NATIONAL BIODIVERSITY CENTRE

STATUS REPORT (2022-23)

2022-23

STATUS REPORT

NATIONAL BIODIVERSITY CENTRE

NATIONAL BIODIVERSITY CENTRE
MINISTRY OF AGRICULTURE AND LIVESTOCK
ROYAL GOVERNMENT OF BHUTAN
SERBITHANG, THIMPHU

EDITORS:

Dr. Karma Dema Dorji, Program Director, NBC
Dr. Asta Maya Tamang, Plant Genetic Resource (PGR), NBC
Dr. Sangay Dema, National Herbarium (NH), NBC
Karma Wangchuk, Biodiversity Information Management (BIM), NBC
Tshering Dorji, Animal Genetic Resources (AnGR), NBC
Kezang Wangchuk, Bioprospecting and Access and Benefit Sharing (BP&ABS), NBC
Kezang Tobgay, Royal Botanical Garden (RBG), NBC

COMPILED & EDITED BY:

Karma Wangchuk, Dy. Chief Biodiversity Officer, Biodiversity Information Management Program
Tshering Pem, Biodiversity Officer, Biodiversity Information Management Program

PUBLISHED BY:

National Biodiversity Centre
Ministry of Agriculture and Livestock
Royal Government of Bhutan
Serbithang, Thimphu 11001, Bhutan
P.O. Box: 875

+ 975-2-351417

www.nbc.gov.bt (NBC Website)

www.biodiversity.bt (Bhutan Biodiversity Portal)

Pictures and articles featured in this report have been provided by respective programs within the Centre (NBC) unless specified, the design work was done by Karma Wangchuk and Tshering Pem.

February, 2024 | © National Biodiversity Centre, Thimphu, 2024 | Layout and Design: Karma Wangchuk & Tshering Pem | Cover photo: Small Pranticole by Ugyen Tamang | All Photos by NBC, unless credited.

ABBREVIATIONS

ABS - Access & Benefit Sharing

AFACI - Asian Food & Agriculture Cooperation

AnGR - Animal Genetic Resources

APA - Annual Performance Agreement

ARDC - Agriculture Research & Development Centre

BABS Fund - Bhutan Access & Benefit Sharing Fund

BAP - Biodiversity Action Plan

BOLD - Biodiversity for Opportunity, Livelihood, and Development

BTFEC - Bhutan Trust Fund for Environmental Conservation

CBD - Convention on Biological Diversity

CBNRM - Community-based Natural Resources Management

CITES - Convention on International Trade of Endangered Species

CNR - College of Natural Resources

COP - Conference of Parties

DANIDA - Danish International Development Agency

DoA - Department of Agriculture

DoL - Department of Livestock

DoFPS - Department of Forests & Parks Services

DNA - Deoxyribonucleic Acid

EPB - Evolutionary Plant Breeding

FAO - Food & Agriculture Organisation

GBIF - Global Biodiversity Information Facility

GBIS - Genebank Information System

GEF - Global Environment Facility

HANAS - High Altitude Northern Areas of Bhutan

IBD - International Biodiversity Day

IFAD - International Fund for Agriculture Development

ILCCP - Integrated Livestock & Crop Conservation Project

ITPGRFA - International Treaty on Plant Genetic Resources for Food & Agriculture

IUCN - International Union for Conservation of Nature

LDCF - Least Developed Countries Fund

MoAL - Ministry of Agriculture & Livestock

MTA - Material Transfer Agreement

NAPA - National Adaptation Programme of Action

NBC - National Biodiversity Centre

NBSAP - National Biodiversity Strategies and Action Plan

NCOA - National Centre for Organic Agriculture

NGO - Non-Governmental Organization

NH - National Herbarium of Bhutan

NNBC - National Nublang Breeding Centre

NPHBC - National Poultry & Heifer Breeding Centre

NSC - National Seed Centre

NUS - Neglected & Underutilised Species

PGR - Plant Genetic Resources

PGRFA - Plant Genetic Resources for Food & Agriculture

RBGS - Royal Botanical Garden Serbithang

SAARC - South Asian Association for Regional Cooperation

SGP - Small Grant Programme

TK - Traditional Knowledge

UNDP - United Nations Development Program

WWF - World Wide Fund

MESSAGE FROM THE PROGRAM DIRECTOR

In 1995, Bhutan strengthened its commitment to biodiversity conservation by ratifying the UN Convention on Biological Diversity (CBD). This significant decision, undertaken during the 73rd National Assembly, reflected Bhutan's commitment to sustainable utilization and conservation of its rich biodiversity. In line with the obligations outlined in the convention and the country's own aspirations for biodiversity conservation, the National Biodiversity Centre (NBC) was established in 1998. Furthermore, Bhutan demonstrated its commitment to responsible management of biological resources by signing the Nagoya Protocol on Access and Benefit Sharing (ABS) in 2011. This significant step aims to facilitate meaningful collaborations in ABS with both national and international partners, with the goal of ensuring that access to biological resources is regulated in a manner that benefits both the country and its people.

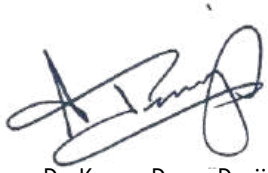
The fiscal year 2022 - 2023 marked notable achievements in Bhutan's biodiversity sector. The Centre's Status Report for this period highlights a range of conservation efforts, achievements, and progress towards both national and international targets. The report encompasses key highlights of the past year, including success stories, research abstracts, details on the Annual Performance Agreement, project information, and other relevant data concerning Bhutan's biodiversity.

Recognizing the escalating threats to biodiversity from factors such as climate change, pollution, invasive species, overexploitation, habitat loss, and global pandemics, Bhutan intensified its conservation strategies. In response to these challenges, the Biodiversity Act of Bhutan 2022 was enacted during the 7th session of the Third Parliament and received Royal Assent from the Druk Gyalpo on 15th July 2022 and the Biodiversity Rules and Regulations 2023 was endorsed and adopted by Competent National Authority 13th February 2023. This legislation ensures regulated access to biological resources and associated Traditional Knowledge, maximizing benefits for the people.

The Centre, aligned with CBD obligations, has been actively contributing to the development of the Post-2020 Global Biodiversity Framework and has commenced the formulation of new NBSAP since June 2023. To enhance international access to biodiversity information, datasets were made available on the Global Biodiversity Information Facility (GBIF) and the Bhutan Biodiversity Portal (www.biodiversity.bt). This year, the Centre became a member of the World Flora Online to improve access to and availability of country's floral data and information.

The Centre's successful initiatives include the establishment of Access and Benefit Sharing projects with local communities, citizen science initiatives, discovery of species new to science and rediscovery of species in the country, enhancement of agrobiodiversity ex-situ conservation, implementation of the 2nd Global Plan of Action on Plant Genetic Resources for Food and Agriculture (GPA-PGRFA), and the development of nature-based products.

