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Inside the issue ...

Biodiversity conservation research in IHR: A futuristic view for solutions

Mountains are remarkably diverse and globally important as centres of biological diversity. Mountains have been recognized as important ecosystems by the Convention on Biological Diversity (1992). This great wealth of biological diversity is attributed to the wide variety of environments in the mountains, particularly the Himalayas which is one among the 35 biodiversity hotspots of the globe. In response to this recognition, the Government of India (GOI), under its protected area (PA) programme, has established 36 national parks, 123 wildlife sanctuaries and 7 biosphere reserves in the Indian Himalayan region (IHR), accounting for about 2% of the country's total geographical area and ~ 15% of the area of the IHR. This region harbours nearly 50% of the total flowering plants of India, of which 30% are endemic to the region. In this region, about 1748 species with medicinal uses, 675 wild edibles and 118 essential oil plants with medicinal values have been recorded. Similarly, out of the total records from India, 65% of mammals, 50% of birds, 35% of reptiles, 36% of amphibians and 17% of fish are reported from the IHR (Ghosh, 1997; Samant *et al.*, 1998). The wealth of biodiversity of this region supports peoples' livelihood directly and indirectly through a range of ecosystem goods and services (Joshi and Negi, 2011). Inevitably, any erosion in biodiversity through both anthropogenic and climate change would influence forestry, agriculture, livestock husbandry, NTFPs and medicinal plant-based livelihoods and many other intangible services of the forests. In the recent decades increasing pressure of development infrastructure, concurrent habitat loss, over and unscientific harvesting accompanied by increasing people's apathy, have increased the threats on biodiversity of IHR. A recent report on threatened species of Indian Himalaya indicates 456 plant taxa under various threat categories of IUCN.

Realizing the above, the GBP-NIHE organized a Webinar, "Biodiversity conservation research in IHR: a futuristic view for solutions", on the occasion of IBD (2021) under the theme of IDB for this year, 'We're the Part of Solution'. The Webinar was envisaged to invite inputs from the diverse group of stakeholders to deliberate on solution for conservation and sustainable utilization of Himalayan biodiversity and focued on: (i) Generating wider awareness towards biodiversity based livelihood options, (ii) Encouraging and effectively utilization of diverse group of stakeholders for biodiversity conservation and its sustainable utilization, and

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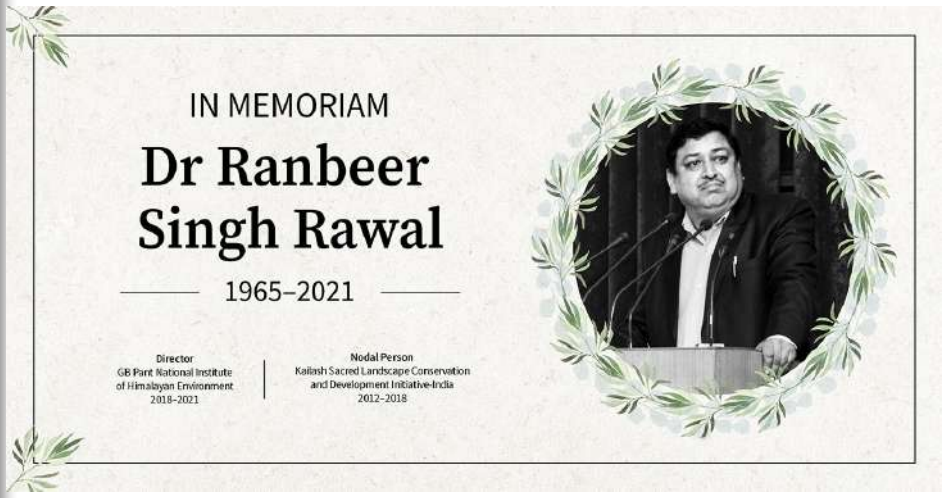
Biodiversity has gained popularity among the masses for promoting bioresource based enterprises and increasing craze of nature based solutions. This popularity is due to the high richness, uniqueness and representativeness of the biodiversity, especially in the Himalayan region. The region as provider of ecosystem goods and range of ecosystem services is vital for sustaining life of billion of people both in uplands and the adjacent lowlands. However, the depletion of biodiversity is the cause of concern. The Institute has organized a webinar on the "Biodiversity conservation research in IHR: a futuristic view for solutions", with the aim to deliberate on solutions for conservation and sustainable utilization of Himalayan biodiversity. After detailed deliberations, it was recommended that there is a need to promote biodiversity conservation and sustainable utilization through (i) encourage *in situ* and *ex situ* conservation of high value species, (ii) generate datasets on the distribution, population status, (iii) map important elements of biodiversity through Citizen Science approach, (iv) link biodiversity with the quality of life of people, (v) harness potential of agro-ecological farming practices, and (vi) build capacity of diverse stakeholders and especially younger generation. All these may help in promoting biodiversity conservation and strengthen nature based solutions in the Himalayan region. I hope the readers will get benefitted through the proceedings and articles published in this special issue.

Dr. I.D. Bhatt
Scientist F & Head, CBCM



A Tribute to 'Son of Mountains' Late Dr. Ranbeer S. Rawal (26 April 1965 - 23 April 2021)

B. Sc. (Bio.) (1984): Kumaun University, Nainital
Masters (1987): Botany from Kumaun University, Nainital
Doctoral (1991): Botany from Kumaun University, Nainital
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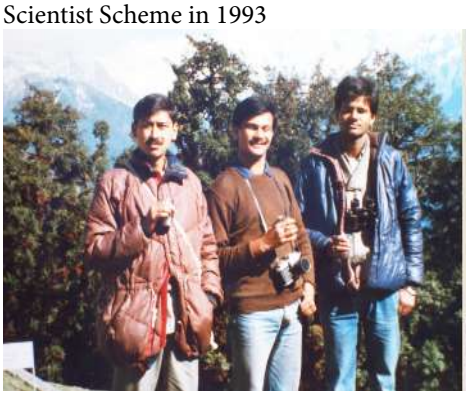

Memoriam contd. on Page 11

Proceedings of a webinar organized on the occasion of International Day for Biological Diversity- 2021

(iii) Providing alternate options of livelihoods to rural youth, including the COVID 19 returnee.

