading awareness about the loss to biodiversity.
3. Hunting is one of the major causes of loss of biodiversity. The local traditional institutions (like Kebang) has played important role in restricting hunting in Arunachal Pradesh.
4. There is a strong need of people's participation in the biodiversity conservation programme being implemented by the Govt. Dept./other agencies.
5. Community driven efforts motivated and coordinated by forest departments and other such government agencies have to come together to make the conservation programmes effective.
6. It would be appropriate to develop a mechanism through which rewards and recognition to local community/individuals can be given to those who are helping/contributing in biodiversity conservation.

Himachal Regional Centre

The day was also celebrated in the Himachal Regional Center of the Institute. To begin the webinar, Er. R.K. Singh, Centre Head, HRC welcomed all the resource persons and informed about the objectives of proposed webinar-cum-brainstorming pants for the celebration of International Day for Biological Diversity (IDB) 2020. He welcomed resource person and participants of the webinar-cum-brainstorming on “Biodiversity of North-Western Himalaya”. Afterwards, Dr. K.S. Kanwal, Scientist, HRC formally introduced the resource persons to the participants.

The first presentation was made by Dr. Gopi G.V., Scientist-E of Wildlife Institute of India, Dehradun. He presented a comprehensive overview on diversity, distribution and conservation prospective of faunal elements of Indian Himalayan Region. He specifically emphasized the richness and uniqueness of faunal diversity of North Western Himalayan

region, conservation and management challenges of mammals, avifauna, reptiles, fishes, etc. He underlined the following key points for the faunal diversity conservation in the IHR:

(i) Tigers were reported in the higher altitude areas (around 3000 masl) of Dibang valley, Arunachal Pradesh and Askot Wildlife sanctuary, Uttarakhand during recent times. It clearly indicates that the anthropogenic pressure aggravated with climate change impact has pushed the upward migration of Tigers in the Himalayas. Therefore, more scientific studies and appropriate conservation strategy is essentially required for Tiger conservation in the IHR, and (ii) Poaching & Illegal wildlife trade has increased various zoonotic diseases in the recent past. Hence, stringent actions and awareness among community will be required to check the poaching and illegal trade of wildlife.

Vinod Bisht, Scientist In-Charge, Zandu Foundation for Health Care, Valsad, Gujrat presented the role of Medicinal and Aromatic Plants (MAPs) in biodiversity conservation and livelihood development particularly in the Himalayan region. He elaborated upon the opportunities and challenges in cultivation, processing, value addition, marketing and value chain development in MAP sector. Dr. Bisht further mentioned that the herbal medicine have enough potential to provide the solutions to overcome the present COVID - 19 Pandemics.

Ms. Sheetal Sharma, Field Biologist, HRC Kullu talked about the solutions provided by biodiversity for environmental, social and economical sustainability in the Himalayan region. Thereafter, Dr. Shiv Paul, Research Associate, HRC presented the status of floral diversity including economically important plants and conservation and management measures for biodiversity conservation in the context of Himachal Pradesh.

In the concluding session, HRC faculty and researchers brainstormed on the conservation and sustainable use of biological resources in

the North Western Himalayan region. Comprehensive documentation of biodiversity, assessment of genetic variability, value addition of economic important plants, strengthening of traditional knowledge, promotion of agro-diversity, MAPs cultivation and trade, awareness and capacity building of stakeholders have emerged as key points for biological diversity conservation in the North Western Himalayan

Sikkim Regional Center, GBP-NIHE



To begin the IDB celebration **Rajesh Joshi**, Centre Head of Sikkim Regional

Centre welcomed all the participants and briefed about the programme and its importance in current Covid-19 pandemics. He mentioned that the increasing frequency of disease outbreaks is increasing steadily and one or other way it is linked to climate change and biodiversity loss. He pointed out that today's crisis creates an urgent need for an in-depth reflection on the relationship between human beings and nature, the risks associated with current economic development pathways, and how we can better protect ourselves in the future.



R.S. Rawal, Director of the Institute in his opening remarks highlighted the importance of the Himalayan biodiversity and explained the

dependency of the inhabitants on the bioresources. He underlined the fact that biodiversity of Himalaya consists rich resources of wild edible fruits and medicinal plants, which can be harnessed for nutritional security and livelihood opportunity for the region. He emphasized the need to have concrete solutions based on rich bioresources of the region and livelihood to combat the current pandemic situation.

In the following discussion, panelist Dr. Sarla Khaling, Regional Director, ATREE, Gangtok, Sikkim; Prof. N. Saytanarayana, Dean, School of Life Sciences, Sikkim University; Dr. S.

K Nandi, Former Head, CEA&CC, NIHE; Dr. Shriprakash, Assistant Director, RARI, Sikkim; Dr. Rajib Gogoi, Head, BSI, Sikkim Himalayan Regional Centre; Dr. T. N. Deka, Head, Indian Cardamom Research Institute, Sikkim; Prof. R.M. Pant, Director, NIRD & PR-NERC, Guwahati; and Dr. R.S. Rawal, Director, NIHE participated. This discussion was moderated by the Head, SRC. Summary of each presentation by panelist is given below:



Sarala Khaling, Regional Director, Ashoka Trust for Research in Ecology and the Environment, Gangtok, Sikkim spoke on Challenges in nature and emergence of

pandemics drastic changes in the environment (land, seas, water and air) through anthropogenic activities, e.g., deforestation, degradation, pollution, land use change, mining, other developments, etc., are continuing contributing to ecological imbalance and climate change.

Wildlife trafficking, large farms of birds and animals and open wet markets may invite dengourous pathogens and may become virulent to mankind. What we are experiencing now in COVID 19 is unprecedented in modern human history when we consider ourselves at the epitome of technological achievements. The world has lost 60 percent of all wildlife in the last 50 years while the number of new infectious diseases has quadrupled in the last 60 years. The unregulated trade in wild animals and direct contact with animal parts is causing exposure to zoonosis. She highlighted upon certain facts such as (i) Unsustainable consumption practices: Culture of wild meat, large imports of poultry and livestock for meat from distant markets, that leads to a repository of diseases (e.g. Bird flu, Swine flu, Mad Cow disease, etc.), (ii) Disappearance of scavengers such as vulture populations in South Asia due to anti-inflammatory drug Diclofenac. Upsurge in cases of rabies in the human population reported. This is because vultures were not there to feed on the carcasses thus rapidly increasing in the population of dogs, feral dogs, which are the main vector of rabies for humans, (iii) Closer home (in context to Eastern Himalaya): Scrub typhus outbreak: Caused by mites in rodents and linked to probably climate

change (warming) particularly in Sikkim, Darjeeling, Nipah virus-cases in Siliguri, Malaria and dengue in the foothills of the region due to improper drainage, waste disposal and polluting wetlands and decimation of predators, and (iv) Altered habitats and habitat destruction: Altered habitats through infrastructure development, palm oil and rubber plantations.

She concluded that human health is closely linked to other animals (wild and domestic) and environmental health. Therefore, the "One Health" approach which has been promoted at a global level is one way of approaching these emerging pandemics. Therefore, avoid any actions that destroy habitats, promotes wildlife trade and unsustainable consumption lifestyles.



Shriprakash, Assistant Director Incharge, Regional Ayurveda Research Institute, Gangtok, Sikkim spoke on the "Role of medicinal plants Biodiversity for meeting the

challenge arising out of spread of CORONA virus (COVID-19)". He mentioned that Corona viruses are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Severe Acute Respiratory Syndrome (SARS-CoV) originated from China through cat in 2003; Middle East Respiratory Syndrome (MERS-CoV) originated from Saudi Arabia through camel in 2012; and the 2019 noble COV (COVID-19) reported from Wuhan, China, on 31 December 2019. He appreciated the fact that in the Himalayan region, rich diversity of medicinal plants has important role for protection of the environment as well as pandemic of virus infection. The function of the immune system is critical in the human response to infectious disease. Given the increased use of traditional medicines, possibilities that would ensure its successful integration into a public health framework should be explored. Hence, the links between biodiversity and traditional medicine needs to be identified to addresses their implications to public health. There is also a need of documentation of the traditional uses of plants in traditional medicine and the cultural and ecological aspects associated with such

practices. Further, informed participation of holders of traditional medical knowledge in decision processes may further foster much needed co-operation to ensure the equitable sharing of the benefits arising from the utilization of traditional knowledge, innovations and practices.



Rajib Gogoi, Head Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok, Sikkim spoke on the "Role of biodiversity to combat pandemics".

He mentioned that biodiversity loss can have indirect effects on human well-being. By disrupting ecosystem function, biodiversity loss leads to ecosystems that are less resilient, more vulnerable to shocks and disturbances, and less able to supply humans with needed services. Covid-19 is a serious threat to humanity and it is affecting adversely the economy globally. To think forward with biodiversity during this pandemic three important issues emerges: (i) How to stop the infection/boosting immunity of human being, (ii) If infected how to get cure from natural sources; and (iii) Adaptation of healthy traditional practices/ or sustainable utilization of bio-resources for a nature based society as followed still in many indigenous/ethnic communities.

He pointed out that in India, there are about 250 known medicinal plants and to name a few e.g., *Justicia adhatoda* (Basak), *Tinospora cordifolia* (Giloy), *Hemidesmus indicus* (Anantamul), *Lithocarpus dalbatus*, etc. are reported as anti-viral plants. But the studies are still in very preliminary stage and needs validation for human use. Apart from these known plants there may be much more potential plant species which may prove effective to fight COVID like viruses. Now it is the time for the scientific community to initiate collaborative research on these plants. Further, the institutions need to play a key role to promote awareness and popularize the immune boosting/effective ethnic health traditions among masses across the Himalaya. Further he mentioned that AYUSH Ministry, Gol has already put an advisory to regular use of some plants/or plant products to keep

ourselves healthy which are quite common and known to all. Along with these, there are many more immune booster plants in India/Himalayas which need to be documented and inventorised. The whole world is in search of a medicine about COVID-19. In this context, there is need to look for medicinal plants which can be a real nature based remedy for such kind of pandemic.