We extend our heartfelt thanks to our conservation partners and donors, for their contribution to the successful management of Bhutan's biodiversity. The report is an open invitation for readers to learn more about efforts made in the conservation and sustainable utilization of our biological resources.



Dr. Karma Dema Dorji
Program Director

EXECUTIVE SUMMARY

Bhutan's dedication to biodiversity conservation is exemplified through the ratification of the Convention on Biological Diversity and the establishment of the National Biodiversity Centre (NBC) in the early 1990s. The NBC's vision emphasizes conservation, sustainable utilization, and fair and equitable sharing of benefits arising from the use of biological resources and associated traditional knowledge. It aims to lead biodiversity management, enhance livelihoods, and contribute to global conservation efforts through various programs and initiatives

Key achievements within the Animal Genetic Resources (AnGR) Program in the fiscal year 2022-23 include the transfer of two conservation farms, namely the National Nublang Breeding Centre and the Native Poultry & Heifer Breeding Centre. Other notable accomplishments include additional collection of 1,228 semen doses from five indigenous chicken breeds, 1,350 semen doses from various sheep breeds and completion of phenotypic characterization of all indigenous sheep breeds. Currently, the National Animal Genebank holds over 27,000 doses of semen samples from various traditional animal breeds.

During fiscal year 2022-2023, the Plant Genetic Resources (PGR) Program achieved significant milestones. This included conducting On-farm Crop Diversity inventory in multiple gewogs, successful implementation of a project to conserve Neglected and Underutilized Crop Species, (NUCS) by engaging communities in germplasm collection activities across various regions, and initiating seed system characterization in the Genebank through the BOLD work package 3.

The notable achievements of Bioprospecting and Access and Benefit Sharing Program (BP & ABS) in the fiscal year 2022-2023 included successful launch of *Pangtse Makhu* project, handing over of ZHINOR production, training workshop on the relevance of Biodiversity and Biopiracy to Tourism and other relevant sectors. In terms of enhancing the Access and Benefit Sharing mechanism, the program renewed two ABS agreements and one scoping agreement and executed one new scoping agreement with a national company.

The National Herbarium currently houses approximately 19,309 collections of plant specimens. In the fiscal year 2022-23, description of five species new to science and the rediscovery of the critically endangered plant *Maharanga griersonii* were the most notable achievements of the National Herbarium.

The key achievements of the Royal Botanical garden in the fiscal year 2022-23 include the launch of an accessible footpath, Orchid micropropagation laboratory and successful trial of orchid micropropagation. The garden also raised flowers/plants for the 8th Royal Bhutan Flower Exhibition. Even though the Flower Exhibition was postponed, the garden was able to sell some of the flowers grown for the exhibition, earning a total of Nu. 6,17,635.

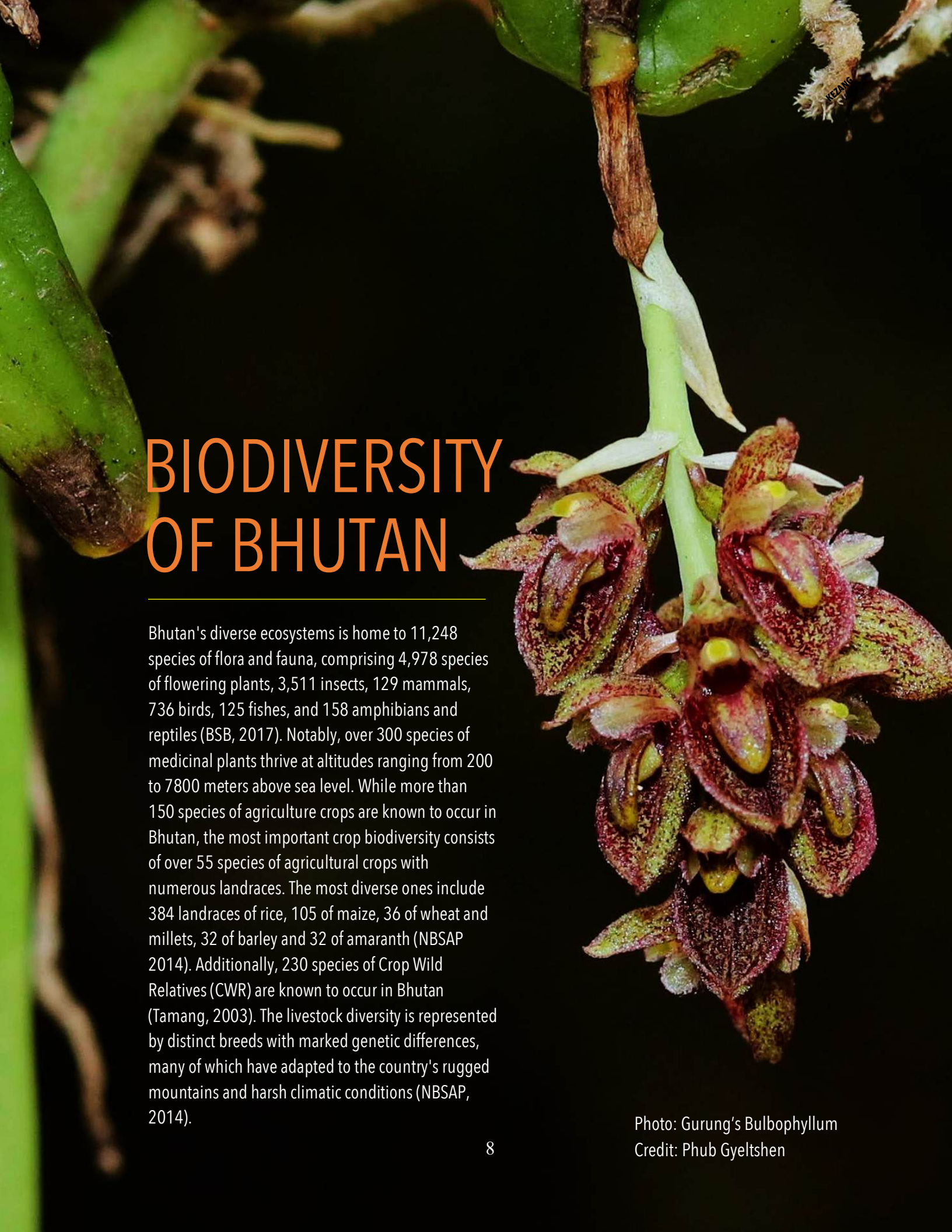
The National Invertebrate Program continued with the collection and documentation of diverse invertebrates. During the fiscal year, the program gathered over 200 snail specimens from different regions, adding to the extensive collection housed at the National Invertebrate Repository, which now contains over 25,000 invertebrate specimens.

