



**ENVIS Newsletter** 

# Himalayan Ecology

ISSN: 2277-9000 (Print) ISSN: 2455-6823 (Online)

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# **Climate smart practices in IHR**



# Weaving using traditional handloom techniques to increase the livelihood in Kullu district

Kullu is a beautiful district in the Indian state of Himachal Pradesh. Kullu is a popular tourist destination known for its natural beauty, snow capped mountains, crystal clear rivers, outdoor recreation, and rich cultural history. Adventure seekers from all over the world come to the area for the trekking, mountaineering, river rafting, paragliding, and skiing opportunities. The vibrant and colourful locals' traditional clothing reflects the area's rich heritage. Kullu has good transport connections to other significant cities in Himachal Pradesh and neighbouring states and is well-connected by road. The area is air-connected through the Bhuntar Airport, which is close to Kullu. According to the Department of Himachal Tourism, 2880219 tourists came to Kullu district in 2022 (Fig. 1).



### Fig. 1 Estimate of tourists arrival for the year 2022

**Hand Loom Products of Kullu:** The Kullu region's traditional art is weaving, which they inherited from earlier generation and are still continuing to practise from centuries ago to the present. In Kullu, the majority of locals also work at this centuries-old tradition of spinning and weaving woollen clothing in addition to farming. The most popular handwoven items from Kullu include the Kullvi shawl, Pattu, Kullu caps, Patti, and Mufflers etc. The significance of kullu shawls goes far beyond their status as stylish accessories. Kullu

### EIACP Centre on Himalayan Ecology

# ENVIS Newsletter

A Quarterly Publication		Vol	Vol. 20(2), 2023		
The	"EIACP		Centre		
Himalayan Ecology"		is l	noused	at	
G.B. Pant	G.B. Pant National Institute of Himalayan				
Environment (GBPNIHE), Kosi-					
Katarmal, Almora, Uttarakhand, which				nich	
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# The **"EIACP Centre on Himalayan Ecology"** collects, collates, compiles and builds quantitative and qualitative databases of information in the fields related to the Himalayan Ecology. The information is disseminated regulary via online as well as hardcopies to several valuable stakeholders and various users such as DICs, universities, institutions along with other EIACP Centres across India to support overall Environmental Information System in India.

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Editor's Note



Climate change poses significant challenges to agricultural practices worldwide, and hill agriculture is particularly vulnerable to its impacts. Sustainable hill agriculture becomes crucial as it aims not only to adapt to the changing climate but also to mitigate its adverse effects. Indian Himalayan Region is certainly experiencing shifts in temperature, altered precipitation patterns, and increased frequency of extreme weather events. These changes can disrupt traditional farming practices and also leading to soil erosion, reduced water availability, and threats to crop yields.

To address the climate change in Himalayan region, development of climate-smart-villages or climate smart community can be an appropriate approach wherein technological solutions and institutional capacities can be amalgamated to a great extent.Sustainable hill agriculture and its integration with other alternative livelihoods is essential for food and livelihood security. Dairy farming, production of high value medicinal crops etc. can be integrated with of traditional agriculture for better yields and climate resilient agriculture. By integrating resilient farming practices, enhancing community engagement, and adopting suitable mitigation strategies, hill farming can be built climate-resilient and more sustainable system.

In light of the this, the EIACP Centre on Himalayan Ecology is publishing this issue of the Newsletter which includes short notes and articles on topics such as soil management, low-carbon agriculture incentives, rainfall forecasts, dairy development, fish farming, beekeeping, and other livelihood opportunities, as well as carbon finance for crop field restoration. The present volume [20(2), 2023] of the EIACP Newsletter is the 2nd one in the series of quarterly non-priced publications. This particular issue contains 11 good quality articles which are focused on livelihood, bamboo craft, micro-dairies, dry farming, apiculture, carbon farming, climate adaptation, soil management, hydroponics, watershed restoration etc. The general views presented in the articles are the views of the concerned authors. Comments/suggestions for further improvement of the EIACP Newsletter are welcome.

### Er. Mahendra Singh Lodhi EIACP, Coordinator

shawls are warm and comfortable because they are made of high-quality natural fibres like angora, pashmina, and sheep wool. Vibrant hues and patterns were used in Kullu shawls. Pattus are typically worn by women in the Kullu district as part of their traditional clothing. It resembles a shawl but is longer, thicker, and heavier and comes in sizes of 2.80 x 1.40 metres and 3 x 1.50 metres (Sharma *et al.*, 2008). In Himachali society, kullu caps have a significant cultural significance. Typically, kullu caps are made of pure wool.

### Market for Handloom Products in Kullu District

**Tourist market:** Kullu district is also known for its attractive tourist destinations, Raghunathji Temple, Vaishno Devi Temple, Bijli Mahadev Shrine Camping Sites: Katrain, Naggar, Kasol, Manikaran, Malana, Bajaura, Larji, Banjar, Nehru Kund, Solang Valley, Kothi, Rahala Water Falls, Rohtang Pass, Arjun Gufa (Cave), and Jagatsukh are the districts well known tourist destinations (Gupta *et al.*, 2015). According to the Himachal Pradesh department of Tourism, Kullu district has the largest state wide tourist market. Because 5637102 tourists visited Himachal Pradesh in 2022, and 2880219 of them travelled to Kullu. Out of all districts, Kullu received the most tourists. Consequently, District Kullu has the greatest opportunity to market its own traditional handicrafts. Tourist markets and handcrafted goods frequently coexist because travellers are frequently eager to buy distinctive or culturally significant items as souvenirs or keepsakes of their travels. Owning a handloom item from a particular location helps to forge a connection and preserve a memory of the travel experience, reminding the person who travelled of the location they visited and the diversity of the local culture they encountered.

**Fairs in Kullu District:** Kullu is well-known for its regional and international fair. Dusshera is one of Kullu district's most popular fairs. This festival is dedicated to Lord Raghunath ji. Hundreds of Gods and Goddesses dressed up with their retinue for a weeklong festival at Dhalpur Grounds during Kullu Dusshera (Kumar *et al.*, 2023). Fairs can be great venues for showcasing and selling handloom products because they draw a wide range of people interested in distinctive and genuine goods. For handloom artisans and weavers, participating in fairs that emphasise crafts, textiles, or traditional arts can be a fantastic opportunity to reach a larger market, gain exposure, and establish direct relationships with customers.





genetic

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 Table 1. Estimate of domestic and foreign tourist arrival for the year 2022 (January to December)

S.N	Schemes	
1	Handloom weavers' comprehensive welfare scheme (HWCWS)	Pradhan Mantra Jivan Bima Yojna(PMJJBY), Pradhan MantrI Surksha Bima Yojna(PMSBY), Mahatma Gandhi Bunker Bima Yojna(MGBBY)
2	National handloom development programme (NHDP)	Education of Handloom weavers and their childrens,Weavers MUDRA scheme, Block Level cluster, Hathkargha Samvardhan Sahayata (HSS), Handloom Marketing Assistance, Indian Handloom Brand, e- commerce, Urban Haats, Sany Kabir Award National award
3	Comprehensive handloom cluster development scheme(CHCDS)	This strategy aims to assist handloom weavers both inside and outside of designated handloom clusters in pursuing sustainable development.
4	Yarn supply scheme	The Scheme reimburses goods and pays depot operating agencies at a rate of 2%.

**Government Schemes:** There are several government schemes for handloom weavers. (Welfare Schemes for Handloom Weavers, n.d.)

**Conclusion:** The Kullu district's traditional handloom methods have stood the test of time and have preserved the cultural heritage of the area. All parties involved must work together to ensure their survival and support the skilled artisans' livelihoods. We can protect Kullu's cultural heritage and give its weavers the tools they need for a prosperous future by raising awareness, offering support, and promoting these handcrafted marvels. Together, we can create a vibrant tapestry of innovation and tradition to ensure that the threads of this exquisite craft are preserved for future generations.

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### Pre-breeding for enhancement of pulses

Introduction: The narrow genetic base of crops today is alarming as genetic diversity determines the success of any crop improvement program. Use of uniform high yielding few varieties especially in selfpollinated grain legumes like chickpea, mungbean, urdbean, clusterbean, cowpea, rajmash, fieldpea and mothbean becomes the serious problem to our rich biodiversity, as the genetically uniform modern varieties has replaced the highly diverse local cultivars and landraces in traditional agro-ecosystems, resulted in increased genetic vulnerability of the cultivars for pests and diseases. In addition to this varieties are developed to benefit farmers in specific target environments, but increased climate variability has meant that they need to broaden the adaptability of varieties grown and increase the yield stability to help minimise climate-induced risks and build resilience. Grain legumes are cultivated mostly in marginal lands under rainfed conditions, with low and unstable productivity. Their production is adversely affected by several biotic and abiotic stresses. Low grain legume productivity due to biotic and abiotic stresses coupled with limited genetic variation in the cultivated gene pool necessitates the identification and utilization of diverse germplasm sources to develop new high-yielding cultivars with a broad genetic base. Wild relatives with enhanced levels of resistance/ tolerance to multiple stresses like heat, drought pest and diseases provide important sources of genetic variation for crop improvement. However, their exploitation for cultivar improvement is limited by difficulty in hybridization as they are at extreme end of gene pool and even when hybridization is possible, linkage drag hinders their use in crop improvement.

**Pre-breeding:** Pre-breeding refers to all activities designed to identify desirable characteristics and genes from unadapted materials that cannot be used directly in breeding populations and to transfer these traits to an intermediate set of materials that breeders can use further in producing new varieties for farmers. The success of any pre-breeding program depends mainly upon the identification of promising donor with good expression of the trait, type of germplasm used as donor for the trait and cross compatibility of the donors.

### Activities in Pre-breeding

**Characterization of germplasm:** Germplasm can be categorized into wild relatives, wild forms, landraces, advanced breeding lines, popular varieties, etc. These unique genotypic lines shouldharbour useful genes for earliness, local adaptability, disease and pest resistance and other desired traits. They can also be used to define or generate a new trait not available in domesticated germplasm.

**Introgression or incorporation of new traits from germplasms:** Introgression involves the transfer of one or few alleles from exotic genotypes to adapted breeding populations that lack the alleles controlling a specific trait. This is achieved by making crosses and backcrosses between donor and recipient parent. While incorporation refers to a large-scale germplasm, aiming to develop locally adapted population (genotypes) using exotic germplasm, which will broaden the genetic base of new breeding materials. This results in the development of potential





# The immense contribution of bamboo: As a potential source of livelihood

parents, which can be further used in breeding programme.

