



Proceedings of the Stakeholder Workshop for TEEBAgriFood Initiative in Uttarakhand, India

Discussion on Draft Integrated Scenario Modelling and Valuation Results



30th September 2023, Hotel Pacific, Dehradun, Uttarakhand, India

Background

TEEB, The Economics of Ecosystems and Biodiversity is a global initiative, hosted by United Nations Environment Programme (UNEP) that seeks to recognize, demonstrate, and capture values of ecosystems and biodiversity, in both monetary and non-monetary terms. It aims to achieve this goal by following a structured approach to valuation that helps decision-makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrate their value in economic terms and where appropriate, capture those values in decision-making.

TEEB for Agriculture and Food (TEEBAgriFood) framework is an offshoot of the TEEB framework and is specifically applied to food systems. Unlike traditional assessments in the food and agricultural sector limited to farm-level evaluations, often overlooking the interconnectedness between the environment and the food system, the TEEBAgriFood framework emphasizes the need for a comprehensive approach to address long-term sustainability and equity concerns in relation to food supply, human health, and nature. It recognizes the diverse elements involved in the eco-agri-food system, including ecosystems, agricultural lands, farmer livelihoods, infrastructure, technology, policies, culture, and institutions.

The TEEBAgriFood framework applies a capitals approach to build resilience, mainstream best practices, protect biodiversity and contribute to a more sustainable food system. The four capitals include – produced capital, natural capital, human capital and social capitals. This holistic strategy of addressing these four capitals together intends to create avenues for supporting various national and international commitments, including most of the sustainable development goals, while also providing an efficient mechanism for implementing an effective system of true cost accounting, where the environmental, social, cultural, and economic cost and benefits are considered, leading to a more comprehensive understanding of the actual cost of consumption and production.

In India, the TEEBAgriFood project is guided by the Project Steering Committee (PSC) co-chaired by the Ministry of Agriculture and Farmers Welfare (MoAFW) and the Ministry of Environment, Forests and Climate Change (MoEFCC). As per the guidance of the PSC, the project focusses on evaluating the environmental and socioeconomic costs and benefits of scaling programmatic interventions of the Government of India on organic farming and agroforestry in three states, namely the Ganga basin states of Uttar Pradesh and Uttarakhand, and Assam in the Northeast Region of India. The analyses will contribute to informing national and state priorities and commitments such as Doubling Farmers Income, crop diversification, Nationally Determined Contribution (NDC) on carbon sequestration through increase in tree cover, land degradation neutrality and biodiversity conservation targets.

The TEEBAgriFood project in India aims to inform planning processes by providing comprehensive scientific evidence to support food and agricultural policies in the country with the help of modelling and valuation studies conducted across various scenarios developed in accordance with the policy interventions for upscaling organic farming and agroforestry at a 10-year interval till 2050. The scenarios are being modelled for 2030, 2040, and 2050 under six scenarios i.e., business as usual (BAU), optimistic and pessimistic at RCP 4.5 and RCP 8.5 each, taking 2020 as the base year.

G.B. Pant University of Agriculture and Technology (GBPUAT) is the research partner in Uttarakhand undertaking the TEEBAgriFood assessment for the state. The TEEBAgriFood assessment in Uttarakhand has previously benefited from the stakeholder workshop held in the state on 27th September 2022. The workshop aimed to determine the scope of the project and prioritized elements of natural, produced, social and human capital to be assessed. Following the finalization of

the scoping and scenario setting for the TEEBAgriFood application in Uttarakhand, the G.B Pant University of Agriculture and Technology has carried out extensive modelling and valuation studies utilizing the TEEBAgriFood framework. These draft integrated scenario modelling results of the study in Uttarakhand were shared at the second stakeholder consultation in Uttarakhand organized on the 30 September 2023, aiming to obtain feedback from a diverse group of stakeholders, validate the findings, and ensure their alignment with national and global priorities.

The workshop brought together varied stakeholders to deliberate on the preliminary findings of comprehensive scenario modelling and assessment of prioritized elements of four capitals. It aimed to –

- Discuss and receive inputs on the draft results of scenario modelling and valuation assessment in Uttarakhand.
- Engage in discussions with policymakers to explore the linkages of the TEEBAgriFood assessment with ongoing government flagship programs and related projects aimed at expanding organic farming and agroforestry.
- Discuss the national and local context of agriculture and environmental policy to ensure the policy relevance of TEEBAgriFood India and discuss the key policy entry points for the TEEBAgriFood Initiative at both national and state levels.

The valuable contributions from varied stakeholders served to discuss the findings and their applicability to agri-food systems in the state and it was useful in establishing synergies with national priorities and also encouraged collaboration amongst decision-makers through the discussion of results, methodologies, and approaches. These inputs will ultimately be incorporated into the finalization of the TEEBAgriFood assessments and synthesis report for Uttarakhand, India.