Shyamal K. Nandi, Former Scientist- 'G' and Head, Centre for Environmental Assessment & Climate Change, GBP-NIHE, Almora focused his talk on biotechnological approaches for

nature based solutions to combat pandemics. He mentioned that Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Generally, viruses are ultramicroscopic, acellular, metabolically inert nucleoprotein particles containing bundles of gene strands of either RNA or DNA, with or without surrounded by a lipid-containing envelope. They are obligate intracellular parasites, utilize the host cell machinery to propagate new viruses and can cause diseases. More than 200 viruses are known to cause human diseases. Some of them present high public health importance, such as cytomegalovirus (CMV), Epstein-Barr virus (EBV), hepatitis B and C viruses (HBV and HCV, respectively), herpes simplex virus (HSV), human immunodeficiency virus (HIV), cervical cancer caused by human papillomavirus (HPV) infection, rabies virus and Ebola virus. He stressed upon (i) phytochemicals as antiviral drugs i.e., Plant based compounds well known since ages particularly in Ayurvedic, Unani, Chakma, Tibetan and Chinese traditional medicines and these are good sources for potential antiviral drugs. The World Health Organization estimates that 70-95% population in developing countries depends on medicinal and aromatic plants (MAPs) for their primary healthcare. At present, there are about 121 clinically useful prescription drugs in the market developed from 90 plant species, and 74% of these compounds were used following folklore claims. India is amongst the major repositories of biodiversity and the Indian Himalayan Region (IHR) is known to harbor a large number of highly prized MAPs. Such

plants also contain bioactive phytochemicals which have shown antiviral properties. For example, *Picrorhiza kurroa* extract showed treatment of viruses in humans. Similarly, a number of plants of IHR possess antiviral properties. Using biotechnological methods these bioactive phytochemicals can be obtained. In vitro multiplication of elite/high quality plant material for commercial cultivation to obtain the phytochemicals; Callus, cell and suspension culture; Culture of transformed cells, tissues or hairy roots; biotransformation. Extracts from such plants can therefore, be tested to develop antiviral drugs for Covid-19, and (ii) Antiviral compounds of animal origin: Antiviral have been reported from animal venoms (Scorpions, snakes, amphibian, insect, etc). In scorpions the biologically active peptides are classified as disulfide bridged peptides (DBPs) and non-disulfide-bridged peptides (NDBPs). Snake venoms are composed of a mixture of proteins, peptides (90–95%), free amino acids, nucleotides, lipids, carbohydrates and metallic elements coupled to proteins (5%). Some studies have reported the antiviral activity of snake venoms and their components against measles, Sendai virus, dengue virus (DENV), yellow fever virus (YFV) and HIV. Thus, more than 45 compounds obtained from vertebrate and invertebrate organisms have been reported to have in vitro or in vivo antiviral activity. These compounds may lead to new classes of therapeutic drugs after additional chemical and pharmacological studies. At the end of his talk he recommend that-

(i) Create awareness about various killer diseases and impart trainings to cope with pandemics like Covid-19, (ii) Improve immunity to cope with health issues by consuming natural products, (iii) Explore more plants for drug development focusing on plant source. GBP-NIHE have developed multiplication technologies (using biotechnological and conventional methods) and field trials for more than 30 species of medicinal plants; these can be adopted in other parts of IHR for commercial cultivation and subsequently obtaining bioactive compounds for drug preparation. He concluded that biotechnological interventions will lead to more active phytochemicals from natural sources and will provide important information for the development of new plant products in controlling the threats posed by some pathogenic viruses.



R.M. Pant, Director, NIRD, Guwahati dwelt upon economic perspectives of conservation for preparedness towards pandemics. He mentioned that the costs of restoration of natural ecosystem are outweighed tenfold by its benefits to communities.

Restoring coastal mangroves, for example, can protect land from storm surges and coastal erosion, develop fisheries and support ecotourism. Investing in the restoration of wetlands, mangroves and coral reefs could reduce insurance costs for businesses in coastal areas vulnerable to flooding. Likewise, financing ecological forestry practices could reduce insurance costs for businesses, such as power and water utilities, that are exposed to wildfire risks. Restoration of the degraded

Improve immunity to cope with health issues by consuming natural products, and Explore more plants for drug development focusing on plant source.

forests can boost local employment and increasing community awareness of biodiversity's importance. He emphasized that to combat with pandemic situations in Himalaya, livelihood options for nature based solutions need to be promoted and market linkages of agro based products be strengthened. Further, market exposure and agro based business needs to be strengthened. There is essential requirement for the long term (e.g. market linkages) and short term (farm based) solutions. The innovative solutions to local products and self sustainable approach in the systems is required to combat the pandemics.

R.S. Rawal, Director, GBP NIHE in his final remarks talk on communicating the value of biodiversity highlighted the fact that Coronavirus disease 2019 (COVID-19) as a global crisis is crippling economic, health and environment, which has triggered widespread changes in human behaviors, reduction in pollution and increasing dependency in rural

setups in Himalaya. It is expected that the COVID 19 has the potential to trigger huge effects on biodiversity and conservation practices. Realizing the importance of biodiversity in the current situation and in the future, there is a need to identify the communication tools that may help to communicate the biodiversity conservation protocols and value of biodiversity at grassroots level having potential of supporting livelihood and generate income in the normal setups. The vision of Honble Prime Minister as 'Vocal for Local' directs to strengthen skill and capacity of rural workforce not only in generating livelihood, but it should be concentrated on its sustenance of livelihood and conservation of biodiversity. The communication mechanism should be based on lab-to-land model that support to grassroots workers in term of livelihood and conservation of biodiversity. Also there is a need to communicate the value of biodiversity upward so that people at policy practice domain appreciate the same.

In the WayForward session of the webinar, Dr. S.K. Nandi, Prof. R.M. Pant and Dr. R.S. Rawal summarised the event and highlighted following key points:

(i) Solution for Covid-19 pandemic is available in nature as amongst the thousands of active metabolites present in the medicinal plants, various molecules having strong anti-viral properties need to be identified. Also, using transformation and propagation methods potential of medicinal plants can be enhanced for improvement of clinical efficacy and large scale production.

(ii) The vast diversity in bioresources available in the region such as indigenous fruits, vegetables, crops and medicinal plants rich in nutrients, active metabolites and medicinal values along with dietary importance has potential of uplifting socio-economical status of inhabitants, which has emerged as an burning issue in current reverse migration during Covid-19 pandemic. Therefore, medicinal plants, large cardamom cultivation, and promotion of local bamboo products need to be upscaled in the region.

(iii) There is a need to realize the slogan of vocal for local given by honorable Prime Minister, which implies that regional specificity of local products must to be explored and promoted in local market through local value chain.

Himalayan biodiversity vs. COVID-19 pandemic: Solution to Corona hiding somewhere in Himalaya?

Is solution to Corona virus hiding somewhere in Himalaya? Amid the COVID-19 pandemic, Himalayan biodiversity is the hope of not only Himalayan people but also for the billions of people from all over the globe. Since ancient times, India has been the country of traditional medicinal system. The age-old traditional medicinal practices that include Ayurveda, Yoga, Naturopathy, Homeopathy, etc. have been proved very effective against several diseases. About 25,000 formulations have been used in folk remedies in Indian medicinal system (Pundarikakshudu and Kanaki, 2019). Vellingiri et al. (2020) have compiled a list of 25 medicinally important plants that can be



effective against Corona and various other viruses. Ministry of Ayush has recommended a list of 15 plant species along with details of trade names, preparations, doses to increase immunity against Corona virus (Ministry of Ayush, 2020). In spite of Himalayan biodiversity, the societal system of Himalayan people (especially in the eastern Himalaya) deserves great appreciation amid COVID-19 pandemic. The tribal communities inhabiting these areas, which are treated as backward and uneducated people, had started following self isolation before the official declaration of countrywide lockdown. They strictly followed the rules of social distancing and helped each other by providing necessary items door-to-door during this difficult time. Besides this on their own, they have converted huts in quarantine camps with all necessary facilities for people coming from outside. Now whether the world believes or not, there is definitely

something in the Himalaya. An extensive survey of the ethno-medicinal literature on Himalayan region and consultation with elderly people of indigenous communities may definitely reveal some solutions to COVID-19.

From the biodiversity conservation point of view Corona virus is being proved as a boon so far. A very recent publication in Biological Conservation has concluded that the reduced human activities due to COVID-19 are benefitting biodiversity in many places of the world (Corlett et al. 2020). But still it is not clear that what will be the effects of Corona virus on biodiversity in future. Besides this one can find several examples of returning of lost biodiversity in daily newspapers from all across

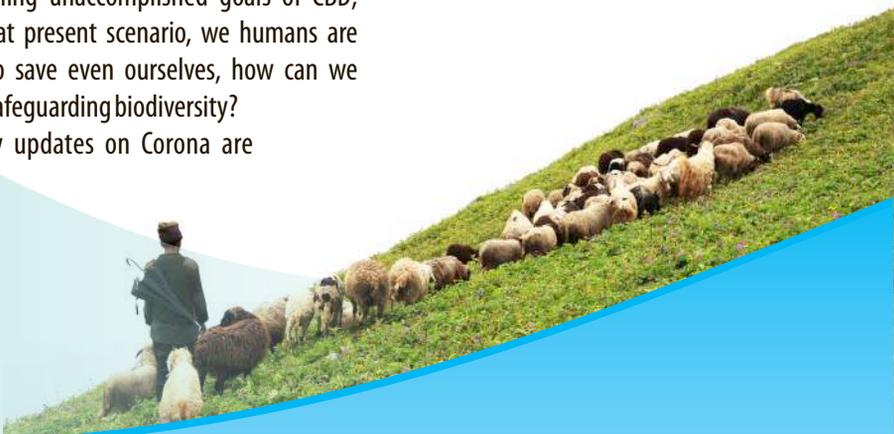
the world, here are some headline – “Britain's largest bird of prey, white tailed eagle, returns home after 240 years”; “Jungle ka dayra nahi samajh pa rahe jeev (Naintal ke aas-pas aabadi wale ilakon me vanya jivon ko mil raha prakritik vas)”; “Lockdown

affects harvest and trade of keeda jadi (the country wide lockdown due to COVID-19 put a check on collection and trade of keeda jadi that is also known as yartsa gumbu/caterpillar fungus, one of the most expensive and threatened elements of alpine Himalayan biodiversity)”; and many more. Is COVID-19 is contributing towards biodiversity conservation and fulfilling unaccomplished goals of CBD; because at present scenario, we humans are unable to save even ourselves, how can we think of safeguarding biodiversity?

The daily updates on Corona are

being provided by WHO through Wikipedia, based on the information gathered from various health ministries and departments of respective countries. While comparing the active cases and casualties of COVID-19 in Himalayan countries with those of European and American countries it is clear that, the Corona outbreak has dramatically affected and taken more human lives in these highly developed European and American countries.