In terms of enhancing biodiversity information, the Biodiversity Information Management (BIMs) program organized the Butterfly BioBlitz, which documented 71 butterfly species; and the National Bird Month resulting in over 2,487 bird observations. As the Secretariat for Bhutan's National Biodiversity Strategies and Action Plans (NBSAP), the program coordinated the national inception workshop to kick start the development of the 5th NBSAP.

TABLE OF CONTENT

INTRODUCTION

Credit: Beejai Darjee



BIODIVERSITY OF BHUTAN

Bhutan's diverse ecosystems is home to 11,248 species of flora and fauna, comprising 4,978 species of flowering plants, 3,511 insects, 129 mammals, 736 birds, 125 fishes, and 158 amphibians and reptiles (BSB, 2017). Notably, over 300 species of medicinal plants thrive at altitudes ranging from 200 to 7800 meters above sea level. While more than 150 species of agriculture crops are known to occur in Bhutan, the most important crop biodiversity consists of over 55 species of agricultural crops with numerous landraces. The most diverse ones include 384 landraces of rice, 105 of maize, 36 of wheat and millets, 32 of barley and 32 of amaranth (NBSAP 2014). Additionally, 230 species of Crop Wild Relatives (CWR) are known to occur in Bhutan (Tamang, 2003). The livestock diversity is represented by distinct breeds with marked genetic differences, many of which have adapted to the country's rugged mountains and harsh climatic conditions (NBSAP, 2014).

Photo: Gurung's Bulbophyllum
Credit: Phub Gyeltshen

NATIONAL BIODIVERSITY CENTRE

In recognition of biodiversity's critical role in sustainable development and due to the committed leadership in environmental conservation, Bhutan ratified the Convention on Biological Diversity (CBD) in 1995 during the 73rd session of the National Assembly. The CBD underscores the importance of conserving and sustainably utilizing biological resources while ensuring fair and equitable benefit-sharing. Subsequent to the ratification, Bhutan developed its first Biodiversity Action Plan in 1997.

Recognizing the fragmented responsibilities for biodiversity management in the country, the plan recommended an institutionalized and integrated biodiversity conservation program. This led to the establishment of the National Biodiversity Program in 1998, which was upgraded to the status of a non-departmental agency in 2001 and renamed the National Biodiversity Centre (NBC).

VISION: Effective conservation, sustainable utilization and equitable sharing of benefits arising from access and use of biological resources.

GOAL: To become a premier institute on biodiversity in the country resulting in the effective management of biodiversity and maximizing the benefits from it as well as contributing to international efforts toward conserving biodiversity.

MISSION: Biological resources effectively conserved, sustainably used and benefits equitably shared for enhancement of livelihood, food security and environmental well-being of the country

CORE MANDATES

To coordinate biodiversity conservation and sustainable use programs in the country and implement where relevant/necessary.

ABS
NAGOYA PROTOCOL

To serve as the national focal agency to regulate access to and utilization of biological resources of the country, ensuring equitable sharing of the benefits arising from their access and utilization.

To serve as a national biorepository for genetic resources, botanical collections, and collection of other biological resources.

To serve as the national focal agency for bioprospecting and documentation of traditional knowledge associated with biological resources.

To coordinate formulation and implementation of policies and legal frameworks for conservation and sustainable use of biological resources.

To serve as the national clearing house and repository of biodiversity information of the country.

OTHER FUNCTIONS

To provide specialized technical services related to conservation and sustainable utilization of biodiversity

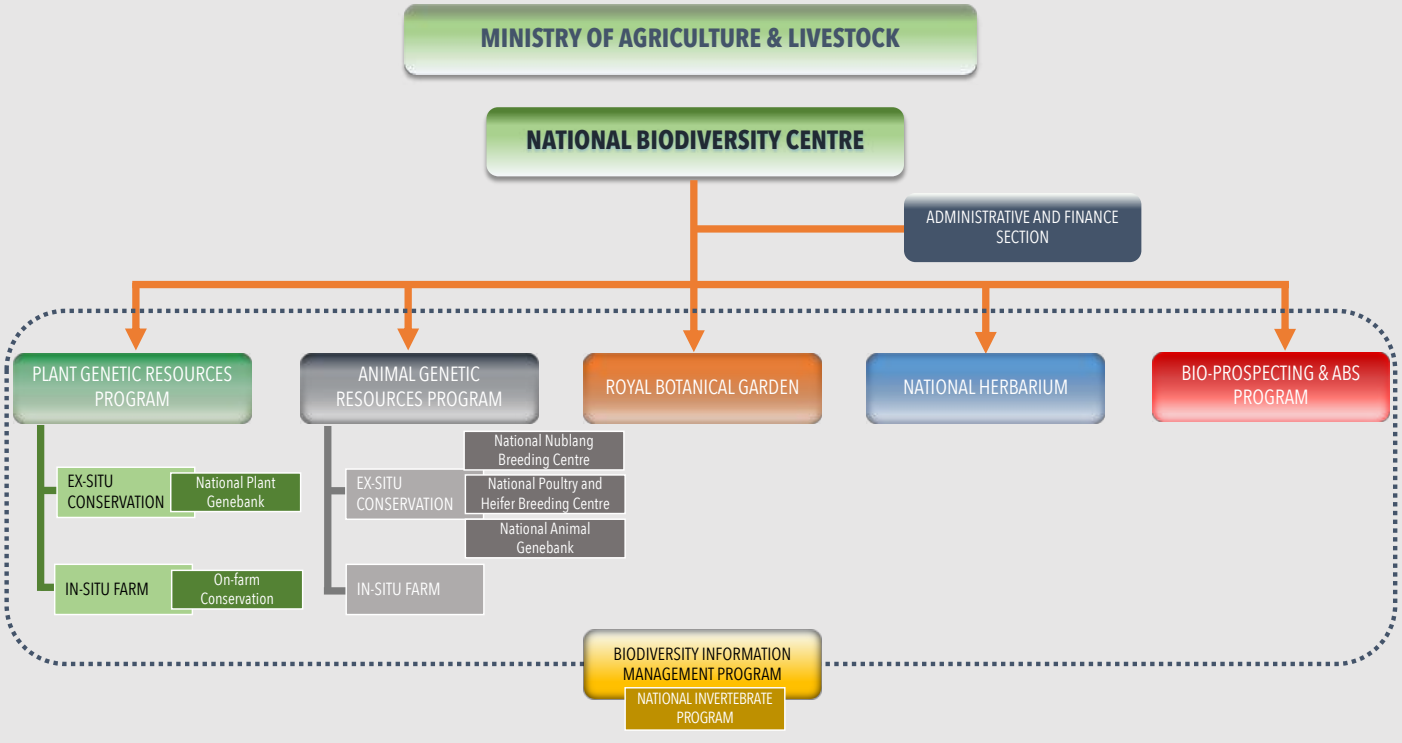
To provide taxonomic and systematics service on flora of Bhutan.