**Challenges to adopt pre-breeding in pulses:** (i) Lack of characterization, evaluation and documentation of genetic diversity in grain legumes, which hinders the use of available accessions in the pre-breeding programme. (ii) Difficulty in wide hybridization, inter species cross incompatibility are the major factor which limits the use of different species especially in pigeonpea and chickpea in transferring gene of importance across species. (iii) Embryo rescue techniques and facilities are not easily accessible to plant breeders. (iv) Breaking linkage drag i.e., separating desirable gene from undesirable ones is difficult and time consuming requiring several generations of back-crossing in conventional system but molecular markers can assist in quickly breaking this linkage drag.

Future Prospect and Conclusion: Pre-breeding assumes greater role in continuous supply of useful variability from promising landraces and wild relatives to the breeding pipeline. For grain legume improvement, sufficient genetic diversity exists in the form of landraces and wild relatives, which carry several useful genes for cultivar improvement. However, utilization of these resources in breeding programs is time-consuming and resource-demanding. To overcome this, pre-breeding activities should be initiated to generate new genetic variability using promising landraces and wild relatives for use by the breeders in crop improvement programs. Recent advances in plant biotechnology provide a mean to broaden the genetic baseof crops and to monitor the introgression of new alleles into breeding stocks. Molecular markers can be used in several ways from selection of parents with desired traits to evaluation of progeny for donor trait introgression. Genomic-assisted pre-breeding will help to overcome the linkage drag and will facilitate focused transfer of useful genes/segments from wild relatives for genetic enhancement of grain legumes.

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Bamboos constitute fastest growing tall woody grass with joined stem and are versatile plant on the earth, which have been closely associated with mankind since ancient times. Bamboo belong to subfamily of Bambusoidae of the grass family poaceae (Ramanayake *et al.*, 2007). Bamboo is a self regenerating renewable raw material which serves for rendering many ecological services like erosion control, protecting riverbanks, preventing landslides, soil moisture retention, land rehabilitation, biodiversity conservation, carbon sequestration, etc. (Ben-zhi *et al.*, 2005). They can tolerate as well as grow in extreme low temperature of about -20°C and precipitation ranging from 800mm to 1300mm annual rainfall (Goyal *et al.*, 2012).



Fig. 1 Golden Grass Bamboo

Latest ISFR data, 2019 suggests that India has 125 native and 11 exotic bamboo species. Madhya Pradesh is the leading state in terms of maximum percentage coverage of bamboo species contributing around 18% of total coverage area followed by Maharashtra, Arunachal Pradesh and other states.

### Top 10 state % coverage of bamboo



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### Source: Indian State of Forest Report, 2019 Bamboo for millions of people in India an

Bamboo for millions of people in India and around the world, bamboo is a tremendous source of income. There is a lot of literature on the diverse uses of bamboo, and it emphasis the importance of bamboo in terms of supporting livelihoods. Bamboo is used to build houses, make bamboo ply, agricultural implements, handicrafts, irrigation, brooms, medicine, food, fuel, fodder, paper & pulp, and many other things. Bamboo is also utilised as a perfect substitute for several wood-based items. Bamboo goods that provide livelihoods can be broadly classified as follows:



### A. Wood Substitutes and Composites

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**Bamboo furniture:** Natural round or split bamboo is used in traditional bamboo furniture. Glue-laminated bamboo panels are used in a new sort of 'pack-flat,' 'knock-down' furniture. Unlike traditional designs, this furniture can be delivered in flat boxes that can be built on-site. Traditional bamboo furniture has a number of drawbacks, including high labour and transportation expenses, low productivity, instability, fluctuating quality, and sensitivity to insects and fungi. It retains the physical, mechanical, chemical, environmental, and aesthetic characteristics of bamboo at the same time.

**Bamboo housing:** Bamboo housing can be divided into three categories: Traditional bamboo houses are made of bamboo culms, traditional bahareque bamboo buildings are composed of bamboo frames coated with cement or clay and modern prefabricated bamboo houses are made of bamboo laminated boards, veneers, and panels. Unlike brick or cement constructions, these structures are usually less expensive than timber dwellings, are light, sturdy, and earthquake resistant. Engineered bamboo-based prefabricated buildings have a number of advantages. They can be packed flat and transported for a low cost over large distances. They are more aesthetically pleasing and environmentally friendly.

**Bamboo raw materials:** Bamboo is a non-permanent material. Its use in exposed settings necessitates prior treatment (Liese and Kumar, 2003), and it can be improved further with the use of current engineering techniques. Bamboo may be turned into modern items (engineered bamboo) that can compete in price and performance with wood products. The use of bamboo in composite panels and boards overcomes culm-related quality discrepancies and allows for the development of uniform products. Engineered bamboo has the potential to replace wood, steel, and concrete in a variety of applications.

### **B. Industrial Use and Products**

**Bamboo pulp, paper and cloth:** Bamboo is used as pulp, paper, and more recently fabric in several bamboo-producing countries, including China and India. Bamboo paper is nearly identical to wood-based paper in terms of quality. Its brightness and optical qualities stay steady over time, whereas those of wood-based paper may deteriorate. Bamboo fibres have morphological properties that produce paper with a high tear index, similar to hardwood paper.

### **C. Food Products**

**Bamboo shoots:** Bamboo shoots are edible and appetising in about 200 species of bamboo, including: *Acidosasa edulis, Chimonobambusa quadrangularis, Phyllostachys heterocycla* var. pubescens, *Phyllostachys praecox, Phyllostachys dulcis, Phyllostachys iridescens, Phyllostachys iridescens, Phyllostachys iridescens, Phyllostachys iridescens, Phyllostachys are tasty and nutritious, with a high fibre content.* Bamboo vegetables are available at Chinese grocery stores and restaurants all over the world. Because cooking does not alter the texture of the shoots, they remain crisp after cooking. Bamboo shoots that have been cooked can be preserved in containers and exported all over the world.

### **D.** Construction and Structural Applications

**Bamboo charcoal:** Bamboo charcoal has long been used as a replacement for wood charcoal and mineral coal. It has the ability to act as a fuel, absorbent, and conductor. Bamboo charcoal has about half the calorific value of oil of the same weight. Bamboo charcoal that has been activated can be used to clean the environment, absorb excess moisture, and make medications. Bamboo charcoal has a six-fold higher absorption capacity than wood charcoal of the same weight. When compared to tree species, bamboo grows quicker and has a shorter rotation, bamboo charcoal has a calorific value and absorption properties that are comparable to or better than wood charcoal; and it is cheaper and easier to make.

**Bamboo panels:** Bamboo panels were first produced in China in the early 1800s. In Asia, more than 20 different types of panels are currently produced. The panels are commonly utilised as structural elements or as shapes for concrete mouldings in modern building. Due to their rigidity and endurance, bamboo panels have several advantages over

wooden boards. Veneers, stripboards, matboards, fibreboards, particle boards, medium density boards, mixtures of these, and combinations of these with wood and other ligno-cellulose materials and inorganic substances are all examples of bamboo veneers, panels, and boards.

**Bamboo flooring:** Bamboo flooring is a high-quality product with a wide range of applications and a significant worldwide consumer market. Because of its smoothness, brightness, stability, high resistance, insulating capabilities, and flexibility, it offers some advantages over timber flooring. Bamboo flooring has a smooth natural shine that preserves the natural gloss and elegance of bamboo fibre. This flooring appeals to the most discerning customers in Europe, Japan, and North America.

**Bamboo fuel:** Bamboo may be pyrolysed to produce three useful products: bamboo charcoal, oil, and gas. Bamboo gas can be utilised as a petroleum alternative. Bamboo charcoal is a fantastic cooking and barbecuing fuel. Activated charcoal is used as a deodorant, a purifier, a disinfectant, a pharmaceutical, an agricultural chemical, and a pollutant and moisture absorbent.



Fig. 2. Multidimensional uses of Bamboo

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# Promotion of lifestyle for environment (LiFE) in IHR: A global initiative for climate change adaptation and mitigation

Environmental degradation and climate change are global phenomena where actions in one part of the world impact ecosystems and populations across the globe. Estimates suggest that if requisite action is not taken against the changing environment, approximately 3 billion people globally could experience chronic water scarcity. The global economy could lose up to 18% of Gross domestic product (GDP) by 2050. The human beings are getting cut-off from nature and all natural processes in life which is creating an imbalance in all planetary processes including the human lifestyle. We need to connect people with nature and natural environment instead of creating an artificial environment. The health of the earth is dependent on the balance of biodiversity on this earth. However, our need for food, fodder, fuel, water is going beyond what the Earth can provide so, human beings are creating artificial substitute which in the long run is harming the human beings through unknown diseases and impacting mental and physical well being like never before. Over the last two decades, several macro measures have been implemented globally to address environmental degradation and climate change, including policy reforms, economic incentives and regulations. Despite their enormous potential, actions required at the level of individuals, communities and institutions have received limited attention. The changing individual and community behaviour alone can make a significant dent in the environmental and climate crises. According to the United Nations Environment Programme (UNEP), if one billion people out of the global population of eight billion adopt environment. Friendly behaviours in their daily lives, global carbon emissions could drop by approximately 20 per cent (https://www.mygov.in). At the 26th session of the Conference of the Parties (COP-26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom, India shared the mantra of LIFE - Lifestyle for Environment - to combat climate c

LIFE- L. I. F. E. which means Lifestyle for Environment, Today, there is a need for all of us to come together and take Lifestyle For Environment (LiFE) forward as a campaign. These movements together can set goals that can revolutionize many sectors in diverse areas such as fishing, agriculture, wellness, dietary choices, packaging, housing, hospitality, tourism, clothing, fashion, water management and energy. The Lifestyle for Environment (LiFE) is an initiative to promote sustainable living by changing individual lifestyles. The initiative focuses on seven themes, which include food, energy, transport, water, waste, nature, and purchasing.

### Broad Objective of the LIFE Programme:

1. LIFE is activated amongst various stakeholders—children, youth, municipalities, private sector, think tanks and civil society organisations.

2. Innovative best practices are fostered & shared domestically and internationally in alignment with Make in India and & Atma Nirbhar Bharat. 3. Knowledge management, advocacy and communication for spreading the fundamental principles of LIFE in domestic and global arena.