Despite of having tremendous resources in form of money and state of the art technologies in medical science sector, these developed countries have bowed down against COVID-19. Out of the 8 Himalayan countries, 4 countries viz. China (1st), India (2nd), Pakistan (5th) and Bangladesh (8th) hold positions among world's top ten most populated countries. But none of these is among top ten most affected countries (based on numbers of active cases and casualties) due to COVID-19. As far as Indian Himalayan Region (IHR) is concerned the COVID-19 is prevailing in 12 states out of the 13 Himalayan states. But the magnitude of COVID-19 is very low in these states. China, which is being considered as the origin of Corona virus, makes 3488 km long boundary with 5 Indian states viz. Jammu and Kashmir, Himachal Pradesh, Sikkim, Uttarakhand and Arunachal Pradesh. Despite of being that much closer to China these Himalayan states are least affected due to COVID-19 as compared to the other parts of India as well as world. What could be the possible reasons behind it - the richness, uniqueness and high medicinal value of Himalayan biodiversity? the living in harmony with nature life style? the sacredness of the landscapes? the indigenous traditional knowledge to increases immunity to fight



against any kind of microbial attack? more dependency on nature?; the environment? the crop biodiversity that they consume? the knowledge of medicinally important biodiversity elements? Questions could be many but our solutions are in nature.



Kapil Bisht and Poonam Mehta

Centre for Biodiversity Conservation
and Management, G B P-NIHE, Almora

email: kapilkannu@gmail.com

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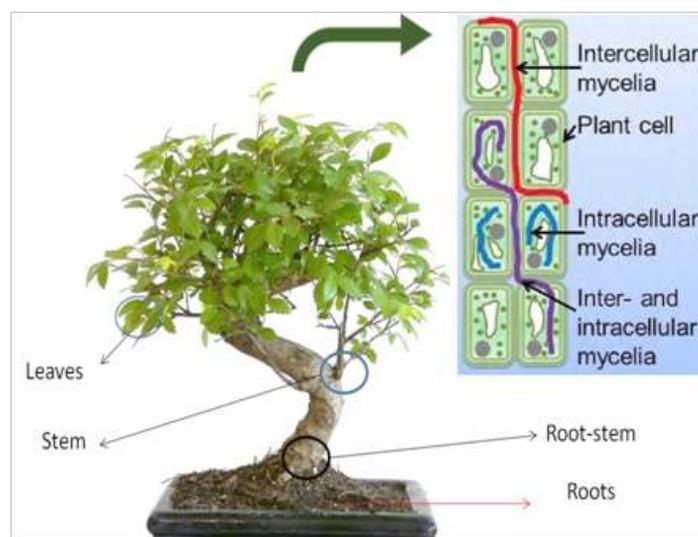
Endophytic fungi- an alternative bioresource to prevent medicinal plant biodiversity from industrial exploitation

Plants have played a vital role for humankind since ages. They have always been and will continue to be the source of medicinally bioactive compounds against numerous ailments. Medicinal plants are the precious part of the world flora. From centuries, the medicinal plants have been the source of therapeutics and played a vital role in developing the drugs against most serious diseases such as cancer, heart stroke etc. Age-old exploitation of the natural resources and the dramatically increased interest of these bioresources are a real threat for the biological diversity. In such a situation endophytic fungi are the new ray of hope which can be used to preserve these, medically important plants. Medicinal plants and their endophytes produce 80% of the novel compounds which have been used to treat various ailments and considered as the foundation for discovery and development of modern therapeutics. Owing to the outbreak of fatal diseases, requirement of searching novel compounds with potent activity and/or novel action mechanisms, screening for promising sources of biologically active compounds that fulfill the current needs of humanity is in exigency. It is evident from the studies that endophytic fungi represent

prospect factories for production of bioactive natural substances, which could extend healthy life span of humanity (as done by penicillin from centuries). Endophytes secrete metabolites that help the host plants in its root development having greater access to nutrients. It also helps to protect the plant from desiccation and from pathogenic infections.

This symbiotic activity enables endophyte to promote host plant's growth and concrete its resistance mechanisms.

There are around 300,000 or more plant species on the earth and each plant is the host of one or many fungal endophytes, which gives the clear image about the diversity of these endophytes and their taxa. Endophytes produce plethora of bioactive molecules that may serve as the potential source of novel natural products with anti-fungal, anti-viral, anti-oxidants, and immunomodulatory compounds. Taxol, the billion dollar anti-cancer



drug, has been shown to be produced in higher amount by endophyte *Metarhizium anisopliae* found in the bark of *Taxus* tree. Camptothecin, shown to *Nothapodytes foetida* is known to have cytotoxic and antifungal properties. These findings further substantiate the importance of endophytes and how they can be a prime bioresource for drugs in the coming years. Moreover, endophytes play important roles in promoting plant growth, and protecting the host plant from some pathogens. Endophytes can colonize in the stem, roots, petioles, leaf segments, and inflorescences of weeds, fruits,

buds, seeds and also dead and hollow hyaline cells of plants. There are many studies demonstrating the vast diversity of endophytic fungi such as in *Ocimum sanctum*, was reported to harbor maximum endophytic fungi in petiole. Some studies also show that fungi are non-host specific like *Colletotrichum gleosporioides* and *Curvulaia* whereas some are host specific like *Fusarium proliferatum* and *Neocosmospora falciformis*. The endophytes are the new area of exploration for their ability to produce the secondary metabolites with potential use in various therapeutic settings. Endophytes are the pool of naturally available

colorful dyes such as *Bankera violascens*, which produces green dye; *Agaricus arvensis*, which generates blue shades; *Chroogomphus vinicolor*, which gives red dye; and *Collybia iocephala*, which gives a purple-blue dye. The dyes produced by fungi are ecofriendly, nonhazardous to health. The endophytes are also biocontrol agent and promote growth by producing phytochemicals; increasing plant tolerance to external stress, inducing the defense system e.g. *Phomopsis cassiae* secretes cadinane sesquiterpenes that protects its host *Cassia spectabilis* from the pathogenicity of *Cladosporium sphaerospermum*, and

fuel is a tremendous work in the field of endophytes. These aureate resources could be manipulated further for higher production by applying new and improved biotechnological approaches like recombinant DNA technology, metabolic and fermentation technology. Exploiting endophytic fungi across the world could serve as alternative bioresource for pharmaceutical exploitation. This in turn could conserve plant biodiversity and establish an eco-friendly ecosystem. So without going beyond our nature or by exploiting least, if an alternative industrially relevant microbial source is available then industrial choices are to be mended. Thus a slogan is apt: Save Plantae Exploit Fungae.



Garima Tyagi and Lokesh Gambhir

Department of Biotechnology, School of Basic & Applied Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India 248001

email: garimatyagi2894@gmail.com

compounds with bountiful properties which have found their use in many sectors such as, endophytes are the anti-biotic producers, and the classical example of this is the discovery of Penicillin, which till date serve mankind. Except this there are many other antibiotics such as Cephalosporin from *Cephalosporium spp.* against Gram positive bacteria. Used in treating dermal infections, Griseofulvin from *Penicillium griseofulvum*, Lentinan from *Lentinussp.* is active against *Mycobacterium tuberculosis*, *Listeria sp.*, and Herpes Simplex Virus-1 (HSV-1) and Schizophyllan from *Schizophyllum commune* used against *Candida albicans* and *Staphylococcus aureus*. The endophytes are explored for the potential to produce immunosuppressive drugs such as Cyclosporin that is used in organ transplantation surgery. Cyclosporin-A is derived from *Tolypocladium inflatum*, and *Aspergillus sp.* Lovastatin is a cholesterol biosynthesis inhibitor derived from *Aspergillus terreus*. These multi-tasking microorganisms are also used as pigment producers. Some mushroom extracts give

C.cladosporioides. The endophytic fungus *Piriformospora indica* isolated from roots of many plants was commonly used as a plant growth promoter.

Endophytic fungi establish a very significant and quantifiable part of biodiversity of fungi which are known to affect the plant diversity and organization. The bioprospecting of high altitude medicinal plants have shown tremendous endophytic fungi colonization. The biologically actived compounds from these could be produce commercially on large scale as these fungi are easily cultured in laboratory and fermented. Endophytes are able to synthesize plethora of bioactive compounds from their use in medicinal field to the industrial sector, fungal endophytes are proving to be promising with their excellent results in medical field, from their cost effective production of pigments to being the target for bioremediation.

Choosing endophytic fungi as efficient enzymes producer to convert biomass into fermentable substrate in order to produce bio-



Complying with biodiversity conservation initiative that holds the future for Himalayan people

The term biodiversity can be described as a resource upon which natural systems, families, communities, nations and future generations depend. It can be signified as the link between organisms, binding each into an interdependent community or ecosystem in which all living creatures have their assigned place and role. The conservation of regional biodiversity can be achieved through the implementation of Convention on Biological Diversity (CBD). The CBD was signed at the Earth Summit in Rio de Janeiro, Brazil, in 1992, and entered into force on 29 December 1993. It is the first global agreement to cover all aspects of biological diversity: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources.

The enactment of National Biodiversity Authority (NBA) also acts significantly towards management of biological diversity through provision of advised to Central Government on conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising out of the utilization of biological resources. The NBA advise the State Governments in the selection of areas of biodiversity importance to be notified as heritage sites and measures for the management of such heritage sites and the process of access and benefit sharing (ABS) as well. The procedure involves the inculcation of formula for benefit sharing which is

determined on a case-by case basis, while the quantum of benefits is mutually agreed upon between assessors and the NBA in consultation with the local bodies and benefit claimers with keeping in view the extent of use, sustainability aspect, levels of impact and expected outcomes, and including measures ensuring conservation and sustainable use of biological diversity. NBA also stipulates the time frame for assessing benefit sharing on short, medium, and long term benefits. In the regions where traditional knowledge (TK) is accessed from a specific individual or a group of individuals or organizations, NBA takes steps to ensure that the agreed amount is paid directly to them. While, where such individuals or group of individuals or organizations cannot be identified, the monetary benefits are deposited in the National Biodiversity Fund. It is to be noted that 5% of the assessed benefits are to be earmarked for the Authority or Board as the case may be, towards administrative and service charges.