Session 1: Opening and Special Remarks

Welcome Remarks:

Dr. JP Jaiswal, Director, Extension Education and the Principal Investigator of TEEBAgriFood initiative in Uttarakhand, initiated the consultation by extending a warm welcome to the chairman of the session, Dr. Man Mohan Singh Chauhan, Vice-chancellor, GB Pant University of Agriculture & Technology, Pantnagar, dignitaries on the dais and off the dais, and attendees. He introduced the TEEB initiative (The Economics of Ecosystems and Biodiversity) funded by the European Union. Dr. Jaiswal highlighted the TEEBAgriFood project's implementation in Assam, Uttar Pradesh, and Uttarakhand and emphasized on the project's core objectives, focusing specifically on upscaling organic farming and agroforestry practices in the state through policy support.

Special Remarks:

1. Dr. Kapil Lall, Additional Chief Conservator of Forests:

Dr. Lall, Additional Chief Conservator of Forest, Government of Uttarakhand delivered the special remarks, extending to the esteemed international and national dignitaries in attendance, and began by highlighting the major concerns in the state; rural to urban migration and the importance of upscaling organic farming and agroforestry practices in the state. He highlighted high rate of rural migration in the state and the decline in rural populations is a major challenge in the state of Uttarakhand, especially in the hilly districts. However, women participation is observed to be increasing highly in these areas especially in the agriculture sector. Further he added by saying that

Uttarakhand is a state with varied agro-ecological zones. Talking out the various agro-climatic zones variability in Uttarakhand he talked about exploring different zones to upscale the measures specific for the area. He also talked about the future variability especially in the changing climate scenario and how that will impact the natural resources and the associated costs in future.

2. Dr. SS Negi, Director, Department for Prevention of Migration Commission:

Dr. Negi, the Director of the Prevention of Migration Commission under the Government of Uttarakhand, spoke to the audience about the concerning problem of migration from rural to urban areas in Uttarakhand. He discussed the main causes and obstacles leading to the desertion of villages, with some areas having as few as 10 residents. Dr. Negi emphasized that this situation has prompted the government to establish the "Prevention of Migration Commission" in the state. He shared the following points for support:

- There is a huge disparity between plain districts like Dehradun and Haridwar, which have experienced doubling of population numbers due to urbanization, and hilly areas like Rudraprayag and Haridwar, where the difference is fourfold, revealing the significant migration of rural populations to urban centres. The Human Development Index indicates a disparity between developed districts like Dehradun, Haridwar, and US Nagar, while hill districts lag behind. Outmigration has resulted in numerous ghost villages, leaving rural populations in dire straits.
- Reasons behind hill area outmigration encompass factors such as low agricultural earnings, limited irrigation, fragmented land holdings, climate change impacts, and wild animal interference. Aspirations for a better life and a lack of regular employment opportunities have driven this trend. Additionally, the quality of health services, education, and the burden of women's labour contribute to the challenges faced by rural populations.
- Citing the census data on population figures, he focused attention on declining population notably in districts like Rudraprayag and Almora, with a decadal growth rate of approximately 17%. The decline is particularly prominent in rural populations, for instance, dropping by 4.29% in Rudraprayag and Almora. Subsequently, out of 17,000 villages, a staggering 1,700 are completely deserted, leading to the abandonment of agricultural fields. The average village population has plummeted to less than 100 residents, raising concerns about rural economy regeneration.
- Talking about the impacts on out-migration in the state, Dr. Negi mentioned that labour scarcity has become a pressing issue, with 60-70% of people, particularly women, relying on schemes like MNREGA for their livelihoods. The rural socio-economy faces challenges such as low-income levels, high poverty rates, a shortage of surplus agricultural produce, and a higher population of women compared to men.
- Women, constituting 70% of the labour force, struggle for empowerment and inclusion in decision-making processes. Traditional methods like fuelwood are still prevalent among rural women, while cooking gas is used sparingly due to economic constraints. Strengthening the rural economy is imperative, not only in hill districts but also in plains, where agricultural land is rapidly being converted into urban spaces.
- Dwelling on the Agricultural situation in the state, he mentioned a significant portion of the state's farmers (75%) are categorized as marginal farmers, possessing land holdings smaller than 1 hectare. Uttarakhand's agriculture sector faces declining trends, including reduced net sown area, low productivity, lack of quality seeds, damage from wild animals, and minimal crop rotations due to insufficient irrigation facilities. The primary sector's

contribution to the Gross State Domestic Product (GSDP) has dwindled to a mere 10%. Meanwhile, poultry farming, dairies, and fisheries sectors are experiencing growth, with the tertiary sector accounting for half of the state's economic output.