### Broad Themes under LiFE:

- 1. Empowering People & communities by leveraging the Topography and Natural Resource management
- 2. Preservation and Popularization of eco-systems
- 3. Propagating waste to resource practices among all sections of the society
- 4. Encourage celebration of eco-friendly cultural practices

Items to be exhibited by EIACP GBPNIHE Almora (i.e. GSDP/LiFE Products/Calendars/Posters etc.): EIACP, Centre on Himalayan Ecology, G.B Pant National Institute on Himalayan Environment, Kosi-Katarmal, Almora will exhibit the following product/items and technology during the occasion of World Environment Day-2023. These products based on natural bio resources i.e. Pine needle based products, Natural fiber based products, Traditional artifacts,Organic crop produce, Ecosystem goods, Traditionally processed foods/beverages/condiments and the Technologies are Gharat: Traditional water flour mill and Making of bio-briquette and pine sheets

In the view of the above the EIACP Centre on Himalayan Ecology, Almora was conducted series of 28 action & awareness events from 9 May 2023 to till date 9 Aug. 2023 among stakeholders—children, youth, municipalities, private sector, think tanks, civil society organisations, students, teachers, National Cadet Corps, tourist, villagers, shopkeepers, mahila mangal dal and general public for create mass awareness among the populous on environment issues and its sustainable solutions. The programmes were also a part of larger celebration of "Bharat ke Azadi ka Amrit Mahotsav" and G-20. Total 17905 peoples has been sensitized under 7 themes (Save Energy, Save water, Reduce waste, Adopt sustainable food systems, Reduce e-waste, Adopt health lifestyle and Say no to single use plastic) of Mission LiFE.

Table. 1. E	IACP centre of	n Himalayan	Ecology	conducted [	plans to	undertake the	following activity
			()/				

Month/ Event	LiFE Theme	Place	Number of Participants
May/ Action & Awareness	Save Energy,Save Water, Say No to Single Use Plastic, Adopt Sustainable Lifestyle, Reduce Waste, Adopt Healthy Lifestyles, Reduce E-Waste, Adopt Healthy Lifestyles, Reduce E-Waste, Say No to Single use Plastic, Adopt Sustainable Lifestyle,	Campus School, Kosi-Katarmal, Almora, S.S.J University, Almora, DSB Campus, Kumaun University, Nainital and 05 UK Neval Subunit, NCC, Nainital, Government Inter Collage Hawalbaghand, Government Inter Collage Syalidhar, Almora, S.S.J University, Almora, S.S.J University, Almora, KainchiDham - NeemKaroli Baba Ashram, Nainital, Govt. Sen. Sec. School Bajaura, Distt. Kullu, Himachal Pradesh, Govt. Sen. Sec. School Bhuntar and SSB Shamshi, Bhuntar, Distt. Kullu, Himachal Pradesh, ITI Shamshi, Distt. Kullu, Himachal Pradesh, Vivekanand Inter College Almora, Almora Main Market	11,119
June/ Action & Awareness		<ul> <li><sup>althy</sup></li> <li><sup>valthy</sup></li> <li><sup>valthy</sup><!--</td--></li></ul>	
July/ Action & Awareness		Plantation Drive Under Mission LiFEDuring Local Harela Festival With State Bank Of India Kosi, Almora, Govt. Inter Collage Hawalbagh, Almora	175
August Action & Awareness	Save Energy	Nanda Van Forest, NTD, Almora,Vivekananda inter college, Jharoli, Kafligair, Bageshwer, GIC Kafligair, Bageshwer, Vivekanand Inter Collage Jharoli, Kafligair, Bageshwar, Jageshwar Temple, Almora	746
Total			17 005



# Establishing sustainable decentralized micro-dairies in mountains: Challenges and potential solutions



Livestock husbandry, especially of largeruminants or milch cattle, is an integral component of the mountain farming system. In the context of the Indian Himalayan Region (IHR), a dynamic relationship between man-livestock-forests and fodder resources is observed, which aggregate to form a mixed crop-livestock farming structure (Ralhan *et al.*, 1991). This conformity not only supplements nutrition security, and family income, and sustain crop production but is also closely linked to the social and cultural lives of the peoples in the rural landscape (Maikhuri *et al.*, 1996). Therefore, sometimes it is often referred to as 'engines and inspirations' in the context of the rural mountain economy (Negi *et al.*, 2010).In Uttarakhand, a Western Himalayan state, more than 70% of households own at least one animal (KPMG, 2014), with subsistence farming being the prime fiscal activity along with the prevalence of migration cum remittancebased economy.

The last two decades for the hilly region marked a substantial increase in population & migration often reflected as expansion in urbanization among various peri-urban regions and townships, thus, initiating the development of new residential complexes, tourist routes, etc. This has led to the inception of new markets appealing to large demand for livestock products, especially in relation to milch commodities. But, despite this proliferating demand, the milch sector of the mountain still underperforms in terms of quality, quantity, and inefficient supply chain due to certain barriers and bottlenecks, with most of the demand being met via external players (Negi et al., 2021). Primarily (i) Low fodder availability in the dry season especially in rainfed systems leading to drudgery in relation to fodder management, (ii) Poor feeding & storage practices, (iii) Meager productivity of milch animals specifically of traditional breeds, (iv) Deficient livestock health services coupled with long distances and harsh terrain further barricading the timely healthcare services for livestock during emergencies, (v) Feeble linkages of the producers and their institutions to the market due to poor economy of scale, and (vi) Low awareness and technical skills in relation to availing credit services among stakeholders, are a few to name. These elements coupled with the pulling factors from the modern consumerism-driven lifestyle often impede youth aspirations towards the adoption of the dairy business as a sustainable source of livelihood. As a result, many socio-cultural practices which are closely associated with large ruminants are under accelerated dilution, thus, thinning cultural traditions as well.

This situation warrants the development of sustainable largeruminant based settlements in the mountains that not only support the rural economy but shall augment local traditions as well along with provisioning for the well-being of the livestock even after the point where the animal is considered as 'spent'. However, given several unique natural challenges offered by the mountainous terrain and anthropogenic factors, thus, placing restrictions over holding large tracts of land parcels, connectivity, etc.,it is relatively difficult and uneconomical to manage large herds of livestock by a single person. But the establishment of cluster-level Self-Reliant Cooperatives (SRCs) and Self-Help Groups (SHGs) following support from line and non-line agencies for pilot interventions may function well in this regard.

SRCs and SHGs can overcome the limitation of small land holdings and less number of cattle among the stakeholders by providing services such as (i) Development of fodder nurseries and plotson community lands for fodder security and drudgery reduction during lean periods along with ensuring equitable distribution, (ii) Leveraging government schemes such as MGNREGA, etc., for establishing fodder plantations, (iii) Establishment of local units for cattle feed (otherwise fulfilled from foreign market supply), and incorporation of local crops such as millets in the production of the same, (iv) Providing a platform and network of milk collection centers, micro-dairies, and other community institutions where the stakeholders can supply their milk and other farm-based produce at fair prices based on quality of milk produce over indices such as fat content, Solid Not Fat (ŚNF), etc., (iv) Development of value chains in context of selling lesser produced goods, e.g., secondary dairy products such as clarified butter (ghee) from indigenous cattle breeds like Badri, etc., as niche produce at premium prices, and (v) Development of a cadre of self-sustained para-vets via



Fig. 1. Schematic for the development of micro-dairies and other subsidiaries





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convergence with line departments like livestock development boards, for improving services of first-aid, Artificial Insemination (AI), etc. at the doorstep of milch Producer Groups (PGs). Further, the SRCs may provide insight into best practices for the management of milch cattle which are often overlooked among the PGs in the mountains. These include, (i) Balanced feeding, chaffing of fodder, and feeding in the manger, (ii) Periodic de-worming and vaccination of milch cattle, (iii) Adoption of improved cattle breeds, and (iv) Providing or facilitating credit services to PGs such as animal insurance, soft loans, etc.

In regards to the sustenance of developed de-centralized micro-dairies post-pilot support, the key operators of the dairy must understand their local market dynamics, more precisely, (i) The pattern of annual variation of demand and supply, (ii) Periods of peak and low demand along with the development of secondary dairy products with larger shelf life from the surplus, (iii) Daily supervision of quality and grade of sold milk and allied products, (iv) Showcasing of products at local, regional, and national platforms for improved visibility, and (v) Even leveraging online platforms for selling of goods. Further, rather than opting for a salary-based system to run the micro-dairy avenues, a commission-based model should be opted for from the very points of collection, transportation, processing, and sale (Negi et al., 2021). This shall improve the degree of ownership among the people in charge, irrefutably, augmenting the business and visibility of the enterprise in the market. Moreover, provisioning for so-called 'spent' cattle, i.e., those which cannot be utilized for milch purposes, shall also be made at the SRC level. This may include the development of farms/ sheds in collaboration with government departments where the same may be kept and fed from the vegetable and fruit wastes from mandis, local markets, etc. This shall not only contribute to waste management but shall also control the nuisance due to stray cattle. Furthermore, excreta from these cattle can be easily utilized for the generation of biogas and the spent slurry from the biogas reactors can be used to develop compost/ vermicompost. Additionally, integration of other activities like poultry farming of fowl, ducks, etc. with these spent cattle sheds/ ventures can make them self-reliant. Besides, the development of decentralized micro-dairies & feed units, the incorporation of other avenues like semi-intensive goat farming, backyard poultry, beekeeping, pisciculture, etc., may be someaddons for integration. The feasibility of these ventures may also be facilitated at the SRC level for improved uptake and upscale among the PGs towards further diversification of products, strengthening of livelihood, and added fiscal security.

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# Embracing dry farming for a greener future

**Background:** Geographical location and climatic patterns. India is an agrarian nation where the majority of the people depend on agriculture for a living. The droughts result in severe impacts on agriculture, which thus leads to reduced crop yields, livestock losses, and economic hardships for farmers. Thus, to overcome the losses dry farming can be a viable approach during drought conditions, as it depends on conserving soil moisture and utilizing the limited water available efficiently. By using approaches that promote water retention and minimize evaporation, dry farming can support crops survival rate and can be produced even in arid or drought-prone regions Drought is an ineradicable natural phenomenon in India, the susceptibility to drought is mainly due to its.