In the beginning of this Webinar all the delegates and participants paid hearthelt tribute to the former Director of the Institute Dr. R.S. Rawal and remembered his contribution to this subject. The webinar started with the welcome of the esperts and elaboration on the theme of the Webinar by Dr. I. D. Bhatt, Scientist-F & Centre Head, CBCM, GBPNIHE. He mentioned that the programme is divided into three parts i.e. setting the stage, panel discussion and way forward session. He requested the experts for addersing the following points during panel discussion: (i) what should be the solution oriented research for biodiversity in Himalayan region, (ii) what should be the ways for encouraging and effectively utilizing diverse group of stakeholders for biodiversity conservation and its sustainable utilization, and (iii) what should be the alternate options of livelihoods to rural youth, including the COVID 19 returnee.

In his opening remarks, Er. Kireet Kumar (Director I/C, GBPNIHE) highlighted the importance of IDB to create awareness among the people. He stated that there is a need to look into whether the 5 strategic goals and 20 targets, collectively known as the Aichi Biodiversity Targets set for 2020, as adopted in 2010 for 2011-2020 by Parties to the CBD (1992) have been achieved. Also, many targets are set under Sustainable Development Goal (SDG 15.4) thoseare specific for mountains and biodiversity. He requested the panellists to provide recommendations on such issue of biodiversity conservation., Setting the Stage of this event, Dr. G. S. Rawat, Former Director, Wildlife Institute of India (WII), Dehradun in his Key Note address said that we all are supposed to ponder about our understanding and awareness about biodiversity issues, and about the kind of research we can do. He suggested to focus on the (i) good research on nature-based solutions so that research findings are applied in policy and practice. This will help to improve the quality of life for rural communities, (ii) promote local products by establishing market linkages etc. which will help to ensure livelihood of local communities and conservation of species; (iii) find alternate livelihood options to rural youth who have come back to villages during pandemic; (iv) document traditional knowledge w.r.t. agro-biodiversity, good practices, other nature-based solutions, success stories etc. and (v) assess the capacity, interest and need of Covid returnees. Dr. Rawat requested the panellists to flag the relevane and priority research areas which can be achieved in shorter time.

During the Panel Discussion various subject experts from different research organizations, universities, and teachers of schools presented their viewpoint. Dr. B. S. Adhikari (Scientist-G, WII, Dehradun) mentioned that Eastern Himalaya is home to many globally significant plant and animal species, and one third of the flora is endemic to Eastern Himalaya and 25 eco-regions have been identified in Eastern Himalayan region including Nepal and Sikkim. However, over the period change in species composition and loss of biodiversity is happening. Climate change has also contributed to species' range contraction and extinction. He recommended the need to (i) work on lower texa present in Himlayan region as they are the least studied, (ii) develop separate classification in which the species endemism will be based on bio-geographic regions or particular zone, and (iii) reassessment of biodiversity in different parts of Himalaya because many plant and animal species are being spotted outside their known distribution range after the lockdown. Dr. Mukund Behera (Associate Professor, IIT, Khargpur) recommended: (i) need of functional diversity related research to complement/link with structural diversity, (ii) increased use of geo-spatial data and techniques having predictive/modelling ability, (iii) need for long-term climate-biodiversity monitoring studies in Himalaya to provide climate adaptation/mitigation strategies, (iv) more focus on under-utilized or non-utilized species and to bring them to domestication to address the food/ nutrition/medicinal use, and (v) growing medicinal plant based kitchen garden to assure own immunity and live healthy life. Dr. Nakul Chettri (Sr Biodiversity Specialist, ICMOD, Nepal), ICIMOD highlighted the importance of Himalayan region for providing goods and services and suggested that synergistic long-term multidisciplinary research and restoration actions among the countries sharing these fragile mountain ecosystems are needed to address the challenges. Dr. G.C. Joshi (Former Scientist Incharge of Central Council for Research in Ayurvedic Sciences, Tarikhet) highlighted the importance of promoting *in situ* conservation of high altitude Himalayan plants and point out that many medicinal plants are associated with other species for survival. He also emphasized the need to regulate developmental activities in IHR for conserving the biodiversity. Dr. M. C. Nautiyal (Professor & Head, HAPPRC, HNBGU, Srinagar-Garhwal) emphasized on promoting awareness among people regarding conservation of biodiversity, involvement of local people in conservation by making them a part of policy, and conduct more research on immune-booster plants, and agro-biodiversity. Dr. S. K. Nandi (Former Scientist, GBP-NIHE) emphasized on reassessment of biodiversity elements of important and endemic/threatened species and explore more plants (also microbes) for drug/product development in the IHR. Dr. S.S. Samant (Director, HFRI, Shimla) highlighted the need to (i) assess biodiversity of protected areas and biodiversity rich areas, and to develop comprehensive database based on species richness, use value, nativity, endemism and IUCN threat category, (ii) assess the extraction trends of medicinal plants and wild edibles and niche modeling of rare and endemic species so that suitable areas for in-situ conservation be identified. Dr. G.C.S. Negi (Scientist-G & Centre Head, CSED, GBP-NIHE) showed his concerns on declining experts of taxonomy in IHR, documentation of traditional practices of biodiversity and bio-resource use for healthcare, and defining sustainable harvest critera of bioresources. He also made a presentation on Biodiversity Conservation Act (2002) that safeguards the illegal extraction of bioresources, indigenous knowledge, intellectual property rights and ensures equitable sharing of benefits (ABS) arising from its sustainable use, which is being implemented through a three-tier legal structure comprising of Biodiversity Management Committees at local village/bodies level, State Biodiversity Boards at State level, and a National Biodiversity Authority and about the preparation of People's Biodiversity Registers in Gram Panchayats. Dr. M.A. Shah (Kashmir University, Srinagar) stated that the Himalayan biodiversity and its threats are central to sustainability agenda and recommended to follow citizen science appraoch, alternative use of invasive species and the use of social media to create awareness.