To promote education, awareness and participation in biodiversity conservation and sustainable use to enhance peoples' participation and leadership in conservation

To coordinate and implement obligations under regional and international conventions, treaties and protocols related to biodiversity.

To promotee national, regional and international institutional linkages and collaboration for technology transfer, technical capacity enhancement and collaborative research in the field of biodiversity

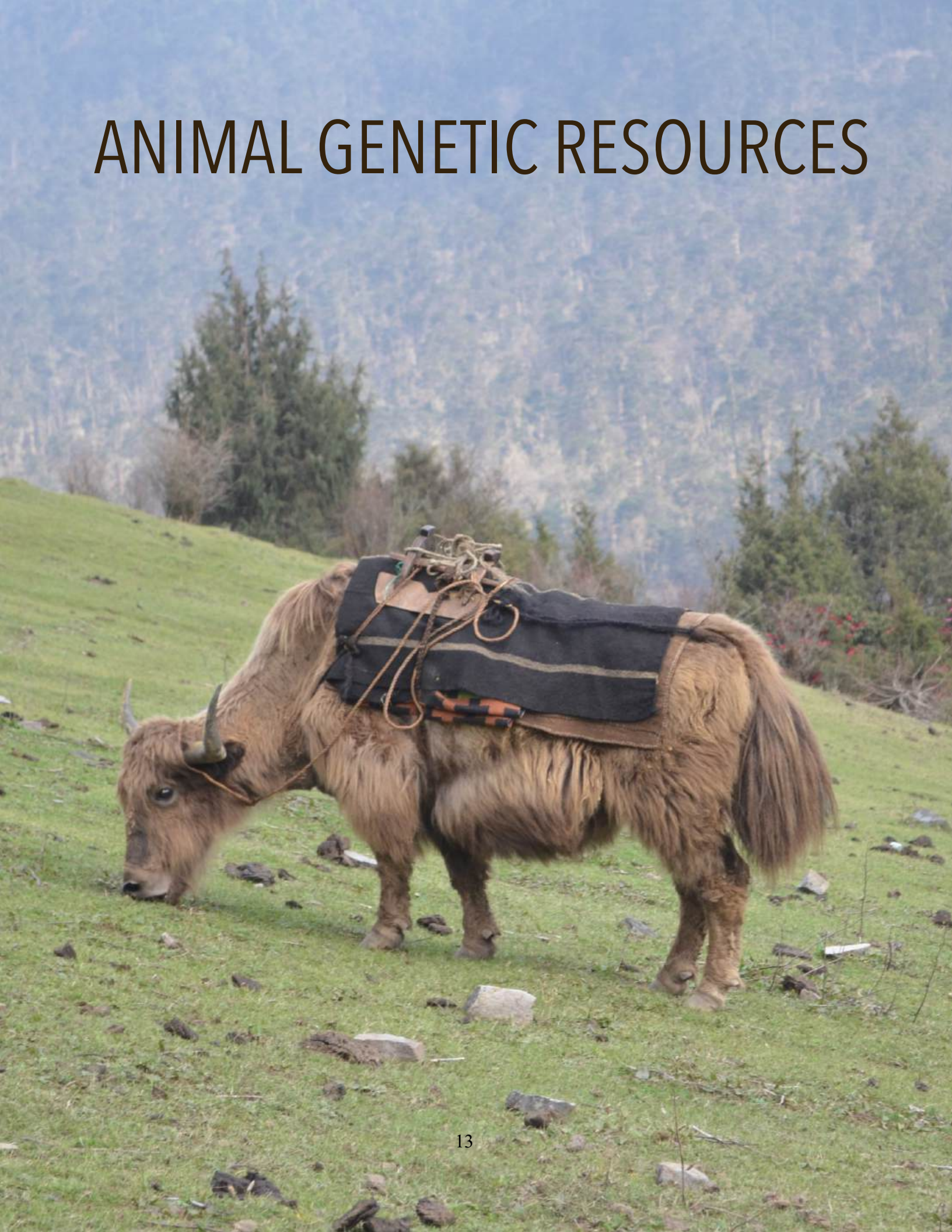
ORGANIZATIONAL CHART



PROGRAMS

KEY ACHIEVEMENTS

ANIMAL GENETIC RESOURCES



BACKGROUND

The Animal Genetic Resources (AnGR) Program, initiated in 2005, focuses on conserving and sustainably utilizing animal genetic resources in Bhutan. Over the past decade, the program has evolved, enhancing capabilities in Genebanking, in-situ conservation, and supporting the sustainable use of prioritized genetic resources.

Notably, key projects such as the Type Three project, Integrated Livestock and Crop Conservation Project, High-Altitude Northern Areas of Bhutan project (HANAS), and Asian Food and Agriculture Cooperation Initiative (AFACI) have played pivotal roles in this progression. Presently, the program is actively involved in the GEF-LDCF project aimed at revitalizing the Sapha pig population.In 2011, the program received validation for semen cryopreservation, marking a significant milestone. Beyond its local scope, the program contributes to global initiatives by submitting reports to Food and Agriculture (FAO) and engaging in collaborative genetic research with various institutions. Furthermore, the program is mandated to manage data, oversee the operation of the molecular laboratory, and collaborate on studies related to animal genetic resources in the country.

KEY ACHIEVEMENTS

IN-SITU CONSERVATION OF ANIMAL GENETIC RESOURCES

The in-situ conservation of animal genetic resources was launched in 2008 with funding support from the GEF-UNDP ILCCP. The primary focus of the project was capacity building and promoting local diversity. The project in collaboration with the Department of Livestock (DoL) was able to establish the Nublang Conservation Fund.

Ongoing efforts seek to secure resources for strengthening the in-situ conservation of animal genetic resources in the wake of emerging threats to the existence of traditional livestock genetic resources. Furthermore, in collaboration with various stakeholders, the program is in the process of establishing conservation communities for other indigenous livestock species.