**Introduction:** Dry farming, also recognized as rain-fed farming or dryland agriculture, refers to agricultural practices that are acclimated to regions with less rainfall and water availability. In India, dry farming has a long prevalent history, where the local communities developed techniques to cultivate their crops in arid and semi-arid regions. The farmers of these regions used their indigenous knowledge and techniques to cope with confined water availability. These methods and techniques included contour ploughing, terracing, mulching, and water harvesting structures like tanks and ponds. The contribution of dryland agriculture is of utmost importance, as 44 per cent of the nation's total food production is coming from the drylands(Vijayan, Roshni (2016)Dryland Agriculture refers to growing of crops entirely under rainfed conditions. According to the extent of rainfall obtained , dryland agriculture can be categorised into three main categoriesi.e:

1. Dry Farming: Cultivation of crops in areas where rainfall is less than 750mm per annum

2. Dryland Farming: Cultivation of crops in areas receiving rainfall above 750mm

Rainfed Farming: Cultivation of crops in regions receiving more than 1,150mm In today's scenario dry farming continues to be practiced in various regions of India, exclusively in states like Rajasthan, Gujarat, Maharashtra, and in some parts of Karnataka and Andhra Pradesh. This practice plays a crucial role in ensuring food security and livelihoods for millions of farmers in these arid and semi-arid areas, adapting to the challenges posed by limited water availability and erratic rainfall patterns. Majority dry farming crops are millets suchas Jowaralso called as Sorghum, bajra (pearl millet), ragi (finger millet), oilseeds like mustard, rapeseed, and pulses like pigeon pea, gramand lentil. Dryland areas also contribute significantly to wheat and rice production. Thirty-three per cent of wheat and 66% of rice are still rainfed. With enhanced technology and scientific researches modern dry farming practices have advanced in India. Few such advances are the use of improved seeds, conservation agriculture techniques, soil moisture management, agroecology principles, and the integration of traditional knowledge with scientific innovations.



Fig. 1. Dry Land Crops: a) Jwar b) Bajra c) Ragi d) Mustard



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Table 1. Crops with various stress tolerances

Characteristics	Crop name
High temperature tolerance	Cotton, Ground Nut, Chilies, (favor Jute & Yams only in humid tropics)
Drought resistance	Common Millet, Barley, Chickpeas, Safflower (lower temperatures) Sorghum, Bullrush Millet, Phaseolus crops Radiatus (gram mung bean), Cassava, Castor Bean, Sesame, Ground Nut (Spanish variety), Pigeon peas, Sunflower
Lower temperatures favor	Wheat, Potato, Sugar, Tomato, Safflower
Very high rainfall tolerance	Rice, Cassava, Yam
Wide climatic tolerance	Maize, Soybean, Ground Nut (Valencia & Virginia type), Phaseolus lunatis, Kenaf, Hemp, Sweet Potato, Sugar cane, Tobacco

Dryland farming: crops & techniques for arid regions by randy creswell & Dr. franklin w. martin published 1993; revised 1998 by echo staff

In near future dry farming is likely to be a resultant of several factors, inclusive of the increasing global demand for food, water scarcity issues, and climate change. Dry farming techniques, which depend uponbarely adequate irrigation or exclusively on natural rainfall, can propose sustainable solutions in locations where water resources are scarce. Enhancement in technology can play a crucial role in the future of dry farming such as advanced irrigation systems, moisture sensors, and climate monitoring tools can help farmers revamp water usage and make more apprized decisions about planting and harvesting. Furthermore, genetic engineering and crop breeding programs may also be able to develop drought-resistant or droughttolerant crop varieties that prosper in arid conditions. As water dearth has been a pressing concern, efficient water managementstrategies like Implementing rainwater harvesting, micro-irrigation, and water recycling can help enhance the usability of present water resources. Dry farming often highlights the increased emphasis on regenerative agriculture practices to enhance soil fertility, reduce erosion, and improve overall ecosystem resilience. By modifying planting schedules, diversifying crops, adopting agroforestry practices, or utilizing climate-resilient crops that can withstand higher temperatures and water stress we can come closer in meeting the food needs of the world.

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### Apiculture-based livelihood in mountains: opportunities for uptake and upscale

Apiculture or Beekeeping is often regarded as an important resourcein the context of mountainous agriculture through provisioning of the pollination services. It is a direct contribution towards improving food security and the livelihood of mountainous households. This activity typically requires relatively very low acreages of land and complements other farming systems. Additionally, it assists not only in the conservation of forests & grassland ecosystems but also in combating soil degradation, i.e., more pollination, more seed, and more plants, thus, returning more biomass to the soil (Pratap, 2016). Though for most of the people services rendered via beekeeping in terms of pollination management and its auxiliary impacts are relatively oblique. Besides, contributing to pollination services, traditionally beekeeping in mountains has been a key source of honey and wax, which has supplemented not only the livelihood but also finds application in traditional medicine and culture.

Uttarakhand, one of the Indian Himalayan Region (IHR) states, holds three native species of honey bees, namely, the Asiatic honey bee (Apis cerana), rock bee (Apis dorsata), and dwarf honey bee (Apis florea), with the European honey bee (Apis mellifera) being an additional introduction. Of these, only two, i.e., Apis cerana and Apis mellifera are used for domesticated beekeeping ventures. The other two species are part of wild beekeeping enterprises which are typically carried in the Terai-Bhabhar and the Shivalik regions, respectively (Verma, 1992). In the mountainous region of Uttarakhand, traditional farming due to its increasing input costs and low returns, changing socio-economic demographics, and polity finds meager liberty in engaging the youth mass in respectable employment. Though many efforts of developing innovative livelihoods for the region have been made but achieved little success so far with sporadic individual examples thriving on their capacities, capital, and physical assets, hence, not up-taken and upscaled by the masses. Further, industrial outreach to this area has many economic impediments and ecological implications, therefore, finds limited applicability. However, with the advent of scientific and technological expertise, the scope for diversification for improved income flow has opened new avenues for developing sustained livelihoods. Among the traditional occupations, beekeeping (typically done in wall and log hives) with some modern integrations, is perhaps the most appealing and promising sector. This venture is relatively easy to diversify and holds room for improvement considering its (i) Low-cost investment module, (ii) Product diversity (honey, bee wax, bee venom, pollens, and propolis) with longer product shelf life, hence more resilient to sudden fall of demand over short durations, (iii) Low gestation period in terms of return flow, (iv) Less input in the context of managerial operations, thus, allowing the stakeholder to look for other avenues to engage in other income generating ventures, (v) Economic and ecological benefits, and (vi) Fewer stakeholders in the value chain from production to end users generating higher returns.

Despite the numerous benefits and technological advancements in the apiculture sector, beekeeping has still largely remained a traditional and under-tapped activity in this region and has not flourished and evolved to its full potential yet. It has been observed that beekeepers, still prefer traditional wall hives over modern bee hives despite low qualitative produce and high mortality of broods. Likewise, technical know-how of bee management in modern bee hives is relatively lacking, including hive managerial activities such as maintaining colony strength, colony division, an inspection of diseases, pests & predators, seasonal foraging requirements, and many more particularly related to extraction of different honey types (uni-& multi-floral), and the other hive products (GSDP, 2022). Further, thewaning agriculture of mountains accentuated with relatively small landholdings of marginal productivity has limited the forage availability for bees in lean seasons, thus, capping the capacity of the number of hives an individual may operate.

This stature, therefore, exigencies for the development of an apiculture-based enterprise that may act as a supplement or a passive income source to contemporary livelihood activities considering





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the diversity in topography, climate, floral resources, the knowledge base of traditional beekeeping, impediments of promoting migratory beekeeping, and scope of skilling the stakeholders for adapting more profitable modern beekeeping practices. A cluster-based enterprise operated by Producer Groups (PGs) between multiple villages may act well in this regard. This shall provide a platform for interested parties/ stakeholders to get hands-on with the desired technology/ equipment and necessary skills/training to manage their respective bee colonies and collect diverse products from the same (Gurung et al., 2012). Such clusters can provide effective hands-on communication, deliberation, and outreach to stakeholders who wish to upscale their traditional ventures into a commercial enterprise. Further, such enterprise can facilitate (i) Showcasing of diverse apiculture-based products at various levels, thus, improving market visibility and, (ii) Leveraging line schemes from the Department of Horticulture, State Bee Board, Khadi Gram Udyog Board, etc., towards benefaction of PGs. Additionally, well-developed apiaries under such PGs may offer ventures apart from conventional beekeeping products for supplementing revenue generation. These include, (i) Apiculturebased tourism and nature learning programs involving local hotels and travel agencies as publicizers, (ii) Transect walks with interested tourists and enthusiasts in bee farms providing them a real-time experience and hands-on over various aspects of beekeeping, a glimpse of 'field to table' concept, etc., and, (iii) Seasonal renting of bee hives and selling of excess swarms of desirable species to orchards owners as evidenced in Himachal Pradesh and Jammu & Kashmir. As harvest of honey, royal jelly, wax collection, etc., cannot be done throughout the year, therefore, new initiatives as discussed above shall act as gap fillers for existing conventional ventures, hence, aiding in revenue generation thus supporting the avenue during the lean time. Under the changing land use scenario where large-scale land parcels are usually leased or engaged for non-agricultural purposes, such as in the case of solar and wind farms, integration of apiculture-based enterprises may be explored towards optimizing the farm output. Following such product and enterprise diversification cum integration with other avenues then only a sustainable apiculture venture may be thought for the mountains.



**Fig. 1.** (i) Traditional capturing of a swarm of *Apis cerena*, (ii) A house hold-level apiary

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When researcher(s)writes a scientific article for publication in any journal, eventually as avery common procedure, it is required to arrange the manuscript (MS) as per the 'author's guidelines' of the selected journal. This process starts with reading the author's guidelines and preparing the MS according to a completely unique format. The most complicated part of arranging the MS according to the given guidelines is arrangement of 'references' which largely consists of puttingcomma, full stop, parenthesis, italic, bold etc. in different styles.Today, there are dozens of journals on a single subject and almost every journal has its own unique system of MS formatting. At times, it is very much acceptable that this process does not take much time; however, in some certain cases where the size of MS is large and it has a long list of references, the process of MS formatting essentially takes time and efforts.Nevertheless, in case, if the MS gets rejected from first journal thenre-arranging the entire MS according to another unique format seems of lesssignificanceas compared toimproving thescientific outcomes. An unfortunate but true fact is that sometimes this re-re-formatting delays the MS submission to weeks or more.