Ms. Neena Grewal, Project Director, Uttarakhand Watershed Management Directorate:

Ms. Grewal extended her congratulations to the GB Pant University of Agriculture and Technology and TEEB team for their extensive study, which has thrown light on the economic rationale for expanding organic farming and agroforestry. She noted that this research will serve as a guide for different departments, outlining strategies to promote the adoption of agroforestry and organic farming in Uttarakhand. She further emphasized the following points:

- There is increasing popularity of organic farming in the state, encouraging farmers to adopt these practices, which would mutually benefit both the farmers and the community by creating enhanced employment opportunities. The success of organic farming in places like US Nagar demonstrates its potential for broader implementation in hill areas.
- Addressing the issue of abandoned agricultural lands, she stressed the importance of focusing on horticulture, which presents a mutually beneficial opportunity. Agroforestry has also gained significant attention in this context. Encouraging farmers to transition towards organic farming and agroforestry was emphasized. She expressed eagerness to explore collaboration methods and implement these measures in the field, seeking partnerships and mutual learning opportunities.

Dr. Manmohan Singh Chouhan, Vice Chancellor, GB Pant University of Agriculture and Technology:

Dr. Chouhan addressed the audience by emphasizing the importance of partnership with state government departments for the successful implementation of any project. He added by highlighting the following points:

- Drawing on his experience in Uttarakhand, he emphasized the necessity for horticultural development in the hilly region due to the prevalence of small and marginal landholdings.
- Reflecting on his background in animal science, he shared his research findings related to mangroves. He pointed out a lack of coordination between the state government and TEEB project at GBPUAT as well as cited instances from his past projects. He noted that while projects are implemented at GBPUAT, the involvement of the state government is notably low. Additionally, he highlighted deficiencies in mineral distribution despite the provision of inputs.
- Discussing the importance of sustainable agriculture in the state of Uttarakhand, he expressed concern about the excessive use of fertilizers and pesticides, emphasizing the need for more sustainable agricultural practices.

Session 2: Presentation on TEEB and TEEBAgriFood Initiative in India

Mr. Reuben Gergan, Project Officer, TEEBAgriFood– UNEP

Providing a concise overview of The Economics of Ecosystems and Biodiversity (TEEB) and TEEB for Agriculture and Food Initiative in India, Mr. Gergan, Project Officer – UNEP outlined the scope of work in the three states in India – Uttarakhand, Uttar Pradesh and Assam and other countries through the EU Partnership programme. Explaining the aim of TEEB to capture, recognise and demonstrate the values of ecosystem services, Mr. Gergan added:

- There is an emphasis on need to quantify the economic worth of ecosystem services and elaborated on the applied TEEBAgriFood framework towards assessing changes in the capital base over time. Explaining the four elements of the framework – stocks, flows, outcomes, and incomes, Mr. Gergan added that the stocks of eco-agri-food systems comprise the four different “capitals” – produced capital, natural capital, human capital and social capital.
- In the context of India, the TEEBAgriFood framework is being employed in the states of Uttarakhand, Uttar Pradesh and Assam all falling under different agroclimatic zones with different demographic pressures specifically concentrating on agroforestry and organic farming. The analysis considers policy interventions by the government such as National Mission for Clean Ganga, National Agroforestry Programme, Paramparagat Krishi Vikas Yojana and Rashtriya Krishi Vikas Yojana. Assessing the monetary values of these programs when scaled up is an integral part of the TEEBAgriFood evaluations in the country. The outcomes of these evaluations will contribute to both national priorities and international commitments.
- Explaining that the scope of application of the TEEBAgriFood framework across various elements under different capitals can be extensive based on the study area these capitals assessed are prioritised that were finalised during the first stakeholder consultation for the state in 2022. Henceforth, the assessment in Uttarakhand focuses on decadal scenarios, which were similarly determined during the initial stakeholder consultation in the region and the national level. The scenarios explained are presented below:

Table 1: Scenarios for Hills in Uttarakhand

Business as Usual (BAU) Scenario	Pessimistic Scenario	Optimistic Scenario
<ul style="list-style-type: none"> • Builds on existing policies and initiatives (as of 2021) and SDGs implemented by the Uttarakhand Vision 2030. • Organic Agriculture: Organic farming increases from current 36% of total cultivated area to 65% of the total cultivated area as per the scaling potential. • Agroforestry: Area under agroforestry continues to be maintained at 12% of the cropped area in the study area. 	<ul style="list-style-type: none"> • Assumes the emergence of unforeseen factors that may possess threat to current goals and hamper the modernization and green transformation of Uttarakhand. • Organic Agriculture: Organic farming continues to cover 36% of the total cultivated area due to low yields and weak post-harvest processing infrastructure. • Agroforestry: Area under agroforestry reduces to 6% of the cropped area in the study area due to growing urbanisation and commercialisation. 	<ul style="list-style-type: none"> • Assumes progress in agricultural modernization by organic policies and initiatives implemented under UK Vision 2030. • Organic Agriculture: Organic farming increases to cover 95% of the total cultivated area based on Uttarakhand’s vision to establish the entire state as an organic state. • Agroforestry: Area under agroforestry grows at 3.5% per annum as per growth trends for agroforestry in the study area.