KEY ACHIEVEMENTS (IN-SITU)

- → The program carried out monitoring of the existing nucleus native pig breeding farm and provided technical backstopping for the nucleus native pig fattening farm at Harachhu, Wangdue Phodrang.
- → The program provided financial and technical support for the construction of the nucleus indigenous pig breeding farm at Rukha under Wangdue Phodrang.
- → Identified core marketing areas for upcoming niche pork products.
- → The program conducted an awareness program and provided training on farm management practices, product handling, and packaging at Athang gewog

EX-SITU CONSERVATION OF ANIMAL GENETIC RESOURCES AT THE NATIONAL ANIMAL GENEBANK

Bhutan's traditional animal genetic resources hold exceptional importance, playing a central role in the livelihoods of rural communities with significant socio-cultural and economic value. In 2005, in collaboration with the Centre for Genetic Resources of the Netherlands, the Animal Genebank was established with the primary goal of preserving the genetic diversity of Bhutan's unique traditional animal breeds. Currently, the Genebank safeguards 27,292 doses of semen and DNA samples from various indigenous livestock breeds. Besides long-term preservation of genetic diversity, these resources serve as a foundation for genetic research, as well as crucial genetic backup for the reconstruction of breeds facing extinction.

In addition to semen cryopreservation and DNA banking, the program has also initiated embryo cryopreservation programs for vital livestock species in collaboration with the National Dairy Research and Development Centre and the National Nublang

Breeding Centre in Tashiyangphu. To date, approximately 20 viable Nublang embryos have been collected and preserved. Ongoing activities include comprehensive studies to characterize production parameters and other economically significant traits through selective breeding and DNA mapping. This preserved germplasm serves as a critical genetic reservoir to bolster national food security against the emerging challenges posed by climate change and other associated risks. As part of our ex-situ conservation program, the following activities were carried out:

KEY ACHIEVEMENTS (EX-SITU)

i. Collected **1,228** semen doses from five breeds of indeigenous chicken (Pure black, Belocham, Seim, Barred, and Bobthra).

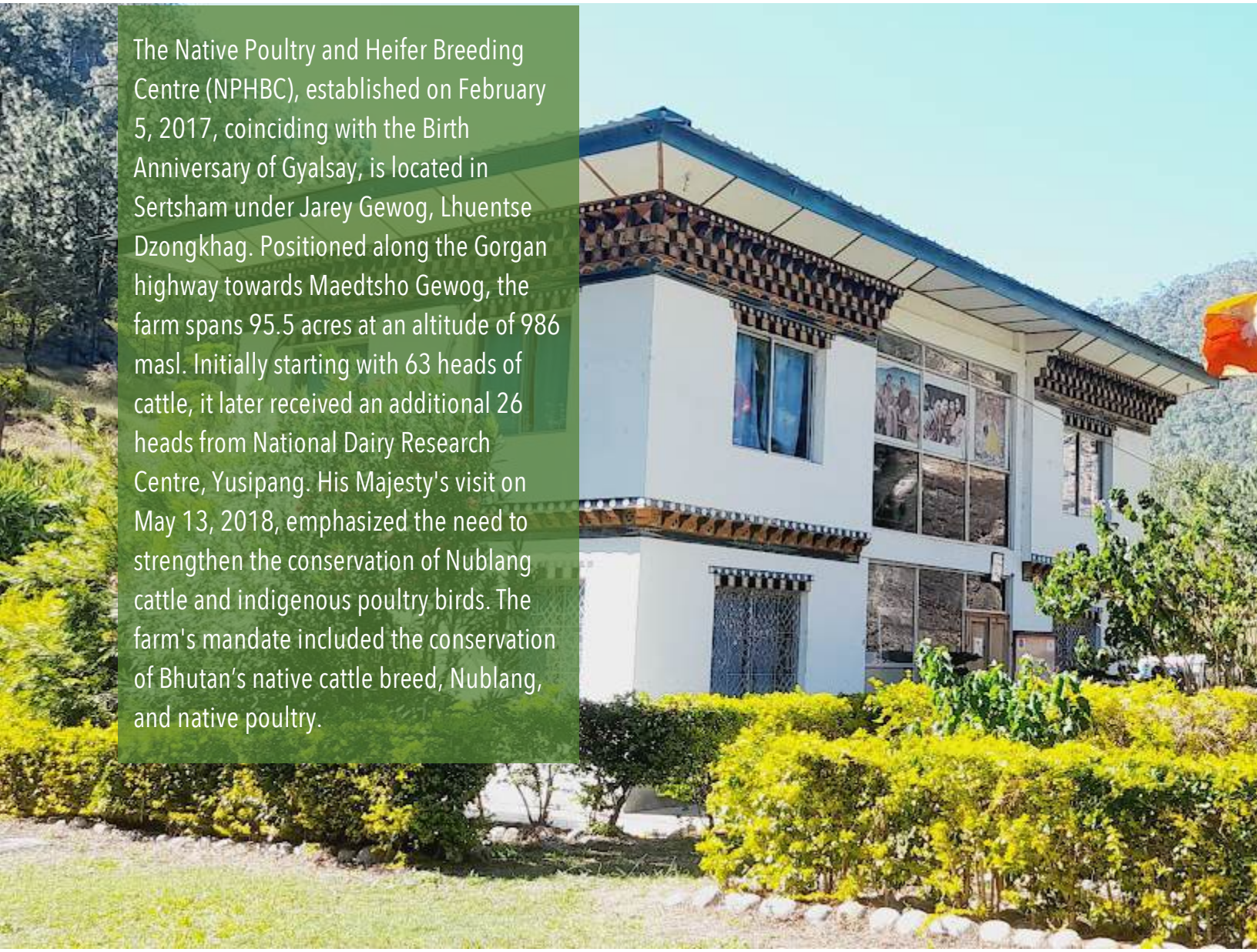
ii. Completed phenotyping **62** sibsoo type sheep, with **27** from the Tendu herd and **35** from the Norgaygang Herd. This collection completes the phenotypic data for all indigenous sheep breeds in the country.

iii. Collected **1,350** semen doses from **11** rams (male sheep) of Sakteng type, **1** ram of Sapang type, and **7** Jakar rams, **1** sibsoo, and **2** comeback type sheep through on-farm collections at the National Small Ruminants Research and Development Centre.

TRANSFER OF TWO CONSERVATION FARMS FROM DoL TO NBC

To establish clear mandates, ensure focused utilization of limited resources, and progressively develop native domestic animal genetic resources, the DoL transferred the conservation farms National Nublang Breeding Centre and National Poultry and Heifer Breeding Centre (NPHBC) in Sertsam to NBC. The transfer, completed on November 14, 2022, aligns with the overall goal of civil service reforms, aiming to strengthen efficiency, effectiveness, and service delivery for nation-building. This ensures the streamlining of mandates, focused intervention, optimal resource utilization, and increased synergy between organizations.

NATIVE POULTRY AND HEIFER BREEDING CENTRE



The Native Poultry and Heifer Breeding Centre (NPHBC), established on February 5, 2017, coinciding with the Birth Anniversary of Gyalsay, is located in Sertsham under Jarey Gewog, Lhuentse Dzongkhag. Positioned along the Gorgan highway towards Maedtsho Gewog, the farm spans 95.5 acres at an altitude of 986 masl. Initially starting with 63 heads of cattle, it later received an additional 26 heads from National Dairy Research Centre, Yusipang. His Majesty's visit on May 13, 2018, emphasized the need to strengthen the conservation of Nublang cattle and indigenous poultry birds. The farm's mandate included the conservation of Bhutan's native cattle breed, Nublang, and native poultry.

