NATIONAL CONFERENCE PROCEEDINGS 2025

Connecting Practitioners & Researchers

Thematic areas: Climate Crisis, Natural Disasters, Environmental Sustainability, Agriculture and Food

March 25 – 27, 2025

Organised by
College of Natural Resources and the Department of the Academic and Research Services, OVC, RUB

Co-Sponsored by
B-KIND Tarayana Foundation and Royal Society for Protection of Nature, and Asian Food & Agriculture Cooperation Initiative

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Edited by Rekha Chhetri (PhD)

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National Conference
"Connecting Practitioners and Researchers"

The National Conference on *Connecting Practitioners and Researchers* was held at the College of Natural Resources (CNR) from March 25-27, 2025. It focused on thematic areas, specifically, the climate crisis, natural disasters, environmental sustainability, agriculture, and food. The conference was jointly organised by the Department of Academic and Research Services (DeARS), the Office of the Vice Chancellor, and the Centre for Rural Development Studies (CRDS), CNR.

The objectives of the conference were to:

1. Share and disseminate cutting-edge research findings to a diverse and trans-disciplinary audience.
2. Strengthen collective capacity in developing and implementing evidence-based policies.
3. Foster meaningful connections and establish a groundwork for future collaborations between researchers and practitioners.

The event brought together researchers from the Royal University of Bhutan, representatives from various government and non-governmental organizations, agri-entrepreneurs, practitioners, scholars, and experts. They presented papers on pressing and emerging issues concerning the climate crisis, natural disasters, environmental sustainability, agriculture, and food security. The conference noted numerous challenges, including land, labor and market, and policy gaps in building a resilient and sustainable food system.

It provided a valuable platform for sharing not only the current research and insights, facilitating the exchange of knowledge and best practices, but also for networking and partnership building. Additionally, a session (Day 3) addressing cross-cutting emerging issues with an emphasis on the formulation of policy briefs was conducted.

The conference proceedings start with the opening sessions, followed by summaries of the presentations that highlight the key challenges, gaps, and recommendations. Insights from the panel discussions are also included. Abstracts of all presentations are provided in the appendix.

We thank our partners, the B-KIND Tarayana Foundation, Royal Society for the Protection of Nature (RSPN), and Asian Food and Agriculture Cooperation Initiative (AFACI) based in South Korea, for co-sponsoring the conference.

We would like to thank all the participants.

Rekha Chhetri (PhD)
Head, Centre for Rural Development Studies, CNR

Sonam Wangmo
Chief, Research & Development, DeARS
Royal University of Bhutan

Foreword from the Dean
Research and Industrial Linkages

It is our pleasure to present the proceedings of the National Conference on *Connecting Practitioners and Researchers*, held at the College of Natural Resources, Royal University of Bhutan. This conference brought together a diverse group of researchers, practitioners, policymakers, and students to deliberate on some of the most pressing challenges of our time, particularly climate change, natural disasters, environmental sustainability, agriculture and food security.

As the impacts of the climate crisis intensify globally and locally, there is an urgent need for interdisciplinary collaboration and knowledge-sharing. This event served as a good platform for bridging the often-isolated worlds of academic research and field-level practice. By having dialogue across sectors and disciplines, the conference aimed to generate solutions that are not only grounded in scientific evidence but also informed by real-world experience.

The abstracts of papers, discussion, and actionable recommendations featured in this volume reflect a wide spectrum of insights, including grassroots-level case studies. Together, they underscore the importance of integrating traditional wisdom with modern science and the value of participatory approaches in addressing environmental and agricultural challenges in Bhutan and beyond.

In addition to the proceedings, as a direct result of this conference, three policy briefs and one fact sheet on various important and relevant themes were also developed and launched.

We believe that these proceedings, the policy briefs, and the fact sheet will serve as a valuable resource for academics, practitioners, students, and decision-makers committed to building resilient and sustainable systems. More importantly, we hope that the conversations and collaborations initiated through this conference will continue to grow, contributing to a more informed, inclusive, and responsive approach to development and environmental stewardship.

On behalf of the College, I extend my heartfelt appreciation to all contributors, participants, panellists, and organisers whose dedication and engagement made this conference a success.

Sonam Tashi (PhD)
Dean, Research and Industrial Linkages

Table of Contents

OPENING SESSION

Opening Remark 1: Welcome remarks by the Dean of Research and Industrial Linkages, College of Natural Resources

Speaker: Dr. Sonam Tashi

Summary

The conference started with the Dean of Research and Industrial Linkages welcoming the Honourable Chief Guest, the Secretary of the Ministry of Agriculture and Livestock, the Vice Chancellor of the Royal University of Bhutan, the President of the College of Natural Resources and other dignitaries. Delivering his emphasis on the conference theme "Climate Crisis, Natural Disasters, Environmental Sustainability, Agriculture and Food" as a critical area for academic discourse, Dr. Tashi remarked on the need to connect researchers and practitioners to generate innovative solutions to enhance livelihoods, build resilient systems, address climate crisis and disasters, ensure environmental sustainability and enhance agricultural and food security.

The need for an integrated and innovative solution stems from the interconnectedness of climate crisis, agriculture, and food sustainability. He acknowledged the importance of research as a crucial tool for addressing these areas of concern. He concluded by thanking all the attendees for their participation in the conference.

Opening Remark 2: Opening address by the Chief Guest, Secretary of the Ministry of Agriculture and Livestock

Speaker: Dasho Thinley Namgyel

Summary

Dasho Thinley Namgyel addressed the pressing reality of climate change on Bhutanese agriculture with examples on erratic rainfall and hailstorms significantly impacting the farmers. In light of the recent events, including the loss of 2000 metric tons of rice in Paro, damage to 500 potato growers in Bumthang due to erratic rainfall, significant losses in Tsirang caused by hailstorms, and unexpected frost in Phobjikha and Bumthang affecting 542 households, the government devised several policy reforms and interventions.

The Ministry of Agriculture and Livestock [MoAL] revised its Food Security Policy to build resilient agricultural systems, alongside a budget allocation of Nu. 2 billion to support agricultural programs aimed at mitigating these challenges. In Samtse Dzongkhag, the 'Foreign Day Worker' initiative has been introduced to address labor shortages in farming.

With the increasing incidence of pests, diseases, and erratic weather calling for adaptive measures to protect food production, the government is implementing cost-sharing mechanisms, farm mechanization, improved seed distribution, and collateral-free financing to support farmers. Additionally, the National Agrifood Sector's 10-year plan focuses on improving nutrition and ensuring long-term food security, while efforts are also underway to strengthen agricultural value chains and market systems to enhance food sustainability. He also highlighted that the protection and revival of wetlands is a priority to safeguard productive farmlands and ensure sustained agricultural output.

In conclusion, Dasho Thinley Namgyel emphasised the need for strong partnerships among government agencies, research institutions, farmers, and other stakeholders as essential for developing timely and effective solutions for agricultural sustainability.

Opening Remark 3: Keynote address by the Vice Chancellor of the Royal University of Bhutan

Speaker: Dasho Chewang Rinzin

Summary

The Vice Chancellor, Dasho Chewang Rinzin acknowledged the ongoing collaboration with the Ministry of Agriculture and Livestock, and emphasised the need to further strengthen the collaboration between the MoAL and the College of Natural Resources, to inspire innovative solutions and breakthroughs. Followed by the role of the conference in connecting researchers with farmers, policymakers, entrepreneurs, and various sectors to foster evidence-based solutions, he emphasised the importance of bridging the gap between research, policymaking, and practice to develop effective climate adaptation strategies.

Considering the emerging challenges of the African Swine Flu outbreak in Nyalakha village (Wangduephograng), the increasing fallow land in Bhutan with 85.7% of cultivable land reportedly left fallow in 2024 due to water shortages, and the rising temperatures, he asserted that research is a crucial tool for building climate-resilient systems and guiding national policies. He also encouraged strengthening research capabilities to implement evidence-based, innovative solutions for climate adaptation and food security.

The need for serious collaboration between researchers and policymakers to tackle issues such as erratic weather, water shortages, and labour scarcity was emphasised, as essential for addressing the climate crisis and ensuring future preparedness.

Simultaneously, Dasho Chewang Rinzin, reaffirmed RUB's mandate to conduct research and provide evidence-based solutions for practitioners and policymakers, while highlighting the need to leverage the university's research capacity to inform policy decisions and build resilient systems.

In conclusion, Dasho expressed his gratitude to all stakeholders from the conference organisers to students for their efforts, and reiterated the conference's slogan *"Connecting Practitioners and Researchers,"* encouraging active participation and engagement in discussions to drive meaningful solutions for Bhutan's climate and agricultural challenges.

PRESENTATION SUMMARIES

[Session I] [25.03.2025]

Presentation 1: Altitude, Land Use and Soil Depth Effects on Earthworm Density and its Relationship to Soil Properties in an On-Farm Study

Speaker: Ms. Ameeta Adhikari [National Soil Services Centre, MoAL]

Moderator: Dr. Sonam Tashi [Associate Professor, CNR]

Challenges & Gaps Identified

- A limited and poor understanding on the status of soil biota and the effects of altitude, land use, and soil depth on soil fauna in Bhutan's agricultural landscape has led to this study.
- Although the study confirms a positive relationship between earthworm density, organic carbon, and total nitrogen, the long-term effects of different land management practices on soil biota remain insufficiently understood and require further research.
- Similarly, the extent to which chemical fertilizers influence earthworm density remains uncertain, as they tend to increase populations only up to a certain threshold.
- There are gaps in understanding how national policies affect soil biodiversity in Bhutan, due to the lack of systematic studies on soil fauna under the National Flagship Program.
- In addition, there is insufficient data on how different land use practices impact soil biodiversity across altitudinal gradients, and the role of soil fauna in enhancing climate resilience and soil health remains underexplored.

Actionable Recommendations

- Conducting in-depth studies to explore earthworm population dynamics across different land use types, altitudes, and soil depths, along with initiating longitudinal studies to monitor trends and the impact of soil biota on soil health in Bhutan are recommended.
- Similarly, encouraging organic farming practices, particularly the long-term use of cattle manure to enhance earthworm density and improve soil fertility, and advocating for the gradual substitution of chemical fertilizers with organic alternatives would promote soil biodiversity and ensure long-term sustainability.
- Bhutan's National Flagship program should include soil biodiversity indicators to support the conservation of earthworms and other soil fauna in sustainable land management strategies. It should also develop guidelines for land users and policymakers on improving soil health through the use of biological soil amendments and organic inputs.

- Earthworms should be recognized as key bio-indicators of soil health, and their monitoring should be integrated in climate-smart agricultural practices. Moreover, retaining soil organic matter and ensuring the availability of food for earthworms are essential for maintaining soil productivity across altitudinal gradients.
- Finally, raising farmers' awareness of the importance of soil biodiversity, organic farming techniques, and earthworm-friendly practices, along with promoting knowledge-sharing among researchers, policymakers, and farmers would encourage sustainable soil management and reduce reliance on chemical fertilizers.

Presentation 2: Impact of Areca Nut Plantation on Farming System and Livelihood: A Case Study of Chhuzanggang Gewog, Sarpang

Speaker: Mr. Ugyen Gyeltshen [National Soil Services Centre, MoAL]

Moderator: Dr. Sonam Tashi [Associate Professor, CNR]

Challenges & Gaps Identified

- Land fragmentation limits expansion and diversification of crop cultivation. Chhuzanggang's potential for cultivating diverse crops is limited by the conversion of a significant portion of its land to areca nut plantations, raising concerns on its long-term sustainability.
- The monoculture dependency poses potential risks to food self-sufficiency, biodiversity, and long-term soil fertility.
- Although areca nut contributes significantly to household income, households with extensive areca nut cultivation have the lowest levels of calorific fulfillment.
- Farmers have limited awareness of the long-term economic risks, environmental impacts, and sustainability concerns associated with the expansion of areca nut plantations.
- Knowledge gaps remain regarding the factors influencing areca nut expansion - such as market dynamics, soil health, water resource management, policy incentives, as well as its impacts on livelihood patterns, dietary habits, and food security strategies. These areas require further investigation.

Actionable Recommendations

- An integrated farming system can help maintain crop diversity while sustaining income from areca nut plantations. Furthermore, promoting agroforestry models can reduce reliance on monoculture plantations.
- Longitudinal studies are needed to examine the long-term effects of areca nut plantations on soil fertility, water availability, and climate resilience, as well as the impact of areca nut cultivation on household dietary patterns and strategies to mitigate food security risks.
- A study on market risks associated with overdependence on a single cash crop could help raise farmers' awareness and promote better financial security.

- Policy and institutional interventions such as subsidies and incentives for diversified farming, along with improved access to irrigation, soil fertility management, and pest control, can support farmers transitioning to mixed-crop farming systems, promote sustainable land-use practices, and prevent excessive expansion of areca nut cultivation.
- Conducting farmer education and training programs on the economic risks, soil health concerns, and sustainability challenges of monoculture farming, along with establishing knowledge-sharing platforms for diversified farming techniques and sustainable practices.
- Promoting farmer cooperatives to enhance collective bargaining power and market access for alternative crops can help ensure market stability and support for diversified agricultural enterprises.
- A multi-stakeholder collaboration involving researchers, policymakers, and farmers to formulate evidence-based agricultural policies and establish monitoring systems for land-use and socio-economic dynamics is essential to addressing these challenges.

Presentation 3: Panbang Youth Cooperative

Speaker: Mr. Pema Zangpo [Agri-entrepreneur, Zhemgang]

Moderator: Dr. Sonam Tashi [Associate Professor, CNR]

Challenges & Gaps Identified

- Increased climate variability negatively impacts crop yields and livestock productivity.
- Crop failures and declining fruit production, such as the decline in mandarin production in Panbang highlight the vulnerability of traditional farming practices.
- Farmers not only have limited access to mechanization and modern agricultural technology, but the fragmented landholdings also restrict them from pursuing commercial farming.
- These limitations are compounded by unskilled labour and a lack of technical competency in adopting innovative and efficient farming techniques, especially amid a declining agricultural workforce due to youth rural-urban migration.
- Limited societal encouragement to pursue agriculture as a career because farming is often perceived as a low-status profession, which discourages youth participation.

Actionable Recommendations

- The adoption of precision agriculture, hydroponics, and greenhouse farming can boost productivity even with limited landholdings. Farmers should be equipped with climate-resilient farming techniques to effectively mitigate the impacts of unpredictable weather patterns.
- Developing local agro-processing units would add value to agricultural products, enhancing marketability and income generation, while strengthening post-harvest management and storage facilities would extend shelf-life and reduce produce wastage.
- Establishing an integrated agricultural hub would provide access to modern farming technologies, training, and market linkages, while also promoting cooperative farming models to pool resources and enhance economies of scale.