We are part of the solution

Dr. Lalit Tewari (Professor of Botany, Kumaun University, Nainital) stressed the need for assessment of progress/success of various steps and enforcement of legislation, administration and environmental laws for biodiversity conservation. Dr. Pankaj Tewari (CEO, Aarohi, Nainital) emphasized on the involvement of local communities and NGOs in conservation of biodiversity by linking biodiversity with livelihood opportunities. Dr. Sanjay Uniyal (CSIR, IHBT) recommended the need to conserve Himalayan biodiversity (i) Using next generation innovative techniques like artificial intelligence, machine learning, use of drones, etc., (ii) Replication of AROMA and Floriculture Mission of CSIR for Covid returnees to provide them livelihood opportunity and to conserve biodiversity. Dr. Praveen Joshi (GIC Gortilasya, Rudraprayag) emphasized on establishing herbal garden in schools. Dr. Arvind Bhatt (Chines Academy of Sciences, China) felt a need to study physiological changes in plants, their regeneration potential, adaptation to climate change and seed bank development. Dr. A.K. Bisht (Associate Professor, Department of Botany, Kumaun University, Ninital) stressed the need for promoting medicinal plant farming and with prpoer cultivation protocols. Dr. Sanjay Gairola (Sharjah, United Arab, Emirates) was concerned about capacity building of Covid returnees for medicinal plant cultivation and processing. Dr. Bhawana Pathak (Central University, Gujrat) suggested to study impact of climate change on biodiversity and associated ecological processes. Dr. Anurag Tewari (Chitkara University, Chandigarh) stressed upon involvement of local community for biodiversity conservation.

In the Way Forward Session following points emerged: (i) Reassessment of biodiversity elements of important and endemic/ threatened plant, animal and microbes for drug development, (ii) Identification of biodiversity hotspots based on criteria such as species richness, native, endemic, threatened and economically important species, (iii) Long-term monitoring of important plants in relation to climate change, (iv) Use of RS/GIS and modern technology such as drones for mapping of plants distribution and impact of climate change, (v) Strenthening the taxonomy experts and develop cadre of parataxonomists, (v) Management of invasive species, (v) Demand driven research and citizen science approach, and (vii) Capacity building of Covid returnees on medicinal plants cultivation. At the end of this day-long webinar, Vote of Thanks was proposed by Dr. K.C. Sekar (Scientist-E, GBP-NIHE).

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The uniqueness that sets Earth apart from other planets in our solar system is that it sustains "Life", ranging from the single celled organism *Mycoplasma genitalium* to the largest living organism; honey mushroom or *Armillaria ostoyae* (Fleming, 2014), and the complex array of interconnecting and interlinked ecosystems existing on this earth. *Homo sapiens* represents only 0.01% of the total biomass on earth but has wiped out 83% of wild animals and half of the plants (Bar-On *et al.,* 2018). With the rise of industrial revolution in the 18th century, it transformed small a grain-based society into the large scaled mechanized industry and thus brought economic prosperity and ease of living that resulted into over-consumption, population explosion and urbanization giving rise to a plethora of ecological crisis stretching from global warming, climate change, pollution, acid rains, etc. In spite of our technological prowess, we are still largely dependent on biodiversity for the basic needs such as clothes, fuel, shelter and energy that not only accentuates our lives but necessary to sustain life. Biodiversity provides us with life sustaining services or the more aptly termed "ecological services" such as the conversion of solar energy into carbohydrates and protein, oxygen production, water purification, helps regulate climate through carbon storage and regulating rainfall to name a few. They provide the soil for plants to grow and help to remove greenhouse gases from the atmosphere. The theme of the IBD (2021), "We are part of the solution" goes to suggest that we, the people are a part of nature rather than separate from nature and how the problem lies deep inside us to take the responsibility to be accountable for our actions and how as a species can we unite to solve the ecological crisis. The solution to the problem lies in adopting "Nature Based Solution" or (NbS); which reads out as "actions to protect, sustainably manage and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" as stated by International Union for Conservation of Nature (IUCN, 2016). These NbS approaches can be classified into five main categories and can be applied in a variety of local interventions that can be streamlined to fit a wide range of issues dealing with environmental conservation and sustainable development (Table 2). There is need to adopting a more environment-friendly lifestyle that reduces our ecological footprint

NbS approaches	Examples
Ecosystem restoration approaches	Ecological restoration; Ecological engineering; Forest landscape restoration
Issue-specific ecosystem-related approaches	Ecosystem-based adaptation; Ecosystem-based mitigation; Ecosystem-based disaster risk reduction
Infrastructure-related approaches	Natural infrastructure; Green infrastructure
Ecosystem-based management approaches	Integrated coastal zone management; Integrated water resources management
Ecosystem protection approaches	Area-based conservation approaches including protected area management

Conservation of agricultural diversity for food, nutrition and livelihood security in Uttarakhand

and thus lessen our own adverse effects as per the following: (i) Reducing use of chemicals and synthetic fertilizers and pesticides in our gardens or agriculture fields, (ii) Emphasizing on the 3Rs- Reduce, Reuse and Recycle. Reduce the use to a bare minimum, reusing them and recycling lessens pollution by decreasing energy, electricity and water consumption and the need for landfills, (iii) Opting for use of organic foods as they helps reduce inputs of fertilizers and pesticides into the environment, which in turn reduces negative impacts on beneficial insects for pollination and pest control, (iv) By reducing the energy demand, CO_2 release into the atmosphere can be lessened by use of appliances that consume less energy and incorporate the use of renewable energy; and (v) Keeping abreast of laws and policies affecting biodiversity so to deter harvesting of natural resources that has irreversible effect on biodiversity and support governmental departments and NGOs that demonstrate their support for ecological sustainability (Gupta, 2020). These measures are just a few alternative that every individual can take up to contribute their fair share towards improving the future for the next generations as there is no alternative to a world without life.