DAIRY SECTION

i. The NPHBC currently manages 116 cattle and produced a total of 38 calves (22 males and 16 females).

ii. The Centre maintained an average of 26 milch cows per month, which resulted in the of 13.18 MT of milk. Each cow recorded a lactation yield of 1.44 liters per day, totaling 439.2 liters per lactation. Additionally, the Centre supplied 21 heads (12 bulls and 9 heifers) to farmers and replaced 12 heifers within the farm.

iii. The Centre recorded an age at first service of 35.37 months, an age at first calving of 45.36 months, and a calving interval of 15.98 months.

iv. The NPHBC treated 29 clinical cases, achieving 100% in vaccination, deworming, and ectoparasite control, with a medicine usage rate of 83.8%. The herd mortality rate was 4.47%, while bird mortality was 11.89%. The farm maintained 100% biosecurity.

v. The Centre developed and renovated 7 acres of improved pasture and conserved 68 MT of winter fodder.

Yubjha rearing facility at the National Poultry and Heifer Breeding Centre

POULTRY SECTION

The NPHBC recorded **1,247** birds, with 72.6% consisting of *Seim*, followed by native black and *Belochem* breeds.

The Centre produced **23,766,** of which 13.57% were second-class eggs and 86.43% were settable eggs.

2,088 chicks hatched, registering a hatchability rate of **44.92%.** The fertility rate was recorded at 75.64%, and the average age at first laying was 21 weeks.

Generated revenue for **Nu. 0.519 Million** from the sale of milk, butter, cheese, eggs, and live animals/birds

NATIONAL NUBLANG BREEDING CENTRE

National Nublang Breeding Centre (NNBC) was initially established in 1978 as a sheep breeding unit at Bidung, Trashigang, which was later shifted to Tashiyangphu (present location). Later, when all the sheep stocks were further transferred to Bumthang, the farm was converted to Mithun calf rearing Centre , as the sub-station of Regional Mithun Breeding Farm, Arong. Subsequently, under the Royal command, NNBC was instituted in the year 1994-1995 with a core mandate to conserve Siri cattle to preserve its gene pool.

The Centre is located 8 km away from Wamrong Dungkhag towards Trashigang Dzongkhag, at an altitude of 2050-2550 meters above the sea level. The Centre initially started with 40 Thrabum Heifers, four breeding bulls and two Mithun cross bullocks, which were procured from Somboeykha, Haa and Doban, Sarpang in 1995. After 1996, the farm produced its own elite herd stocks through improved selection breeding to sustain in the future.

KEY ACHIEVEMENTS (NNBC)

i. The NNBC achieved a conception rate of 75%, owing to good handling and a preference for natural service in breeding. Despite heifers coming into heat at 36 months and leading to late age at first calving at 46 months its subsequent heat is on time leading to maximum cows giving birth annually.

ii. The NNBC introduced wooden troughs for uniform concentrate feeding toensuring optimal nutrition for the animals.

CURRENT STATUS

The National Animal Gene Bank, also referred to as the National Animal Repository, safeguards 27,292 samples of semen collected from various traditional animal breeds. The gene bank's extensive collections is presented below;

Table 1: List of samples at the Animal Genebank

List of samples at the Animal Genebank	
Donor Animals	Total Semen Doses
Poultry	5,764
Pig	209
Sheep	13,678
Goat	4,051
Mithun	1,390
Nublang	2,200
Total	27,292

PLANT GENETIC RESOURCES

BACKGROUND

Plant Genetic Resources for Food and Agriculture (PGRFA) comprise of genetic material found in traditional varieties, modern cultivars, semi-domesticated, wild relatives, and wild edible plant species, all of which hold actual or potential value for food and agriculture. This PGRFA is categorized into four subcomponents: domesticated crops (DC); semi-domesticated crops; crop wild relatives (CWR); and wild edible plants.

The PGRFA serves as the foundation for the country's food and nutrition security and acts as the reservoir of genes essential for developing pest and disease resistance, enhancing nutritional quality, and improving crop yields. Moreover, PGRFA diversity provides functional diversity crucial for adapting crops in changing climatic conditions. However, plant genetic diversity faces a significant threat from genetic erosion, primarily caused by the replacement of local varieties with modern ones. Other contributing factors to genetic erosion include climate change, emergence of pests, weeds and diseases, environmental degradation, rural-urban migration. Two strategies have been implemented to address this issue and conserve diversity:

1) In-situ on-farm conservation (2001)
2) Ex-situ conservation (2005).

The National Plant Genebank currently safeguards 3,500 accessions of germplasm from 59 crop species. Additionally, these accessions are duplicated and stored at the Security Duplicate Genebank at ARDC, Wengkhar.

SCAN TO LEARN MORE ABOUT THE PROGRAM

KEY ACHIEVEMENTS

ON-FARM MANAGEMENT OF PGRFA

On-farm management of PGRFA is the conservation of germplasm directly within the agricultural landscape such as farms and fields through promoting sustainable utilization.

KEY ACHIEVEMENTS

On-farm Crop Diversity inventory at Kengkhar, Phongmay and Lumang Gewogs: The program conducted an on-farm crop diversity inventory at Kengkhar, Phongmay and Lumang gewogs with the primary objective to create awareness among the farming communities on the importance of crop diversity. Additionally, it also aimed to assess the level of crop diversity existing in the farmers' field, identify crops and varieties, and determine the donor farmer for germplasm collection.

The inventory in all three gewogs revealed a significant diversity of crops maintained by the farmers. However, despite this richness, it was learned that certain crops and varieties have already been lost from these gewogs while others are experiencing a rapid decline.
Refer Annex 1 for the summary of the On-farm Crop Diversity Inventory under 3 sites

REHABILITATION AND PROMOTION OF NEGLECTED AND UNDERUTILIZED CROP SPECIES (NUS PROJECT)

The program implemented a project on *"Participatory on-Farm Conservation, Sustainable Use and Management of Neglected and Underutilized Crop Species (NUS) for Livelihood and Adaptation to Climate Change"* to mitigate the challenges of declining on-farm diversity of invaluable millet species, especially NUS crops like millets *(Setaria italica, Eleusine coracana and Panicum miliaceum).* The project was funded by the International Treaty on Plant Genetic Resourcews for Food and Agriculture (ITPGRFA) and implemented in collaboration with the National Centre for Organic Agriculture (NCOA), Yusipang; Agriculture Research and Development Centres (ARDCs) of Samtenling and Wengkhar, Dzongkhag Agriculture Sectors of Chukha, Samtse, Samdrup Jongkhar and Tashi Yangtse.