- Furthermore, promoting eco-friendly farm tourism, farm-stay experiences, organic food tourism, and educational farming would engage youth create supplementary income streams for farmers.
- Providing agriculture-focused vocational training would equip youth with the essential skills for modern and sustainable farming practices.
- Most importantly, awareness campaigns should be launched to rebrand farming as a viable and profitable career choice.

Presentation 4: Re-imagining Bhutanese Agriculture in a Land and Labour Constrained Scenario

Speaker: Dr. Nawang Norbu [Executive Director, Bhutan Ecological Society]

Moderator: Dr. Sonam Tashi [Associate Professor, CNR]

Challenges & Gaps Identified

- Commercial farming remains economically unviable in Bhutan, as 82% of farming households own less than 5 acres of land, and 25% own less than 1 acre.
- Over the past 50 years, the number of farm workers in Bhutan has dropped from 180,000 to 120,000, reflecting rural-urban migration and an aging farmer population, with one in three farmers now over the age of 50.
- The nation has also witnessed a 26% decline in rice production, a 5% drop in maize, and a staggering 90% decline in wheat production, resulting in a growing dependence on food imports.
- Farming remains fragmented and small-scale, making mechanization and large-scale investments difficult to implement.
- Small-scale farming is often economically unviable, with some communities, particularly those engaged in rice cultivation, spending more than they earn.
- The continued rise in food imports over the past two decades highlights the ineffectiveness of subsidies and other support mechanisms in developing a robust agricultural sector.
- As Bhutan continues to develop, the agriculture sector's share of employment is expected to decline.
- The 20% reduction in agricultural labour over the past two decades reflects a structural shift away from traditional farming.

Actionable Recommendations

- Bhutanese agriculture should pivot toward niche, high-value, and low-labour intensive crops such as organic vegetables, medicinal plants, spices, and special grains to enhance profitability and sustainability.
- It should also promote export-oriented farming of niche products that command higher market prices.
- Land transfer and lease policies should be revised to allow for farmland consolidation, enabling economies of scale and more viable commercial farming operations.

- Moreover, introducing land pooling and cooperative farming would help optimize land use and facilitate mechanization.
- Promoting farm mechanization and labour-saving technologies can offset the declining agricultural workforce, while investing in precision agriculture, drip irrigation, and greenhouse farming can boost productivity on small landholdings.
- Furthermore, strengthening agricultural cooperatives and aggregator models would help farmers secure better pricing and market access, while promoting contract farming and partnerships with the private sector would ensure stable demand for Bhutanese agricultural products.
- Incentivizing youth participation in agribusiness through subsidies, alongside developing structured seasonal labour programs to bring in farm workers during peak seasons, would help address the declining agricultural workforce.
- All in all, Bhutan's agricultural policy should be redefined to balance food security with economic viability, while promoting diversification into horticulture, agroforestry, and livestock farming to offer alternative income sources for farmers.

Session I: Question and Answer Session in Plenary

Moderator: Dr. Sonam Tashi [Associate Professor, CNR]

Presentation 1: Altitude, Land Use and Soil Depth Effects on Earthworm Density and its Relationship to Soil Properties in an On-Farm Study

Speaker: Ms. Ameeta Adhikari [National Soil Services Centre, MoAL]

The study confirmed that farmers in Thimphu, Samtse, and Tsirang are utilizing earthworms for vermicomposting. However, Ms. Adhikari noted that her research didnot identify any new earthworm species, citing the lack of necessary facilities in Bhutan and restrictions on sending live specimens abroad as limiting factors. Additionally, the use of mustard extract in the extraction method caused earthworms to surface due to isothiocyanate, which irritates their epithelial cells. Since, she measured only a limited number of factors affecting earthworm density, the audience suggested incorporating soil moisture in future studies, given that earthworms thrive in moist environments. Further research was also recommended to explore the impact of soil properties on earthworm biomass.

Presentation 2: Impact of Areca Nut Plantation on Farming System and Livelihood: A Case Study of Chhuzanggang Gewog, Sarpang

Speaker: Mr. Ugyen Gyeltshen [National Soil Services Centre, MoAL]

Mr. Ugyen Gyeltshen expressed that the landscape of areca nut cultivation is likely to change with the development of the Gelephu Mindfulness City. While areca nut growers enjoy high incomes, their reliance on cash crops over diversified agricultural production poses a threat to food security. Although the speaker highlighted the feasibility of alternative crops such as ginger, which was historically cultivated before areca nut, requires intensive care. In areas like Chhuzanggang, wildlife such as elephants, monkeys, rabbits, and porcupines further complicate ginger cultivation, making areca nut a more viable option. To address such localised challenges, a bottom-up approach should be adopted in strategic agricultural planning to ensure that policies align with on the ground realities.

Presentation 3: Panbang Youth Cooperative

Speaker: Mr. Pema Zangpo [Agri-entrepreneur, Zhemgang]

The Panbang Youth Cooperative operates with an organized workflow managed by its Human Resource team, which allocates tasks in advance. Certified under the Organic Flagship Program, the cooperative cultivates a variety of crops, including cereals, watermelon, and chili. It also runs a coffee seedling nursery and maintains a three-acre pineapple plantation, with established market linkages through Bhutan Blossom.

Despite these advancements, the cooperative faced significant setbacks due to chili blight and yellow worm infestations in cabbages, underscoring the challenges of relying solely on agriculture

for income. While biosecurity measures for livestock are actively implemented, Mr. Zangpo emphasised ongoing difficulties in managing preventive and biosecurity measures effectively.

Presentation 4: Re-imagining Bhutanese Agriculture in a Land and Labour Constrained Scenario

Speaker: Dr. Nawang Norbu [Executive Director, Bhutan Ecological Society]

Given the predominance of women in farming, Dr. Norbu emphasised the need to critically reassess the feminisation of agriculture. To restore dignity and pride in the profession, he suggested that policy-makers should create conditions where individuals engage in farming by choice, rather than by default. Urgent policy interventions are needed to address the declining farming population and to ensure that farmers can operate under more favourable conditions, similar to those in developed countries. The discussion also highlighted the importance of shifting focus towards high-value crops along with the adoption of aggregated farming models to reduce individual burdens and enable farmers to dedicate more time to agricultural activities. Dr. Norbu further recommended an ideal landholding size of approximately five acres per family to achieve self-sufficiency, as well as improved road connectivity and the strengthening of farmer cooperatives to sustain agricultural livelihoods.

Session I concluded with the discussions emphasising the need for a holistic approach to agricultural development in Bhutan. To achieve sustainable farming, it is essential to address climate vulnerabilities, enhance agricultural profitability, and improve policy frameworks. Strengthened collaboration among government agencies, NGOs, and other stakeholders is vital to implement strategic interventions that empower farmers and build long-term agricultural resilience. Key recommendations included:

- Investment in high-tech farming solutions to enhance productivity.
- Establishment of agro-processing industries to add value to raw agricultural products.
- Promotion and development of agricultural hubs to improve market access and facilitate knowledge sharing.
- Strengthening of policy frameworks to ensure agriculture remains a viable and dignified profession.

[Session II]
[25.03.2025]

Presentation 1: Role of Local Traditions and Cultural Norms for Environmental Sustainability

Speaker: Dr. Tshering Yangden [Tarayana Foundation]

Moderator: Dr. Ugyen Thinley [Assistant Professor, CNR]

Challenges & Gaps Identified

- There is insufficient research on the role of local traditions and cultural norms in environmental sustainability.
- The existing studies often lack documented links between traditional knowledge, climate change, and nature conservation.

Actionable Recommendations

- Bhutan should integrate traditional ecological knowledge into contemporary environmental policies and promote eco-friendly, sustainable farming practices including soil, weed, and seed management.
- Bhutan should preserve and revitalize indigenous crops, support traditional healers, while documenting their relationships with the environment, and recognize traditional medicinal practices, including balneotherapy (hot spring treatments).
- Community-driven conservation efforts should be strengthened through education programs that raise awareness about the role of traditional knowledge in sustainability, and through interdisciplinary research that bridges the gap between traditional and scientific knowledge.
- At the national level, incorporating traditional knowledge into conservation policies, along with collaboration between the government, NGOs, and local communities, can reinforce Bhutan's commitment to sustainability while preserving its rich cultural heritage.
- Establishing knowledge-sharing platforms is also essential to record and safeguard indigenous practices.

Presentation 2: Unlocking Nature's Wealth: Bhutan's Model for Conservation and Sustainable Use of Biodiversity

Speaker: Mr. Mani Prasad Nirola [National Biodiversity Centre]

Moderator: Dr. Ugyen Thinley [Assistant Professor, CNR]

Challenges & Gaps Identified

- Before the 1992 Convention on Biological Diversity [CBD], biodiversity was largely regarded as common property with no clear ownership.
- The CBD introduced the concept of national sovereign rights over biological resources, paving the way for access and benefit-sharing agreements.
- However, due to limited awareness of biopiracy risks and country's constrained capacity to explore and commercialize its biological resources, Bhutan remains vulnerable-particularly given its rich natural resources and porous borders.
- Both commercial and non-commercial research approaches can help derive economic benefits from bioprospecting, and traditional knowledge can play a key role in facilitating biodiscovery.

Actionable Recommendations

- Greater awareness of biopiracy risks and the importance of protecting traditional knowledge and biodiversity is essential.
- Enhancing national capacity, including technical and laboratory capabilities, to explore Bhutan's natural resources will enable the private sectors to participate in bioprospecting efforts and product development, contributing to sustainable economic growth.
- Strengthened collaboration among the government, private sector, and local communities is crucial to promote equitable bioprospecting, and ensure fair benefit-sharing for all stakeholders.
- Improved product certification processes and supply chains can support the creation of sustainable and high-value products based on Bhutan's biodiversity.

Presentation 3: Transboundary Micro-Plastic Contaminations in Fish and Aquatic Food Chain along Brahmaputra River

Speaker: Ms. Yogeeta Dahal [Lecturer, CNR]

Moderator: Dr. Ugyen Thinley [Assistant Professor, CNR]

Challenges & Gaps Identified

- As a major water pollutant, the widespread presence of microplastic has drawn increasing attention, particularly due to the lack of significant research on their presence in major freshwater systems.
- Existing studies have focused on water bodies in neighboring countries such as India and Nepal, while limited information is available on the environmental, aquatic, and human health impacts of microplastics in Bhutan.
- Few studies conducted in Bhutan are largely confined to the southern regions, highlighting the need for more comprehensive national wide research.
- Another critical challenge in this field is limited availability of standardized tools for microplastic detection, which is further constrained by current capacity of national laboratory facilities.

Actionable Recommendations

- Comprehensive studies should be undertaken across a broader range of freshwater systems in Bhutan, particularly those feeding into the Brahmaputra river, to assess microplastic contamination and its impact on the aquatic food chain.
- Similarly, research is needed to evaluate the effects of microplastics on human health, with a focus on their accumulation in the food chain and associated health risks.
- Monitoring contamination levels from upstream to downstream flow can provide insights into spatial variations, with particular attention to the color composition of the microplastics- blue, black, and red being the most commonly detected.
- Policy measures, such as plastic bag bans, should be implemented through a gradual transition period to ensure smooth adoption by businesses and public.
- The government should support this transition by promoting and providing alternatives to plastic products, thereby reducing microplastic contamination in water bodies.
- Addressing the issue also requires behavioural change, including reducing plastic consumption and encouraging the use of sustainable alternatives.

Session II: Question and Answer Session in Plenary

Moderator: Dr. Ugyen Thinley [Assistant Professor, CNR]

Presentation 1: Role of Local Traditions and Cultural Norms for Environmental Sustainability

Speaker: Dr. Tshering Yangden [Tarayana Foundation]

Dr.Yangden emphasised the importance of integrating traditional and scientific knowledge in conservation efforts. She asserted that transdisciplinary research fosters mutual learning and helps prevent the dominance of one knowledge system over another. Moreover, effective conservation strategies should involve multiple stakeholders to promote inclusivity and sustainability. The discussion also alluded to traditional norms, particularly those that restrict women's participation in environmental conservation. Dr.Yangden suggested that certain cultural restrictions should be critically re-evaluated to ensure that they do not hinder progress. In conclusion, a multi-stakeholder engagement should be encouraged to develop holistic conservation solutions.

Presentation 2: Unlocking Nature's Wealth: Bhutan's Model for Conservation and Sustainable Use of Biodiversity

Speaker: Mr. Mani Prasad Nirola [National Biodiversity Centre]

The National Biodiversity Centre (NBC) facilitates and regulates bioprospecting activities in Bhutan. Mr. Nirola stated that bioprospecting is still in its early stages, with NBC working towards the sustainable utilization of the biodiversity resources. To reduce pressure on wild populations, the domestication of key plant species is encouraged. For species that cannot be domesticated, rotational harvesting methods are employed. For For example, the harvest of *Swertia chirata* is limited to 2000 kg annually to maintain ecological balance. Given the limited research capacity and inadequate laboratory facilities, NBC is exploring collaborations with private and international partners to strengthen research infrastructure and market Bhutanese biodiversity based products. The speaker emphasised the importance of promoting the sustainable domestication and rotational harvesting of medicinal plants, while enhancing research collaborations to expand laboratory facilities for bioprospecting. Additionally, a branding and certification strategy should be developed for Bhutanese biodiveristy based products along with increased community involvement to ensure equitable benefit-sharing from bioprospecting activities.

Presentation 3: Transboundary Micro-Plastic Contaminations in Fish and Aquatic Food Chain along Brahmaputra River

Speaker: Ms. Yogeeta Dahal [Lecturer, CNR]

The study highlights that there is no established threshold for permissible microplastic levels in the human body, as the impact of microplastic contamination depends on the toxicity levels and the chemical composition of the ingested particles. To address concerns regarding sample contamination, Ms. Dahal explained that the study used three replications based on established protocols from India and Bangladesh. Given the use of plastic equipment during the research process, rigorous validation techniques were employed to minimize contamination. While there is

currently no conclusive evidence directly linking microplastics to cancer, certain plastic additives, particularly colorants, may have potential carcinogenic effects. Therefore, further research should be conducted using enhanced sample validation techniques to reduce contamination risks, and help establish safe exposure levels for microplastics in humans. Additionally, the long-term health impacts of plastic additives and other contaminants must be studied.