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Kajoli Begum
GBPNIHE, NERC, Itanagar, A.P.

In Uttarakhand, majority of people depend on agriculture for their food and livelihood security. The large altitudinal range (450-6500 m asl), topography, diverse climatic conditions and habitats support wide variety of agricultural crops such as cereals, pseudocereals, millets, pulses, spices and condiments and oil seeds all these have high nutritional value, vitamins, minerals etc. (Table 1). Diverse agricultural practices are adopted by the local communities such as mixed cropping, crop rotation, baranaja (mixture of twelve grains) system according to suitability of agro-climatic conditions. They also possesses a huge knowledge base to utilize this agricultural diversity for food, medicine, cultural and other uses. Various food items/dishes prepared from these crops cured a number of ailments. However, in the recent decades due to loss in agri-divesity and net cropped area this indegenous practice and associated knowledge is also disappearing fast.

In the present circumstances of Covid-19 pandemic where everyone is fighting for survival and looking for the alternatives to boost immunity and keep themselves healthy local dishes of Uttarakhand such as chane ke dubke (made up of chikpea), jau ki roti (barley), mass ka chais (black gram), bhatt ki chutkani (black soybean), chapatis made up of mixture of grains (wheat, chickpea, barley, nacked barley) etc. have again started

Crop groups	Local name	Common Name	Scientific name
Cereals and	Gehun	Wheat	*Triticum aestivum*
	Dhan	Rice	*Oryza sativa*
	Jau	Barley	*Hordeum vulgare*
	Uva	Nacked barley	*Hordeum himalayens*
	Makka	Maize	*Zea mays*
	Chaulai	Amaranth	*Amaranthus viridus, A. caudatus*
	Ugal	Buckwheat	*Fagopyrum esculentum*
	Phafar	Buckwheat	*F. tataricum*
Pulses	Tor	Pigeon pea	*Cajanus cajan*
	Bhatt, Soybean	Soybean	*Glysine soja, Glysine max*
	Masoor	Lentil	*Lens culinaris*
	Gahat	Horsegram	*Macrotyloma uniflorum*
	Mass/Urad	Blackgram	*Vigna mungo*
	Chana	Chikpea	*Cicer arientinum*
	Rajma	Kidney bean	*Phaseolus vulgaris*
	Lobia	Lima bean	*Phaseolus lunatus*
Millets and minor millets	Jhangora	Barnyard millet	*Echinochloa frumentacea*
	Madua	Finger millet	*Eleusine coracana*
	Koni	Foxtail millet	*Setaria italica*
	Cheena	Proso millet	*Panicum miliaceum*
	Jowar	Sorghum	*Sorghum vulgare*

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Potential of agri-diversity and wild plants diversity in a mountain village

Oil seeds	Rai	Yellow and brown sarso	*Brassica junecea*
	Til	Sesame	*Sesamum orientale*
	Alsi	Flaxseed	*Linum usitatissimum*
	Bhangeera	Perilla	*Perilla frutescens*
Spices and condiments	Dhania	Coriander	*Coriandrum sativum*
	Haldi	Turmeric	*Curcuma longa*
	Methi	Fenugreek	*Trigonella faenum-graceum*
	Bhang	Hemp	*Cannabis sativa*
	Pyaj	Onion	*Allium cepa*
	Lahsun	Garlic	*Allium sativum*
	Adrak	Ginger	*Zinziber officinale*
	Jakhia	Cleome	*Cleome viscosa*
	Dalcheeni	Dalcheeni	*Cinnamomum tamala*

returning to the diet of local people. Also, there are a number of special dishes such as bade (made up of black gram), halwa, pure and single (wheat flour), kheer (rice), til ka pin (sesame) are most popular offering to God. In recent years, various value-added processed food items having nutritional and medicinal value such as biscuits and namkeen made up of finger millet, methi ke laddoo, chaulai ke laddoo and buckwheat flour are also finding place among the natives. However, there is a remarkable change in traditional agricultural practices due to the modern life style, increasing population, low productivity, migration of younger generation for employment that is eroding our traditional knowledge very fast. So, there is an urgent need to conserve this rich agri-diversity thorugh participation of concerning institutions, organizations and line agencies along with the indigenous people for sustainable development and human welfare.

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Agricultural biodiversity encompasses the variety and variability of animals, plants and micro-organisms that are necessary to sustain key functions of the agro-ecosystem, its structure and processes and support of food production and food security. Agro-biodiversity can be broadly defined as all domesticated biodiversity (i.e. crops and livestock) within agricultural systems, plus non-domesticated biodiversity that interplay in various ways with the human health and functioning of agricultural systems (Pascual *et al.,* 2011). The International Union of Forest Research Organizations (IUFRO) estimates that nearly 20% of the global population directly depend on forests, tree-based systems and wild species. Maintaining biodiversity in natural as well as human managed ecosystems is key for the sustainability of both types of ecosystems as well as responding to growing challenges that emanate from climate change induced stresses. The Indian Himalayan region (IHR) is rich in biodiversity resources and endowed with rich faunal and floral diversity. Studies on agri-diversity have pointed out that there is an urgent need to conserve genetic resources for native agriculture practices.

In Uttarakhand between 500-2500 m amsl, over 40 different crops comprising cereals, millets, pseudo-cereals, pulses, oil seeds, tubers and condiments and their hundreds of locally selected cultivars are cultivated by local farmers. However, Uttarakhand is losing this precious resource due to a variety of factors related to environment, policy and institutional arrangements amidst high rate of out migration. Further, increasing, incidences of crop raiding by wild animals such as monkey, wild boar, porcupine in many areas and villages have become the cause of land abandonment in recent times (Negi *et al.,* 2019). Consequently, the area under a number of traditional crops has drastically come down (> 60%) particularly during the last few decades that has threatened the food security of village people in this region (Semwal *et al.,* 2015).