The conservation of biological resources requires to implement the participation of stakeholders which can be termed as benefit claimers, who conserves biological resources, their by-products and acts as creators and holders of knowledge and information relating to the use of such biological resources, innovations and practices associated with such use and applications.

In case of Himalayan region, the wide range of biologically important tools are readily available for implementing the provision of

ABS for the native communities. These tools are inclusive of economic valuation and bio-prospecting of locally available resources among the Himalayan region, capacity building and awareness creation among native communities. While the necessary negotiation skills for achieving the targeted goals and sectoral links with different local and regional sectors i.e. agriculture and markets, IPRs (Intellectual property rights) are immensely required. Though traditional knowledge, documentation of innovations and practices, and the rights of indigenous and local communities over these resources are protected and being monitored, the progress towards common ground agreements will take some more time. Although it was expected to achieve the Aichi-Nagoya 2020 targets by the year end, but the looming COVID-19 pandemic will be impacting the progress made so far.

The Himalayan region being rich in biological diversity, has its vulnerability issues as well, such as increased incidents of natural and man made disasters that causes significant damage to precious ecosystem of this biodiversity rich region and leads to decline in livelihood services. The Himalayan hill communities were engaged in conservation of their forest and other related natural resources since decades, and such an examples are the Van Panchayat or community managed forests of Uttarakhand, which have been envisaged in 1931 and being managed through the community intervention and organised participation through the village stakeholder communities.

These management systems contributes towards the long-term management of the resources and paves way for the intervention of biodiversity management at community level. Various Biodiversity management committees (BMCs) also act towards conservation of biological diversity at village and block level and can be associated with these Van panchayats for ensuring the biodiversity monitoring and management practices. As the mountain communities are entirely dependent on these forest ecosystems, it is immensely necessary to provide local and regional level sustainable management guidelines intertwined with global sustainable developmental goals for these institutions. In



respect of present ABS situation in Uttarakhand, 139 applications for ABS have been received by State Biodiversity Board (SBB, 2018) since its inception in 2010; total 891 BMCs have been constituted in different developmental blocks of Uttarakhand state, with highest (178) in Almora and 129 in Uttarakashi districts, respectively.

For the proper functioning of these authorities and ensuring the sustainable management of the biological diversity, it is of high priority that for the future interventions towards biodiversity conservation, proper implementation of the ABS provisions is necessary, with communities in the Himalayan region have to begin work towards different administrative, legal and policy measures,

apart from focusing on capacity building and awareness raising and developing the legal, regulatory, and market-based instruments and strategies which are relevant to realize the potential of ABS and harnessing it in sustainable ways. It is to be ensured that creation of awareness among all stakeholders and strengthening of institutional structures, particularly at local levels along with close monitoring of all ABS agreements is to be made mandatory for successful ABS interventions. It can be summarized as following:

*The only resource in which rural poor are rich is their traditional knowledge
Let's bring benefits to them by implementing ABS regime*

Harshit Pant Jugran

Centre for Socio-economic Development,
G. B. Pant National Institute of Himalayan
Environment, Kosi-Katarmal, Almora

email: drharshitpant@gmail.com

Our solutions are in nature

Nature has given us remedies to cure every disease that ever existed. It has the ability to heal our wounds. As of now, we are not sure whether COVID-19 is natural or man-made but its solution would surely be hidden within the realm of nature. In fact, nature itself is a solution to many of our problems. Nature helps us to relax when we are stressed and we feel calm and composed when we are surrounded by nature.

The world saw rapid changes in the field of Technology in the past few decades which rapidly changed our way of living. Humans had sort of lost their contact with nature. We were aiming to form a fully digital world which would function virtually. But the year 2020 has showed us the reality. It showed us that humans are not superior than nature. The year 2020 devastated the world with the new pandemic COVID-19 or novel coronavirus. This new disease has put a halt to the fast moving world. The whole world is looking for its cure but nobody has achieved any significant success in finding the cure. Scientists around the world have been struggling to invent the solution for this disease. Many assumptions are being made for the resources which can cure COVID-19.

This is the right time to realize that all possible solutions of our problems lie in nature. It has showed us that problems will arise if we maintain a dysfunctional relationship with

nature. Studies have proven that deforestation and loss of wildlife cause increase in infectious diseases. Infact, focusing in nature can help us understand where pandemic come from and save the world from such situations in the future. The current economic system had put huge pressure on the nature and the evolving pandemic shed a light on the domino effect showcasing how the elements of nature are interconnected and what impact it has when functioning of nature is destabilized. COVID-19 is an emergence of the various destructive human activities like deforestation, excessive want of experimentation and distortion of microorganism. Following are some examples which shows that nature is healing itself and our solutions are really in nature.

We already known about the river Ganga which was polluted due to various activities of human being such as bathing, washing clothes, dumping various harmful industrial waste, ,now becoming clean which was nearly impossible by man-made methods. Sounds of birds and other animals are becoming easier to hear now that human made sounds are taking up less volume in the sound landscape. Air also become less polluting due to this Himalayan mountains become easier visible from Saharanpur .On the other hand people in Srinagar, Kashmir could see the Pir-Panjhal mountains more clearly. So sustainable

natural activities are the only way out only if we undertake sustainable development we will be able to fight this situation and curb such crisis. Therefore, we must look for our solutions in nature and create a balance with the natural environment.

Mahima Chamola

BSC Agriculture hons., Graphic era hill Univ.
(Gehu), Dehradun

email: mahimachamola@gmail.com

Medicinal plants for the future sustainability of Himalayan people

Medicinal plants have been used in various systems of medicine for curing range of diseases and ailments since time immemorial. World Health Organization (WHO) has estimated that approximately 80% of the world population still depend on herbal medicine for their primary health care needs. WHO assessed that around 21,000 plants having the medicinal potential around the world. Age old Indian Vedas and Puranas such as Rigveda, Atharveda, Ramanaya, Mahabharata, Charak Samhita, Sushruta Samhita highlights the usefulness of medicinal plants. As per National Medicinal Plant Board (NMPB), more than 7000 species are estimated to have medicinal usage in folk and traditional medicine health care in the country. Whereas, about 2,700 plants species are reported to be used in the codified Indian Systems of Medicine viz. Ayurveda (1800 species), Siddha (500 species), Unani (400 species) and Amchi (300 species). Medicinal plants not only provide the primary healthcare needs of thousands of dependant populace but also support the livelihood of many indigenous communities. In India, about 1178 species of medicinal plants are estimated to be in trade of which 242 species have annual consumption levels in excess of 100 metric tons/year. The domestic demand of medicinal plants has been estimated 1.95 lakh MT for the year of 2014-2015 and export demand of medicinal plants has been estimated 1.34 lakh MT during 2014-2015. However, more than 90% of the species used in trade continue to be collected from the wild, and nearly 66% are being gathered through destructive and un-sustainable way to full fill the demand of the herbal industries. This has brought several plants at the verge of extinction.

The Indian Himalayan Region (IHR) is the major repository of medicinal plants. The region as a whole support nearly 50% of the total flowering plants in India, of which 30% are endemic to the region. A review of existing biodiversity information of IHR reveals that there are approximately 18,440 plant species of which 1748 are medicinal plants, 675 wild edibles, 279 fodder species, 155 sacred plants and 118 essential oil plants with medicinal values.

Himachal Pradesh is a biodiversity rich

Himalayan state of IHR, it is popularly known as the Devbhumi "Land of the Gods". The landscape of state is characterized by snow capped mountain, lush green forest, rich biological resource, diverse agroclimatic zones, mesmerising horticulture orchards and culturally diverse populace. It was adobe of the various scholars, who studied the medicinal plants of the region. Around 800 species are estimated to be used for some or the other medicinal purposes within and outside the state. Medicinal plants are being used by indigenous communities of the state for their primary health care needs. Traditional wisdom of community on medicinal plants play key role in the treat various diseases particularly in the rural areas of the state. Medicinal plants sector has been identified and prioritized by the state government for boosting the economy of the state. It will not only provide livelihood opportunities to people of the state but also generate ample amount of employment option particularly for the younger generation. The forest dependant indigenous communities of the state have several rights such as collection of non timber forest products (NTFP) including medicinal plants from the wild. These rights are known as bartan and holders of these rights are called bartandars. However, unsustainable extraction of medicinal plants from the wild, diverse anthropogenic interventions, disinterest of traditional indigenous knowledge etc. are the main reasons for the depletion of medicinal plant resources and associated knowledge in the state.



Swertia chirayita

In Himalayan region particularly in Himachal Pradesh several farmers have adopted the medicinal and aromatic plant cultivation as livelihood option. Mr. Jahan Singh is one of the farmers of Shangarh village of Sainj valley, cultivating Kutki/Kadu (*Picrorhiza kurroa*) in 3 acre land. Similarly, Mr. Dheeraj Sharma of Suppa village of Chamba district is cultivating *Picrorhiza kurroa*, *Aconitum heterophyllum*, *Bergenia ciliate*, *Cinnamomum tamala*, *Valeriana jatamansi*, *Angelica glauca*, *Podophyllum hexandrum*, etc. medicinal plants. Mr. Trithaj Raj Thakur of Solangnalla village of Manali has also started cultivation of *Picrorhiza kurroa* and *Aconitum heterophyllum*. Himachal Regional Centre supporting such medicinal plants cultivators and promoting other farmers for cultivation of medicinal plants. These

Picrorhiza kurroa cultivation in Sangarh Village of Sainj Valley, Kullu, H.P.



interventions will not only help to increase the farmers income but at the same time organic medicinal plants cultivation will reduce the pressure on wild genetic resource of the such threatened medicinal plants in IHR.

Presently, the entire world is facing the Pandemic COVID 19 problem, under this global health emergency situation, Govt. of India is hopeful that the Indian traditional medicinal system will provide the solutions to overcome COVID 19 Pandemics. Therefore, Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy), Government of India is planning to start the clinical trials of four traditional medicines to treat coronavirus infection. The selected herbal medicines are Ashwagandha (*Withania somnifera*), Yashtimadhu or Mulethi (*Glycyrrhiza glabra*), Guduchi Pippali or Giloy (*Tinospora cordifolia*) and AYUSH-64. These medicines were invented for the treatment of malaria. AYUSH-64 is developed with the composition of *Picrorhiza kurroa*, *Swertia chirayita*, *Alstonia scholaris*, *Caesalpinia Crista*, species. Most of the selected herbal species are only occur in the Himalayan region and have properties of immunomodulators, therefore, they may play key role for curing COVID 19.