Session II highlighted the need for policy interventions to support bioprospecting, microplastic research, and the integration of traditional knowledge into modern conservation efforts. The key takeaway from this session was the importance of facilitating interdisciplinary collaboration among policymakers, researchers, and traditional knowledge holders to advance Bhutan's conservation and sustainability goals. For instance, NBC should collaborate with the Faculty of Traditional Medicine, Khesar Gyalpo University of Medical Sciences of Bhutan to strengthen research on bioprospecting and traditional knowledge integration, as well as to enhance regulatory frameworks for sustainable bioprospecting and biodiversity conservation. Finally, investing in research infrastructure will further build Bhutan's capacity for scientific discovery and innovation.

Panel Session 1

Session Title: Youth and Women in Agriculture: Harnessing their Potential for Climate Action

Moderator: Dr. Sangay Dema [National Biodiversity Centre]

Panellists:

- Dr. Tulsi Gurung [CNR]
- Mr. Mahesh Ghimiray [CNR]
- Ms. Kesang Tshomo [Department of Agriculture]
- Mr. Nado [Assitant Dzongkhag Agriculture Officer, Wangdue]

Key Issues Discussed

The panel discussion centered on the significant role of youth and women in agriculture, the challenges they face and the strategies to enhance their participation in the sector. The key themes included the following:

- The youth views agriculture as a labour-intensive, unappealing and low-income profession.
- Need for government policies to encourage youth involvement in agriculture through financial incentives, training and technological interventions.
- The social stereotypes, labour shortages, and limited access to technology create gender barriers for women despite their crucial role in agriculture.
- Although the youth are venturing into agriculture and agribusiness, they face challenges such as financial constraints, lack of support, and unfavourable societal perceptions.
- To ensure sustainable farming and food security, modern agricultural practices must incorporate emerging, climate-resilient technologies.
- Access to resources such as capital, land, labour are crucial for women and youth venturing into agriculture.
- Family support is a determining factor whether young people, especially women can pursue a career in agriculture.

Panellists' Perspective

Panellist 1: Mr. Mahesh Ghimiray [College of Natural Resources]

Many young people in Bhutan perceive agriculture as an unappealing profession, associating it with failure and drudgery. As a result, there is growing disinterest in farming as a career choice. However, given that youth make up a significant proportion in the national population, they hold immense potential to revolutionize the agriculture sector.

The success of youth-led agricultural cooperatives demonstrates that young people can thrive in agribusiness when provided with proper support and motivation. The inclusion and provision of financial aid, technical training, and market access into policy formulation can make farming a viable and attractive career, thereby fostering greater youth engagement in agriculture.

With experience in both research and teaching, Mr. Ghimiray raised concerns about whether the current agricultural programs are adequately preparing youth to meet real-world agricultural challenges. Prioritizing practical skills and hands-on training will equip graduates with necessary tools to succeed in the agriculture sector.

Panellist 2: Dr. Tulsi Gurung [College of Natural Resources]

Creating an inclusive agricultural sector requires challenging gender stereotypes and societal expectations, as women face systemic barriers that limit their full participation despite their significant contribution to agricultural activities. Similarly, encouraging youth to pursue agriculture as a career, begins at home where parents should foster positive perceptions of farming. This cultural shift must also extend to the education system and broader society.

Although graduates from CNR possess technical expertise, the challenge lies in their ability to apply these skills effectively in real-world farming. Young individuals who show interest in agribusiness often face challenges such as access to land, finance and market opportunities.

Ultimately, for agriculture to become a preferred career choice, it must be modernized and made more appealing through incentives, innovative farming techniques, and technological interventions.

Panellist 3: Ms. Kesang Tshomo [Department of Agriculture]

This discussion serves as a platform to bridge the gap between researchers and practitioners, shedding light on opportunities in agriculture, such as bioprospecting. However, labour shortages in rural areas remain a significant concern. Moreover, many farming tools and technologies are not designed for women, making agricultural labour even more challenging for them.

The lack of water, financial capital, and other resources limits the ability of women and youth to engage in agriculture. Beyond policy-level interventions, on-the-ground support is needed this includes access to finance, technical guidance, assistance in value addition, and strengthening the entire agricultural value chain from seed procurement to market access to sustain their participation in agribusiness. Many young entrepreneurs bring innovative ideas to agribusiness but struggle to succeed due to lack of financial backing. The absence of collateral assets makes it

difficult for them to secure loans or investments. Additionally, there is a lack of mentorship and support during the critical early years of their agribusiness ventures.

Panellist 4: Mr. Nado [Assistant Dzongkhag Agriculture Officer]

Integration of emerging technology is essential to improving productivity, climate resilience, and ensuring food security. *Aum-tsu Puen-dru,* a successful women-led agricultural cooperative in Wangduephodrang uses technology, to ease farming burdens, and supplies produce to Gyalsung Academy in Khotokha. This initiative highlights the importance of supporting women's cooperatives. Family and community support influence aspiring agripreneurs. The government must ensure that the financial aid reaches genuinely motivated youth. Panbang Youth Cooperative exemplify successful youth-led agricultural ventures that deserve greater support.

Audience Questions and Responses

- Participants inquired about policy measures that would enable women, especially mothers to actively engage in agriculture. Their suggestions included allowing women to bring their children to meetings and establishing Early Childhood Care and Development (ECCD) Centres near agricultural training sites.
- Participants raised concerns about challenges related to irrigation water and labour, which greatly affects the participation of youth and women in agribusiness.

Key Takeaways and Recommendations

- Youth and women play a crucial role in promoting food security, climate resilience, and sustainable farming practices.
- Hence, a mindset shift from families to education systems is necessary to make agriculture an attractive and viable career choice.
- Encouraging families to support young agripreneurs can significantly enhance their chances of success in agriculture.
- For women, gender-friendly mechanization, better childcare support, and greater inclusion in decision-making processes are needed to strengthen their participation in agriculture.
- While digital tools, precision farming, hydroponics and climate smart techniques should be promoted to make agriculture more efficient and appealing, strengthening the agricultural value chain from seed provision to market access is essential to ensure sustainability of agribusiness ventures.

The panel discussion underscored the urgent need for collaborative efforts among policy makers, researchers, and communities to harness the potential of youth and women in agriculture, making it a viable and rewarding career option.

[Session III]
[26.03.2025]

Presentation 1: *Tupistra* (Nakima) - an Underutilized Plant Species and its Socio-economic Contributions

Speaker: Dr. Sonam Tashi [Associate Professor, CNR]

Moderator: Mr. Mahesh Ghimiray [Lecturer, CNR]

Challenges & Gaps Identified

- Despite the widespread consumption of *Tupistra* species, there is a lack of scientific studies on their morphology, genetic diversity, distribution, and medicinal properties.
- Currently, no research exists on their nutritional profile or therapeutic benefits.
- With approximately 65% of farmers relying on wild harvesting, the absence of domestication practices puts increasing pressure on natural populations, threatening their long-term sustainability.
- For this particular species, further research is needed to understand its ecological role such as its contribution to pollinator attraction and soil erosion prevention, as well as its medicinal potential, to identify possible health and economic applications.
- The development of cultivation protocols is essential to support sustainable farming and reduce reliance on wild harvesting.

Actionable Recommendations

- Research and documentation on *Tupistra's* taxonomy, medicinal properties, and nutritional profiling along with ecological contributions such as biodiversity support and soil conservation are indispensable.
- To promote sustainable domestication of *Tupistra* and reduce pressure from wild harvesting, the development of science-based cultivation techniques is essential.
- Providing training and incentives to farmers to transition from wild collection to cultivation was recommended.
- In-situ management and community-based conservation programs involving local participation would further strengthen conservation efforts.
- It is also crucial to educate stakeholders about sustainable harvesting practices and the ecological benefits of the species, while advocating for policies that support *Tupistra* cultivation as an alternative source of income for rural livelihoods.

Presentation 2: Knowledge and Perception toward Conservation of Bats in Bhutan

Speaker: Mr. Sangay Tshering [Lecturer, CNR]

Moderator: Dr. Nedup Dorji [Lecturer, CNR]

Challenges & Gaps Identified

- Bats are often associated with evil spirits, bad omens and vampire folklore.
- Common misconceptions include beliefs that bats cause baldness or pose a threat to livestock and humans.
- While many fear them, some communities regard bats as protecting dieties.
- Beyond these mixed traditional beliefs, there is a general lack of awareness about the ecological role of bats.
- Additionally, the absence of comprehensive checklist of bat species in Bhutan, hampers effective conservation efforts.
- Untrained handling of bats further increases risks of zoonotic disease transmission and exacerbates human-wildlife conflict.

Actionable Recommendations

- A checklist of national bat species should be developed
- Ecological studies should be conducted to assess their role in pollination and pest control.
- Conservation and policy measures such as strengthened legal protection of bad habitats and roosting sites, and bat-friendly agricultural practices to support ecosystem health should be promoted.
- To reduce the risk of zoonotic diseases, the public should be advised to avoid direct contact with bats, while wildlife officials and researchers must be trained in proper bat handling techniques.
- Additionally, launching community outreach programs can help dispel myths and raise awareness of the ecological benefits of bats.
- Collaborating with religious and local leaders can also help reshape cultural narratives and promote more positive perceptions of bats.

Presentation 3: Transhumant pastoralism in a changing world: challenges and opportunities to sustainable yak farming in Bhutan

Speaker: Dr. Nedup Dorji [Lecturer, CNR]

Moderator: Mr. Mahesh Ghimiray [Lecturer, CNR]

Challenges & Gaps Identified

- Only a few young yak herders are willing to continue traditional yak farming due to labour shortages and the lack of successors.
- Migration in search of more profitable livelihood further threatens the continuity of this traditional practice.
- Further, the reduced availability of grazing lands and the increasing horse population driven by tourism have limited forest access for yaks, negatively impacting their health and productivity.
- Rising yak mortality caused by wild predators is another growing concern..
- This study identified a limited understanding of the impacts of climate change, market shifts, and policy decisions on yak farming.
- It highlights the need for situation-specific policies to sustain yak herding communities.

Actionable Recommendations

- Policy and institutional support should be developed to address labour shortages, predator management, and grazing rights.
- Providing financial incentives such as subsidies, insurance can help retain herders and encourage generational succession.
- Training programs for herders in predator deterrence and diversified income generation (e.g., yak cheese production, and eco-tourism), along with youth education on the cultural and economic value of yak farming can further support succession.
- The engagement of government agencies, NGOs, and tourism operators is essential to balance landuse (yaks versus horses).
- Promotion of community-based conservation efforts is encouraged to mitigate human-wildlife conflict.
- Climate-resilient forage options and alternative grazing strategies can address the issue of declining availability of grazing lands.
- Documenting the socio-economic drivers of herder attrition can inform more effective retention strategies.

Presentation 4: The Organic Journey: Insights and Experiences

Speaker: Mr. Pema Dorji [Agri-entrepreneur, Peltari Organic Farm, Punakha]

Moderator: Mr. Mahesh Ghimiray [Lecturer, CNR]

Challenges & Gaps Identified

- There is limited technical expertise in organic farming and climate-resilient practices.
- Early carrot cultivation failed due to lack of market linkages, which discouraged member participation, while the absence of price stabilization mechanisms further contributed financial instability.
- Crop failures such as soyabean and garlic resulting from pests/diseases demonstrated the lack of adequate pest management training.
- The discontinuation of government support such as field tour opportunities, along with small landholdings continue to restrict economics of scale and limit diversification potential.
- Recurrent losses, the absence of alternative livelihood options/safeguards, and weak conflict-resolution mechanisms within the cooperative structure have contributed to high member attrition.

Actionable Recommendations

- Establishing guaranteed procurement agreements with agribusinesses or institutional buyers, and facilitating cooperative participation in farmers' market and e-commerce platforms are some strategies to strengthen market linkages and agricultural value chains.
- Risk mitigation initiatives such as targeted training in integrated pest management (IPM), disease control, and high-value crop cultivation, along with the introducing of crop insurance schemes, can buffer against climatic and biotic shocks.
- Dedicated agricultural advisors should be assigned to cooperatives, and public-private partnerships should be fostered to support infrastructure development (e.g., greenhouses, irrigation systems) and provide input subsidies.
- To enhance cooperative sustainability and governance, member retention strategies such as profit-sharing models, youth engagement programs should be implemented.
- Cooperative-led conflict resolution frameworks, supported by local government mediation, can help address internal disputes and strengthen the institutional resilience.

Session III: Question and Answer Session in Plenary

Moderator: Dr. Tulsi Gurung [Assistant Professor, CNR]

Presentation 1: *Tupistra* (Nakima) - an Underutilized Plant Species and its Socio-economic Contributions

Speaker: Dr. Sonam Tashi [Associate Professor, CNR]

Nakima is propagated through suckers, which multiply autonomously post-transplantation. It thrives in leaf-litters or organic manure (excluding cow dung) with consistent moisture. For optimal growth, it requires shaded conditions similar to cardamom cultivation. Although Nakima is relatively easy to cultivate, its limited seasonal availability, bitter taste, and high market prices are some downsides. While the presence of bioactive compounds has been reported, clinical evidence is lacking. As an alternative, underutilized species such as *Adhatoda vasica* should also be explored, given the absence of local studies despite extensive global research on its medicinal properties.

Presentation 2: Knowledge and Perception toward Conservation of Bats in Bhutan

Speaker: Mr. Sangay Tshering [Lecturer, CNR]

Bat distribution declines with altitude, and with migratory shifts reflects the climate change impacts. Although bats role as bioindicators underscore ecological value, no formal income-generating initiatives are documented. It exhibits crespuscular activity typically drinking at sun set before foraging. Therefore, cave visitors are cautioned against drinking water or removing objects due to the risks of viral contamination. While frugivorous bats have not been linked to Nepa virus, testing is recommended to confirm their status. Pre and post-exposure vaccination is advised in the event of bite incidents.

Presentation 3: Transhumant pastoralism in a changing world: challenges and opportunities to sustainable yak farming in Bhutan

Speaker: Dr. Nedup Dorji [Lecturer, CNR]

Short-term gains from extended grazing may be offset by long-term habitat degradation. Competition with horses and cordyceps collectors reduces available grazing areas. Breeding innovations such as crossbreeding yaks with cattle can enhance resilience to climate change.

Presentation 4: The Organic Journey: Insights and Experiences

Speaker: Mr. Pema Dorji [Agri-entrepreneur, Peltari Organic Farm, Punakha]

Although past crop trails failed due to pest infestations and no market linkages, soyabeans, peas and garlics are currently cultivated. The use of bio-pesticides for pest management has been largely unsuccessful due to farmer-led trials despite prior training. Although systematic studies are absent, anecdotal evidence suggests potential benefits from using cow urine. An initial

investment of Nu.50,000 in strawberry production generated Nu.45,000 in returns highlighting the potential for high-value crops.