KEY ACHIEVEMENTS

- Evaluated farmers-preferred varieties/accessions in the project sites. (Rongshong Yangra, Khang Yangra, Beypaa Yangra, Khoshomo, Chakhrey, Lawa Sumpa, Local, BTNC1987, BTNC1981, BTNC830).
- Carried out on-station seed multiplication of 4 Foxtail millets (BTNC1786-Ran from Minji, BTNC 2608-Yangra from Zobel, BTNC2464-Yangra Changlu from Norbugang, Yangra from Khangma) and 1 finger millet from Daifam (BTNC830-Kongpu) at ARDSC Khangma for further distribution to the farmers.
- Supply of post-harvest production facilities (dehusking and flour milling machine) to the project farmers of Bumdeling, Tading, Dorokha and Bongo to ease the milling of the millet and improve the quality of the flour.

Foxtail millet

CAPACITY BUILDING

- Conducted capacity building of farmers (20 farmers in Bumdeling and 13 farmers in Dorokha) on product development and diversification of millet products viz. cookies, noodles, spicy and sweet snacks.
- Supported two members, including a farmer and an extension from Trashi Yangtse project site to attend the 9th session of the Governing Body of the ITPGRFA from 17th to 23rd September 2022 in New Delhi, India.

EVOLUTIONARY PLANT BREEDING (EPB) PROJECT

- The EPB project was carried out in Tsento (Paro), Kabjisa (Punakha), Tsangkha (Dagana), Mendrelgang (Tsirang) and Singye (Sarpang). The project aimed at producing evolutionary populations of rice and beans was implemented with technical support from the NCOA (Yusipang), ARDC Bajo and ARDC Samtenling and in collaboration with the Agriculture Sectors of Paro, Punakha, Dagana, Tsirang and Sarpang Dzongkhag.

- 25 pure-stand rice and 19 bean varieties (both dwarf and climbing types) were used to evaluate the yield, adaptation and nutritional values in the trial as indicated in annexure 2. The project also supported awareness programs on Biodiversity Rules and Regulations 2023. Additionally, the project provided support to the Royal Botanical Garden and Community Seed Bank in Bumthang.

EX-SITU CONSERVATION IN THE NATIONAL PLANT GENEBANK FOR SUSTAINABLE UTILIZATION

Ex-situ conservation refers to the preservation of genetic diversity outside the natural habitat of a particular species, varieties, and alleles.

Key Achievements

i. Collected a total of 51, 55, and 20 germplasm samples of traditional crop varieties from Kengkhar, Phongmey, and Lumang gewog respectively using the Farmers' Participatory Germplasm Identification method

ii. Processed and accredited 395 accessions of germplasm in the Genebank using the Genebank Operation Manual and FAO Genebank standards as indicated in annexure 3.

iii. On-station multiplication of "Small Samples" and repatriated germplasm samples are conducted every year. During this fiscal year, a total of 31 germplasm samples were multiplied as indicated in annexure 4 for conservation.

iv. Maintained 35 samples from 8 clonally crops in the Mini Field Genebank. A total of as indicated in annexure 5.

BIODIVERSITY FOR OPPORTUNITIES, LIVELIHOODS AND DEVELOPMENT (BOLD) PROJECT- WORK PACKAGE 3

The BOLD (Biodiversity for Opportunities, Livelihoods and Development) project aims to strengthen food and nutrition security by supporting the conservation and use of crop diversity and is funded by the Crop Trust. The BOLD has different Work Packages of which the Work Package (WP) 3 on Seed System Characterization in Bhutan is technically supported by the Norwegian University of Life Sciences.

KEY ACHIEVEMENTS

The program coordinated the Work Package 3 in collaboration with the Department of Agriculture and other relevant stakeholders with technical support from the Norwegian University of Life Sciences. The launch workshop was attended by stakeholders from various organizations including National Genebank, Department of Agriculture, Agriculture Research and Development Centres, Agriculture Research and Development Sub-Centres, National Seed Centre , College of Natural Resources, Dzongkhag Agriculture Officers and representatives from the Private Seed Companies etc.

SEED SYSTEM CHARACTERIZATION

As a part of seed system characterization, the program in collaboration with Department of Agriculture (DoA) conducted a Key Informant Interview (KII) with 26 different stakeholders and a Focused Group Discussion (FGD) with 14 gewogs representing different regions The objective of the seed system characterization was to characterize seed systems, identify key issues and challenges related to seed system, gather recommendations for improving the seed system and identify options (technical and institutional) for supporting genebanks to enhance farmers' access to and uptake of crop diversity in the country.
This information will be used to develop Genebank-seed system linkages and theories of change which will in turn guide the development of the project document for strengthening the Seed System in Bhutan.

CURRENT STATUS

The Evolutionary Plant Breeding project cycle completed successfully on 30th April 2023. Pureline varieties and dynamic evolutionary populations were distributed to the project farmers. The dynamic evolutionary populations are being maintained at the ARDCs (Bajo, Samtenling), ARDSC Tsirang and NCOA Yusipang on-stations. Currently, there are 3,500 accessions (cumulative) from 28 crops covering 49 species as indicated in Table 2 below that are being conserved at the Genebank. As a safety measure, these accessions are duplicated at the Security Duplicate Genebank at ARDC, Wengkhar.

Table 2 Crop and germplasm accession in the National Plant Genebank

Crop and germplasm accession in the Genebank		
Sl.Nno	**Crop Name**	**Accession**
1	Paddy	1100
2	Maize	459
3	Bean	235
4	Finger millet	252
5	Sweet buckwheat	180
6	Vigna	49
7	Mustard	149
8	Bitter buckwheat	200
9	Barley	93
10	Soya bean	100
11	Foxtail Millet	98
12	Wheat	80
13	Amaranth	60
14	Little Millet	120
15	Perilla	90
16	Niger	9
17	Pea	29
18	Turnip	9
19	Sesame	25
20	Sag	5
21	Sorghum	25
22	Chili	92
23	Watermelon	2
24	Mungbean	10
25	Radish	10
26	Fodder	15
27	Tomato	2
28	lettuce	2
	Total	**3,500**

BIOPROSPECTING

ACCESS AND BENEFIT SHARING

BACKGROUND

Bhutan ratified the Nagoya Protocol in 2012, which sets out core obligations to regulate access to genetic resources, benefit-sharing, and compliance. Established in 2009, the Bioprospecting and ABS Program focuses on recognizing the value of Bhutan's biological resources and associated Traditional Knowledge (TK). Serving as the national focal point for the Nagoya Protocol on ABS, the program conducts biodiscovery research within the ABS framework. The program operates a bioprospecting laboratory and oil distillation facility, conducting phytochemical analysis and maintaining a collection of over 1200 plant extracts. Additionally, the program oversees the Bhutan ABS Fund, which was created as a reinvestment mechanism, receiving financial benefits generated from accessing genetic resources or associated TK and directing these funds toward supporting initiatives aimed at conserving biodiversity.