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### Boosting climate adaptation and resilience in the Himalayas through agriculture and soil management



Introduction: Today, universal food security and climate change adaptation, resilience and mitigation are very crucial. As we work to accomplish Sustainable Development Goals (SDG), especially SDG-2 for zero hunger and universal food security and SDG-13 for climate action, we must acknowledge their interconnectedness. Climate change poses a significant threat to our existing food systems, with potential consequences ranging from increasing frequency of extreme to unseasonal weather events. The agricultural sector, while providing sustenance, is also a substantial contributor to carbon emissions, which in turn aggravates climate change. In this context, it is crucial to address the challenges posed by carbon emissions due to agriculture, the impacts of carbon emissions on the environment through climate change, and the vulnerabilities of the fragile Himalayanecosystem to these changes. This article delves into these interconnected issues and explores potential solutions, particularly focusing on the adoption of climate-smart agricultural practices.

Carbon Emissions in Agriculture: Agriculture has long been essential for human survival, but it is now understood that it comes at a cost to the environment. A significant concern is the carbon emissions attributed to agricultural activities such as tilling and crop residue burning. Current estimates suggest that agriculture contributes upto 37% of total anthropogenic greenhouse gas emissions (GHG) (Mbow et al., 2019). These emissions result from practices such as deforestation, rearing of livestock, the use of synthetic fertilizers, etc.Potent greenhouse gases, such asmethane and nitrous oxide are released during fertilizer application and during the process of food digestion by livestock. Large-scale clearing of forests for agricultural purposesor the practice of shifting cultivation in North-East India also releases carbon stored in the soil into the atmosphere. As population and demand for food increases, these emissions are projected to rise unless effective mitigation strategies are adopted.

Vulnerabilities in the Himalayas: The Himalayas is a region of immense biodiversity and cultural significance andis particularly vulnerable to the risks associated with climate change. The region is already witnessing shifts in temperature and precipitation patterns, affecting crop yields and water availability. Glacial melt in the Himalayas contributes to water scarcity, affecting agricultural irrigation and drinking water supply, both whose effects are not restricted to the Himalayan region only. The region's rugged terrain and socioeconomic conditions pose further challenges to smooth adaptation to the changing circumstances. The livelihoods of millions are intricately linked to agriculture, making climate-induced disruptions particularly impactful. Extreme weather events, such as cloudbursts and flash floods, can devastate agricultural lands, especially in the hilly terrains of the Himalayas, further compromising food availability. In 2023, instances of unusual summer snowfall were observed in Jammu & Kashmir and Himachal Pradesh, followed by several instances of cloudbursts and subsequent flooding across the Western Himalayas, especially in Uttarakhand, Himachal Pradesh and even the cold desert of Ladakh. Apart from the risks to human life, livelihood and infrastructure, these extreme weather events also affect the yield of various seasonal crops in these areas. Climate- Smart Agriculture: A Way Forward: To address the complex interplay of carbon emissions, climate change impacts, and vulnerabilities, a proactive approach is necessary. One promising avenue is the adoption of climate-smart agriculture. This approach emphasizes the integration of technological, institutional, and participatory strategies to make agriculture more resilient to climate change while mitigating its impacts. Climatesmart villages, for instance, act as pilot projects that implement and test climate-smart agricultural practices. These practices include water-efficient irrigation, crop diversification, agroforestry, and improved soil management. The goal is to enhance both the productivity and sustainability of agriculture while reducing its carbon footprint. By adopting agroforestry practices, incorporating Fig.1. Paddy growing in a field under shifting cultivation

cover crops, and minimizing soil disturbance through reduced tillage, farmers can significantly enhance soil carbon sequestration, contributing to global efforts to combat climate change (Basu, 2017). Traditionally, Himalayan communities have relied on agriculture as a way of life having high vulnerability to climate impacts. About 97% of rural Himalayan households depend on agriculture and of these Himalayan farmers, about 85% are marginal and highly vulnerable to impacts of climate change. However, modern conventional farming practices often involve the excessive use of chemical fertilizers and pesticides. Such practices can degrade soil quality, disrupt the balance of beneficial microorganisms and contaminate water sources. Embracing organic farming techniques, which prioritize composting, crop rotation, and natural pest control, not only conserves soil fertility but also enhances the resilience of crops and reduces environmental pollution. Sustainable soil management in the Himalayas necessitates a community-centred approach. Local communities are the custodians of these precious landscapes and must actively participate in sustainable land use practices. Educational initiatives play a vital role in increasing awareness among communities about the importance of soil conservation. Integrating local knowledge and traditional wisdom allows for the adaptation of soil management techniques to the specific needs and challenges of the region. Steep slopes and fragile soils that have been shaped over millennia characterize the Himalayan landscape. The region experiences intense monsoon rains, which combined with deforestation, unsustainable agricultural practices and infrastructure development, lead to widespread soil erosion. The loss of fertile topsoil and sedimentation in rivers pose severe challenges to the region's ecological stability. Therefore, implementing erosion control measures such as terracing, contour farming and reforestation, is vital for safeguarding soil health and preventing landslides. The Himalayas are the source of several major rivers that provide water to millions of people downstream. Soil management is an integral part of watershed conservation. Protecting the soil from erosion and pollution helps maintain water quality and quantity, ensuring a sustainable water supply for both human and ecological needs. Finally, another option to support GHG mitigation strategies is through the sustainable disposal of agricultural wastes. Instead of burning, crop wastes can be composted or used as cattle feed. They can also be used as sources for bioenergy. Agrowastes can also serve as resources for the production of biochar, biocompost, bioenzymes, biofertilizers, bioplastics, briquettes and other products (Handique et al., 2022). The Himalayas are known for their extraordinary biodiversity, boasting numerous plant and animal species found nowhere else on Earth. Healthy soils play a pivotal role in supporting this biodiversity by providing essential habitats for various organisms and acting as a source of nutrition for plants. Conserving soil health, therefore, becomes indispensable for the survival of rare and endemic species that rely on specific soil conditions for their existence (Das et al., 2016).







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1 दिक्षि उत्तराखण्ड में पानी तथा आवश्यक पोशक तत्व खनिज लवण की कर्मी से फसलों का उत्पादन दिन–प्रतिदिन कमी हो रहा है, जिससे कृषि आय में कमी आ रही है तथा कृषि पर आधारित पलायन तेजी से निचले, शहरों में रोजगार की खोज केलियें हो रहा है, जिस वजह से उत्तराखण्ड के गांव से पलायन तेजी से हो रहा है। उत्तराखंड के परिपेक्ष में हाइड्रोपोनिक विधि के संबंध में अवगत कराना है कि इस विशेष विधि से खेती करने पर आवश्यकतानुसार पो ाक तत्व तथा पानी का कम उपयोग होता है तथा सब्जियों की उत्पादन क्षमता में वृद्वि होती है तथा उत्तराखण्ड के परिपेक्ष्य में यह खेती करना यहां के वातावरेंण के अनुकूल है। उत्तराखण्ड के पर्वतीय क्षेत्रों में इस विधि से खेती करके फुसलों के उत्पादन को बढ़ाया जायेगा जिससे रोजगार के अवसर भी बढ़ेंगें। वर्तमान में उत्राखण्ड में हाइड्रोपोनिक की खेती का अभाव है जबकि विदेशों में जैसे– अमेरिका, आस्ट्रेलिया, कनाडा, इजराइल, मास्को, में इस खेती से वहां की मुद्रा में इजाफा हुआ है तथा किसानों की आय दिन–प्रतिदिन बढ़ गयी है तथा उन्नत किस्म की फसलों का उत्पादन हो रहा है। उत्तराखण्ड में पानी तथा खनिज लवण की कमी से फसलों का उत्पादन दिन–प्रतिदिन कम हो रहा है, जिससे कृषि आय में कमी आ रही है तथा कृषि पर आधारित पलायन तेजी से निचले शहरों में रोजगार की खोज में हो रहा है, जिससे हमारे गांव विगत दिनों से खाली हो गये है। हाइड्रोपोनिक विधि से खेती करने पर पानी की कम आवश्यकता होती है तथा संब्जियों, फसलों की उत्पादन क्षमता में वृद्वि होती है तथा उत्तराखण्ड के परिपेक्ष्य में यह खेती करना यहां के वातावरण के अनुकूल है। उत्तराखण्ड के पर्वतीय क्षेत्रों में इस खेती से फसलों के उत्पादन को बढा सकते है तथा जिससे रोजगार के अवसर भी बढ़ेंगे तथा गांव का पलायन भी रूकेगा। वर्तमान में यूकॉस्ट में विभिन्न प्रकार की सब्जियों का उत्पादन किया जा रहा है। हाइड्रोपोनिक विधि का पूरा मॉडल/ढ़ांचा तैयार हो गया है तथा इसी कम में इस खेती को प्रोत्साहित करने के लिये किसानों, विद्यार्थियों को इसकी उपयोगिता के बारे में जानकारी देना अतिआवश्यक है। इस अनूसंध ान उद्देश्य शोधार्थियों, विद्यार्थियों, विभिन्न संस्थाओं और आम जनमानस में विज्ञान लोकव्यापीकरण के माध्यम से वैज्ञानिक चेतना का प्रचार प्रसार करना है, जिसके लिए समय समय पर कार्यशालाएं, सेमीनार, संगोष्ठियों और कौशल विकास प्रशिक्षण कार्यक्रमो का आयोजन किया जा रहा है। विज्ञान आधारित ग्राम्य विकास द्वारा सुदूर ग्रामीण अंचल में रहने वाली आबादी भी वैज्ञानिक शोध कार्यों से अवगत केरना है

et; 'lift%काश्तकार, आजीविका, हाइड्रोपोनिक विधि, वैज्ञानिक चेतना

ifp; & बढ़ती जनसंख्या मे बढ़ती खाद्य मांगों को पूरा करने एवं प्रादेशिक एवं राष्ट्रीय खाद्य सुरक्षा सुनिश्चित करने के लिये वर्ष 2050 तक खाद्य उत्पादन में 60 प्रतिशत की वृद्धि का अनुमान है। दुनिया भर में तेजी से बढ़ते शहरीकरण के कारण कृषि के लिये उपयुक्त प्राकृतिक संसाधन, अर्थात् कृषि योग्य भूमि और जल में कमी आ रही है। बढ़ती आबादी का खाद्य आपूर्ति के लिये न केवल मौजूदा