In view of the above, and providing agri-diversity and wild-diversity based life supporting solutions a study was undertaken in Jyoli village (1440 m asl; Hawalbagh block, Almora district). The village comprises of 112 households with population of 636 person (327 M; 309 F). The main occupation of the village is rain-fed agriculture and livestock rearing, which has declined in present times due to various reasons. We conducted household survey in 2020 to determine the agricultural and wild plant diversity in and around the village to assess the potential for meeting out the food, healthcare and livelihood enhancement requirements of the village people. The study showed that there are 4 varieties of cereals and millets, 6 pulses, 3 spices and condiments, 12 vegetable and 15 fruit species. The wild vegetation occupied by Chir Pine forests has 88 herbs, 46 shrubs and 25 tree species. The agri-diversity occupies ~60% of the total plant species diversity of the village area with the dominance of Finger Millet (*Elusine coracana* Gaertn.) followed by Foxtail Millet (*Echinochloa frumentacea* L.), while the paddy and wheat cultivation is declining in this village. Seasonal vegetables are grown for self consumption and sale along with rearing of honey bees for apiculture.

The assessment of wild plant diversity showed that out of a total

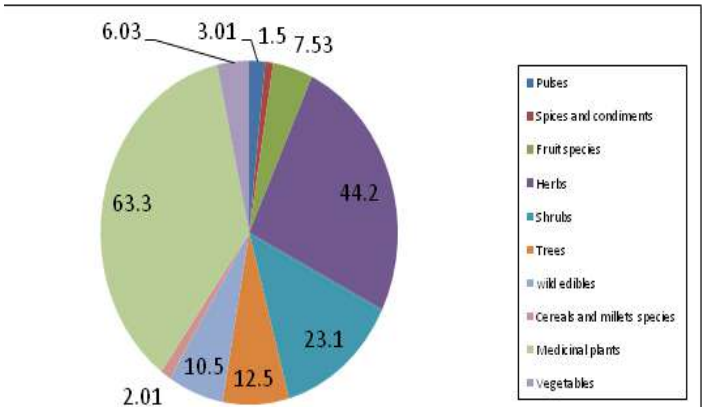

Fig. 1. (a) Agri-diversity and wild plants diversity in the Jyoli village

Fig. 1. (b). Wild edibles in Jyoli village (*Rubus ellipticus* and *Myrica esculenta*)

Table 1. Some important medicinal plants,wild edible plants and horticulture plants of Jyoli village

SN	Species name	Local name	Type	Uses
1.	*Berberis asiatica* Roxb. ex DC.		Medicinal plant/Wild edible	Edible fruit,roots are used in treating ulcers, urethral discharges, ophthalmic ailments, jaundice, fevers etc.
2.	*Cinnamomum tamala* (Buch.-Ham.) T. Nees&Nees	Tejpatta	Medicinal plant/ Condiment	Bark used in treatment of asthma, cough
3.	*Dioscorea bulbifera* L.	Gaithi	Medicinal plant/Wild edible	Edible bulbs, used in treatment of Piles, stomach ailments, diabetes, asthma
4.	*Ficus palmata* Forssk.	Bedu	Medicinal plant/Wild edible	Edible fruits, used demulcent and laxative
5.	*Ficus roxburghii* Steud.	Timil	Medicinal plant/Wild edible/ Fodder species	Edible fruit, Leaves are used in treatment of diarrhoea and dysentery
6.	*Myrica esculenta* Buch.-Ham. ex D. Don	Kafal	Medicinal plant/Wild edible	Edible fruit, used in treatment of lung disorders
7.	*Prunus cerasoides* Buch.-Ham. ex D. Don	Padum	Medicinal plant/Wild edible/ Fodder species	Skin diseases, increasing the complexion and used as uterine tonic
8.	*Pyrus pashia* Buch.-Ham. ex D. Don	Mehal	Medicinal plant/Wild edible	Edible fruit, used in treatment for eye infections
9.	*Pyracantha crenulata* (D. Don) M. Roem.		Medicinal plant/Wild edible	Edible fruit, used in treatment of myocardial weakness, paroxysmal tachycardia, hypertension, arteriosclerosis
10.	*Rubus ellipticus* Sm	Hisalu	Wild edible	Edible fruit, root used in detoxification
11.	*Ziziphus jujuba* (L.) Lam.	Ber	Wild edible	Edible fruit
12.	*Zanthoxylum armatum* DC.	Timur	Medicinal plant/ wild edible	Anti-inflammatory, analgesic, antinociceptive, antioxidant, antibiotic,

of 199 species, tree form 12.5% of the plant diversity, followed by shrubs (23.1%) and herbs (44.2.%). Out of this wild plant diversity, 126 species (5 trees, 46 shrubs and 75 herbs) of plants are both herbs and shrubs (63.3%) which are having medicinal value and wild edibles (18 species) comprises of 10.5% of the diversity. Wild edibles such as Kafal (*Myrica esculenta* (Bhatt *et al*., 2000) and *Rubus ellepticus* are cherished by the local people (Fig.1 a & b). Most of the plants of medicinal importance are used under Unani, herbal, Tibetan, Chinese and Ayurveda and homeopathic and some of these are being used by local healers in the village area (Table 1). The study shows that there is a vast potential of agri-diversity, wild-edible plants and medicinal plants that needs to be conserved, cultivated and sustainably used for securing food, nutrition and well-being of the native people. Now, with the Biodiversity Conservation Act (2002) under force with provisions of Biodiversity Management Committees and People's Biodiversity Register at the Gram Panchayat level it has become legalized to use the bio-resources with Access and Benefit Sharing (ABS). Also, involving the village self-help groups, NGOs and co-operative societies local product development and agri-business can be undertaken that will address the theme of International Biodiversity Day 2021- We are part of the solution.