Table 2: Scenarios for Plains in Uttarakhand

Business as Usual (BAU) Scenario	Pessimistic Scenario	Optimistic Scenario
<ul style="list-style-type: none"> Builds on the existing policies and initiatives (as of 2021) and SDGs implemented by the Uttarakhand Vision 2030. Organic Agriculture: Organic farming increases to cover 38% of the state's total cultivated area (250,000 ha out of 647788 ha). Agroforestry: Area under agroforestry continues to be maintained at 12% of the cropped area in the study region. 	<ul style="list-style-type: none"> Assumes the emergence of unforeseen factors that may possess a threat to current goals and hamper the modernization and green transformation of Uttarakhand. Organic Farming: Organic farming continues to cover 4% of the total cultivated area (current status). Agroforestry: Area under agroforestry reduces to 6% of the cropped area in the study region to increase in urbanisation and land use change. 	<ul style="list-style-type: none"> Assumes progress in agricultural modernization by organic farming policies and initiatives implemented under UK Vision 2030. Organic Agriculture: Organic farming increases to cover 75% of the total cultivated area based on the scaling potential in the study area. Agroforestry: Area under agroforestry grows at a 3.5% per annum as per growth trends for agroforestry in the study area.

- Two specific study areas are identified for in-depth analysis, with a focus on various scenarios, including policy and climate considerations, specifically tailored for Uttarakhand. These two study areas include Kosi watershed majorly encompassing hilly districts and Kailash watershed majorly encompassing districts covered in the plains.
- The different elements covered under various capitals were explained of which in the state of Uttarakhand, under natural capital – soil erosion, carbon sequestration, water yield and nutrient export ratio were considered. Under produced crop and timber provisioning services under social and human capital soil health analysis and women's empowerment in agriculture index.
- Mr. Gergan added that the results of this study will serve in providing key insights for policymakers on the true value of organic farming and agroforestry practices compared as opposed to the conventional farming methods in Uttarakhand. By incorporating the values of biodiversity and ecosystem services into policies and decision-making, the project serves to highlight the social, economic and environmental value of scaling organic farming and agroforestry in the state.

Session 3: Presentation of Draft Results on Social and Human Capital

Dr. Jaiswal, Director, Extension Education, GB Pant University of Agriculture and Technology

Dr. Jaiswal commenced the discussion by presenting an overview of the TEEBAgriFood study in Uttarakhand. He highlighted the study's focus on two distinct watersheds: Sunkiya village in the hilly terrain of Nainital district, and Bidaura village in the plains of Udham Singh Nagar. The study aimed to demonstrate the advantages of organic farming without compromising crop yield. The trials

sought to educate farmers on producing their own organic inputs and encourage the use of high-quality biofertilizers and biopesticides. A demonstration plot study has been carried in two villages of the two watersheds; Sunkiya village, situated in the hilly terrain of Nainital district, and Bidaura village, located in the plains of Udham Singh Nagar. These two areas were chosen to represent contrasting geographical regions. He further added -

- The on-farm demonstration plot study also known as the front-line demonstration plot study is a unique study approach to provide a direct interface between scientists and farmers to demonstrate the strategies, inputs and technologies developed in research institutions. Convince the farmers to participate, organize meetings and provide farm trainings on organic cultivation.
- The data on input and output of crops were collected from demonstration and farmers practice in the study areas beside the production cost, input used, agriculture practices and adoption of farmers were collected to analyse the demonstration study.
- The inputs biofertilizer were provided from the rhizosphere biology lab, college of basic science and humanities, GBPUAT. These biofertilizers contained microorganisms such as *Trichoderma* Spp, *Variovorax paradoxus*, *Pseudomonas palleroniana* in optimized population and formulation to maximise soil health upon application on seed coating or furrow application or mixing with compost. The candidate microbes are highly functional in properties like phosphate solubilization, etc.
- Results indicate that in Sunkiya village for pea crop the yield under organic farming increased compared to conventional farming practices.

Discussions

Dr. Manmohan Singh Chouhan, the Vice Chancellor of GBPUAT sought clarification about the sample size employed in the demonstration plot study. *He questioned the adequacy of the sample size used and expressed discord with the results, citing ambiguity in the study's control variables. He emphasized upon the importance of proper sampling methods for such exercises, which he felt were lacking in the study.* Additionally, Dr. Chouhan sought clarification on the specific crops studied, the study's timeframe, and the techniques employed for soil sampling.