Excessive extraction of high value medicinal plants from wild has depleted the wild stock of such species. Therefore, cultivation is the only way to conservation of genetic stock of such species. In addition, documentation of medicinal plant diversity, assessment of bio-chemical and genetic variability, value chain development, standardization of agro-techniques and propagation protocols, strengthening of medicinal plant trade and enterprises, capacity building of stakeholders and legal reforms are urgently required for the holistic development of the medicinal plant sector in the Himalayan region. The article concludes that the medicinal plant sector would be a potential vehicle for the future sustainability of Himalayan people.

K.S. Kanwal

Himachal Regional Centre, Mohal, Kullu- 175126,
Himachal Pradesh, India
email-kskanwal03@gmail.com

–: कविता :-

हारेगा कोरोना

तृतीय स्थान

जीवन कितना व्यस्त था,
बस दूसरो से आगे बढ़ने की चाह मे संतुष्ट था।
अमीरी मे अक्सर इंसान अपने सुकून को खोता था,
गरीब खा कर भी सूखी रोटी बड़े चैन सोता था
अमीरी गरीबी का यह नाता बड़ा ही भ्रष्ट था,
जीवन कितना व्यस्त था।
तब अचानक एक झोंके ने शहरों का पत्ता पलटाया
एक भय सामने है दूर शहर से आया।
सारे जग में मायूसी छाई हुई है कोई न दिखता हँसता खेलता,
डर बसा है सबके हृदय में न सबका सहमा रहता।
देश भर में मच रही है अफ़सा-तफ़री
कौन कहाँ से आता है कौन कहाँ को जाता है,
इस महामारी मे दो से चार और न जानें उन चारों से कितनों का नाता
है।
यह कुछ क्षण सबके जीवन पर विपत्ति का एक भार है,
अपने घरों से बाहर निकलना संकट का एक संसार है।
कोरोना योद्धाओं के साथ मिलकर एक संगठन हमने बनाना है,
मिलकर सबने कोविड-19 को मात दिलाना है।
हमें दिया गया है थोड़ा समय काम आराम का,
तो उस काम को हमने अपनाया है।
भीड़ भरी दुनिया में कुछ समय,
बाहर नहीं आना - जाना है।
मिलकर सबने कोविड -19 को मात दिलाना है।
तरक्की की सीढ़िया चढ़ी है देश के वीरों ने,
कठिनाई भरे रस्तों पर भी हर मुकाम को पाया है उन्होंने।
जरा पूछकर तो देखो उन कोरोना योद्धाओं को,
कि कैसी उनकी हालत है।
न दिन का खाना न चैन से सोना,
क्योंकि वे जान गये है कि अभी देश को
उनकी जरूरत है।
मेहनत उनकी रंग लाएगी, प्रयास उनका विफल न जायेगा।
विश्वास और बढ़ेगा।
जब मेहनत से उनकी हारेगा कोरोना और देश जीतेगा।
प्रयास उन कोरोना योद्धाओं का विफल न जायेगा।

||| जय हिन्द |||

पूजा भट्ट छात्रा- बीएससी (प्रथम वर्ष)
राजकीय महाविद्यालय पिथौरागढ़, उत्तराखण्ड
email-priyanshibhatt2072@gmail.com



Promoting bio-resources as a viable livelihood option for biodiversity conservation and livelihood enhancement in Central Himalayas



Himalayas are one of the global assets. It has more ice and snow than any other parts of the planet outside the two poles; Hindu Kush Himalayas (Himalayas and Hindu Kush mountains) are source of 10 river basins where over 1.3 billion people live. Stretched over an area of more than four million square kilometres, the HKH region is a dynamic landscape endowed with a rich variety of gene pools and species (Pei 1995; Guangwei 2002), and ecosystems of global importance, the region hosts parts of the four Global Biodiversity Hotspots; namely, the Himalayas Hotspot, the Indo-Burma Hotspot, the Mountains of South-West China Hotspot, and the Mountains of Central Asia Hotspot (Mittermeier et al. 2004). A total of 10,503 species are reported from the Himalayan region representing 240 families and 2322 genera, of which the different life forms include 1382 trees, 1542 shrubs, 6350 herbs, 573 woody climbers, 285 herbaceous climbers, and 371 epiphytes (Rana and Rawat 2017).

In Himalayas, forest ecosystems and their surrounding communities are among the most ecologically and economically threatened and because of that the residents of hilly regions remained marginalized in the context of larger development process. Communities in forest ecosystems are dependent on natural resources and biodiversity for food security and livelihoods through fuelwood, fodder, and non-

timber forest products (NTFPs) collection. Now a days, medicinal and aromatic plants (MAPs) and herbs have gained a global recognition as a source of raw material for pharmaceuticals and traditional health care (Maikhuri et al. 1998; Diallo et al. 1999; Azaizeh et al. 2003; Kandari et al. 2012). The global demand for herbal products is not only large, but growing (Srivastava 2000) and the market for Ayurvedic medicines is estimated to be expanding at 20% annually in India (Subrat 2002). Aarohi has been involved in collection of culinary herbs and oil extraction from kernels of wild Apricot and Peach for last three decades, as a bio-resource based potential solution for maintaining ecological integrity and improving life quality of inhabitants in mountainous regions. Beside use of *chuyra* ghee (extracted from *Diploknema butyracea* Roxb. commonly known as Chyura is one such under exploited

and lesser-known multipurpose tree species) in manufacturing handmade soaps. The product development from all above bioresources is taken up by a team of professionals and local communities in a harmony. In this light, an endeavour was put forward by us to analyse the efforts of Aarohi to create bio-resource based development opportunities for rural Himalayan communities particularly through a case study.

Aarohi is working with around 1,385 villagers as CBOs and individuals from 182 villages in Uttarakhand which together facilitate the Livelihood Unit of Aarohi based at Satoli, Nainital as a small enterprise under Livelihood Promotion Program (LPP). The initiative to generate supplementary options for income for mountain communities in the form of cold pressed Apricot oil, extracted from kernel (the part of the fruit which is considered as waste), the organization is attempting to provide crop buy back to subsistence farmers. The extracted oil formed the base of an extensive body care range products such as body scrubs, creams and soaps. Alongside this, dried culinary herbs and herb teas and local niche agro-products are also providing an alternate livelihood options for the communities of Kumaun and Garhwal in Uttarakhand. The targeted herb species are (*Salvia rosmarinus*) Rosemary, (*Petroselinum crispum*) Parsley, (*Thymus serpyllum*) Thyme, (*Mentha arvensis*) Mint, (*Mentha balsamea*) Peppermint, (*Salvia officinalis*) Sage, (*Ocimum basilicum*) Basil, (*Origanum vulgare*) Oregano, (*Origanum majorana*) Marjoram, (*Melissa officinalis*) Lemon Balm, (*Carum carvi*) Caraway, etc. An additional annual income of INR 15 lakhs is generated for ~1,300 households only



through procurement and processing of apricot seeds, nuts and culinary herbs by Aarohi's Livelihood unit. On an average, there is an increase of INR 2,500 in the annual income of the beneficiaries on individual basis, for last four years. ~6.17 quintals of apricot seeds were processed to extract apricot oil and scrub and a total of ~3.86 quintals of culinary herbs were cultivated, processed and marketed during 2019-20. The average annual revenue generated by Aarohi's Livelihood Unit through the aforesaid activities is approx. INR 49.45 lakhs. Around 18 local community members (25% females) are continuously employed at this unit since last 10-25 years round the year.

To meet the requirement and supplement biodiversity, Aarohi is following the approaches for cultivation, sustainable harvesting, and protection against existing threats through livelihood enhancement of local communities in the Indian Himalayan region. As a result, the organization is involved in the plantation of around 1,400 Apricot and Peach seedlings in last three years with an average survival rate of ~75% and ~2.5 ha area is under herb cultivation. Aarohi endeavours to create awareness for the sustainable harvesting of the aforesaid

and other herbs found in the region, skill development and capacity building of the subsistence farmers and strengthening indigenous techniques of cultivation through promoting cost-effective and appropriate climate resilient rural technologies. The practices such as collection, production, management, and marketing practices has changed significantly in the region after Aarohi's initiatives. The concept of utilizing the barren and fallow land for agro-biodiversity conservation is the focus area inclusive of organic farming, cultivation of niche traditional millets and pulses, spices, herbs, etc. along with efficient supply chain that is well established and this need to be replicated as a micro enterprise to ensure both (i) conservation and management of land and bio resources, and (ii) creating livelihoods and providing employment to producers, collectors, skilled people involved in value addition and marketing.

The aim of this case was to assess the impact of

Aarohi's initiatives in regard to the promotion of bio-resource based livelihood options in Central Himalayas. It is evident that the locally available and commercially valuable natural resources, including NTFPs, herbs and agro-based products have a huge potential to improve the livelihoods of the mountain communities and biodiversity conservation as well and have immense scope to maintain the ecosystems as well as in reducing the stress migration which is in support of the previous studies (Olsen 2005, Roy 2010, Rasul et al. 2012) conducted in other Himalayan regions. This study also provides important insights for mountain development practitioners and policy-makers in relation to livelihood improvement and poverty reduction for communities that depend on available natural



resources for livelihoods. There is a need to develop a framework in terms of conservation and sustainable development, particularly for the Indian Himalayan region, however, future initiatives aiming at the commercialization of bio resources must need to take an integrated approach of skill development in production, processing, marketing, and value chain development. sustainable harvesting, and protection against existing threats through livelihood enhancement of local communities in the Indian Himalayan region. As a result, the organization is involved in the plantation of around 1,400 Apricot and Peach seedlings in last three years with an average survival rate of ~75% and ~2.5 ha area is under herb cultivation. Aarohi endeavours to create awareness for the sustainable harvesting of the aforesaid and other herbs found in the region, skill development and capacity building of the subsistence farmers and strengthening indigenous techniques of cultivation through promoting cost-effective and appropriate

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Pankaj Tewari^{*1}, Ripu Daman Singh² and Neha Jacob¹

^{*1}Aarohi, Satoli Village, Nainital,; ²Central Himalayan Environment Association (CHEA), Nainital

* email: pankutewari@gmail.com

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Carbon sequestration by eastern Himalayan forests : a north east Indian perspective



The Eastern Himalayas, located at the juncture of the Indo-Malayan, Palearctic and Sino-Japanese realms, stand out as being one of the biologically richest areas on the Earth. The topographic complexity along with considerable climatic variations and elevational gradient makes the Eastern Himalayan biogeographic region a repository of wide diversity of flora and fauna including diverse human ethnicities. The Eastern Himalayan region provides various forest ecosystem services to the mountain-dwelling communities which are necessary to sustain their livelihood. Such communities are directly or indirectly dependent on agricultural

products provided by the Himalayan ecosystem to regulate their socio-economy. The rich diversity of flowering plants and tree species of the Eastern Himalayan forests also help in regulating the climatic balance by sequestering carbon which reduces the levels of atmospheric CO₂ and mitigates the ill-effects of global warming to some extent.