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Nature based solution for promoting conservation of *Pheselous vulgaris* landraces in Uttarakhand hills

Legumes are well known nutritious staple diets around the world and therefore, their demand is increasing for nutritional security and health benefits. Furthermore, recent years have seen more people substituting animal protein with vegetable protein; thus, further increasing the demand for legumes as they are chief source of plant proteins. In addition to the source of proteins, the role of legumes in soil amelioration (ability to fix nitrogen) is well known and largely been used in traditional agriculture system. In Uttarakhand, the yield as well area under legumes is continuously declining. The contribution of legumes in Uttarakhand was 43.53 MT during 2010-11, which has been declined to 9.38 MT in the year 2016-17 (https://shm.uk.gov.in/). However, the yield of french bean (*Phaseolus vulgaris*) has been found nearly static during past several years. This might be due to non-availability of early, high yielding, disease and insect-pest resistant varieties (Das *et al.,* 2019). As a result, the contribution of pulses has gone down considerably in the diet of rural people. To bridge this gap, there is a need to identify potential varieties or landraces of selected legumes like french bean (*Phaseolus vulgaris*) for cultivation. Genotypes or landraces of *P. vulgaris* exhibit a wide range of variation within and between climatic conditions because of genotype x environment (G x E) interactions. Variation of yields in different varieties of the crop growing across a range of environmental condition necessitates the use of stable performing genotypes for higher yields with best nutritional and cooking qualities. It has been reported that specific germplasm of some of the potential varieties are distributed only in high hills of Uttarakhand but the knowledge on these species/germplasm particularly on yield, nutritional quality and their domestication is very limited. The modern farming practices with intensive selection pressure of hybrid crops have led to loss of landraces, traditional varieties and erosion of the gene pool. Therefore, conservation through Nature Based Solutions (NBS) is a key concern. Nature based solution is the adequate management of natural resources for sustainable use to protect the biodiversity from over exploitation, which in turn help us to overcome the challenges of conservation and sustainable use of biodiversity. Following NBS approach we can create synergy between nature, economy and society. Nature based practices for better management of crop yield has directly or indirectly provided benefits to the society and farmers. NBS provide abundant opportunity for biodiversity protection and promotes holistic growth of agricultural crops by restoring agro-ecosystems and all its components. This approach also emphasizes on traditional knowledge along with the modern scientific knowledge.

Phaseolus vulgaris is a traditional low-cost leguminous crop rich in protein, carbohydrates, fibres, vitamins and its can be very useful for self consumption and to get adequate returns. This crop is mostly consumed both for its dry and green beans and found useful in curing diabetes, reducing the risk of colon cancer, kidney stones etc. The matured seeds have high protein and fiber contents than the green bean pods, along with remarkable minerals (Iseman *et al.,* 2021). The amounts of anti-nutritive factors, such as trypsin inhibitors, influencing the digestibility of protein in the legume seeds are different depending on the variety (8.8-26.8 TIU mg/g). Irrigation decreases the level of trypsin inhibitors in the seeds, and the protein quality declines because of the decrease in the ratio of TEAA and NTEAA. The nutritive value of colored-seeded dry beans grown under non-irrigated conditions seem to be more favorable than the white seeded beans, but their high level of trypsin inhibitor activity hampers the digestibility of the protein. *Phaseolus vulgaris* roots contain Rhizobium- a nitrogen-fixing root nodule bacterial symbiont of legume plants that helps in nitrogen fixation and improving soil fertility. Also, application of organic compost and mulches for conservation of soil moisture and use of fibre net to protect crop from hailstorms results in higher yield of *P. vulgaris.*

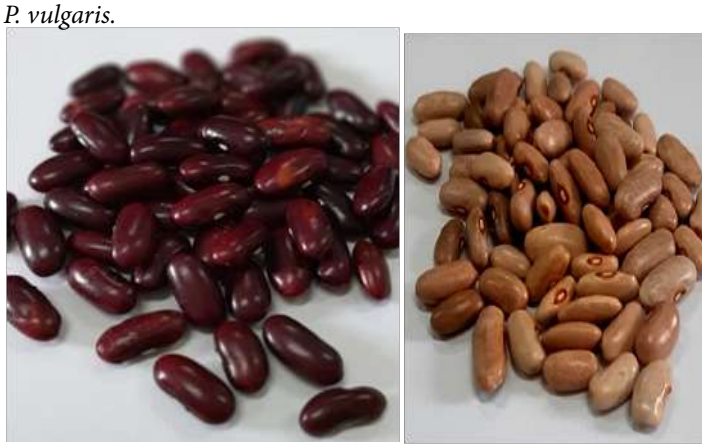

Fig 1. Seed colour variation of some landraces of *Phaseolus vulgaris* collected from Uttarakhand hills

Fig 2. *Phaseolus vulgaris* plant

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Biodiversity conservation to improve livelihood through cultivation of *Swertia chirayita* in Himachal Pradesh