Session III highlighted the need for collaboration between the extension officers and academics/researchers. The extension officers require the scientific expertise of the academics and researchers, while the academics/researchers will need the support of the resources available in the lab and agencies. Such cooperation and collaboration can avoid duplication of efforts and resources among stakeholders with shared interests.

The validation of the medicinal properties of *Tupistra* and *Adhatodha vasica* was highlighted as a priority, along with promotion of shaded Nakima cultivation to reduce pressure from wild harvesting. On the other hand, the assessment of bat-borne zoonotic risks particularly the potential of frugivorous bats as virus reservoirs is essential. Strengthening biosecurity at pilgrimage sites through regulated water collection is critical. Education on bat conservation and safe handling can help balance ecological and health priorities.

The session also called for the integration of crossbred yaks into pastoral systems to mitigate climate change impacts. Lastly, support for cooperative market access, and training in climate-resilient, organic farming practices were recommended for vulnerable communities.

Panel Session 2

Session Title: Natural Resource Management and Conservation: Balancing Development and Sustainability

Moderator: Mr. Mani Prasad Nirola [National Biodiversity Centre]

Panellists:

- Dr. Nawang Norbu [Bhutan Ecological Society]
- Dr. Sangay Dema [National Biodiversity Centre]
- Dr. DB Gurung [College of Natural Resources]
- Mr. Tsheten Dorji [Royal Society for Protection of Nature]

Key Issue Discussed

- Bhutan is known for its strong conservation policy. What are the opportunities and challenges faced by the country?

Panellist 1: Dr. DB Gurung [College of Natural Resources]

The panellist highlighted Bhutan's tradition of sustainable practices such as leaf litter collection, as emblematic of the Gross National Happiness [GNH] philosophy. However, infrastructure development and pollution now threaten freshwater ecosystems. Preserving natural resources is a collective responsibility essential to upholding the principles of GNH.

Conservation and sustainable development across programs are prioritized by CNR through its curriculum and beyond coursework. Co-curricular activities and student-led club further fosters environmental stewardship. Early value instillation by families also plays a critical role complementing institutional efforts in sustainability education.

He questioned whether innovation should encompass knowledge generation alongside technological advancements, citing CNR's agricultural product development as an example. Innovation must not lead to resource depletion and highlighted the importance of funding and partnerships in translating students' ideas into viable solutions.

Bhutan's economic dependence and GNH framework are underpinned by water and other natural resources. However, rapid growth risks resource degradation, calling for long-term conservation commitments from all stakeholders.

Sustainability concepts should be instilled from childhood, with parents and educators sharing the responsibility. Meanwhile, CNR's Research and Innovation Committee must clarify the scope of innovation to align with conservation goals.

In conclusion, there should be a cultural-scientific synergy, and a strong emphasis on sustainability across all curricula including early childhood education. Bhutan must also define innovation inclusively to ensure its alignment with GNH's conservation ethos. Families, educators, and policymakers must work together to instill and operationalize sustainability values.

Panellist 2: Dr. Nawang Norbu [Bhutan Ecological Society]

Although GNH is Bhutan's philosophical resistance to global consumerism and capitalism, it faces significant implementation challenges. GNH doesnot fully account for the value of natural resources in national accounting systems, and GDP continues to dominate as the primary development metric globally. The demands of market capitalism make it difficult to balance GNH principles, leading to under utilization of Bhutan's natural assets for sustainable economic benefits.

The challenges are substantiated by implementation gaps, such as, the limited capacity to monetize environmental assets (carbon, water, and biodiversity credits), incomplete institutional frameworks for sustainable resource management, two decades of stalled progress on natural resource accounting systems, and only 10% of tourism qualifying as nature-based tourism.

For balanced development, the panellist proposed the following recommendations:

i. Tourism sector development
   - Expansion of nature-based tourism offerings (e.g., Snowman Trek)
   - Increase Forest Management Unit (FMU) coverage by 10%
   - Strengthen NRDCL's capacity for value-added services

ii. Natural capital validation
   - Develop comprehensive systems for carbon, water resource and biodiversity crediting
   - Build technical capacity for sustainable resource management
   - Create market mechanisms that aligh with GNH principles
   - Develop alternative economic indicators beyond GDP

Moving forward, Dr. Norbu also highlighted some persistent obstacles such as:
- The tension between GNH values and global economic systems.
- The need for technical expertise in natural capital valuation.

- Requirement for innovative policy frameworks.
- Balancing rapid development with conservation imperatives.

Panellist 3: Mr. Tsheten Dorji [Royal Society for Protection of Nature]

The panellist emphasised the cultural view of natural resources as divine gifts, the urgency of balanced economic development in alignment with GNH, and Bhutan's global leadership in environmental commitments such as, its carbon negative status, and the constitutional mandate for 60% forest coverage.

He highlighted the initiatives taken by RSPN to promote integrated conservation and development. As Bhutan's oldest conservation NGO, RSPN implements the following initiatives:

- Ecotourism partnerships: Collaborates with the Tourism Department to preserve cultural traditions while generating sustainable livelihoods.
- Springshed management: Ensures clean drinking water and irrigation supply through watershed conservation.
- Thematic focus areas: Wetland protection, endangered species conservation, and community-based resource management.

In the conservation process, the critical role of local communities were identified and several key insights on community participation emerged:

- Community Forest Management (CFM): Demonstrated success of inclusive governance models.
- Traditional-Scientific Knowledge Integration: Vital for program acceptance and effectiveness.
- Ownership & Engagement: The degree of local involvement directly correlates with conservation outcomes.

Based on the insights provided, some of the tensions and opportunities were:

- Development vs. Conservation: Challenges in maintaining ecological integrity amid economic growth.
- Institutional Leadership: Bhutan's unique position as a global conservation exemplar under monarchical guidance
- Scalable Models: Potential to expand successful initiatives (e.g., spring-shed management) nationally.

Panellist 4: Dr. Sangay Dema [National Biodiversity Centre]

Although GNH has been a driving force behind Bhutan's environmental achievements, the lag in the economic development demands for a more balanced approach. Dr. Dema asserted that it is a challenge to reconcile conservation priorities with developmental needs.

Moving forward the way to address this is by developing adaptive conservation strategies that align with economic growth.

The National Biodiversity Centre contributes to long-term sustainability in the following ways:

i. Conservation Approaches
   - In-situ: Protection of ecosystems in their natural habitats (e.g., protected areas).
   - Ex-situ: Gene banks for preserving genetic diversity.

ii. Research Focus
   - Taxonomic studies to document biodiversity.
   - On-farm and wild conservation initiatives.

iii. Beyond Conservation
   - Bioprospecting: Exploring economic value of biodiversity (e.g., medicinal plants).
   - National Biodiversity Strategy and Action Plan (NBSAP): Mainstreaming biodiversity into national policies.

iv. Institutional Coordination for Biodiversity Management
   - Department of Forests and Park Services (DoFPs): Manages ecosystem and species-level diversity.
   - NBC's Complementary Role: Focuses on genetic conservation and sustainable utilization.

In conclusion, the panellist mentioned that there is a need for stronger inter-agency collaboration and scaling up of bioprospecting for livelihood linkages.

Audience Questions and Responses

The questions and responses centered on the following areas:

i. Overprotection vs. Mismanagement
   - Bhutan's conservation policies may be overly restrictive, leading to underutilization of natural resources (e.g., water scarcity despite abundant reserves).
   - Poor management exacerbates issues (e.g., wild pig overpopulation, inefficient water distribution).

ii. Mining Debate
   - Questions about the necessity of mining versus exploring sustainable alternatives.
   - Tension between environmental protection and economic needs (employment, livelihoods).

iii. Protected Areas & Resource Allocation

Current Status
   - 50% of land under protected areas—sufficient for biodiversity conservation.
   - Need to reassess whether strict protection limits socio-economic opportunities.

Mismanagement Issues
   - Lack of adaptive strategies for controlled resource use (e.g., sustainable hunting, water infrastructure).

iv. Reconciling GNH with Economic Realities

External vs. Internal Priorities:

- GNH as a Global Brand: Effective for promoting Bhutan's conservation leadership.
- Domestic Challenges: Youth unemployment, rural livelihoods, and infrastructure gaps require pragmatic solutions.

v. Call for Policy Reform

- Need to revisit conservation policies to allow sustainable utilization.
- Explore alternative economic models beyond strict protectionism.

vi. Development Focus: Economic vs. Holistic

Clarifying Objectives

- Is the discussion centered on economic growth (jobs, industry) or broader development (health, education, well-being)?
- A need to align conservation with tangible benefits for local communities.

Key Takeways and Recommendations

The key takeways and recommendations from Panel Session II were:

i. Optimization of resource management

- Shift from overprotection to sustainable utilization (e.g., regulated wild pig culling, improved water infrastructure).

ii. Explore alternatives to mining

- Invest in green industries (eco-tourism, agroforestry, renewable energy).

iii. Reform GNH implementation

- Balance global conservation branding with domestic economic needs.

iv. Develop adaptive policy framework

- Reassess protected area regulations to allow controlled, sustainable use.

v. Stakeholder Dialogue Needed

- Engage communities, policymakers, and scientists to redefine conservation-economic trade-offs.

vi. Academic & Policy Implications

- Highlights gaps in Bhutan's conservation model—protection without utilization leads to inefficiencies.
- Calls for evidence-based policy shifts to align environmental and economic goals.

[Session IV]
[26.03.2025]

Presentation 1: Assessing the Fish Diversity of Bhutan using a Combination of Molecular and Morphometric Techniques

Speaker: Dr. DB Gurung [Professor, College of Natural Resources]

Moderator: Dr. Nedup Dorji [Lecturer, College of Natural Resources]

Challenges & Gaps Identified

- Although historical data dates back to 1839, there is no definitive record of fish species in Bhutan.
- Phenotypic plasticity and ontogenic variations often lead to misidentification, and an over reliance on morphological traits increases the livelihood of errors compared to genetic analysis.
- Lack of standardized protocols for data collection hinders publication and verification.
- Taxonomic uncertainty and methodological limitations are aggravated by infrastructure deficits such as inadequate laboratory facilities for genetic studies and poorly maintained DNA banks due to improper sampling practices.

Actionable Recommendations

- It is necessary to establish a reliable DNA database for Bhutanese fish species to reduce reliance on phenotypic traits, and to adopt standardized genomic protocols (e.g., DNA barcoding) for accurate identification.
- Upgrading laboratories with genetic sequencing tools, training researchers in modern taxonomy, and developing a centralized digital repository for all Bhutanese aquatic biodiversity research would enhance these studies.
- Creating a national task force to consolidate and verify historical data would facilitate data validation, while fostering partnerships with international ichthyologists and regional research institution would help widen the scope of the research.
- At a policy and outreach level, a definitive field guide with peer-reviewed morphological/genetic data should be published.
- Additionally, advocacy for funding prioritization is needed to address taxonomic gaps in national biodiversity assessments.

Presentation 2: Ecohydrological factors regulating Brown Trout in Himalayan Rivers Systems in Thimphu, Bhutan

Speaker: Mr. Laxmi Sagar [Associate Lecturer, College of Natural Resources]

Moderator: Dr. Nedup Dorji [Lecturer, College of Natural Resources]

In Mr. Ugyen Dorji's absence, Mr. Laxmi Sagar (Co-PI) presented the paper.

Challenges & Gaps Identified

- The high adaptability of brown trout (Salmo trutta) has led to its invasive spread, posing a threat to native aquatic biodiversity.
- Limited research on native fish diversity in Bhutan's alpine and sub-alpine freshwater systems, combined with a lack of data on ecohydrological responses of brown trout to high altitude river systems, highlights the need for studies on how hydrological characteristics affect brown trout populations.

Actionable Recommendations

- Longitudinal studies are recommended to investigate prey-predator dynamics between brown trout and native species, and to assess the habitat-specific influence (e.g., riffles, pools) on its distribution.
- Further research should study the effect of climate-driven hydrological changes on trout invasiveness in high altitude rivers.
- Targeted removal of brown trout in critical native fish habitats, and enforcing fishing regulations such as catch and keep policies was suggested as an alternative approach to control its invasiveness.
- Apart from prioritizing baseline studies on endemic fish species in alpine zones, partnering with scientists from the Himalayan region would be valuable for comparing trout impacts and mitigation strategies.

Session IV: Question and Answer Session in Plenary

Moderator: Dr. Nedup Dorji [Lecturer, CNR]

The discussions for Session IV, unlike the earlier sessions, are presented point-wise under specific headings.

i. Public Health & Ecological Concerns
   - Heavy metal contamination: Catfish (Order Siluriformes) in Bhutanese waters may exhibit high levels of heavy metals as observed in other regions, and may therefore pose risks to human consumption and ecosystem health.
   - Impact of invasive species: Poorly regulated fishing permits such as allowing only 4–5 species, fail to control invasive fish proliferation, exacerbating native species decline.

ii. Gene Bank & Taxonomic Challenges
   - Current status: About 75% of Bhutan's fish species are documented in the national gene bank, but gaps persist.
   - Collaboration barriers: Experts often work in isolation, hindering consensus on species identification and data standardization.
   - Urgent need: Expand genetic databases with whole-genome sequencing to resolve phenotypic misclassification (e.g., morphologically similar species).

iii. Policy & Regulatory Gaps
   - Amend fishing permits: Need to advocate for dynamic regulations targeting invasive species and protect native species.
   - Native species protection: Policies must prioritize habitat restoration and invasive species control to curb biodiversity loss.
   - Need of advocacy on life saving acts like Tshethar (release of captive animals into the wild).

iv. Research Shortfalls
   - Migration studies: Only one documented study by Dr. DB Gurung addresses fish migration patterns, this is critical for conservation planning.
   - Mapping urgency: Lack of comprehensive fish distribution maps limits adaptive management.

Actionable Recommendations

i. Public Health & Safety
   - Conduct nationwide heavy metal screening of catfish and other high-risk species.
   - Issue consumption advisories for contaminated fisheries.

ii. Genetic & Taxonomic Solutions
   - Establish a mandatory collaboration framework for ichthyologists to standardize species identification.
   - Secure funding for high-throughput DNA barcoding of all Bhutanese fish species.

iii. Policy Reforms
- Amend fishing permits to target invasive species (e.g., Brown trout) and protect native species.
- Integrate climate resilience into aquatic biodiversity policies.

iv. Research Priorities
- Expand migration studies and publish open-access distribution maps.
- Partner with international institutes such as IUCN for invasive species management training.