Dr. Suvigya, a postdoctoral fellow at GBPUAT responded by providing the following insights:

- The study included 14 farmers from Sunkiya village and 7-8 farmers from Bidaura, with Sunkiya being a PKVY-adopted village and the study was conducted for 18 months. Notably, the sample size for the demonstration plot study was limited, and the primary aim was to showcase the quality of inputs, particularly in the rainfed hilly areas where agricultural production is challenging.
- The main objective was to educate farmers about the effective use of biofertilizers. Surprisingly, even in PKVY villages, farmers continued using chemical inputs. However, Bidaura village, which lacked PKVY assistance, exhibited an exceptionally high usage of chemical inputs. A significant development was the substantial increase in the microbial population in Bidaura, especially the rise in actinomycetes population, which may be useful in promoting organic farming.
- Soil sampling revealed minimal presence of nitrogen fixers due to the high concentration of chemicals and residues. However, over time, there was a notable increase in microbial population, indicating a natural process of microbial re-establishment in the soil.

The discussion emphasized how biofertilizers could contribute to soil health rejuvenation in these areas. Dr. Suvigya explained the improvement in soil richness and highlighted a significant increase in organic carbon levels, which were initially critically low in Bidaura. Post organic interventions, nitrogen fixers were found in the soil samples of Bidaura village, indicating positive changes brought about by organic farming practices.

Dr. M. Madhu, the Director of ICAR – Institute of Soil and Water Conservation, Dehradun, emphasized that chemical farming has significant impacts on organic matter reduction, that are essential for microorganisms. He suggested that in demonstration plots, the additional cost of biofertilizers and bioinputs should be considered along with the extra returns received.

Dr. Suvigya further added that the demonstration plot study results indicated higher species richness.

- The Chao 1 estimator, calculating the presence of rare taxa in a sample, showed greater species richness and diversity of the microbial community in both villages' demonstration plots.
- Regarding soil characteristics, Bidaura showed no significant change before and after intervention, except for organic carbon levels increasing from low to medium. In contrast, Sunkiya experienced a shift from low to medium-high organic carbon content.
- The total microbial population demonstrated a 5-fold increase for bacterial population in Sunkiya, whereas it was 3.45-fold for Bidaura. For fungal population, the increase was 4.26-fold in Sunkiya and 4.54-fold in Bidaura. The actinomycetes population remained consistent in both villages.

Session 4: Presentation of Draft Results on Natural and Produced Capital

Dr. Pankaj Kumar, Assistant Professor, GB Pant Institute of Agriculture and Technology presented the draft integrated scenario modelling and valuation results on natural and produced capital. He outlined the TEEBAgriFood initiative in Uttarakhand and shared the research results under various policy scenarios (Business-as-Usual, Optimistic, and Pessimistic). This analysis also considered two climatic projections (RCP 4.5 and 8.5) and their impacts on four key areas: natural, produced, human, and social capital.

The biophysical modeling focused on two watersheds: Kosi and Kailash watershed. The Kosi watershed encompasses two districts, Almora and Nainital, with 897 villages, including significant areas such as Jim Corbett National Park and Binsar Wildlife Sanctuary. Notably, the Kosi River, originating from Dharpani Dhar, irrigates agricultural land primarily practicing terrace farming. On the other hand, the Kailash watershed covers three districts, Udham Singh Nagar, Champawat, and Nainital, comprising 92 villages. This ungauged watershed includes the Champawat and Haldwani forest divisions.

The study examined Land Use and Land Cover (LULC) changes, a crucial driver of ecosystem alterations. Using supervised classification with the maximum likelihood algorithm and GRASS GIS software, the team mapped ecosystem extents. Temporal remote sensing data was classified through supervised classification, utilizing "ground truth" information. The InVEST Rule-based Scenario Generator tool generated unique LULC scenario maps based on user/stakeholder preferences, offering visual representations of future land use changes.

The research also focused on changes in agroforestry and organic farming areas under different policy scenarios in the Kosi and Kailash watersheds:

Kosi Watershed:

- In the base year (2020), organic agriculture covered 2% of the total agriculture area, increasing to 22% in BAU (2030) and 32% in BAU (2050).
- Agroforestry accounted for 1% of the total agriculture area in the base year (2020) and grew to 4% in BAU (2050).
- Optimistic(2030), organic agriculture constituted 38% of the total agricultural area, rising to 72% in the optimistic scenario for 2050. Agroforestry covered 6% (2030) and 9% (2050) of the total agricultural area.
- Pessimistic(2030), organic agriculture dropped to 17%, becoming 3% in the pessimistic scenario for 2050. Agroforestry area reduced from 1% (2030) to 0.5% (2050).