कृषि योग्य भूमि में खाद्य फसलों की उत्पादकता बढ़ाने की आवश्यकता है, बल्कि वैकल्पिक कृषि तकनीकों को प्रोत्साहित करने की भी आवश्यकता है। सरल शब्दों में हाइड्रोपोनिक्स का अर्थ है पोषक तत्वों के घोल में या एक अक्रिय माध्यम में पौधों को उगाना। यह एक मृदारहित कृषि प्रणाली है। पिछले कुछ दशको के दौरान हाइड्रोपोनिक्स के उत्पादों की मांग विशेष रूप से बढ़ी है, क्योंकि यह पर्यावरण और जलवायु कारकों को प्रभावित किए बिना उच्च गुणवत्ता की फसल उपज प्रदान करता है। हाइड्रोपोनिक प्रणाली में नियंत्रित परिस्थितियों में पूरे वर्ष में अधिकांश फसले उगाई जा सकती हैं इसलिए यह दुनिया भर में बढ़ती हुई खाद्य आपूर्ति को पूरा करने का सफल समाधान भी है। हाइड्रोपोनिक्स शोध बताते है कि हाइड्रोपोनिक्स आधारित खेती के माध्यम से पानी की खपत में 12.5 गुना की उल्लेखनीय कमी आती है। सोलर ग्रीन हाउस हाइड्रोपोनिक सिस्टम जो ऊर्जा की खपत कम करने में सहायक है तथा और हरित ऊर्जा का महत्वपूर्ण स्रोत है। इससे सतत उत्पादकता में भी अतिरिक्त रूप से कई गुना वृद्धि होगी और दूसरी ओर पारंपरिक बिजली के बिल में भी कमी आएगी।

हाइड्रोपोनिक शब्द दो ग्रीक शब्दों से मिलकर बना है, हाइड्रो अर्थात पानी और पोनिक मतलब कार्य करना। इस विधि में पौधों को उगाने के लिये आवश्यक पौषक तत्वों की संतुलित मात्रा को पानी के साथ मिलाकर पौधों की उपलब्धता सुनिश्चित की जाती है। हाइड्रोपोनिक प्रणाली में पौधों के लिए आवश्यक पौषक तत्वों को पानी में घोलकर नियमित तरीके से आवश्यक्तानुसार

**Conclusion:** The challenge of achieving universal food security while mitigating climate change demands a holistic approach that addresses the interconnected issues of carbon emissions, environmental impacts and regional vulnerabilities. The Himalayas serve as a poignant example of the urgent need to embrace climate-smart agriculture. By promoting sustainable farming practices that enhance resilience and reduce carbon emissions, we can strive to secure food systems, protect ecosystems and support communities in the face of a changing climate. As we work towards a sustainable future, recognizing and addressing these linkages will be crucial for the well-being of both current and future generations.



**Fig. 2.** Wild varieties of vegetables gathered from nearby forests in a market in Karbi Anglong, Assam



Fig. 3. Silkworms being fed eri (Ricinus communis) leaves; the pupa can be consumed as well as used to extract threads for weaving

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ENVIS Newsletter on Himalayan Ecology Vol. 20(2), 2023



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दिया जाता है। जिससे पौधे मिट्टी में उगने वाले पौधों से ज्यादा तेजी से वृद्धि करते है, क्योंकि हाइड्रोपोनिक में पौधे संतुलित मात्रा में विभिन्न प्रकार के पौषक तत्व लेते है तथा पौधों का मिट्टी से सीधा संपर्क न होने के कारण किसी भी प्रकार की मृदा जनित बीमारी नहीं होती है। इस प्रक्रिया में पानी का पुनर्चक्रण (त्मबलबसम) होता रहता है और पुनः प्रयोग किया जाता है, जिससे पानी की बचत भी होती है। विषम भौगोलिक परिस्थितियों वाले वातावरण जैसे कम उपजाऊ भूमि, पानी की कमी वाली जगहों आदि में हाइड्रोपोनिक पद्धति से पौधों, अधिक कीमत वाली गुणवत्ता युक्त सब्जियों का उत्पादन एक सफल प्रयोग साबित हो सकता है। हाइड्रोपोनिक विधि द्वारा पोषक तत्व सीधे ही पौधे को मिलते हैं जिससे पौधे अच्छी तरह से वृद्धि करते है और पौधों से उत्पादन भी अधिक होता है। हाइड्रोपोनिक विधि से उगाये गये फल सब्जी इत्यादि स्वादिष्ट और पोषक तत्वों से भरपूर होते हैं। क्योकि पोषक तत्वों की मात्रा फल तथा सब्जी में संतुलित मात्रा में दी जाती है।

यूकॉस्ट परिषद में स्थापित अत्याधूनिक सौर आधारित ग्रीनहाउस हाइड्रोपोनिक प्रणाली ऊर्जा की खपत कम करने में सहायक है और हरित ऊर्जा का महत्वपूर्ण स्रोत है और इससे सतत उत्पादकृता में कई गुना वृद्धि होगी। इस हाइड्रोपोनिक प्रणाली में एक बार में कुल 6000 से 7000 पौधे उगाये जा सकते हैं तथा यह फर्टिब्रिज ऑटोमेशन यूनिट से संचालित किया जाता है। इसके साथ ही 100 डच बकेट इँस प्रणाली में है जिसके द्वारा) स्वतः ही समय समय पर पोषक) तत्वों सही पीएच मापन व कुल विघटित ठोस (टी.डी.एस) के साथ ही पौधो को पोषक तत्वों डोजाट्रोन यूनिट से दिया जाता है। परिषद् का उद्देश्य शोधार्थियों, विद्यार्थियों, विभिन्न संस्थाओं और आम जनमानस में विज्ञान लोकव्यापीकरण के माध्यम से वैज्ञानिक चेतना का प्रचार प्रसार करना रहा है, जिसके लिए समय समय पर कार्यशालाएं, सेमीनार, संगोष्ठियों और कौशल विकास प्रशिक्षण कार्यक्रमो का आयोजन किया जाता रहा है। विज्ञान आधारित ग्राम्य विकास द्वारा सुदूर ग्रामीण अंचल में रहने वाली आबादी भी वैज्ञानिक शोध कार्यों से अवगत हो, यही हमारा उद्देश्य है। इसी क्रम में उत्तराखण्ड राज्य विज्ञान एवं प्रौद्योगिकी परिषद द्वारा "वाटर एनर्जी फूड नेक्सस (WEFN) सोलर –ग्रीन हाउस बेस्ड हाइड्रोपोनिक सोल्युशन विथ एंड्राइड मोबाइल एप्लीकेशन ऑफ वेजिटेबल मार्किट फॉर रूरल फार्मर्स एंड अर्बन यूजर्स" नामक यह परियोजना यूकॉस्ट (देहरादून, उत्तराखण्ड), टेरी स्कूल ऑफ एडवांस स्टडीज, नई दिल्ली, डी०ए०वी० (पी०जी०) कॉलेज, देंहरादून और जी०बी० पत यूनिवसिंटी ऑफ एग्रीकल्चर एंड टेक्नोलॉजी, पंतनगर, उधमसिंहनगर, उत्तराखण्ड के संयुक्त तत्वाधान से क्रियान्वित की जा रही है। तथा विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार, नई दिल्ली के जल तकनीकी पहल कार्यक्रम द्वारा वित्तपोषित है। परियोजना के अंतर्गत देश का पहला अत्याधुनिक सुविधाओं से परिपूर्ण स्वचालित सोलर ग्रीनहाउस आधारित हाइड्रोंपोनिक्स सेटअप की स्थापना की गयी है, जिसका उद्देश्य कम ऊर्जा व कम पानी में अधिकतम कृषि उपज के उत्पादन का समाधान खोजना और शोध कार्य करना है, इसी परियोजना के अंतर्गत ग्रामीण किसानो और शहरी उपभोक्ताओं को अत्याधुनिक खेती की तकनीकों से अवगत कराने हेतु, 'हाइड्रोपोनिक कृषि उत्पादों के भाव और मंडी' बाजार सम्बन्धी जानकारी उपलब्ध कराने हेतु और कृषि उत्पादो के क्रूय–विक्रय में सहायता हेतु एक एंड्रॉइड् मोबाइलू एप्लिकेशन भी विकसित की गयी है। इस मोबाइल एप्लीकेशन में किसान, व्यापारी मध्यस्थ और ट्रांसपोर्टर्स आदि निःशुल्क में अपना रजिस्ट्रेशन कराकर कृषि उत्पादों के क्रय–विक्रय सम्बन्धी सभी जानकारी हासिल कर सकते हैं। यह डिजिटल कृषि की और अग्रसर होने में एक सक्षम कदम है। यह हाइड्रोपोनिक प्रणाली उद्यमिता या व्यवसाय मॉडल के रूप में उपयोग करने की क्षमता रखता है तथा उत्तराखंड सहित अन्य हिमालयी राज्यों में पहाड़ी किसानों और युवाओं के लिए बेहतर आजीविका के अवसरों की प्रतिकृति विकसित करने में सहायक होगा। सौर–आधारित हाइड्रोपोनिक प्रणाली के इस मॉडल को राज्य के दूरस्थ क्षेत्रों में स्थापित किया जा सकता है जहां बिजली की कम आपूर्ति प्रमुख मुद्दों में से एक है। इससे पहाड़ी किसानों की व्यक्तिगत आय में वृद्धि होंगी और दूरस्थ क्षेत्रों में रोजगार के नए अवसर सृजन करने में सहायता मिलेगी। इस तरह की वैज्ञानिक पद्धतियां रोजगाँर के लिए किये जाने वाले पलायन को कम करने में मददगार साबित हो सकती हैं।



fp=- 1- न्यूट्रिएंट फिल्म तकनीक (एन.एफ.टी.) से पत्तेदार सब्जी का उत्पादन

यूकोस्ट, देहरादून के परिसर में 6000 वर्ग फुट क्षेत्र में आधुनिक सौर ग्रीनहाउस आधारित हाइड्रोपोनिक्स सिस्टम स्थापित किया गया है।