[Session IV]
[27.03.2025]

Session V: Technical Session - Policy Brief

Session V focused on a technical session addressing cross-cutting emerging issues with selected working partners, with an emphasis on the formulation of policy briefs. The session was moderated by Ms. Sonam Wangmo, Chief, Research & Development, DeARS, OVC.

APPENDIX

BOOKLET: ABSTRACTS/POSTER TITLES AND BIO OF THE PARTICIPANTS

Table of Contents

A. Conference Program

Thematic areas: Climate Crisis, Natural Disasters, Environmental Sustainability, Agriculture & Food

DAY 1

25 March	Agenda	Responsible Person
8.30 - 9.00	Registration of participants	Organising team
9.00 - 9.10	Welcome remarks	DRIL, CNR
9.10 - 9.25	Opening address by the Chief Guest	Dasho Secretary, MoAL
9.25 - 9.40	Keynote address by Dasho VC, RUB	Dasho VC, RUB
9.40 - 9.45	Program overview/Introduce partners	MC/Organisers
9.45 - 10.15	PHOTO SESSION & TEA BREAK	
SESSION I: Moderator Dr. Sonam Tashi, Assoc Professor & DRIL, CNR		
10.15-10.30	Altitude, Land Use and Soil Depth Effects on Earthworm Density and its Relationship to Soil Properties in an On-Farm Study	Ms. Ameeta Adhikari (NSSC, MoAL)
10.30-10.45	Impact of Arecanut Plantation on Farming System and Livelihood: A Case Study of Chhuzanggang Gewog, Sarpang	Mr. Ugyen Gyeltshen (NSSC, MoAL)
10.45-11.00	Panbang Youth Cooperative	Mr. Pema Zangpo, Agri-entrepreneur, Zhemgang
11.00-11.15	Re-imagining Bhutanese Agriculture in a Land and Labour Constrained Scenario	Dr. Nawang Norbu (Executive Director, BES)
11.15-12.15	QA Session in plenary	Moderator: Dr. Sonam Tashi
12.15-13.15	LUNCH	
SESSION II: Moderator Dr. Ugyen Thinley, Asst. Professor & DAA, CNR		
13.15-13.30	Role of local traditions and cultural norms for environmental sustainability, health, and well being	Dr. Tshering Yangden (Tarayana)
13.30-13.45	Unlocking Nature's Wealth: Bhutan's Model for Conservation and Sustainable Use of Biodiversity	Mr. Mani Prasad Nirola (NBC, MoAL)
13.45-14.00	Transboundary Micro-Plastic Contaminations in Fish and Aquatic Food Chain along Brahmaputra River	Ms. Yogeeta Dahal (Lecturer, CNR)
14.00-15.00	QA Session in plenary	Moderator: Dr. Ugyen Thinley
15.00-15.30	TEA BREAK/Poster Presentation	
PANEL SESSION 1: Moderated by Dr. Sangay Dema (NBC, MoAL)		
15.30-16.30	PANEL SESSION 1: Youth and Women in Agriculture: Harnessing Their Potential for Climate Action.	Panellists: Dr.Tulsi Gurung, (CNR)/ Mr. Mahesh Ghimiray (CNR)/ Ms. Kesang Tshomo (DoA, MoAL)/ Mr. Nado (Asst. DAO, Wangdue)
16.45-17.00	DAY 1 CLOSE/ Followed by Reception Dinner	MC/Organisers

DAY 2

26 March	Agenda	Responsible Person
9.00-9.05	Overview of the day	MC
SESSION III: Moderator Dr.Tulsi Gurung, Assoc.Professor, CNR		
9.05-9.20	*Tupistra* (Nakima) - an Underutilized Plant Species and its Socio-economic Contributions	Dr. Sonam Tashi (CNR)
9.20-9.35	Knowledge and Public Perception Toward Conservation of Bats in Bhutan	Mr. Sangay Tshering (Lecturer, CNR)
9.35-9.50	Transhumant pastoralism in a changing world: challenges and opportunities to sustainable yak farming in Bhutan	Dr. Nedup Dorji (Lecturer, CNR)
9.50-10.05	The Organic Journey: Insights and Experiences	Mr. Pema Dorji (Agri-entrepreneur), Peltari Organic Farm, Punakha
10.05-11.05	QA Session in plenary	Moderator: Dr. Tulsi Gurung
11.05-11.20	TEA BREAK	
PANEL SESSION 2: Moderated by Mr. Mani Prasad Nirola, NBC, MoAL		
11.20-12.20	PANEL SESSION 2:Natural Resource Management and Conservation: Balancing Development and Sustainability.	Panellists: Dr.Nawang Norbu (BES) / Dr.Sangay Dema (NBC)/Dr.DB Gurung (CNR)/ Mr.Tsheten Dorji (RSPN)
12.20-13.20	LUNCH	
SESSION IV: Moderator Dr. Nedup Dorji, Lecturer, CNR		
13.20-13.35	Assessing the Fish Diversity of Bhutan using a Combination of Molecular and Morphometric Techniques	Dr. DB Gurung (Professor, CNR)
13.35-13.50	Ecohydrological factors regulating Brown Trout in Himalayan River Systems in Thimphu, Bhutan	Mr. Laxmi Sagar (Assoc. Lecturer, CNR)
13.50-14.40	QA Session in plenary	Moderator: Dr. Nedup Dorji
14.40-15.00	Closing of Plenary Sessions/ Collaborations & Way forward	Dr. Sonam Tashi, DRIL,CNR
15.00-16.30	HIGH TEA	

Master of Ceremony (MC): Ms. Kinzang Tshomo & Mr. Wangdi Rigsel, Final year , BSc Forest Science.

Rapporteur: Mr.Tobgay, Chief, Higher Degree Research Division, DeARS,OVC, RUB; Ms. Sonam Lhazeen Wangmo & Mr. Namgay Wangchuk, Final year, BSc Forest Science.

DAY 3

27 March	Agenda	Responsible Person
Session V: Technical Session - Policy brief		
8.30-12.30	Exercise to formulate a policy brief on waste management in Bhutan.	Ms. Sonam Wangmo, Chief, Research & Development, DeARS
12.30-13.30	LUNCH	
13.30-16.00	Presentation by the working team/ Discussion and Collaborations	Expert Team (TBC)
16.00-16.30	A way forward and closing	DRIL,CNR/DeARS,RUB

B. Bio and Abstracts of the Speakers

1. Altitude, Land Use and Soil Depth Effects on Earthworm Density and its Relationship to Soil Properties in an On-Farm Study

Ameeta Adhikari, currently serves as the Assistant Laboratory Officer of the National Soil Services Centre, Department of Agriculture under Ministry of Agriculture and Livestock. She holds a Bachelor of Science Degree with Honours in Microbiology. She is currently working in the field of Soil microbiology, focusing on isolating beneficial microbes from soils associated with various commercial crops cultivated across different regions of the country. These microbes are being studied for their potential use in biofertilizer production and possible applications in bio-prospecting processes. While working in this field, she has recognized the crucial role of molecular biology and biotechnology, mainly the use of sequencing machines and PCR techniques for identifying microbes at the strain level. Therefore, this is an area that she is currently interested in and keen on exploring more about.

Abstract:

Ameeta Adhikari[1], Yadunath Bajgai[2,3], Jimba Rabgyal[3], Rattan Lal[2], Nima Tshering[1], Sarda Gurung[1] and Tashi Wangdi[1]

Earthworms play a critical role in soil ecosystem functions through the cycling of organic matter and nutrients. However, some land uses or environmental conditions provide more favorable habitats for them than others. Therefore, the objectives of this study were to evaluate the prevalence of earthworm density and its relationship to land uses and soil properties. The study was conducted in three districts in Bhutan-Wangdue Phodrang, Chhukha, and Dagana-across three land uses: organic fields (OrgF), conventional fields (ConF), and natural vegetation (NatV). It also accounted for three altitudinal gradients (high-, mid-, and low-altitudes) and three soil depths. The results indicated that overall earthworm density at high-altitude sites was significantly ($P < 0.001$) higher than that at mid- and low-altitude sites. Further, across altitudes and soil depths, OrgF sites exhibited a significantly ($P < 0.001$) higher earthworm density (120 earthworms m^{-2}) compared to NatV (56 earthworms m^{-2}) and ConF (43 earthworms m^{-2}) sites. Moreover, earthworm density decreased significantly ($P < 0.001$) and successively with increasing soil depth. The coefficient of determination ($R^2 \geq 0.51$; $P < 0.001$) demonstrated a positive and moderate relationship between earthworm density and soil organic C and total N in OrgF sites, whereas this relationship was weak ($R^2 \leq 0.22$) in ConF sites and absent in NatV sites. In conclusion, substituting chemical fertilizers with organic manures could increase earthworm density by enhancing soil health through the cycling of organic materials and nutrients in the soil. These findings provide empirical evidence for the prevalence of earthworms in different land use types across altitudinal gradients and offer valuable decision-making insights for land users and policymakers alike.

2. Assessing the Fish Diversity of Bhutan using a Combination of Molecular and Morphometric Techniques

Professor Dhan Bdr Gurung joined the Royal Civil Services of Bhutan in 1989 and joined the Natural Resources Training Institute as a Lecturer in 1992. He continued to serve in the institute and became a faculty member in the College of Natural Resources of the Royal University of Bhutan in 2006. He has MSc in Forestry from Dehradun, India and MSc in Natural Resources Management from the University of Edinburgh in Scotland. He completed his PhD from ETH, Zurich, Switzerland. He has served as the Dean of Academic Affairs and the Dean of Research and Industrial Linkages in the college. He also served as the project coordinator in various projects such as the project funded by Danida, Norway and currently by the Swiss National Science Foundation, Switzerland. He is currently serving as a Professor in the Department of Forest Science in the college and has contributed significantly in fish and orchid taxonomy of Bhutan.

Abstract:

DB Gurung, Karma Wangchuk and Ugyen Dorji

Bhutan, which is located in the eastern Himalayas, is part of the 10 global biodiversity hotspots. While the terrestrial flora and fauna have been well studied, aquatic biodiversity remains under surveyed. The first ichthyofaunal diversity of Bhutan was done in 1978 which recorded 41 fish species. The list was reviewed in 1999 without any change in the number. However, the academic rigour to ichthyofaunal study was initiated in 2009. Since then, there is a record of 109 species of fish known to occur in Bhutan. Since the conventional morphometric method is not efficient in fish diversity study for many groups such as nemacheilids and sisorids, this study made attempts to combine the morphometric and molecular methods to assess the fish diversity of Bhutan. While the morphometric method relied on meristic counts, counts, banding patterns, and colours; the molecular method primarily used DNA barcoding targeted to CO1 gene. In few cases, 16S rDNA and 12S rDNA genes were also used in combination with the CO1 gene. Currently, the fish diversity of Bhutan stands at about 125 species. With shifting focus to molecular study, it is projected that the fish diversity of Bhutan will extend beyond the current figure of 125 species.

3. Unlocking Nature's Wealth: Bhutan's Model for Conservation and Sustainable Use of Biodiversity

Mr. Mani has been working at the National Biodiversity Centre, Ministry of Agriculture & Livestock especially looking after the Bioprospecting and ABS program, and has 15 years of experience working in the field of biodiversity conservation, bioprospecting and Access and Benefit Sharing. His work envisions deriving tangible benefit from Bhutan's rich biodiversity and associated traditional knowledge for the enhancement of conservation and rural livelihood and the promotion of people's leadership in conservation. He is the

Bhutan's National Focal Point for the Nagoya Protocol. He has authored a number of scientific publications and technical and policy papers. On the academic front, Mr. Mani has a M.Sc. in Mountain Forestry from the University of Natural Resources and Life Sciences, Vienna, Austria.

Abstract:

Bhutan, a biodiversity hotspot, has taken significant strides in implementing the Nagoya Protocol on Access and Benefit Sharing (ABS) to safeguard its genetic resources and traditional knowledge. With its Access and Benefit Sharing Model, Bhutan addresses the challenges of biopiracy and resource misappropriation by fostering sustainable and equitable utilization of biodiversity. This paper highlights Bhutan's journey in implementing ABS, from instituting its program in 2009 to revising the Biodiversity Act in 2022. Through its ABS framework, Bhutan has developed standardized agreements, such as Material Transfer Agreements (MTAs) and Benefit Sharing Agreements, to regulate access and ensure fair benefits for custodians of traditional knowledge. These measures have led to the successful signing of 14 ABS agreements and the development of 13 bioprospecting-based products, including partnerships with global companies like Chanel Parfums Beauté, Quantum Pharmaceutical Ltd, and BlueZones Group. Notable products, such as anti-ageing creams and nutraceuticals, underscore Bhutan's capacity for high-value biodiversity-based enterprise development. The establishment of the Bhutan ABS Fund ensures sustainable financing for biodiversity conservation. However, Bhutan faces challenges, including limited capacity, low awareness, and gaps in product certification and supply chains. To overcome these, priorities include strengthening technical and laboratory capacities, fostering community-private sector collaborations, and enhancing branding and value addition to products.

Bhutan's ABS model showcases the potential of leveraging traditional knowledge and biodiversity for sustainable development. Its experience provides valuable insights for countries seeking to balance conservation and economic growth through equitable bioprospecting initiatives.

4. Re-imagining Bhutanese Agriculture in a Land and Labour Constrained Scenario

Nawang Norbu (PhD) is the Founder and Executive Director at the Bhutan Ecological Society. He is also Center Director of the Center for Climate and Sustainable Futures, a collaborative research and education initiative between the School for Field Studies in the US, the Royal University of Bhutan and the BES. Recently, he helped craft Bhutan's RNR Strategy 2030, and also drafted, in collaboration with the Royal Government and the FAO, the national pathways to transform Bhutan's food systems. Nawang is committed to building a just and verdant world and continues to explore the drivers and consequences of development and change.