Kailash Watershed:

- In the base year (2020), organic agriculture represented 4% of the total agriculture area, increasing to 34% (2030) and 55% (2050) in BAU scenarios.
- Agroforestry constituted 7% in the base year and expanded to 12% (2030) and 33% (2050) in BAU scenarios.
- Optimistic(2030), organic agriculture covered 49%, rising to 69% in 2050. Agroforestry expanded from 12% (2030) to 14% (2050).
- Pessimistic(2030), organic agriculture decreased to 40%, becoming 8% in the pessimistic 2050 scenario. Agroforestry areas reduced from 6% (2030) to 2% (2050).

Presentation of results on natural capital assessments included the following elements - carbon sequestration, soil erosion, sediment yield and water provisioning services (quantification). The tools used for assessment are the InVest Model (for carbon sequestration), SWAT model (for sediment and water yield) and Revised Universal Soil Loss Equation for Soil erosion modelling.

Soil Erosion

The Revised Universal Soil Loss Equation is used for estimating the soil erosion rates in Kosi and Kailash watersheds. The results were presented for soil erosion in tons/ha/year for the entire watershed in addition to presentation of the sediment export rate from each sub watershed under the two watersheds under assessments. The study examines present and future soil erosion rates in the Kosi and Kailash watershed across six different situations. The results illustrated that the average soil erosion rate in the Kosi watershed is 18.44 tons per hectare. By 2050, this rate is forecasted to increase further to 29.83 tons/ha under the pessimistic RCP 4.5 scenario and 30.74 tons/ha under the pessimistic RCP 8.5 scenario. Nevertheless, implementing agroforestry and organic farming interventions in future show positive impact on the soil erosion rates in the watershed. These actions are predicted to bring about a decrease of 4.4% - 6.29% in the soil erosion rate under the optimistic policy scenario. Similar results were presented for Kailash watershed as well.

The soil erosion in the Kosi watershed is higher than that in the Kailash watershed, indicating that the hilly terrain of Uttarakhand experiences significant loss of fertile soil. The importance of agroforestry measures in reducing soil erosion in future climatic condition was discussed. Subsequently, the sediment export is also higher in the Kosi watershed. Results presented

showed that the lower part of both watersheds has a low amount of sediment export due to the presence of agroforestry, which controls the sediment from being exported into the stream.

Water Yield

Hydrological modelling is conducted using the Soil Water Assessment Tool (SWAT) Model. To calculate future scenario, the CMIP6 Access-ESM1-5 model is used out of 13 models. CMIP6 models predicted that there would be a steady rise in high flows in all the projected scenarios. The results presented for Kosi and Kailash watershed highlighted the following key findings –

- Changes in precipitation significantly affect water discharge, volume, and availability. Presently, the Kosi watershed has a water yield of 851.29 mm. Future projections indicate increased water yield, especially during monsoon months, hinting at rising precipitation under various RCP scenarios. This heightened rainfall could impact crop growth, soil erosion, and nutrient export.
- By 2030, pessimistic scenarios in the Kosi watershed predict a water yield increase of 258.29 mm in RCP 4.5 and 226.36 mm in RCP 8.5 scenarios. However, little change from current scenario is anticipated by 2050.
- In the Kailash watershed, the current water yield is 827.86 mm. Projections suggest a potential increase to 973.34 mm under pessimistic scenarios by 2050. Monthly water yield changes in the Kailash watershed indicate decreased stream flow from March to June but increased water yield during July and August, indicating more frequent and intense future rainfall events. Agroforestry's potential in mitigating these effects, by holding water and reducing surface runoff, highlights the urgency to expand agroforestry initiatives in the state.

Carbon Sequestration

The carbon sequestration results were presented for Kosi and Kailash watersheds. The results presented indicated high carbon sequestration under optimistic scenario which focuses on upscaling organic farming and agroforestry interventions in the state. The benefits of upscaling agroforestry services on carbon stocks as well as on the timber provisioning services were elaborated that would in-turn contribute to greater livelihood opportunities and increased farmer incomes.

Discussion

Dr. Chouhan sought clarification on any water quality related measurements which were taking place to which Dr. Pankaj responded that nutrient delivery was considered that looks at nitrogen and phosphorous export from the watershed accounting for water quality related elements under the biophysical modelling.

Session 5: Discussions on Key integrated scenario modelling and valuation results

Dr. A.K. Upadhyay, Joint director agriculture mentioning that government of Uttarakhand has the vision to make Uttarakhand an organic state. He elaborated on a few challenges and opportunities associated with upscaling organic farming practices in the state -

- A major challenge in Uttarakhand is the small land holdings of farmers, necessitating either increased production through methods like value addition or enhancing yields significantly. Uttarakhand has an advantage with naturally low chemical usage, particularly evident in hills where chemical consumption is merely 5 kg per hectare, compared to 200 kg per hectare in

the states like Punjab giving a major push to the government towards successful conversion of farming in hilly regions to organic.