The India is not only rich in flora and fauna but also rich in ethnic diversity and considered as one of the Mega Diversity Centre in the world. The Himalayan mountains are endowed with a diversity of topographical and micro-climatic conditions that make suitable environment for a rich diversity of flora and fauna. However, in the recent decades due to various anthropogenic and climate chnage related drivers the rich heritage of biodiversity is facing threats of various magnitudes. Among these, the worst sufferes are medicinal plants. *Swertia chirayita* (Roxb. ex Flem.) Karsten is one such important medicinal plant in Himachal Pradesh. This species is distributed in temperate and sub-alpine regions between 1200-3000 masl in India (Kashmir, Himachal Pradesh, Uttarakhand, Meghalya), Nepal and Bhutan and categorized as critically endangered plants (Anonymous 2010). Commonly this species known as *Chirayita*, Chirata, Kiratatikta and Bhunimba. *Chirayata* is an erect, annual or biennial robust, branched herb, and 60-120cm tall. In India, 40 species of *Swertia* are recorded of which, *S. chirayita* is considered the most important for its medicinal properties. Its wide range of medicinal uses include the treatment of chronic fever, malaria, anemia, bronchial asthma, hepatotoxic disorders, liver disorders, hepatitis, gastritis, constipation, dyspepsia, skin diseases, worms, epilepsy, ulcers, scanty urine, hypertension, melancholia, and certain types of mental disorders, secretion of bile, blood purification, and diabetes. Furthermore, the curative value of this herb has also been recorded in ancient Ayurveda medicine systems and other conventional medical systems (Kumar *et al.,* 2016)). The indiscriminate collection and overharvesting of *S.chirayita* from their natural habitats has adversely affected their availability and population in wild. To conserve this plant and bring it into cultivation by the farmers we distributed 5000 elite seedlings among the farmers of Kullu and Chamba districts of Himachal Pradesh (Fig. 1). Presently 50000 seedlings of this species are ready for distribution. The performance of seedlings cultivated in farmers' fields was assessed at regular interval of time to see growth of plants. Also, germplasm conservation of 4 populations of *S. chirayita* from Nepal, Sikkim, Arunachal Pradesh and Solan (H.P.) have been conserved in the Dhoranala nursery site, Genetic Resource Centre (GRC) of HPRC, Kullu. High medicinal value of *S. chiryata* enhances need for conservation of this species. This species is extracted from wild and utilized in various pharmacological industries. The high anthropogenic pressure on this species may lead to its extinction from the wild in near future. The nature based solution as the way of cultivation for this medicinal plant may prove to be an important strategy in meeting its growing demand and also protect it from depletion in its natural habitat. Therefore, approaches for cultivation, sustainable harvesting, and protection against existing threats should be developed for the conservation of this species and livelihood enhancement of local communities in the IHR. For this purpose, proper agro-technology was explained and demonstrated to the farmers and tie-up for buy-back of the final produce with Zandu Foundation for Healthcare, Gujrat was made. Nature-based soloutions demands conservation of biodiversity (prioritizing threatened plants both in-situ and ex-situ), their agriculturization by the local people and establish linkages for their marketing so that the people earn from them and thus conserve these natural resources.

Fig.1. Field demonstration, distribution and cultivation of *S. chirayita*

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Nature based solution for promoting conservation

The nature provides an immense treasure of valued resources of commercial, industrial, aesthetical, cultural and scientific interest. Natural resources are materials and components that can be found within the environment. Almost all the man-made products are composed of natural resources. A natural resource may exist as a separate entity or it may exist in an alternate form that must be processed to obtain the resource. The rapid increase in human population in recent times, the demand and consumption of natural resources has also increased leading to their depletion at an accelerated rate (that is higher than expected). The depletion of natural resources is caused by 'direct drivers' such as mining, extraction, deforestation, extensive agriculture, as well as 'indirect drivers' such as demography (e.g., population growth), economy, technology, etc. At present, deforestation and degradation have affected 8.5% of the world's forests with 30% of Earth's surface already cropped (Salvati *et al.,* 2008). The depletion of natural resources is considered a sustainable development issue as it has the ability to degrade current environments and the potential to impact the needs of future generations (UN earth summit, 2002). Hence, there has been a major shift in the focus of governments and organizations such as United Nations towards the conservation and management of nature and its resources. This is evident in the UN's Agenda 21 Section Two, which outlines the necessary steps for countries to take to sustain their resources (UN SDG). In India as well, several Bills have been passed by the Parliament for the conservation of biodiversity, such as the Forest (Conservation) Act 1980, Wildlife (Protection) Act 1972, Environment (Protection) Act 1986, National Biodiversity Strategy and Action Plan (NBSAP) 1999, Biological Diversity Bill 2002 and Scheduled Tribes and other traditional forest dwellers (recognition of rights) act 2006; however, loss of biodiversity yet to be stopped (Rules and Regulations). Protection, conservation and management of natural resources is a pre-requisite at all societal levels, from individual to international, and should thus be incorporated into national and international systems of law as well. As per IUCN, "protecting and limiting the use of natural resources by sustainable utilization and management is the need of the hour for the nature and humans to thrive in future" (UN SDG). At individual or community level, one can always conserve resources by simply using materials wisely and not wasting it. The most basic concept of conservation is the "3R Concept" which means "REDUCE", "REUSE" and "RECYCLE". We need to especially manage and reduce utilisation of the exhaustible resources and prevent any illegal activities or over-exploitation/extraction (e.g., waste disposal, hunting, poaching, fishing, deforestation, chemical releases, etc.). In recent times, there has been a strong inclination towards the Natural based techniques and tools to conserve the environment called 'Nature-based solutions' (NbS) and defined by IUCN, as "the actions provided by the nature itself to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits". These solutions not only enhance the existing natural or man-made infrastructure in the form of economic, social and environmental benefits but also can solve the major challenges such as climate change, disaster risk reduction, food- water security and more. There have been multifarious instances of practical applications of NbS for conservation and sustainable use of natural resources at Himalayan region. For example, in China a degraded land area of Loess Plateau was restored through introduction of sustainable farming practices by the community along with aid from authorities. This gradually led to increase in the diversity of the region, thus revitalizing the ecosystem as well as providing diversified employment opportunities and income sources to the locals. In India, community-led conservation initiatives were taken up by establishment of biodiversity conservation sites in Arunachal Pradesh and in Nagaland include the applications of NbS towards resource conservations of the gradually degrading biodiversity. The Singchung Bugun Village in Arunachal Pradesh is home to many endemic and threatened species especially the Bugun Liocichla bird along with the red panda, golden cat and marbled cat. Noticing the diminutive number of wildlife, the local community in partnership with Andhra Pradesh Forest Department, in 2012 made a stride of making the forest area a community reserve and accord legal protection to its wildlife and simultaneously improving the livelihood by encouraging ecotourism following intensive ecological monitoring and data collection. In 2017, the area was officially marked as the Singchung Bugun Village Community Reserve (SBVCR). Similarly, the formation of Yaongyimchen Community Biodiversity Conservation Area (YCBCA) in 2010 in the Longleng district of Nagaland was credited to the persistence of Phom tribe to safeguard their natural habitat transforming around 10 km of community-owned forest into refuge for wildlife. Observations such as extinction of wildlife species, deforestation and loss of crop productivity, led to the manifestation of the idea and hunting (even traditional traps) was banned in the entire area. As a result, now the reserve is a safe haven of 85 species of birds, including Amur falcons, 15 species of frogs, as well as leopards, barking deer, serows and otters. Hence, such types of nature-based solutions not only focus upon the cause of a problem, but treat the cause of the issue as well. They work on the concept of ecosystem-based approach can be implemented alone or in an integrated manner at any geographic scale (local, regional, etc.) and in natural or cultural contexts. Furthermore, these solutions provide the societal benefits with fair and equitable manner that includes transparency and participation from many communities and maintain biological as well as cultural diversity with ability of ecosystem to evolve over time. Current scenarios tell us that we have to include nature-based solutions in design of policies and actions for the current social challenges (Schilling *et al.,* 2011). They embrace nature conservation norms and principles to help achieve technological, scientific and traditional based knowledge. Nature-based solutions maintain biological and cultural diversity and the ability of ecosystems to evolve over time. They recognise and address the trade-offs between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystems services. Thus, NbS act as an umbrella concept for ecosystem-related approaches and are a good way towards the conservation and management of natural resources to solve the current social and ecological challenges as well as provide the long-term productivity.