Abstract:

Close to 60% of the Bhutanese population continue to rely on subsistence-based agriculture. This equates to a farmer feeding only herself/himself and one additional non-farming Bhutanese population. Efficiency, yield and production are constrained by low land holdings, steep terrain, and low availability of farm labour. Across the world, as countries develop, the contribution of primary sectors such as agriculture to employment, wanes. We contend that Bhutan will be no exception to this global trend. Based on the secondary data, we examine land holding patterns, rates of rural-urban migration, and generic farming challenges which constrain agriculture

productivity. Eighty-two percent of Bhutan's farming households own less than 5 acres of land (with 99% owning less than 5 acres of wetland; and 85% own less than 5 acres of dryland). Productivity on these small land holdings is further constrained by an aging farming population, and lack of farm labour, due to continued migration of youth, from rural to urban areas. Extant strategies aimed at developing farming, including disbursement of input subsidies, have not resulted in a robust agricultural sector. This is made clear by the significant rise in imports of agricultural produce over the last two decades. Given small land holdings, continued loss of farm labour, and allied factors which limit production, we propose a radical re-imagination of Bhutan's agricultural sector to prepare for a labour constrained future in the coming decades, where a significant proportion of Bhutanese population will not engage in farming, as their primary source of income. Amongst other things, this re-imagination should provide frameworks to consolidate farms; upscale support to aggregators; promote the adoption of site- specific technology and crops; and allow for import of seasonal farm labour.

5. Transhumant Pastoralism in a Changing World: Challenges and Opportunities to Sustainable Yak farming in Bhutan

Nedup Dorji is a Lecturer at the College of Natural Resources, The Royal University of Bhutan in 2007. In 2008, he was awarded for the Thai International Cooperation Agency to pursue a MSc in Agriculture at Khon Kaen University, Thailand (graduated in 2010). During his MSc, he assessed genetic variations of Bhutanese indigenous chickens, and compared with Thai native chickens and commercial chicken lines. In 2016, Nedup was awarded the Netherlands University Foundation for International Cooperation in Higher Education to pursue a PhD study at the Farm Technology group in collaboration with the Animal Production Systems group of Wageningen University. His study focused on transhumant yak farming in Bhutan.

Currently, he is the Managing editor and editorial board member of the Bhutan Journal of Natural Resources and Development (BJNRD) and till date he has been working as the Lecturer at the College of Natural Resources, The Royal University of Bhutan.

Abstract:

Nedup Dorji[1*], Marjolein Derks[2], Peter W.G. Groot Koerkamp[2] and Eddie A.M. Bokkers[3]

In the high altitude of Bhutan, yak farming is the main livelihood of transhumant pastoralists living 2500 m above sea level. However, yak farming is under pressures because of external factors such as socioeconomic developments, policies and climate change. Little is known about the impact of these factors on yak farming, and what policies and interventions might be required to sustain yak farming under these pressures. Therefore, the aim of this study was to assess the impact of external factors and management on yak farming in Bhutan, with a focus on past developments, the current situation and future perspectives in yak farming. Overall, increasing yak predation by predators, decreasing forage availability in the rangelands, and decreasing number of successors are the major threats to yak farming, while the market to sell yak products is the least threat. The

factors causing forage shortage are specific to certain regions, e.g. competition with the horse population (west), cordyceps collection (central and west) and prohibited burning of shrubs around rangelands (east and central). Although concerns around yak farming have increased over the years due to external factors, most herders (82%) wish their children to continue yak farming in the future. Nonetheless, over half of the herders (58%) and most livestock professionals (96%) think that the number of yak farming families will decline in the future. To get insight into how different stakeholders perceive the challenges and opportunities related to yak farming, six focus group interviews were organised with different stakeholders (herders and representatives of governmental bodies). Most problems and solutions identified in the focus group interviews differed between the stakeholder groups. This suggests a need for a multi-stakeholder dialogue aiming to discuss problems and solutions together with different stakeholders. The government should streamline socioeconomic development by supporting and improving basic facilities in yak farming villages (e.g. better access to communication, animal health services), pay attention to human-wildlife conflicts and forage shortage, and explore sustainable income based on yak farming.

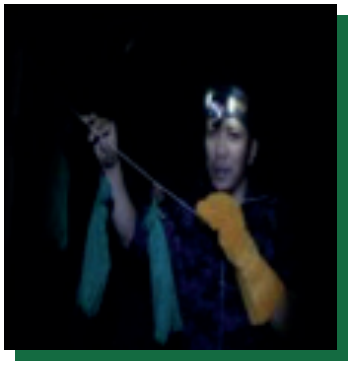
6. Panbang Youth Cooperative

Mr. Pema Zangpo is from Pongchaling, Panbang, Zhemgang Dzongkhag. He holds a Bachelor's degree in Environmental Science from Sherubtse College. He is one of the founding members of the Panbang Youth Cooperative, and currently serves as its secretary and marketing manager.

7. The Organic Journey: Insights and Experiences

Mr. Pema Dorji is an agri-entrepreneur and the chairman of Sonam Phuensum Detshen Cooperative, a certified organic farmers' group based in Peltari, Kabisa, Punakha Dzongkhag. The cooperative was established in 2011 with 21 members, supported by Dzongkhag Agriculture Sector aimed to promote collective agricultural commercialization. Early challenges including market access, failed crop trails (e.g., carrot cultivation, soybean and garlic) led to member attrition with only six members remaining. The cooperative has recently shifted to strawberry cultivation with assistance from the B-KIND Tarayana Foundation.

8. Knowledge and Public Perception Toward Conservation of Bats in Bhutan



Mr. Sangay Tshering is a lecturer at College of Natural Resources (CNR). He started working on bats since 2016 while pursuing MSc. in Environment Management in India. Currently, he is working on 'DNA Barcoding and Phylogenetic analysis of bats of Bumthang District, Bhutan' funded by College Research Grant (CRG).

Abstract:

Bats constitute the second most diverse order of mammals with more than 1400 species globally. In Bhutan, bats are lesser known and low profile species as we don't have even a 'check list'. In 2004 Bhutan is reported to have the record of 65 species which represents 33% of mammal taxa. However, a proper and exhaustive study is required to confirm its actual presence. Exact number of species present in Bhutan still remains uncertain as the information on many of the species is solely based on literature surveys. At present, a reliable diversity and distribution database is available for species recorded from eight Districts (Chhukha, Punakha, Dagana, Sarpang, Thimphu, Paro, Bumthang, Haa and few locations from other district). For this, a combination of capture and acoustic methods were used. Capacity building events and conservation awareness were also conducted as there are different myths. Its important conserve as they are one of the important components of forest ecosystem and agriculture farming as pollinators, seed dispersers and pest controllers.

9. *Tupistra* (Nakima) - an Underutilised Plant Species and its Socio-economic Contributions

Assoc. Professor (Dr.) Sonam Tashi currently serves as the Dean of Research and Industrial Linkages at the College of Natural Resources, Royal University of Bhutan. Prior to his current position, Dr. Tashi served as the Dean of Academic Affairs. He is the Editor-in-Chief of the Bhutan Journal of Natural Resource Development and also serves as an Editor for the International Journal of Environment.

Previously, he was an Associate Editor of the official journal of the International Society of Organic Agriculture Research. Dr. Tashi has authored numerous peer-reviewed articles and is a regular reviewer for both national and international journals. He is specialized in organic and sustainable agriculture practices.

Abstract:

The *Tupistra* species, native to the Eastern Himalayas, serves as both a delicacy with therapeutic properties and a source of income for farmers. Although its domestication is getting popular among farmers, studies on this species remains relatively less. Therefore, this study aimed to

evaluate the socio-economic contributions of *Tupistra* species. Using the snowball sampling method, 200 farmers across four districts who domesticate as well as depend on the wild collection of *Tupistra* species were identified and interviewed using semi-structured questionnaires. Results showed that farmers earned between Nu 5,100 to more than Nu 21,000 in a season, with income variations depending on market location and whether middlemen were involved or not. The income earned from the sale was used in various household expenses, including annual rituals, land tax payments, children's education and the purchase of seeds and fertilizers. Approximately 65% of farmers depended on wild *Tupistra* collection for sale and consumption, while 35% practised domestication, with the majority (31%) cultivating about half an acre. By promoting domestication, rural livelihoods could be improved and at the same time pressure on wild collection could be reduced thus conserving *Tupistra* species in their natural habitats.

10. Role of local traditions and cultural norms on community wellbeing and environmental sustainability

Tshering Yangden is a Senior Researcher with the Tarayana Center for Research Development. She has a master's Degree in Economics from Oita University in Japan, a second master's in Sociology from the University of Canterbury in New Zealand, and completed her PhD in Sociology from the University of Wollongong in Australia.

She has conducted several research on social issues in Bhutan, particularly in the areas of gender, domestic violence, and human trafficking. Besides being a freelance consultant, she also worked as the National Project Coordinator for BAFRA, the then Ministry of Agriculture and Forests, and worked on drafting the Biosafety Rules and Regulations of Bhutan.

Abstract:

Tshering Yangden[1] and Tulsi Gurung[2]

Traditional practices and indigenous knowledge are integral to environmental conservation and sustainability. These practices stem from a community's extensive understanding of their local environment, cultivated over generations, which promotes sustainable interactions with nature across centuries. This traditional knowledge manifests in various daily activities, including sustainable agricultural techniques, management of natural resources, medicinal herbs, and spiritual beliefs that honor the sanctity of the natural world. This research aims to document the intricate web of local traditions and cultural practices, their influence on community well-being, and their role in nature preservation in the gewogs of Laya in Gasa, Dzomi and Kabjisa, in Punakha, and Gangtey and Phobji gewogs in Wangdue Phodrang. A qualitative research approach explored traditional knowledge, spiritual beliefs, and community-based healing practices about nature. The findings revealed that various practitioners, such as shamans, utilize plants for ritualistic purposes, while joint fixers employ herbs for treating dislocations and fractures, and hot springs are revered places of various healing, highlighting the community's commitment to protecting these species and sites. Additionally, traditional agricultural methods contribute to environmental protection through soil conservation and use of local plants as pest repellent, and crop biodiversity via seed preservation and crop rotation. Astrologers also play a role by advising individuals on the significance of honoring sacred sites. The reliance on astrologers for selecting

auspicious dates for significant dates is decreasing with the availability of information from online sources. Nevertheless, their role in performing rituals aimed at achieving positive results remains significant. Consequently, the spiritual belief in the detrimental effects of polluting sacred areas fosters a culture of respect for nature, thereby upholding its sanctity and sustainability. Therefore, documentation of the existing and disappearing traditional knowledge and cultural norms is recommended to ensure their transmission to future generations.

11. Ecohydrological factors regulating Brown Trout in Himalayan River Systems in Thimphu, Bhutan

Mr. Ugyen Dorji is a freshwater ecologist with extensive expertise in the conservation of freshwater fauna and flora. Currently serving as the Dean of Student Affaris at the College of Natural Resources, Royal University of Bhutan, he is an Editor for the Bhutan Journal of Natural Resources and Development and he was also the Programme Leader for the MSc in Natural Resources Management (HDR). His research interests include freshwater biodiversity, aquatic ecosystems, and the impacts of anthropogenic activities on freshwater habitats. Over the years, he has successfully led numerous research projects, including molecular analysis of aquatic species, climate change impacts on water sources, and macroinvertebrate diversity studies. He is also a co-founder of Water Research Bhutan and has served as a National Consultant for various hydropower and ecological impact assessments.

With proficiency in GIS software, R, SPSS, and statistical modeling tools, Mr. Ugyen Dorji is a skilled educator and mentor, having facilitated over 60 capacity-building programs for both national and international participants. His contributions extend to policy-making as a member of the National Technical Working Group on water resource management in Bhutan. Mr. Ugyen Dorji is an accomplished researcher with numerous peer-reviewed publications on freshwater ecology, biodiversity, and climate change impacts. His current projects focus on addressing river pollution and enhancing ecosystem services in the Hindu Kush region.

Abstract:

The introduction of brown trout (Salmo trutta) to Himalayan river systems, including Thimphu, Bhutan, has raised ecological concerns due to competition with native fish, especially the snow trout. This study explores the ecohydrological factors influencing brown trout distribution and habitat selection across seasonal variations within these river systems. Fieldwork was conducted in the Thimphu Chhu River, spanning elevations from 2,485 to 5,620 m, across three seasons (pre-monsoon, monsoon, and post-monsoon) in 2023-2024. Systematic sampling across 30 stretches involved electrofishing and habitat assessments of water depth, velocity, substrate type, cover, and water quality. Results show significant seasonal shifts in habitat use: during the monsoon, brown trout predominantly occupied pool habitats for refuge, while runs were favored during pre- and post-monsoon seasons for foraging. Substrate composition also influenced habitat choice, with a preference for cobble substrates during high flows in the monsoon, shifting to organic substrates like dead wood in calmer pre-monsoon conditions. Larger individuals (>30 cm) were found in deeper, faster sections, especially during monsoon flows, whereas smaller trout (<15 cm) occupied shallower areas with slower currents. Spatial analysis indicated the highest trout densities in mid-

altitude zones, with a decline at higher altitudes, likely due to colder temperatures and steeper gradients. This research underscores the adaptability of brown trout in diverse ecohydrological conditions, highlighting their competitive edge over native species. Findings contribute to understanding brown trout's invasive success in Himalayan rivers, emphasizing the need for habitat management and conservation efforts to mitigate impacts on native biodiversity.

12. Impact of Arecanut Plantation on Farming System and Livelihood: A Case Study of Chhuzanggang Gewog, Sarpang

Mr. Ugyen Gyeltshen has over eight years of experience serving as an Agriculture Extension Supervisor in Tareythang and Samtenling Gewog under Sarpang Dzongkhag. Currently, he serves the Soil Fertility Program under NSSC and provides technical support related to soil and plant nutrients. His ongoing research focuses on assessing the impacts of potato farming soil management practices on the Wetlands of Phobjikha-Gangtey Valley, with an emphasis on improving agricultural sustainability and productivity in these areas.

Abstract:

Ugyen Gyeltshen[1] and Tenzin Wangchuk[2]

Chhuzanggang, a region with a favourable climate for the cultivation of various essential food crops, primarily uses its available land for arecanut cultivation. However, the implications of increased plantations of arecanut are left unknown to many. Therefore, the study was conducted to evaluate the impact of arecanut plantations on the farming system and livelihood in the area. The survey used a multi-stage sampling method: purposive, proportionate, and simple random. A sample of 177 (n=30%) households was chosen from a total population of 389 households, and the data on different types of crop production was analysed to determine achievement of food self-sufficiency, per capita income, land allocation for crop cultivation, the richness of crop diversity, and perception on impact and factors influencing arecanut plantations. Three distinct farm types were identified based on the percentage of land allocated to arecanut plantations. These are (i) Low Arecanut Coverage (LAC) (defined as <25% land usage; n=44, 38%), (ii) Medium Arecanut Coverage (MAC) (defined as 25% to 75% land usage; n=62, 53%) and (iii) High Arecanut Coverage (HAC) (defined as >75% land usage; n=11, 9%). The study revealed households with the highest portion of land allocated to arecanut plantations have the lowest calorific fulfilment of 14.58%. However, they were found to have the highest income per capita of 8.21$PPP day^{-1} $person^{-1}$, suggesting that while food self-sufficiency may be impacted, farmers can remain food secure. Crop diversity was also observed to decrease with an increase in arecanut plantations; SDI score of 0.16 was recorded, indicating low diversity. Although arecanut cultivation has significantly contributed to economic growth, its expansion has affected practices of the diversified farming system. This study acknowledges the need for further research on the impact of increased arecanut production on household dietary habits and crop performance under arecanut plantations.