Forest-based livelihood dependency

North eastern region of India is a part of the Eastern Himalayas biodiversity hotspot. Rich floral and faunal diversity is a key feature of this region being a biodiversity hotspot. Forest-

based livelihood dependency lies mainly with the rural communities residing in and around the forests. The local Himalayan communities are in direct need of forest products for agriculture, firewood and other ecosystem services whereas the communities in the foothills are indirectly dependent on the forest resources. Due to the lack of modern-day lifestyle privileges, the local and ethnic communities have adopted to unique agricultural practices such as shifting cultivation to earn revenue to sustain their life. Shifting cultivation along with rapid extraction of timber and firewood has given rise to deforestation and degradation of forest cover in north east India.

Excessive harvesting of forest resources and rise of forest-based industries has encouraged revenue without considering the conservation or renewal rate of the forest covers. In such case, improvement of forest health is necessary in order to sustain not only human life but also the rich Himalayan flora and fauna. It can be done by restoration of degraded forests using traditional agroforestry systems which may also help in reduction of atmospheric carbon by sequestration process.

Carbon sequestration potential

Climate change is one of the most challenging environmental concerns of modern times. Among the leading contributors of green house emissions, CO₂ alone accounts for 60% of the share. Excess carbon can be removed from the



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atmosphere and can be stored in the biological system by sequestering it into the plants and then the animals, which is one of the most natural ways of maintaining the balance of atmospheric carbon. Carbon sequestration is the process through which agricultural and forestry practices remove CO₂ from the atmosphere. Sequestration activities help to prevent global climate change by not only enhancing the storage of carbon in trees and soils, but also reducing the emission of methane and nitrous oxide. Thus, carbon management in forests is one of the most important agenda in India in 21st century under global climatic change scenario.

The major forest types present in the Eastern Himalayan region in India's north east include tropical forests, sub-tropical forests, pine forests, temperate forests and bamboo forests. The carbon sequestration potential of different vegetation types also differ depending on the

type and richness of species. Tropical forests have the largest potential among all the forests to mitigate climate change by the expansion of carbon sink and by conserving existing carbon pool. One of the noteworthy tree species is *Dipterocarpus tuberculatus*, which is found throughout the tropical forests of north east India. The rate of its carbon sequestration is found to be in the range of 3753-4641 kg/ha/yr. This is followed by *Ardisia peniculata* and *Wendlandia wallichii*, which have carbon sequestration rates in the range of 677-848 and 0-147 kg/ha/yr, respectively. Various other tree, shrub and herb species contribute variably to this process. Special mention may be made of *Camellia sinensis* (tea), which is an evergreen perennial shrub distributed over a wide range of tropical and sub-tropical climate of north east India. It is estimated that the CO₂ assimilation rate of tea ranges between 1244-2527 kg CO₂ kg/ha/yr, with a potential to sequester 50.8±10.5% carbon of assimilated CO₂ in their biomass.

Other important tree species contributing to carbon sequestration are *Shorea robusta* (sal) and *Tectona grandis* (teak) which grow in the deciduous forest types. They have sequestration rate of about 5.45 and 3.36 t C/ha/yr. *Quercus semicarpifolia* (oak), which grows in the high altitudes of evergreen forest sequestration about 4.51 t C/ha/yr. *Havea braziliensis* (rubber) is widely distributed throughout the semi-evergreen forests of north east India, which contribute immensely

to the carbon sequestration process. An estimate of 136 t C/ha is fixed annually by the planted forests of rubber in north east India. Compared to other species, carbon sequestration potential of *Dendrocalamus strictus* (bamboo) has received little attention, but it is quantified that bamboo sequesters carbon at a rate 1.48 times higher than teak plant.

The diversified forest covers of Eastern Himalayas and its foothills in the north eastern region of India have the potential to accelerate the biological storage of anthropogenic carbon. This process can be further enhanced by implementing successful forest management regime. Regeneration of open and degraded forest lands, multispecies reforestation of forest and non-forest wastelands along with re-establishment of ecological balance, bio-carbon oriented watershed forestry and creation of large scale carbon sinks through people's forestry can help rejuvenation of forest lands. Integration of government institutions and local communities is important to encourage forest management. As diverse group of plants have the potential of carbon sequestration and mixed vegetation type contribute better to this process, further research projects should be undertaken to unveil important plant species and major forest types contributing to carbon sequestration process in the Eastern Himalayan region of India.

Anandan Das¹, Shubhadeep Roychoudhury^{1*}, and Sunil Nautiyal²

1 - Department of Life Science and Bioinformatics, Assam University, Silchar, India

2 - Centre for Ecological Economics and Natural Resources, Institute for Social and Economic Change, Bengaluru, India *

shubhadeep1@gmail.com

Biodiversity holds the future for Himalayan People

"Biodiversity is blessing to human but can be a curse if not accessed sustainably"

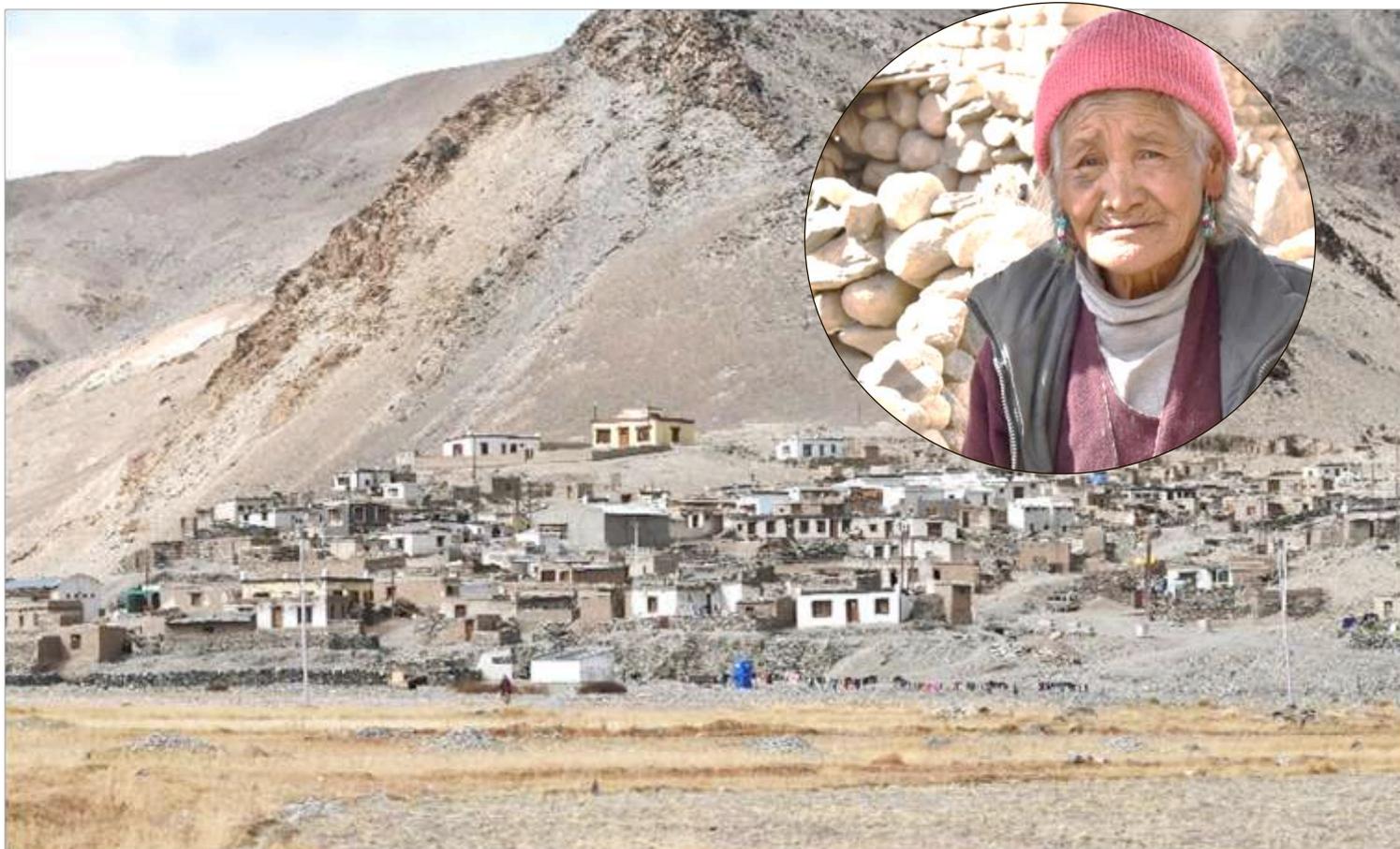
Although there are many ways to define biodiversity, but its simple meaning is variation in animal and plants, which can be genotypic or phenotypic. According to Convention on Biological Diversity (1992), biodiversity is the variation among living organisms from all sources including, among other things, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are a part; this includes diversity

within species, between species and of ecosystems.

Himalayas, the hotspot of biodiversity holds the fortune to provide ecosystem services to human beings in many ways. It is gifted to us as wonder of nature that has fascinated human since ancient times. It has rich flora, fauna, and also a vast diversity in human culture across the Himalayan region. The life of Himalayan people is full of complexities due to undulating topography, weather conditions and rural drudgery. Even though, the people have adapted themselves to the environmental

conditions so well that they are deriving from the nature and stay in good health conditions as compared to the people residing in cities.

Since, human has evolved, the nature-society relationship started to develop an interaction between the human and environment. The way human deal with the nature, so as the nature will respond. Ecosystem services in the form of food, water, and other resources are directly or indirectly related to the nature-society relationship. It is equally important to understand that how to natural resources are sustainably used in an environmentally friendly



manner. People are more aware now about the natural resources and perceived changes are taking place within their environment. However, their perceptions are limited to make difference between nature-society relationship and environmental impacts.