आज के समय में खेती के क्षेत्र में नई—नई तकनीकों का प्रयोग कर खेती करने का चलन तेजी से हो रहा है ऐसे ही एक और नई तकनीक वर्टिकलध्खडी खेती का है देश में लगातार कृषि योग्य भूमि की दर के कम होने की स्थिति में कम जगह में अधिक पैदावार वाली खेती की तकनीकों की आवश्यकता बढ़ी है इसको देखते हुए वर्टिकल खेती का चलन तेजी से बढ़ा है यूकोस्ट, देहरादून में विभिन्न तकनीकों का उपयोग करके सामान्यतया वर्टिकलध्खड़ी खेती प्रणाली द्वारा (चित्र 1.) न्यूट्रिएंट फिल्म तकनीक (एन.एफ.टी.) से 400 पौधे ए फ्रेम (A Frame) एनएफटी तकनीक से और 100 पौधे (चेरी टमाटर, रंगीन शिमला मिर्च आदि) डच बकेट सिस्टम (चित्र 2.) का उपयोग करके उगाये जा सकते हैं। एनएफटी चैनल पर उगायें जाने वाले पौधे फरटिब्रिज स्वचालित सिस्टम से और डच बकेट पर उगाये जाने वाले पौधे स्वचालित सिस्टम से संचालित होते हैं। ग्रीनहाउस में फैन और कुलिंग पैड प्रणाली है जिसमें आवश्यकता के अनुसार तापमान, प्रकाश और सापेक्ष आर्द्रता को नियंत्रित किया जा सकता है। प्रकाश को नियंत्रित करने के लिए ग्रीनहाउस में 600 वाट प्रकाश संश्लेषक सक्रिय विकिरण (PAR) लैंप लगाए गए हैं और मोटर चालित आंतरिक छायांकन स्क्रीन का उपयोग करके बाहरी प्रकाश को कम किया जा सकता है। सर्दियों के दौरान हीटर का उपयोग करके तापमान बढ़ाया भी जा सकता है। प्रोग्रामेबल फॉगिंग सिस्टम का उपयोग करके आर्द्रता को बढ़ाया जा सकता है। पौधों की वृद्धि से संबंधित इन सभी पर्यावरणीय मापदंडों को नियंत्रण प्रणाली का उपयोंग करके नियंत्रित और रिकॉर्ड किया जा सकता है। परियोजना में जल, ऊर्जा, खाद्य (WEFN) नेक्सस के तहत, सौर आधारित हाइड्रोपोनिक प्रणाली के द्वारा बेहतर उच्च मूल्य वाली सब्जियों और फसलों के लिए पानी और ऊर्जा की खपत का आंकलन किया जा रहा है ताकि स्थानीय किसानो की पानी और ऊर्जा की खपत को कम करके बेहतर आर्थिक लाभ सुनिश्चित किया जा सके। परियोजना टीम द्वारा देहरादून घाटी के विभिन क्षेत्रोॅ में सूची (इन्वेंटरी) सर्वेक्षण द्वारा फसलों की जानकारी एकत्रित की गयी है और देहरादून में हितधारको की बैठकों का आयोजन भी किया गया है। इस परियोजना के अंतर्गत देहरादून घाटी में विभिन कृषि पद्धतियों का अध्ययन, बिजली और पानी की मूल्य निर्धारण नीति का मूल्यांकन और अध्ययन क्षेत्र में पायी जाने वाली उच्च मूल्य की सब्जियों तथा फर्सलों की जानकारी हेतु विभिन्न क्षेत्र–सर्वेक्षण आयोजित किये गए हैं। सर्वेक्षण के लिए गाँवों का चयन देहरादून जिले की जनगणना रिपोर्ट और दून घाटी की कृषि जनगणना के आध ार परें किया गया है। सर्वेक्षण में उन गाँवों को शामिल किया गया जो कृषि प्रधान हैं और जहाँ कृषि आधारित औद्योगिक उत्पादन ज्यादा है। इस अध्ययन में देहरादून घाटी के 31 गांवों, 61 किसानों और 190 से ज्यादा फसलों का अध्ययन किया गया है। इसके अंतर्गत 10 प्रमुख फसलों (5 रबी और 5 खरीफ़) में कृषि कार्यों की समीक्षा भी की जा चुकी है जो उत्तराखण्ड के मैदानी और पहाडी क्षेत्रों में जल ऊर्जा खाद्य नेक्सर (WEFN) को नियंत्रित कर रहे हैं और पहाडी क्षेत्रों में सिंचाई सम्बंधित समस्याओं और दन घाटी के मैदानी क्षेत्रों में घटते भूजल के आधार पर स्थानीय किसानों की फसलों की पसंद का आंकलन और ग्रिड आधारित ऊर्जा के माध्यम से उनकी ऊर्जा और पानी की खपत का अध्ययन किया जा रहा है । इस लैब–कम सोलर ग्रीन हाउस का उद्धेश्य हिमालयी किसान समुदाय में जागरूकता और नवीनतम प्रौद्योगिकी का प्रचार-प्रसार करना है। परियोजना के तहत डिजिटल कृषि अपनाने और किसानो को डिजिटल साक्षर बनाने के लिए एक WEFN मोबाइल एप्लीक्नेशन





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भी विकसित की गयी है ताकि वह भी डिजिटल भारत मिशन में अपना सक्रिय सहयोग कर सकें। भविष्य में इस अध्ययन में पहाड़ी क्षेत्रों में उगाई जाने वाली विशिष्ट फसलों और उनकी किस्मों की पहचान की जाएगी और उच्च मूल्य वाली सब्जी फसलों और पारम्परिक खेती द्वारा उगाई जाने वाली उच्च आय की फसलों तथा दुर्लभ प्राकृतिक औषधियो पर भी शोध कार्य किया जायेगा। जिन्हे स्मार्ट हाइड्रोपोनिक प्रणाली के तहत उगाया जा सकता है। भविष्य में यह हाइड्रोपोंनिक सिस्टम कृषक प्रशिक्षण केंद्र का कार्य करेगा। इस आधुनिक हाइड्रोपोनिक सेटअप की प्रतिकृति / मॉडल समूचे उत्तराखंड और सभी हिमालयी राज्यो के लिए उपयुक्त होगी और यह हिमालयी राज्य उत्तराखंड के लिए एक संपत्ति होगी जो किसानो के कौशल विकास में महत्वपूर्ण भूमिका निभाएगी। कृषि विस्तार और बेहतर आजीविका सृजन को बढ़ावा देने के साथ यह सेटअप आधुनिक खेती के गुर भी सिखायेंगा जिससे उच्च गुणवत्ता वाली आधुनिक तकनीको की जानकारी युवाओ और छोटे उद्यमियों प्रगतिशील किसानो को होगी और पर्वतीय क्षेत्रों से पलायन रोकने में भी सहायता मिलेगी। यह सौर ग्रीन हाउस हाइड्रोपोनिक सेट्अप भविष्य में किसान प्रशिक्षण केंद्र एवं शोध केंद्र का कार्य करेगा जिसके अंतर्गत सौर ग्रीनहाउस आधारित हाइड्रोपोनिक खेती की जानकारी, महत्त्व और विभिन्न आधुनिक हाइड्रोपोनिक तकनीको पर वैज्ञानिको और विषय विशेषज्ञो द्वारा व्याख्यान तथा प्रशिक्षण कार्यक्रम भी आयोजित किये जायेंगे।

**ghMi Gull ilid rB&** पौधों के लिए विभिन्न प्रकार के पोषक तत्व बनाये जाते है। इन पो ाक तत्वों को बनाने के लिए साफ खाली बर्तन में थोड़ा गरम पानी डाला जाता है तथा विभिन्न प्रकार के तत्वों को भिन्न–भिन्न मात्रा में बर्तन में एक–एक करके डाला जाता है। जब एक तत्व अच्छी तरह से धुल जाये तभी दूसरा तत्व डालें, पूरा विलयन बन जाने के बाद पानी में घुलनशील तत्वों को ई.सी. और टी.डी.एस./

S. No	illid rlo	<b>ek</b> ⊧kgm
1.	कैल्शियम नाइट्रेट	9.5
2	सल्फेट आफ पोटाश K2804	0.7
3	मोनोपोटेशियम फास्फेट Kn₂Po₄	1.39
4	मैग्नीशियम सल्फेट $MgSO_4(7H_2O)$	2.42
5	आयरन चिलेटेउ ट्रेस एलिमेंट	0.4
6	आयरन (Fe)	7%
7	मैग्नीज (Mn)	2%
8	जिंक (Zn)	0.4%
9	dkWij (Cu)	0.10%
10	बेरोन (B)	1.30%
11	मोलिब्डेनम (Mo)	0.06%

पी.पी.एम. मीटर से जाँच करते है। तथा आवश्यकतानुसार पौधे को दिए जाते है।

- हाइड्रोपोनिक्स कृषि के फायदे–
- –शून्य–कीटनाशक उत्पादन
- –जल संरक्षण
- –सतत् खेती को सुगम बनाना
- कम जगह में अधिक पैदावार/स्थान का उचित उपयोग
- बहुमंजिला खेती
- खरपतवार मुक्त खेती
- पोषक तत्वों की निरंतर आपूर्ति
- जलवायु परिवर्तन का समाधान
- 14

- तीव्र वृद्धि दर
- -संरक्षित खेती में रोजगार
- इंडोर/आउटडोर सेट–अप में खेती

♥Щ5& उत्तराखंड राज्य विज्ञान और प्रौद्योगिकी परिषद (यूकाँस्ट), देहरादून सूचना प्रौद्योगिकी, सुराज एवं विज्ञान प्रौद्योगिकी विभाग उत्तराखंड भाासन एवं डब्ल्यू ई एफ एन, डब्ल्यू टी आई, डी एस टी, भारत सरकार, नई दिल्ली

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प्रशिक्षण मैनुअल, जैव प्रौद्योगिकी परिषद्, उत्तराखंड भाासन हल्दी पन्त नगर उत्तराखंड भारत।

प्रशिक्षण मैनुअल उत्तराखंड राज्य विज्ञान और प्रौद्योगिकी परिषद (यूकॉस्ट), देहरादून सूचना प्रौद्योगिकी, सुराज एवं विज्ञान प्रौद्योगिकी विभाग उत्तराखंड ,भारत।



fofiu d**qlj** lrhjo**Sll**yh'l**ell**jujseuxhjlfer i**jl**(gr²j txolj flgyloly²j vklqkkfeJk,oanq2kitř<sup>1</sup>