13. Microplastics Contaminations in Fish and Aquatic Food Chain in Bhutan

Ms. Yogeeta Dahal is a faculty member in the Department of Environment and Climate Studies in College of Natural Resources (CNR). She holds MSc in Natural Resource Management by Research from CNR and BSc in Environmental Science from Asian University for Women in Bangladesh. Her research interest is in the areas of environmental pollution (waste management, freshwater quality analysis, air pollution), and Climate Change.

Abstract:

Microplastics pollution in natural waters is a growing concern throughout the world. Rivers transport around 8 million pieces of plastics to oceans every day. South Asia ranks 2nd globally in plastic pollution and three mighty rivers (Ganges, Brahmaputra, Irrawaddy) transport most of them to the Bay of Bengal. Considering the huge volume of discharges confluence at the Brahmaputra River, the proposed research is aimed at investigating microplastics contaminations in fish & in Bhutan's major rivers (which ultimately contributes to the Brahmaputra River). Samples of fish, river sediment, river water will be studied for presence of microplastic. The results will showcase the presence, type, size and colour identification of the microplastic found in different samples and an analysis on the implications of these findings to exposure & risks to local community.

C. Bio of the Poster Presenters

Poster Title: **Evaluating the Seismic Risk of Non-Structural Building Components (NSC) in Urban Schools in Bhutan using RVS-Based Assessment**

Mr. Chimi is a practicing architect and Lecturer at College of Science and Technology under Architecture Department since 2012. As a first architecture faculty, he has started Bachelor of Architecture Programme at CST and taken up a role as founding Head of Architecture Department. He has graduated from School of Planning and Architecture, New Delhi and completed his master in Architectural Design from SRM university, Chennai in 2016 under Nehru- Wangchuk Scholarship. Beside teaching students, he has also carried out management works like College Management Committee, College Academic Committee and College Research Committee. He has also taken up role in contributing infrastructure planning and Design in college and university. As an academician he has also actively engaged in carrying out research work in the field of Heritage Conservation, Urban planning, Nature based solution for disaster management and Tertiary Teaching-learning Pedagogy. He is working as a Member of Working Group V- Nature-based Resilience (NBR), under South Asia Alliance of Disaster Research Institutes (SADRI), IEEE R10 Bhutan Subsection and Centre for Disaster working member Risk Reduction and Community Development Studies (CDRR&CDS) under RUB. Currently, he is involved in key projects listed below:

1. Evaluating the Seismic Risk of Reinforced Concrete Buildings of Colleges under the Royal University of Bhutan Using the RVS Method-A research to policy- making, supported by the CDRI fellowship.
2. Exploring strategies for Sustainable riverfront development in Bhutan: A case study of the Omchu river under Phuentsholing Throm supported by the AURG.

Poster Title: **Mapping and Monitoring Rice Agriculture in Bhutan Incorporating Climate Variability Using Remotely Sensed Data**

Mr. Indra Bahadur Chhetri received his Master of Engineering in Civil and Earth Resources Engineering (Geo-informatics), in March 2022, from Kyoto University, Kyoto, Japan, and his Bachelor of Engineering (Civil Engineering), in June 2014, from the College of Science and Technology, Royal University of Bhutan. Mr Indra is currently working as an associate lecturer in the Department of Civil Engineering and Surveying at Jigme Namgyel Engineering College, the Royal University of Bhutan since joining the institution in the year 2014. He has availed the prestigious scholarship of the Sustainable Development Goals (SDGs) Global Leadership Program under the framework of the Japan International Corporation Agency, Development Studies Program (JICA-DSP) to undergo a Master in Civil and Earth Resources Engineering at an esteemed university, Kyoto

University, Japan. His research interests are mainly in earth resources, geo-information (GI), geo-statistical analysis, application of GIS in transportation and geohazards, Geo-spatial data quality assessment, and Drone technology.

Professional Experience:

- Associate Lecturer, Jigme Namgyel Engineering College since August 2014.
- Program leader, BE in Surveying and Geo-informatics and Diploma in Surveying, July 2022 -now
- Member representative of the Centre for GIS Coordination (CGISC), Department of Survey & Land Records (DSLR) under National Land Commission Secretariate (NLCS), 2015-2019.

Educational Background:

- Masters of Engineering in Civil and Earth Resources Engineering (Geo- informatics), March 2022, Kyoto University, Kyoto, Japan.
- Bachelor of Engineering (Civil Engineering), June 2014, The Royal University of Bhutan.

Poster Title: **Multi-Hazard Zoning for National Scale Population Risk Mapping: A Pilot Study in Bhutan**

Karma Tempa is an Assistant Professor with a Master's degree in Civil Engineering, specializing in Geotechnical Earthquake Engineering.

He is a dedicated interdisciplinary researcher with expertise in areas such as local seismic response analysis, civil designs, CAD applications, natural hazards, remote sensing and GIS, and disaster risk reduction (DRR)-informed governance. Currently, he is actively engaged in two significant research projects: The Erasmus+ SQUARES project (2024–2026), which focuses on sustainability and quality in urban environments, and an AURG-funded study (2024–2025) assessing temporal land surface temperature (LST) dynamics using Landsat imagery, with a particular emphasis on the impacts of climate threats on agriculture and socioeconomic conditions in Punakha, Bhutan. Karma Tempa is also passionate about fostering collaborations across disciplines to address complex challenges in civil engineering and disaster risk management.

Poster Title: **Forest Fire Hazard Mapping in Bhutan**

Ms. Monika Thapa is a Faculty at the College of Science and Technology (CST) under Royal University of Bhutan (RUB). She has a Bachelor's Degree in Civil Engineering from the College of Science and Technology and Master's degree in Structural Engineering from the National Institute of Technology, Karnataka, India. Currently she serves as a Lecturer at the College. Her main research interests are building modeling and analysis, construction materials, disaster management and hazard mapping. She had served as a Head of

the Centre for Disaster Risk Reduction and Community Development Services (CDRR&CDS) at the college, a member of College Research Committee at the college, and NAP-RUB and Water Infrastructure and Technology Advisory Committee (WITAC) member at the University level. She was actively involved in E-Flow project under National Environment Commission Secretariat (NECS), Royal Government of Bhutan, Thimphu; developing guidelines for Hydropower projects in Bhutan. She also served as a thematic working group member for NAP (National Adaptation Plan)

Poster Title: **Understanding the relations between sheep farming and its changing environment in Bhutan: A case of the Brokpa shepherds of Merak and Sakteng**

Nedup Dorji is a Lecturer at the College of Natural Resources, The Royal University of Bhutan in 2007. In 2008, he was awarded for the Thai International Cooperation Agency to pursue a MSc in Agriculture at Khon Kaen University, Thailand (graduated in 2010). During his MSc, he assessed genetic variations of Bhutanese indigenous chickens, and compared with Thai native chickens and commercial chicken lines. In 2016, Nedup was awarded the Netherlands University Foundation for International Cooperation in Higher Education to pursue a PhD study at the Farm Technology group in collaboration with the Animal Production Systems group of Wageningen University. His study focused on transhumant yak farming in Bhutan.

Currently, he is the Managing editor and editorial board member of the Bhutan Journal of Natural Resources and Development (BJNRD) and till date he has been working as the Lecturer at the College of Natural Resources, The Royal University of Bhutan.

Poster Title: **Food Delicacies in West-Central Bhutan**

Serki Wangmo serves as an Associate Lecturer at the College of Natural Resources, Royal University of Bhutan. She holds a Master of Science in Agriculture with a specialization in agroecosystem services, complemented by a Bachelor's degree in Sustainable Development and a Postgraduate Diploma in Higher Education. With a strong academic foundation and a passion for sustainability, her research focuses on systems thinking, agroecosystems, and bridging innovations with indigenous knowledge to promote sustainable practices.

Poster Title: **Establishment of Asian Food Composition Database**

Tenzin Wangchuk is an associate Lecturer, teaching under Department of Agriculture at College of Natural Resources (CNR), RUB. He graduated with a master's degree in plant science (Specialization Crop Science) from Wageningen University and Research, Netherlands. His field of interest are Agricultural statistics, Crop production, System analysis and, Climate and crop relation. He is the principal Investigator for the project titled Asian Food Composition Database, Bhutan which was implement in 13 Asian Countries funded by AFACI, Korea.

Poster Title: **Evaluating the Seismic Risk of Non-Structural Building Components (NSC) in Urban Schools in Bhutan using RVS-Based Assessment**

Ms. Tshering Cheki is serving as an Associate Lecturer at the College of Science and Technology, under Civil Engineering Department since 2013. She completed her Master's in Geotechnical Engineering from IIT Roorkee in 2019 and earned her Civil Engineering degree from College of Science and Technology. Ms. Cheki is passionate about teaching and research, focusing on geotechnical engineering and slope stability. Her work involves field studies, lab testing, and computer modelling. She aims to inspire future engineers and help them build strong technical skills. Currently, she is involved in key projects listed below:

1. Regional cooperation for Freshwater Ecosystem Services in Himalayas (REFRESH), examining the impacts of monsoon variability and compound extremes, under the Asia-Pacific Network (APN) for Global Change Research.
2. Evaluating the Seismic Risk of Reinforced Concrete Buildings of Colleges under the Royal University of Bhutan Using the RVS Method, aimed at integrating research with policy-making, supported by the CDRI fellowship.

Poster Title: **Microplastics to Macroinvertebrates: Assessing the Health of Freshwater Ecosystems in the Streams and Rivers of Thimphu, Bhutan**

Mr. Ugyen Dorji is a freshwater ecologist with extensive expertise in the conservation of freshwater fauna and flora. Currently serving as the Dean of Student Affaris at the College of Natural Resources, Royal University of Bhutan, he is an Editor for the Bhutan Journal of Natural Resources and Development and he was also the Programme Leader for the MSc in Natural Resources Management (HDR). His research interests include freshwater biodiversity, aquatic ecosystems, and the impacts of anthropogenic activities on freshwater habitats. Over the years, he has successfully led numerous research projects, including molecular analysis of aquatic species, climate change impacts on

water sources, and macroinvertebrate diversity studies. He is also a co-founder of Water Research Bhutan and has served as a National Consultant for various hydropower and ecological impact assessments. With proficiency in GIS software, R, SPSS, and statistical modeling tools, Mr. Ugyen Dorji is a skilled educator and mentor, having facilitated over 60 capacity-building programs for both national and international participants. His contributions extend to policy-making as a member of the National Technical Working Group on water resource management in Bhutan. Mr. Ugyen Dorji is an accomplished researcher with numerous peer-reviewed publications on freshwater ecology, biodiversity, and climate change impacts. His current projects focus on addressing river pollution and enhancing ecosystem services in the Hindu Kush region.

Poster Title: **Proposals for the Improvement of the Bhutanese Seed Chain in order to Contribute to the Food Security of the Kingdom**

Wang Gyeltshen is an Associate Lecturer with a focus on seed science and technology. With a Master's degree in Science and Engineering, his academic journey has been deeply rooted in exploring the intricate processes involved in seed development, storage, and germination. His research interests lie at the intersection of plant biology and applied technologies that enhance seed quality, preservation methods, and sustainable agricultural practices. He also worked as a Research Assistant in the seed sector, where he gained hands-on experience in various aspects of seed production, quality control, and research. He has worked extensively on value chain analysis of crop, examining the flow of outputs throughout systems. This has allowed him to assess the efficiencies and bottlenecks in chains and propose strategies for improvement. Additionally, he has contributed to studies aimed at developing seed policies that support sustainable agricultural practices and enhance seed accessibility, quality, and distribution. His work in seed policy development focuses on creating frameworks that foster resilience in local farming communities while ensuring long- term sustainability in seed production and usage.

Poster Title: **Soil Carbon Sequestration Dynamics in Himalayan Bhutan amidst the Changing Climate**

Dr. Yonten Dorji is an Academic at the College of Natural Resources, Royal University of Bhutan, specializing in forest dynamics, carbon sequestration, and tree architecture complexity. Dr. Dorji earned his PhD in Forest Sciences and Forest Ecology from the University of Göttingen, Germany. He also holds an MSc in Climatology & Mountain Forestry from BOKU University, Austria, and a BSc in Environmental Botany (Hons) from the University of Queensland, Australia. He has numerous published works in renowned journals like Current Forestry Reports, Trees and Remote Sensing. He has served as a Research Associate at Goettingen University, Germany, and previously headed the Department of Forest Sciences in CNR. Currently, he is a Programme Leader for MSc Conservation Biology at the College of Natural Resources.

Poster Title: **Assessing the Effectiveness of Seeds Pelleted with Trichoderma sp. and Vermicompost**

Sonam Pelzin Dorji serves as the Research and Liaison Officer at the College of Natural Resources (CNR). A top achiever, Sonam graduated with a Bachelors in Organic Agriculture at the top of his class and secured second place in the prestigious Royal Civil Service Examination (Technical Bio-Science) in 2024. With a passion for innovation and sustainability, Sonam's research interests include Microbiology, Sustainable Agriculture and Biotechnology, reflecting a commitment to advancing agricultural science and environmental stewardship.

Poster Title: **Isolation, Characterization, and Biological Activity Assessment of Lactic Acid Bacteria from Milk and Milk Products of Bhutan**

Sumba is a Bachelor of Technology graduate in Dairy Science and Technology from Sam Higginbotom University of Agriculture Technology and Sciences, Uttar Pradesh, India. He is currently an Assistant Lecturer in the Department of Food Science and Technology at the College of Natural Resources. With a strong background in coordinating academic programs, Sumba successfully coordinated three years of field attachment for Food Science and Technology second- year students from mid-2021 to mid-2024. Their research experience includes a study titled "Isolation, Characterization, and Biological Assessment of Lactic Acid Bacteria from Indigenous Milk Products," reflecting a deep interest in dairy microbiology and dairy technology. Sumba's future research interests focus on exploring ethnic food products and advancing dairy processing techniques in mountain regions.