- Mentioning the current success of implementing organic farming practices in the state towards making it an organic state he added - every village in Uttarakhand is designated as a 'Jaivik gram,' emphasizing the practice of organic farming. Techniques like vermi composting and EM technology are promoted, with vermi composting gaining widespread acceptance among farmers.
- The major boost to organic farming happened post implementation of Paramaparag at Krishi Vikas Yojana where 500 clusters were set up with 20 hectares area under each cluster.
- Subsequently, certification in case of organic farming has played a pivotal role, with third-party certification initiated in 2004 through the Uttarakhand Organic Commodity Board. Certification under Participatory Guarantee Scheme has played a crucial role in bringing a large area under organic farming in the state. As of 2018-19, 3900 clusters have been developed till date of which 1231 clusters are with horticulture department to lead production of organic fruits and vegetables. And in future major push is required for the development of organic horticulture space.
- As of 2015-16 35000 hectares is covered under organic farming. Initiatives like Namami Gange mandating organic farming within a 2km radius which was a mandate to avoid fertilizer getting runoff into the Ganges. Has now been expanded to entire blocks, leading to approximately 90% conversion of area around the Ganga river to organic farming.
- Giving examples of crops grown organically, millets and pulses have thrived in Uttarakhand due to their resilience. Additionally, the cultivation of aromatic plants like lemongrass has been successful, especially in areas where farming was abandoned, providing a significant boost. Organic branding, such as organic rose water, has been highly successful in the state.
- Uttarakhand plans to initiate natural farming on 85,000 hectares of land.
- Despite significant progress in expanding organic farming, Uttarakhand faces challenges in convincing farmers about the benefits of organic practices and integrating markets for value addition. To overcome this, the state plans to establish 400 organic outlets along tourist routes to promote organic produce. Collaborations with organic enterprises have been facilitated, providing logistical support and essential equipment like sealing machines for products such as ragiatta, fruits, and vegetables. Additionally, weekly organic markets have been set up to supply fresh organic produce.
- The TEEBAgriFood assessment aims to fill existing gaps in organic farming coverage by providing empirical evidence supporting the expansion of organic practices in the state. This study is crucial for future organic development. However, during the initial consultation rounds with the state, two regions in Garhwal and two in Kumaun were finalized. Tehri and Haridwar in Garhwal were also included, although this inclusion is not reflected in the current study.
- Regarding infrastructure, organic cold chains are primarily essential for horticulture rather than general agriculture. Notably, Rudraprayag has emerged as a fully organic area with no chemical sales.
- The state's total cultivated land is 5.93 lakh hectares, out of which 2.30 lakh hectares are already organic, certified by the state government. To address this issue, Uttarakhand introduced the Uttarakhand Organic Farming Act 2019. This legislation ensures that areas certified as organic by the state will prohibit the sale of chemical fertilizers.

Dr. M. Madhu, Director – Institute of Soil and Water Conservation provided the following insights:

- The TEEBAgriFood initiative in Uttarakhand should also focus on practical project implementation based on its objectives and strengthen the idea of way ahead and how the core recommendations from the project be taken forwards?
- Emphasising the idea of upscaling organic farming within watershed areas, Dr. Madhu suggested the need to consult the Directorate of Agriculture regarding scenarios that have been developed.
- Consideration of specific parameters related to soil, especially concerning the climate change RCP scenario, was emphasized. It was noted that soil parameters do not significantly alter over time under the RCP scenario, and organic farming input, such as biofertilizers and pesticides, could be utilized to enhance soil health.
- Predictions under RCP indicated increased rainfall and numerous events by 2033, despite slow developmental processes in the Uttarakhand. Long-term data, including decadal information, was recommended for scenario analysis.
- A proposal was made to establish demonstration plots focusing on organic farming, particularly with millets, in minority states like the Uttarakhand. Data collection from organic and conventional farmers in the same villages was suggested, emphasizing the need for a structured statistical analysis and specifying the crops considered.
- Collaboration with the Agriculture Department to utilize shared data, such as soil health card information, for comparing conventional and organic farming was proposed.
- Challenges related to agroforestry, such as fragmented land holdings, were highlighted. The discussion pointed to the necessity of clarifying how agroforestry systems could be effectively implemented in such scenarios with fragmented landholdings. Sampling in specific watersheds and identifying optimal threshold levels for agroforestry systems based on landholdings were suggested for further analysis and extrapolation.
- The combination of agroforestry and organic farming was discussed, with an emphasis on identifying best management practices considering land use and cover changes (LULC). To understand the natural resource status and then collaborate with state government for implementation of these practices.
- TEEB (The Economics of Ecosystems and Biodiversity) parameters, especially provisioning and regulating services, were recommended for inclusion in ecosystem services assessments.
- Lastly, support from relevant departments for soil and water conservation initiatives was acknowledged, with a call to develop 5-10 best management practices based on the discussed points.