'उत्तराखंड राज्य विज्ञान और प्रौद्योगिकी परिषद (यूकॉस्ट), देहरादून सूचना प्रौद्योगिकी, सुराज एवं विज्ञान प्रौद्योगिकी विभाग, विज्ञान धाम झाजरा, देहरादून, उत्तराखंड, भारत

²जैव प्रौद्योगिकी परिषद्, हल्दी पन्त नगर, उत्तराखंड, भारत

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छिरगाड़ नदी, गैर हिमानी कोसी नदी जलागम के गणनाथ रिचार्ज जोन के अर्न्तगत प्रवाहित नदी हैं, जो अल्मोड़ा जिले के ताकुला विकासखण्ड में स्थित नाई ढौल ग्राम सभा में पेयजल का मुख्य स्रोत हैं, जिससे नाई धुरापाट क्षेत्र सहित रा0इ0का0नाई, अल्मोड़ा में पेयजल एवं रिचाई की आपूर्ति होती हैं। छिरगाड़ नदी जलागम का भौगोलिक स्थिति 29 36'46'' उत्तरी अक्षांश एव 79 41'36'' पूर्वी देशान्तर हैं। समुद्र तल से इस क्षेत्र की ऊचाई लगभग 1717 मीटर हैं तथा छिरगाड़ नदी जलागम का प्रवाहित क्षेत्र लगभग 7 किमी0 हैं। छिरगाड़ नदी जलागम की सहायक नदियाँ (स्थानीय भाषा में गधेरे) एवं प्राकृतिक जल स्रोत बहुत हैं जैसे–दनगड़ गधेरा, एडीथान गधेरा, तालखनि गधेरा, तलछिती गधेरा, थैइखाव गधेरा, औध्योखाव गधेरा एवं बाटव गधेरा इत्यादि है (चित्र–1)।



**fp= &1** छिरगाड़ नदी जलागम के अपवाह क्षेत्र का मानचित्र

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छिरगाड़ नदी जलागम के बारे में वैज्ञानिक एवं सामाजिक अध्ययन करने के बाद ज्ञात हुआ कि आज से लगभग 25 वर्ष पूर्व छिरगाड़ नदी जलागम में वर्ष भर जल प्रवाहित होता था, इसमें मछलिया तैरती थी, स्थानीय लोग इस नदी में नहाते थे तथा भिमल वृक्ष की टहनियाँ रेशे की प्राप्ति हेत भिगोने के लिए 3–4 माह नदी में डालते थे लेकिन वर्तमान में यह नदी लगभग सूख चुकी है और यह क्षेत्र जल संकट से ग्रसित क्षेत्र बन चुका हैं। इस नदी के पुनर्जनन एवं संरक्षण की अति आवश्यकता है। यदि समय रहते इनके समाधान हेतु कार्य नहीं किया गया तो भावी भविष्य मे स्थिति गम्भीर हो सकती है।

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छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण हेतु कुशल प्रबन्धन, वैज्ञानिक एवं तकनीकी युक्त संसाधनों (उपकरणों) एव तार्किक विचारों की आवश्यकता है जिससे नदी जलागम के पुनर्जनन एवं संरक्षण का सतत पोषणीय विकास हो सके। सभी शासकीय, प्रशासनिक विभागों, वैज्ञानिकों एवं शैक्षणिक संस्थानों के साथ—साथ समाज के बुद्धिजीवियों, विषय विशेषज्ञों, वैज्ञानिकों, समाज सेवियों, जनप्रतिनिधियों, शिक्षकों एवं विद्यार्थियों के अहम योगदान से छिरगाड़ एवं अन्य गैर हिमानी नदियों का पुनर्जनन एवं संरक्षण किया जा सकता है। यह लेख रा0इ0का0 नाई में कार्यरत शिक्षकों एवं विद्यार्थियों द्वारा किये जा रहे ऐसे ही एक अनोखी पहल का उदाहरण पेश करता है।

### ifjdYiuk

विद्यालय, समाज का एक लघु रूप है, जो समाज में जन चेतना तथा परिवर्तन में अहम भूमिका निभाता है। विद्यालय में अध्ययनरत विद्यार्थी प्रतिभाशाली, नवाचार तकनीकी एवं तार्किक विचार युक्त होते हैं तथा समाज में जन जागरूकता के प्रचार–प्रसार में ध्वज वाहक की भूमिका निभाते हैं। यदि इनका उपयोग या इनकी ताकत का सदुपयोग पर्यावरण के संरक्षण में किया जाये तो पर्यावरण का सतत पोषणीय विकास होने में कोई कमी नहीं रहे जाएगी।

अतः विद्यालयों के विद्यार्थियों, अध्यापकों व कर्मचारियों सहित समीपवर्ती गांवों के जन प्रतिनिधियों एवं स्थानीय ग्रामीणो विषेशकर महिलाओं में छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण हेतु जागरूकता निर्माण करना एवं इस विषय में कार्यशाला का आयोजन करके जलागम को संरक्षित करने के वैज्ञानिक तरीकों से उनको अवगत करना अति–आवश्यक है।



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1— माध्यमिक विद्यालयों में अध्ययनरत विद्यार्थियों को छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण के बारे में जानकारी प्रदान करने एवं जन जागरूकता हेतु एक कार्यशाला का आयोजन किया गया जिसके प्रचार—प्रसार हेतु विद्यार्थियों सहित शिक्षकों द्वारा जन जागरूकता रैली, पोस्टर, बैनर एवं पत्राचार का प्रयोग किया गया ताकि समाज में जनजागृति हो सके।

2-छिरगाड़ नदी जलागम के पुनर्जनन एवंसंरक्षण से सम्बंधित विषय पर विभिन्न माध्यमिक विद्यालयों में अध्ययनरत विद्यार्थियों के वैज्ञानिक तकनीकी युक्त मॉडलों, उपकरणों एव विचारा का प्रस्तुतीकरण या प्रदर्शन किया गया। साथ ही में इस विषय पर निबन्ध, भाषण, एवं चित्रकला प्रतियोगिता इत्यादि का आयोजन किया गया (चित्र – 2), जिसमे विद्यार्थियों ने अपने अनमोल विचार एवं कल्पनाये पेश की, जो इस जलागम क्षेत्र के विकास के लिए काफी कारगर साबित होगी और साथ ही में ऐसे कार्यक्रमों से विद्यार्थियों में पानी या नदी के संरक्षण के प्रति अच्छे संस्कार होने की आशा है।

3-छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण हेतु विषय पर आयोजित की गयी एक दिवसीय कार्यशाला में विशेषज्ञों (प्रो0 जे0 एस0 रावत, प्रसिद्ध जल विज्ञानी एवं जी.आई.एस. विशेषज्ञ, पूर्व नेशनल जियो चेयर स्पेशल प्रो्फेसर, विज्ञान एव प्रौद्योगिकी विभाग, भारत सरकार एवं तकनीकी सलाहकार, एन.आर.डी.एम.एस. अल्मोड़ा एव पूर्व विभागाध्यक्ष





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भूगोल विभाग, कु0वि0वि0, नैनीताल), वैज्ञानिक (ई. वैभव ए. गोसावी, वैज्ञानिक, गो.ब.पन्त राष्ट्रीय हिमालयी पर्यावरण संस्थान, कोसी–कटारमल, अल्मोडा), शासकीय व प्रशासनिक अधिकारियों एवं जनप्रतिनिधियों के वैज्ञानिक एवं तार्किक विचार युक्त व्याख्यानों का आयोजन किया गया





### नदी पुनर्जनन हेतु भुमिगत जल भण्डारों के रिचार्ज के लिए वर्षा संग्रहण की यांत्रिक विधि





जलसोत खाल (Infiltration Tani

पक्के चैक डैम (Check Dam)

(चित्र – 3), जिससे कार्यशाला में उपस्थित विद्यार्थी, शिक्षक अभिभावक सहित जन समुदाय लाभान्वित हो सके।

4–इस परिकल्पना का मुख्य बिंदु जिसमे छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण हेतू इस नदी जलागम क्षेत्र में विद्यार्थियों सहित शिक्षकों द्वारा यान्त्रिक एवं जैविक उपचार हेतु क्षेत्रीय कार्य जैसे–वृक्षारोपण, चाल, खाल, कन्टूर ट्रेंचेज (खन्तियां) इत्यादि निमार्ण कार्य किया गया (चित्र – 4),जिससे छिरगाड़ नदी जलागम के रिचार्ज जोनों में भूमिगत जल स्तर मे वृद्धि होगी,।

### Hø'; dhvklk

छिरगाड़ नदी जलागम के पुनर्जनन एवं संरक्षण हेतु इस नदी जलागम क्षेत्र

में यान्त्रिक एवं जैविक उपचार हेतु किये गए क्षेत्रीय कार्य जैसे–वृक्षारोपण, चाल, खाल, कन्टूर ट्रेंचेज (खन्तियाँ) इत्यादि से इस नदी जलागम के जल स्तर में वृद्धि होगीं तथा नदी पूर्व वर्षो की भांति प्रवाहित हो सकती है जिससे स्थानीय विद्यार्थियों व क्षेत्र वासियों को लाभ होगा। विद्यार्थियो को छिरगाड़ नदी जलागम के पुनर्जनन एव संरक्षण हेतू यांत्रिक व जैविकउपचारों की जानकारी, व्याख्यान, विभिन्न प्रतियोगिताओं एव मॉडलों / उपकरणों का प्रदर्शन एवं विचार प्रस्तुतीकरण से विद्यार्थियों के रचनात्मकता, नवाचार तकनीकी, तार्किक विचारो एवं वैज्ञानिक अभिक्षमता में वृद्धि होगी और वे भावी भविष्य में भी नदी जल संरक्षण के प्रति सजग व जागरूक रहेंगे एवं समाज में जन जागरूकता का प्रचार–प्रसार करेंगे जिसका लाभ अन्य विद्यार्थियों सहित सम्पूर्ण समाज को होगा ।

इस अनोखी पहल का उदाहरण क्षेत्र मेंअन्य नदियों के संरक्षण या पर्यावरण के संरक्षण एव प्रबंधन में किया जा सकता है ताकि समाज में जन जागरूकता बढे और सम्पूर्ण समाज को इसका लाभ हो।

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