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Biodiversity Conservation & Management, Specialization:

Floristic Ecology; Conservation Biology; Conservation Education

Published 260 Research Papers, articles, book chapters, etc. [Citation - 4139; h-index 35, i10 index - 88]

Completed 19 R&D Projects; Supervised 10 PhDs

Selected Lead Author for IPBES Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia

Coordinated of two multi-country, multi institutional programmes

Convened 2 side events CBD-CoP XI (2012), 1 side event UNFCC-CoP XXII (2016)




A Mentor, A Leader, Visionary and Administrator, A Friend and Family Man






Let us honor and remember the person who taught us.
Let us keep his words and works in our memory.
Let us reflect his vibes in our work, writing or anything that we do.
Let us make his vision come true.



शोक संदेश

समस्त बीसीएम परिवार और अन्य शुभ–चिंतकों का मैं अभिवादन करता हूँ। हाँ यह एक काफी दुखद समाचार है की मेरे पिताजी जो लगभग एक अरसे से बीसीएम परिवार के मुखिया के रूप में रहे वे अब अपनी पुण्यात्मा की एक नई यात्रा में निकल चुके है जिस वजह से अब वे प्रत्यक्ष रूप से हमारे बीच नहीं है परंतु इसका ये अर्थ यह नही है की अब वे हमारे साथ नही रहे क्योंकि उनकी सीख एवं प्रेरणा सदैव हमारा मार्गदर्शन करती रहेगी। अपने जीवन काल में कठिनाइयों के समय में उन्होंने सदैव संघर्ष किया और उस संघर्ष के दौर में बीसीएम परिवार उनके साथ सदैव खड़ा रहा, कभी उनका मार्गदर्शन करते हुए तो कभी उनके दिखाए रास्ते पर चलते हुए। हाँ आज का समय हमारे लिए कठिन अवश्य है परंतु हम ये जरूर मार्गदर्शन करते हुए तो कभी उनके दिखाए रास्ते पर चलते हुए। हाँ आज का समय हमारे लिए कठिन अवश्य है परंतु हम ये जरूर जानते है ऐसे समय में वे अगर होते तो अपने चेहरे मैं सिकन लाए बिना दुख को समेट आगे बढ़ने के लिए कहते इसीलिए मेरी आप सभी से विनती है की अब आप सभी उनके अधूरे कार्यो को चाहे वे हिमालय क्षेत्र में हो या संस्थान के हित में वे सभी हमने साथ मिल के पूरे करने है और उनकी धरोहर को आगे बढ़ाते हुए संघर्ष उनके खुसनुमा अंदाज में करना है। मुझे विश्वास है की जिस तरह आपने पिताजी का साथ दिया उसी प्रकार आप सभी मेरे साथ एक परिवार की भांति खड़े रहेंगे और मेरा मार्गदर्शन करेंगे।

ऋषभ (रिपु)

ENVIS activities during IBD-2021

International day for biological diversity - 2021

Nature is critical to our survival, nature provides us with our oxygen, regulates our weather patterns, pollinates our crops, produces our food, feed and fibre. But it is under increasing stress. Human activity has altered almost 75 per cent of the earth's surface, squeezing wildlife and nature into an ever-smaller corner of the planet.

About theme

The Secretariat of the Convention on Biological Diversity was announced the Biodiversity Day -2021 slogan: "We're part of the solution". The slogan was chosen to be a continuation of the momentum generated last year-2020 under the over-arching theme, "Our solutions are in nature", which served as a reminder that biodiversity remains the answer to several sustainable development challenges. From nature-based solutions to climate, health issues, food and water security, and sustainable livelihoods, biodiversity is the foundation upon which we can build back better.

ENVIS centre activities

ENVIS Centre on Himalayan Ecology and Centre for Biological Diversity and Mangment (CBCM), GBP-NIHE, Kosi Katarmal, Almora jointly organised national webnar on this year theme "*We're part of the solution # for Nature*. The ENVIS Centre also conducted online national level drawing competition for the student of class III-V. The programe was celebrated on 22 May 2021. Total 112 Scientist, researchers, Student participated during the webinar and 64 students participated in drawing competition.

Mahesha Nand, GBPNIHE,
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Krishiv Puri

Sajal Jain

Kanchan

Shrestha Sharma

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