Biological resources are gift to the Himalayas and from generations it is proving a boon to the Himalayan people in different ways to sustain them and earn the livelihood. In the Himalayas, due to harsh climatic conditions the lifestyle of the people is different than the lifestyle of the people in cities. Himalayan people are largely self-reliant, and nature-dependent. Beauty of Himalayas is maintained due to the traditional lifestyle and culture of the people. In this region, agriculture, livestock farming and ecotourism serves the main source of income generation. Mountains have been the centres of attraction due its biodiversity. Since ancient times, people trust Ayurveda and Homeopathy and always rely on the natural biological resources for the treatment of diseases. Although, for instant remedies people uses the allopathic remedies for curing disease but no one wants to take these pharmaceutical drugs for longer period of time. In this region, majority of people follow the traditional medicine system. Although, Himalayas are

always centre for biodiversity of medicinal and aromatic plants for Ayurveda but it is also the centre of attraction for the pharmaceutical companies and other personal care products industries. Through these industries, Himalayan people are motivated to grow more medicinal plants and that proves a good alternative source of income. In many areas of Himalaya, through governmental and non-governmental agencies, women were more benefited from these biological resources. Government of India also runs various schemes, projects and policies to provide livelihood options to local communities residing in the Himalayas.

In conclusion, it may be reiterated that the Himalayan high ranges are of critical importance for their rich biodiversity and unique ecosystem. Numerous species of flora and fauna and millions of people depend on these ecosystems for food, water, mineral resources, medicinal and aromatic plants, livestock, cultural traditions and spiritual values. However, these ecosystems are threatened due to unplanned and unsustainable land and forest use practices. Due to paucity of proven models for biodiversity conservation beyond protected areas, there is limited capacity and knowledge on

conservation outside the jurisdiction of the forest and wildlife departments. The key conservation challenges in the Himalaya includes habitat degradation, unmanageable waste and water scarcity being caused by unregulated tourism, unsustainable grazing practices, wetland degradation, changes in land use along with threats to wildlife's caused by rapid urbanization and human activity. If the biological resources will be used in regulated and sustainable way, biodiversity can hold the future of the Himalayan people and can be proved as a blessing. However, if these resources were used in the unplanned and unsustainable manner it can also prove a curse to the Himalayan people.

Sheetal Sharma and K.S. Kanwal
G B Pant National Institute of Himalayan
Environment, Himachal Regional Centre,
Mohal-Kullu, 175126, Himachal Pradesh, India.

email: shitalshrma92@gmail.com
: kskanwal03@gmail.com

कोरोना : जैव-विविधता संरक्षण के लिए उम्मीद की किरण

कोरोना वायरस दुनिया ने बड़ी तेजी से अपने पैर पसार कर वैश्विक महामारी का रूप धारण कर लिया है, जिस पर नियंत्रण पाने के लिए वैज्ञानिक दिन रात प्रयासरत है, किन्तु अभी तक कोई सफलता नहीं मिल सकी है। अन्ततः सभी देशों ने मान लिया कि यदि कोरोना वायरस के प्रकोप से बचना है तो उसका एकमात्र उपाय सामाजिक दूरी है। इस महामारी से अर्थव्यवस्था को कितना नुकसान होगा इसका अनुमान लगाना जल्दबाजी होगी, परन्तु इस समय अर्थव्यवस्था से ज्यादा महत्वपूर्ण विषय इंसानी जिंदगी बचाना है। आज दुनिया के अधिकतर देशों को कोरोना की विकटता को देखते हुए अपने-अपने देशों में लॉकडाउन करना

सकता है।

लॉकडाउन के कारण फैंक्ट्रियों, यातायात आदि के साधनों से प्रतिदिन निकलने वाले लाखों टन कूड़ा, हानिकारक अवशिष्ट पदार्थ, विषैली गैसों, जहरीला पानी, धुआं, ध्वनि, वायु प्रदूषण जो हमारे पूरे जैव-मण्डल को प्रभावित कर रहा था नादारद हो गया है। कूड़ा-करकट एवं मैली कुचैली गंगा-यमुना जैसी प्रमुख नदियां स्वच्छ एवं साफ नजर आने लगी हैं, नदियों, मन्दिरों, मस्जिदों, चर्च एवं सामाजिक सामारोह में जमा होने से लगने वाली गंदगी के अम्बार गायब हो गये हैं। गंगा की सफाई एवं स्वच्छता पर अरबों रुपये खर्च किये जाने के पश्चात भी जो नतीजे नहीं दिखाई दे रहे थे वह लॉकडाउन के कारण देखने

प्रदूषण का कहीं नामोनिशान नहीं, साफ नदियों का जल, वातावरण में फैंली रहने वाली धुंध गायब हो गई है, जिससे एक उम्मीद की किरण नजर आती है। इससे हमें सबक लेना होगा कि मानव लाख कोशिश कर ले पर प्रकृति से कभी न जीता था न जीता है और न जीतेगा। यह हम पर निर्भर करता है कि प्रकृति के साथ हम सामंजस्य बनाकर आगे बढ़ना चाहते हैं या चुनौती खड़ी कर संघर्ष का रास्ता अपनाते हैं। प्रकृति से संघर्ष का मतलब साफ है कि पत्थर पर पैर मारो, चाहे पत्थर को पैर पर मारो नुकसान केवल पैर का ही होगा। अतः जहां इस वायरस के दूरगामी प्रभाव देखने को मिलेंगे वही इससे हमें काफी कुछ सीखने का मौका भी है, जिस पर सबक लेते हुए दुनिया को सोचने के लिए विवश कर दिया है। अब देखने वाली बात यह होगी कि इस चुनौती को हम अवसर में कैसे बदलते हैं।

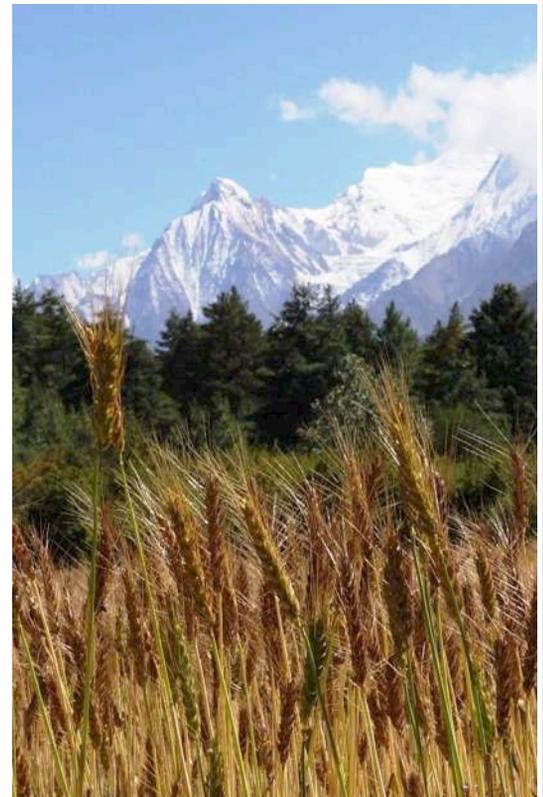


पड़ा। जिसकी बजह से लोग भागदौड़ से दूर एकांत में रहते हुए अपनी आवश्यकताओं को सीमित करके जीना सीख रहे हैं। सामाजिक दूरी के मध्यनजर भारतीय संस्कृति में हजारों वर्षों से रचे बसे नमस्ते को अपनाने के लिए दुनिया को बाध्य कर दिया है। दुनिया महाशक्तियां जो मानवता ही नहीं पूरे जैव-मण्डल के विनाश की सामग्री जुटाने में लगे हुए थे आज मानवता को बचाने के लिए एकजुट हो गये हैं। इस महामारी ने दुनिया की अर्थव्यवस्था से लेकर सभी वस्तुओं पर नकारात्मक प्रभाव डाला है परन्तु इसके सकारात्मक प्रभाव को भी नकारा नहीं जा सकता है। दुनिया के साथ-साथ भारत में जल, थल, नभ प्रदूषण को रोकने में इस वायरस ने अहम भूमिका निभाई है, जिसे नजरअंदाज नहीं किया जा

को मिल रहे हैं। जैव-मण्डल में आई शुद्धता के कारण हिमालय दूर से ही नजर आने लगा है। विभिन्न प्रजाति की पक्षिया, कीट-पतंगे जो कहीं लुप्त सी हो गई थी अचानक नजर आने लगी है। लाखों लोगों द्वारा मांस-मछली का सेवन बन्द करने के कारण विभिन्न प्रजातियों के हजारों जीव-जन्तुओं की हत्या बन्द हो गई है जो जैव-विविधता संरक्षण के लिए शुभ संकेत माना जा सकता है।

वस्तुतः लॉकडाउन की विस्तृत कार्ययोजना बनाकर प्रकृति को बचाने के लिए एक सर्वोत्तम मॉडल के रूप में प्रयोग किया जा सकता है, जिसने देश-दुनिया की आवा-हवा को बदलकर रख दिया है।

दूर-दूर तक साफ आसमान, हवा एवं ध्वनि



दलीप सिंह, पी.एच.डी
असिस्टेंट प्रोफेसर एवं विभागाध्यक्ष, राजनीति
विज्ञान विभाग
ओ प्रो ब० राजकीय स्नातकोत्तर
महाविद्यालय अगस्त्यमुनी, रुद्रप्रयाग
email- drdalipbisht@gmail.com