D. Bio of the Panellists/Moderators

Ms. Kesang Tshomo has over 29 years of experience in agriculture sector working in horticulture research and rural agriculture development based on farmer needs in integrated farming systems. She has been active in initiating organic sector in Bhutan with pilots to a position where the National Organic Programme, at the Research and Development Centre of Organic Agriculture now provides supports to the vision of making the country's organic vision into action plans since the last 20 years. She has coordinated the development of key documents for the development of organic sector.

She has professional training in Horticulture, BSc. Appl Sci.(Agri) from the University of Adelaide, South Australia and a MSc.Hort) Plant pathology from Lincoln University, New Zealand, Advanced training in Organic Agriculture Development in Sweden and represented Bhutan at various International events and recently completed a Scientific Research Fellowship at UC. Davis, Ca. USA.

She currently serves as the Advisor to the Department of Agriculture, Ministry of Agriculture and Livestock (MoAL). Her main responsibility is providing policy, planning and developmental advice, guidance and technical support to the office of the Director. She is also the technical Chair of the technical working group for the National Organic Programme the development of the organic sector in the country by developing enabling environment and linking production, processing and marketing of organic products to local markets on a commercial mode and linking to domestic and export markets. Targeting to build capacity of stakeholders, institutions, private sector and farmer groups to prepare for participation in the organic sector, sectors and agencies within the MoAL to work in tandem for promotion of organic sector with a harmonious system that is user friendly to the farmers and affordable to the stakeholders.

Professor Dhan Bdr Gurung joined the Royal Civil Services of Bhutan in 1989 and joined the Natural Resources Training Institute as a Lecturer in 1992. He continued to serve in the institute and became a faculty member in the College of Natural Resources of the Royal University of Bhutan in 2006. He has MSc in Forestry from Dehradun, India and MSc in Natural Resources Management from the University of Edinburgh in Scotland. He completed his PhD from ETH, Zurich, Switzerland. He has served as the Dean of Academic Affairs and the Dean of Research and Industrial Linkages in the college. He also served as the project coordinator in various projects such as the project funded by Danida, Norway and currently by the Swiss National Science Foundation, Switzerland. He is currently serving as a Professor in the Department of Forest Science in the college and has contributed significantly in fish and orchid taxonomy of Bhutan.

Mahesh Ghimiray is a senior Lecturer, Department of Agriculture at the College of Natural Resources, Royal Government of Bhutan, Punakha. He holds a BSc Agriculture degree from GB Pant University of Agriculture and Technology, India, an MPhil in Plant Breeding and Biodiversity from the University of Reading and Birmingham, UK and a Doctorate (honoris causa) in Agriculture Research from the Thames International University, France. Specialized in crop breeding and variety improvement, he helped to develop several new varieties of rice, maize and wheat while posted in the Agriculture Research and Development Centre at Wangdue under the Department of Agriculture. After formally joining CNR, he teaches plant breeding, seed production, agronomy, climate resilient agriculture, nutrient management, organic agriculture etc. He has several publications to his credit.

Mr. Mani Prasad Nirola has been working at the National Biodiversity Centre, Ministry of Agriculture & Forests especially looking after the Bioprospecting and ABS program, and has 15 years of experience working in the field of biodiversity conservation, bioprospecting and Access and Benefit Sharing. His work envisions deriving tangible benefit from Bhutan's rich biodiversity and associated traditional knowledge for the enhancement of conservation and rural livelihood and the promotion of people's leadership in conservation. He is the Bhutan's National Focal Point for the Nagoya Protocol. He has authored a number of scientific publications and technical and policy papers. On the academic front, Mr. Mani has a M.Sc. in Mountain Forestry from the University of Natural Resources and Life Sciences, Vienna, Austria.

Mr. Nado, Assistant Dzongkhag Agriculture Officer, works in the Agriculture Sector under Wangduephodrang Dzongkhag. Prior to this, he served as an Agriculture Extension Officer in Sephu and Nahi Gewogs. During his tenure at Nahi Gewog, he successfully implemented a one million BTFEC-funded Project in collaboration with the College of Natural Resources. It has benefited 13 households for drinking and vegetable gardening irrigation needs. He is a graduate of the Natural Resources Training Institute, Lobesa (1998-2001), with a Diploma in Agriculture. He pursued a Post Graduate Diploma in Agro-Biosystem from Khon Kaen University, Thailand (2008-2009). Later, he completed a nested in-service degree program at the College of Natural Resources with a Bachelor's in Agriculture (2012-2014). Currently, he is the focal officer for the Green Climate Fund Project, which is in the last phase of implementation in eight Dzongkhags, including Wangduephodrang.

Nawang Norbu (PhD) is the Founder and Executive Director at the Bhutan Ecological Society. He is also Center Director of the Center for Climate and Sustainable Futures, a collaborative research and education initiative between the School for Field Studies in the US, the Royal University of Bhutan and the BES. Recently, he helped craft Bhutan's RNR Strategy 2030, and also drafted, in collaboration with the Royal Government and the FAO, the national pathways to transform Bhutan's food systems. Nawang is committed to building a just and verdant world and continues to explore the drivers and consequences of development and change.

Nedup Dorji is a Lecturer at the College of Natural Resources, The Royal University of Bhutan in 2007. In 2008, he was awarded for the Thai International Cooperation Agency to pursue a MSc in Agriculture at Khon Kaen University, Thailand (graduated in 2010). During his MSc, he assessed genetic variations of Bhutanese indigenous chickens, and compared with Thai native chickens and commercial chicken lines. In 2016, Nedup was awarded the Netherlands University Foundation for International Cooperation in Higher Education to pursue a PhD study at the Farm Technology group in collaboration with the Animal Production Systems group of Wageningen University. His study focused on transhumant yak farming in Bhutan.

Currently, he is the Managing editor and editorial board member of the Bhutan Journal of Natural Resources and Development (BJNRD) and till date he has been working as the Lecturer at the College of Natural Resources, The Royal University of Bhutan.

Sangay Dema (PhD) is a Principal Biodiversity Officer and a Head of Botanical Collections (National Herbarium and Royal Botanical Garden) of National Biodiversity Centre (NBC), Serbithang. She joined NBC in 2000 as a Biodiversity Conservation Officer, and since then she has been working at NBC, with a short tenure from 2007-2009 as senior lecturer and officiating Director at Ugyen Wangchuck Institute for Conservation & Environment (https://www.uwicer.gov.bt/), Bumthang. She has a Master of Science (Biology) and Graduate Certificate in Tropical Biology and Conservation from the University of Missouri, St. Louis, MO, USA and holds a doctorate degree from University of New England, Armidale, New South Wales, funded through Australian government's Endeavour Postgraduate Leadership Award. She is a recipient of numerous international grants and awards, the notable ones being National Geographic Society (NGS) Explorers grant awarded by NGS, USA, Joyce W. Vickery Scientific Research grant, awarded by Linnean Society of New South Wales, and Hans Wissmann Scientific Research grant for Systematic Botany, awarded by the School of Environmental & Rural Science, University of New England, Armidale, NSW, Australia.

Assoc. Professor (Dr.) Sonam Tashi currently serves as the Dean of Research and Industrial Linkages at the College of Natural Resources, Royal University of Bhutan. Prior to his current position, Dr. Tashi served as the Dean of Academic Affairs. He is the Editor-in-Chief of the Bhutan Journal of Natural Resource Development and also serves as an Editor for the International Journal of Environment. Previously, he was an Associate Editor of the official journal of the International Society of Organic Agriculture Research. Dr. Tashi has authored numerous peer-reviewed articles and is a regular reviewer for both national and international journals. He is specialized in organic and sustainable agriculture practices.

Tsheten Dorji, Chief, Sustainable Livelihood Program Division Department of Program Coordination and Climate Change, RSPN tdorji@rspnbhutan.org

I began my career with the Royal Society for Protection of Nature (RSPN) in early 2005, and currently, I oversee the Sustainable Livelihood Programs. Over the years, I have gained experience in leading programs and projects related to community-based water resource management, springshed management, transboundary water governance, climate-smart agriculture, human-wildlife conflict resolution, ecotourism, waste management, and climate change. My passion for sustainable farming, conserving water, birdwatching, photography, cycling, and hiking in the countryside further reveals my commitment to nature conservation and sustainable living.

Professional Qualifications and Trainings:

- Master of Business Administration at University of Canberra, Australia.
- Research Training (two years) in Sustainable Water Resource Management at Eco-Peace Leadership Center, Kangwon National University, South Korea.
- Bachelor of Business Administration at Manipal Academy of Higher Education, India.
- Training on Transformational Leadership at Chulalongkorn University, Bangkok, Thailand.
- Training on Springshed Management in the HKH at ICIMOD, Kathmandu, Nepal.
- Training on Strategic Environment Assessment at Korea University, South Korea.
- Training on Participatory M&E at International Institute of Rural Reconstruction, Philippines.

Major Publications:

1. Dorji, T. (2024). Leadership Traits of Mohandas Karamchand Gandhi: Literature Review. International Journal of Science and Research, Vol. 12, Issue 4, pp. 1426- 1429, ISSN: 2319-7064.
2. Dorji, T. (2024). Effects of Human Wildlife Conflict (HWC) on Livelihoods of the Communities: An Assessment of Crop Damage by Wildlife within the White-Bellied Heron Habitats Along the Punatsangchhu and Mandechhu Basins, Bhutan.

International Journal of Agriculture, Environment and Bioresearch, Vol. 9, Issue-1, pp. 16-32, ISSN: 2456-8643.

3. Dorji, T. (2023). Dryland Water Resource Conservation and Conflict Management in Loisukut Sub-Catchment in Laikipia North Sub-Country, Kenya. International Journal for Multidisciplinary Research, Vol. 5, Issue-5, pp. 1-9, E-ISSN: 2582-2160.
4. Dorji, T. (2023). Managing Performance in Civil Society Organizations in Bhutan. International Journal of Management Studies and Social Research, Vol.5, Issue-2, pp.118-124, ISSN: 2582-0265.
5. Dorji, T. (2023). Developing an Effective Solid Waste Management System to Minimize Adverse Impact on high- altitude Wetland Ecosystem in Phobjikha Valley, Wangdue, Bhutan. International Journal of Development Research, Vol.13, Issue-02, pp.61797-61801, ISSN:2230-9926.
6. Dorji, T. (2023). Comparative Analysis of GNH with SDGs and MDGs. International Journal of Current Research, Vol.15, Issue-02, pp.23644-23647, ISSN:0975-833X.
7. Dorji, T. (2015). Sustainable Water Source Management in Tshogonpa village, Lumang, Trashigang, Bhutan. Policy Analysis Paper, Journal of the Bhutan Ecological Society, Vol. I, Issue- II, pp. 104-117, ISSN 2410-3861.

Tulsi Gurung is an Associate Professor, Department of Agriculture at the College of Natural Resources, Royal University of Bhutan, Punakha. She holds a PhD in Agriculture from Khon Kaen University, Thailand and Masters in Horticulture from the University of Reading, UK. She is one of the pioneers in transforming a training institute to a college offering seven undergraduate programmes, three Masters programmes, and one PhD in climate studies. She has initiated many international research collaborations, and staff and student exchange programmes with other universities. She teaches horticulture, crop production, sustainable agriculture, and climate smart agriculture, water management and has several journal papers to her credit.

Dr. Ugyen Thinley (Assistant Professor) currently serves as the Dean of Academic Affairs at the College of Natural Resources, Royal University of Bhutan. He has been an integral part of the institution since 1998. Today, he not only oversees academic programmes and courses, but also as an active research scholar, he as several publications and technical reports in the field of climate science, environment, and sustainable natural resource management.

Sonam Wangmo is the Chief of Research and Development (R&D) at the Department of Academic and Research Services (DeARS), Office of the Vice Chancellor, Royal University of Bhutan. In this role, she is responsible for developing and implementing research policies and guidelines that foster a conducive research environment across the University. Her key responsibilities include managing the University Research Grant, monitoring the performance and quality of research centres, building research capacity among staff and students, and identifying funding opportunities along with preparing competitive grant proposals.

She also coordinates major institutional research events such as the Faculty Research Meet and the Annual University Research Conference, and oversees the effective functioning of the University's Research and Innovation Committee.

Ms. Wangmo holds a Master's degree in Computer Science and a Diploma in University Teaching from the University of New Brunswick, Canada (2007). Prior to her current role, she served as the Head of the School of Computer Science and Mathematics at Sherubtse College, where she also taught undergraduate courses in computer science.

E. Bio of the MCs/ Rapporteurs

Mr. Tobgay is the Chief of the Higher Degree Research Division under the Department of Academic and Research Services at the Office of the Vice Chancellor, Royal University of Bhutan (RUB). Prior to his current role, he served as a Curriculum Developer at the Department of Curriculum and Professional Development and as a Teacher under the Ministry of Education.

Ms. Kinzang Tshomo is a final year student at the College of Natural Resources pursuing Bachelor's of Science in Forestry. She has served as a secretary of Health and Wellbeing club at the college and she is also a member of Entrepreneurship Club. Her research interests include ethnobotany, phytochemistry, and microbiology. Currently, she is doing her research on phytochemical analysis, antibacterial, and antioxidant properties of an endemic plant species in Bhutan.

Mr. Namgay Wangchuk is a final-year BSc Forestry student (CNR, RUB), focusing on specialising in GIS & RS for environmental applications. He has a deep appreciation for nature, demonstrated through bird watching and photography. He has leadership experience and a keen interest in leveraging technology and AI for advancement.

Ms. Sonam Lhazeen Wangmo, is a final-year student pursuing BSc. in Forestry. Her passion lies in environmental conservation, food security, and youth engagement. As one of the chapter leaders of the World Food Forum-Bhutan Chapter and a member of the Adolescent Youth Advisory Panel, she actively advocates for sustainable solutions and youth participation in decision-making processes. Through her work, she strives to contribute to a more resilient and environmentally conscious future.

Mr. Wangdi Rigsel is a final-year B.Sc. Forestry student with a strong research interest in freshwater ecology. His current thesis, Spatiotemporal Variability of Parachiloglanis benjii Assemblage in Relation to Ecohydrological Drivers in Dangchhu River, explores ecological dynamics in freshwater ecosystems. He has also participated in pre-assessment studies for aquatic biodiversity in hydropower projects, focusing on fish, macroinvertebrates, and water quality. Passionate about aquatic conservation, he serves as an ambassador for SDG 14: Life Below Water in the Global 17 University Ambassador's Consortium, advocating for the protection and sustainable management of freshwater ecosystems.