Dr. Alka Bhargava, Senior Policy Advisor at UNEP, discussed agroforestry initiatives, praising the implementation of aromatic plants in Uttarakhand. She emphasized the importance of incorporating medicinal plants through collaborations with horticulture and forest departments. Additionally, she suggested considering the inclusion of lac plants in agroforestry, providing a significant boost to the ArthaGange vertical under NamameGange.

Dr. Ujjwal Kumar from Doon University shared his agroforestry research in Uttarakhand. Their approach involved analyzing satellite data to identify suitable areas for agroforestry, which was then validated with ground data. This methodology facilitated the creation of agroforestry systems and allowed for future scenario analysis. Their findings indicated that small agroforestry setups are highly vulnerable, particularly in low-lying areas, and even a slight increase in temperature could severely impact them. Larger areas, on the other hand, demonstrated greater resilience.

Dr. Manoj Chandran from the Forest Department highlighted the case of SamriGoan, a village with a population of 22-25 people, where social capital played a significant role. He stressed the importance of education, considering various design aspects such as spatial, temporal, and seasonal factors. Dr. Chandran emphasized the crucial role of high-quality biofertilizers, emphasizing the need to address issues related to residues and heavy metals. He also pointed out the abundant forest produce in Uttarakhand that should be considered as a valuable food resource.

Concluding Remarks

Dr. J.P. Jaiswal expressed his gratitude to Vice-chancellor for his permission to organise the stakeholder workshop and valuable suggestions, and all the participants for their valuable contribution and active engagement in the discussions. He acknowledged the significant amount of information gathered over the duration of the workshop and emphasized that the insights gained will be useful for improving assessments.

Signed by

Dr. J.P. Jaiswal
P.I., TEEB Project
Director Extension Education
GBPUAT, Pantnagar

List of Participants (Physical participation)



Stakeholder Workshop on TEEB AgriFood Initiative in Uttarakhand, India
Date: 30th September 2023

Venue: Hotel Pacific, 19, Subash Rd, near Rajpur Road, Irrigation Colony, Karanpur,
Dehradun, Uttarakhand 248001

S. No.	Name	Name of Organization	Signature
1	MAHESH KUMAR	BHUMRAET EPO	
2	HARMEET CHANDARY	FARMER	
3	PURUSHOTTAM KUMAR	KVK, HARIDWAR	
4	SUCHETA SINGH	KVK, HARIDWAR	
5	Dr. USHWAL KUMAR	SENR, DOON UNIVERSITY DEHRADUN	
6	Dr. Sanjay Chaudhary	GBPUAT, Panty	
7	Rohit Singh Negi	SENR, Doon University	
8	Deepthi Sonawane	SENR, Doon University	
9	A.K. Upadhyay	Joint Div. Agri.	
10	S. S. Meeg	Migration Commission	
11	Ruce Malhotra	UNEP	
12	Dr. Manoj Chandra	IFS, CCF UKPD	
13	Dr. Sanjay Kumar	GBPUAT, KVK Dehradun	
14	Keena Goyal	PD watershed Dept	
15	Dr. M. Madhu	DIRECTOR- IISWC, Doon	
16	Dr. Charan Singh	Head, IISWC, D. Doon	



Stakeholder Workshop on TEEB AgriFood Initiative in Uttarakhand, India
Date: 30th September 2023

Venue: Hotel Pacific, 19, Subash Rd, near Rajpur Road, Irrigation Colony, Karanpur,
Dehradun, Uttarakhand 248001

17	ANKUR SHARMA	SGRR UNIVERSITY	Ankur Sharma
18	Kamlesh Teena	SGRR University	Kamlesh Teena
19	Kavita Pun	SGRR University	Kavita
20	Sobit Sagar	S.G.R. university	Sobit Sagar
21	Swraj Blatt	SGRR university	Swraj
22	Dr. Kian Pant	KVK Dehradun	Dr. Kian Pant
23	Ravleen Kuman	KVK, Dehradun	Ravleen Kuman
24	Ruben Kergan	UNEP	Ruben Kergan
25	Alka Bhargava	UNEP	Alka Bhargava
26	Rhea Malhotra	UNEP	Rhea Malhotra
27	J.B. Jaismal	GBPUAT	J.B. Jaismal
28	Tilhi Dutta	GBPUAT	Tilhi Dutta
29	Yogesh Pandey	GBPUAT	Yogesh Pandey
30	Swigya Sharma	GBPUAT	Swigya Sharma
31	Ghanshyam Jha	GBPUAT Pantnagar	Ghanshyam Jha
32	Dr B.D. Singh	GBPUAT, Pantnagar	Dr B.D. Singh



Funded by
the European Union







Fig. Group photo of delegates attending the 2nd Stakeholder Workshop of TEEBAgriFood India on Sept 30, 2023 at the Hotel Pacific, Dehradun, Uttarakhand, India