कोरोना : जैव-विविधता और पर्यावरण



कोरोना काल में अनेक ऐसे चित्र उभर कर सामने आए हैं जो दर्शाते हैं कि यह आपदा केवल मनुष्य के हिस्से की है, प्रकृति के लिए तो यह एक वरदान है। विगत दो महीनों से धरती पर अधिक हरियाली है, आसमान अधिक नीला है, सब जगह चिड़ियाएं चहक रही हैं। मोर उतों पर नाच रहे हैं, नदियां प्रदूषण मुक्त हो गई हैं, वन्यजीव उन्मुक्त सड़कों पर घूम रहे हैं। ऐसे कितने ही मनोहर और अविश्वसनीय दृश्य हमारी आंखों के सामने आए हैं। करोड़ों-अरबों रूपए बहाकर भी जो गंगा मैली की मैली थी वह एक भी पैसा व्यय किए बिना पनुः पतित-पावनी बन गई है। इस बीच यमुना ने दिल्ली वा"यों को दशकों बाद स्वच्छ पानी पीने का अवसर दिया। नर्मदा का जल आचमन योग्य हो गया। इस बार का वसंत कुछ अधिक चटरव रंग समेटे था। एक और भी सुखद समाचार आया है जिसकी अपेक्षित चर्चा नहीं हो पाई। अमेरिका के भूतपूर्व उपराष्ट्रपति और नोबल पुरस्कार विजेता एलगौर के तत्त्वाधान में चल रहे क्लाइमेट रियलिटी प्रोजेक्ट के एक कार्यकर्ता के अनुसार इस अवधि में विश्वव्यापी कार्बन उत्सर्जन में 8 प्रतिशत कमी आयी है। जिस कार्बन उत्सर्जन की दर को न्यूनतम करने के लिए दुनिया की सारी सरकारें लगी थीं, संयुक्त राष्ट्र संघ के अनेक संस्थान जिसके लिए रात-दिन काम कर रहे थे। वैज्ञानिक जिसके लिए पसीना बहा रहे थे उसे कोरोना ने एक ही झटके में कर दिखाया। कार्बन उत्सर्जन में 8 प्रतिशत की गिरावट जलवायु परिवर्तन के घावों को भरने की दिशा में बहुत महत्वपूर्ण है। इस बार गर्मी ने अभी तक थोड़ी ठण्ड रखी है। मई के महीने में ऊँचे पहाड़ों पर जमकर बर्फबारी हुई। अमेरिका और कनाडा से मई माह के अंत तक भारी हिमपात

और सर्दी प्रकोप के समाचार आए। विगत दो-तीन महीनों में पर्यावरण पर जो सकारात्मक प्रभाव देखने को मिले, उनसे यह तो स्पष्ट हो गया है की पर्यावरण के लिए आदमी के कार्य-कलाप कितने घातक हैं। अभूतपूर्व विश्व-व्यापी महामारी यह सबक दे रही है की यदि हम अपने कार्य-कलापों पर लगाम लगाएं तो पर्यावरण हमारे द्वारा दिए गए घावों को स्वयं भर लेगा। वर्ष 2020 का अंतर्राष्ट्रीय जैव विविधता दिवस को कोरोना की काली छाया में मनाया जा रहा है। यह कहना अधिक सार्थक होगा कि इस बार का यह दिवस कोरोना के प्रकाश में मनाया जा रहा है। मानव जाति ने सारे बौद्धिक अस्त्र-शस्त्रों से लैस हो कोरोना के विरुद्ध एक विश्व युद्ध छेड़ रखा है। देर सवरे इस अभिनव और अदृश्य वायरस पर विजय पा ही ली जाएगी। अब तक कदाचित यह बहस नहीं छिड़ी है कि वायरस पर्यावरण प्रदूषण की ही देन है। पर्यावरण प्रदूषक के कारण जलवायु परिवर्तन इस नए जीव-अजीव (वायरस जीव और अजीव दोनों ही होता है) को दुनियाँ में लाने का माध्यम हो सकता है। बहस यह छिड़ी है कि आदमी तक कोरोना कैसे पहुंचा ? चमगादड़ से या पैंगोलिन से चमगादड़ या पैंगोलिन में वायरस कैसे पहुंचा, यह कोई नहीं पूछ रहा है। इसके पीछे जलवायु परिवर्तन हो सकता है। क्योंकि जलवायु परिवर्तन भी मुख्यतः मनुष्य की ही देन है, इसलिए कोरोना को चमगादड़ अथवा पैंगोलिन तक पहुंचाने में भी आदमी की भूमिका है। लेकिन बहस बलि के बकरों पर है : चमगादड़ और पैंगोलिन पर। जब मैंने जैव विविधता पर चिंतन किया तो मेरे एक मित्र ने यह कहकर चुटकी ली कि जैव विविधता में एक नया जीव कोरोना भी तो जुड़ गया है। कोरोना काल में पर्यावरण उन्नयन में जैव विविधता की अभिवृद्धि भी सबसे शुभ संकेत है। जब से धरती पर जीवन का उद्भव हुआ है, असंख्य प्रजातियों का प्रादुर्भाव जीवन की जड़ें मजबूत करता चला गया है। कालांतर में अनेक प्रजातियां विलुप्त भी हुईं लेकिन नई प्रजातियों के विकास के इतिहास में पांच बार सामूहिक विलुप्तीकरण भी हो चुका है। फिर भी धरती पर जैव विविधता का साम्राज्य अपनी जयकार करता रहा। ऐसा इसलिए कि धरती पर जीवन की प्रक्रियाएँ नैसर्गिक थीं। उनमें किसी एक प्रजाति का अवांछनीय हस्तक्षेप नहीं था। परन्तु मानव प्रजाति के अविश्वसनीय विस्तार एवं पूंजी-केंद्रित विकास की पिपासा से जन्में

कार्य-कलापों जैव विविधता के साम्राज्य की जड़ें ही हिला डालीं। संयुक्त राष्ट्र के पर्यावरण कार्यक्रम के एक अनुमान के अनुसार वर्तमान में 10 लाख प्रजातियों के विलुप्तीकरण का खतरा है। मानव-जनित जैव विविधता क्षरण की बढ़ती दर को देखते हुए अब यह अनुमान लगाया जा रहा है कि धरती पर प्रजातियों के छठे सामूहिक विलुप्तीकरण की प्रक्रिया आरम्भ होने वाली है। जैव विविधता जिन्दा ग्रह पर जीवन के लिए वरदान है। मानव स्वयं इस विविधता का एक बिंदु है। परन्तु मानव प्रजाति के विकास की विलक्षणता देखो कि हम 11.11 प्रतिशत प्रजातियों में आकार में सबसे बड़े हैं और प्रकृति के 11.11 प्रतिशत संसाधनों का उपभोग करते हैं। नैसर्गिक विकास ने मानव का इतना सशक्तिकरण किया है कि यह संपूर्ण पृथ्वी पर फैल गया है और वहां तक अपनी पहुँच बना ली है जहाँ पर्यावरण जीवन के प्रतिकूल है। पृथ्वी पर सभी प्रजातियों पर मानव प्रजाति की पकड़ है। यहाँ तक की समुद्र की गहराइयों तक मे उतर कर उसने सभी जीवों पर अपना वर्चस्व कायम कर लिया है और समुद्रतल परिस्थितक जैव समुदायों तक के रहस्य उसने जान लिए है। एक प्रजाति का स्वामित्व संपूर्ण जीवन पर क्या इससे बड़ी शक्ति किसी प्रजाति को मिल सकती थी। अगर कोई वन बचा है तो वह आदमी की अनुकम्पा से अगर जंगल में पशु पक्षी हैं तो आदमी की अनुकम्पा से, देखा जाए तो एक बीज भी आदमी की अनुकम्पा के बिना अंकुरित नहीं हो सकता। एक प्रजाति को प्रदत्त ये शक्तियां इस प्रजाति को इतने अहंकार में डुबो रही है की वह यह विवेक भी खो बैठा कि इसी जैव विविधता में उसके वर्चस्व, उसकी कीर्ति, उसके भविष्य एवं उसकी समस्त खुशियों के बीज हैं। कोरोना काल में हम यह भी सीख लें कि मानव समाज को सबसे बड़ा खतरा वायरस और कोविड - 19 से नहीं, जैव विविधता के विनाश से है। अंतर्राष्ट्रीय जैव विविधता दिवस हमें इस आसन्न खतरे से सावधान कर रहा है।

वीर सिंह, पी.एच.डी.

पर्यावरण विज्ञान विभाग
पंत नगर विश्वविद्यालय

पंतनगर - 263145 (उत्तराखण्ड)

email: drvirsingh@rediffmail.com

International Day for Biological Diversity: Themes (2002-2020)

- 2002 -Dedicated to forest biodiversity
- 2003 -Biodiversity and poverty alleviation-challenges for sustainable development.
- 2004 - Biosiversity : Food, water and health for all.
- 2005 - Biodiversity : Food, water and health for all.
- 2006 - Protect biodiversity in drylands
- 2007 - Biodiversity and climate change
- 2008 -Biodiversity and agriculture
- 2009 -Invasive alien species
- 2010 -Biodiversity, development and poverty alleviation
- 2011 -Forest biodiversity
- 2012 -Marine biodiversity
- 2013 - Island biodiversity
- 2014 -Biodiversity and sustainable development
- 2016 -Mainstreaming biodiversity : sustaining people and their livelihoods
- 2017 -Biodiversity and sustainable tourism
- 2018 -Celebrating 25 Years of action for biodiversity
- 2019 -Our biodiversity, our food, our health
- 2020 -Oursolutions are in nature

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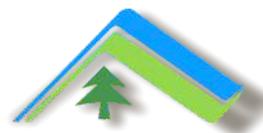
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संस्थान

गोविंद बल्लभ पंत राष्ट्रीय हिमालयी पर्यावरण संस्थान कोसी, कटारमल, अल्मोड़ा की स्थापना सन् 1988-89 में पर्यावरण वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार के एक स्वायत्तशासी संस्थान के रूप में की गई। यह संस्थान संपूर्ण भारतीय हिमालयी क्षेत्र में वैज्ञानिक ज्ञान को बढ़ावा देने, एकीकृत प्रबंधन रणनीति बनाने व उनके प्राकृतिक संसाधनों के संरक्षण में प्रभाविता के प्रदर्शन और पर्यावरणीय दृष्टि से मजबूत प्रबंधन हेतु मुख्य संस्थान के रूप में चिन्हित है।

About the Institute

G.B. Pant National Institute of Himalayan Environment was established in 1988-89 as an **Autonomous Institute of the Ministry of Environment Forest & Climate Change (MoEF&CC), Government of India**. The Institute has been identified as focal agency to advance scientific knowledge, evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and ensure environmentally sound management in the entire Indian Himalayan Region (IHR).



G B Pant National Institute of Himalayan Environment (NIHE)

[An Autonomous Institute of Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India]

Kosi-Katarmal, Almora 263 643, Uttarakhand, INDIA

Web: <http://gbpihed.gov.in> | Phone: +91-5962-241015

Editorial Team :

Dr. I.D. Bhatt, Dr. K.C.Sekar, Dr. Vikram Negi,
Dr. Subodh Airi, Guest editor: Dr. G.C.S. Negi

For further details, please contact:

Dr. R.S.Rawal, Director (psdir@gbpihed.nic.in)
Dr. I.D. Bhatt, Centre Head (CBCM) (id_bhatt@yahoo.com)