SCAN TO LEARN MORE ABOUT THE PROGRAM

KEY ACHIEVEMENTS

HANDING OVER OF ZHINOR PRODUCTION TO DZEDOKHA PHACHENG DETSHEN:

On 8th June 2023, the production of Zhinor (balm and liniment) was formally handed over to Dzedokha Phacheng Detshen in the presence of gewog administration, Officials from NBC, and members of the local community. Zhinor balm and liniment, are products made from the native wild ginger species (*Zingiber cassumunar*) by the Dzedokha community using traditional local knowledge and research expertise from the Bioprospecting team (NBC). This marked an important milestone in the successful implementation of the ABS agreement between the Dzedokha community and NBC. The community will operate the facility with 8% of the net profit generated annually going towards the Dzedokha Phacheng Detshen social enterprise and 2% going towards the Bhutan Access and Benefit Sharing (BABS) Fund. To read more, Click here

LAUNCH OF PANGTSE MAKHU (*Symplocos paniculata* oil):

The people of Petari Chiwog in Punakha Dzongkhag have long used Pangtse Makhu. However, due to the availability of imported oil from the market, the tradition of using the oil has been declining. Therefore, the Bioprospecting and ABS Program, with funding support from the United Nations Development Program (UNDP) and Small Grant Programme (SGP) was able to revivie the dying art of Pangtse Makhu (oil from the seeds of *Symplocus paniculata*) production in Petari chiwog under Kabjisa gewog in Punakha.

The project was initiated with the formation of 32-member community based natural resource management group known as the "Petari Pangtse Zhinchong Detshen" and aimed to improve oil extraction method to ensure the safety, shelf life and consistency of the product quality. The program launched the final product for promotion on 19th September 2023. To read more, Click here

Photo: Sensitization on Biodiversity Act of Bhutan 2022, Biodiversity Rules and Regulations 2023, and Standard Operating Procedures for Enforcement Officers at Samtse

ENDORSEMENT OF BIODIVERSITY RULES AND REGULATIONS 2023 AND STANDARD OPERATING PROCEDURE (SOP) FOR ENFORCEMENT OFFICERS BY THE COMPETENT NATIONAL AUTHORITY

As mandated by the Biodiversity Act of Bhutan 2022, the Biodiversity Rules and Regulations 2023 and the Standard Operating Procedure (SOP) for enforcement officers were endorsed by the Competent National Authority (CNA) on 12th February 2023 during its first meeting.

SENSITIZATION ON BIODIVERSITY ACT OF BHUTAN, BIODIVERSITY RULES AND REGULATIONS 2023, AND STANDARD OPERATING PROCEDURES (SOP) FOR ENFORCEMENT OFFICER

The Biodiversity Act of Bhutan, 2022, a revised version of the Biodiversity Act of Bhutan, 2003, was passed by the 7th session of the third parliament and received Royal Assent on 15 July 2022. To ensure effective enforcement of the new rules and regulations, sensitization programs were conducted at major entry and exit points of Bhutan (Thimphu, Paro, Samdrup Jongkhar, Gelephu, Phuentsholing, and Samtse). A total of 104 official participants attended the program. To read more, Click here

Photo: Training Workshop on Biodiversity, Biopiracy, and its relevance on tourism at Phuentsholing

TRAINING WORKSHOP ON BIODIVERSITY, BIOPIRACY, AND ITS RELEVANCE ON TOURISM

Conducted sensitization programs at major entry and exit points of Bhutan (Thimphu, Paro, Samdrup Jongkhar, Gelephu, Phuentsholing, and Samtse) on Biodiversity, Biopiracy and its relevance on tourism. 159 participants attended the program who were sensitized on biopiracy, misappropriation, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), NBC's role in conservation, plant taxonomy, ex-situ conservation, agrobiodiversity, invasive species, the Bhutan Biodiversity portal, and the national tagline, "Bhutan Believe."

SIGNING OF SCOPING AGREEMENT WITH BHUTAN NUTRACEUTICAL, UGYENTSE, SAMTSE

A scoping agreement was signed between NBC and Bhutan Nutraceutical, Ugyentse, Samtse, to conduct commercial research on plant genetic resources for its potential use in the pharmaceutical field.

REDEEM®

SWITZERLAND

Current Status

A total of 13 ABS agreements have been successfully enacted with both national and international users of genetic resources and related TK, leading to the development of 13 nature-derived products. Additionally, ten community-based natural resources management (CBNRM) groups have been actively involved to encourage community engagement and leadership in conservation efforts. 340 MTAs have been facilitated for both academic and commercial research purposes. Additionally, documentation of TK linked to biological resources has been accomplished in all 205 Gewogs. Currently, the Bhutan ABS Fund holds a sum exceeding Nu. 12.0 million, generated from various ABS initiatives

Access and Benefit Sharing

Renewed the scoping agreement between the Blue Zones Group, Switzerland, and the NBC with the College of Natural Resources as their local partner for research.

Renewed the ABS agreement between Menjong Sorig Pharmaceutical Corporation Limited (MSPCL), NBC, and Namther Menrig Tshogpa.

Renewed the ABS agreement among Bio-Bhutan, Jom Dagam Ngomen Tshogpa, and NBC.

Executed 47 Material Transfer Agreements (MTA) to facilitate the transfer of biological resources for academic and commercial research.

NATIONAL HERBARIUM

Photo: Red Kamala

SCAN TO LEARN MORE ABOUT THE PROGRAM

BACKGROUND

The National Herbarium (NH) was established in 1998 with financial support from the Danish International Development Agency (DANIDA) and became operational in 2003. It is the only herbarium in the country (Herbarium code THIM) listed in the Index Herbariorum (https://sweetgum.nybg.org/science/ih/) - a guide to the world's herbaria and where only those collections that are permanent scientific repositories are included.

The main functions of the National Herbarium are to serve as the national repository of "Type" (A preserved specimen designated as a permanent reference for a new species, new genus or some other taxon) and voucher specimens of botanical collections; lead and coordinate plant systematics and taxonomy-related studies, including national floristic works; and identify conservation priority species in the country. The ancillary functions include providing taxonomic services to other agencies and stakeholders. and programs of the centres.

Over the past 20 years, the National Herbarium focussed on building its collections through routine collections programs, international collaborations and national thematic projects, including the (i) Bhutan fern project, (ii) Pilot project on invasive plant species of Bhutan, (iii) Comprehensive assessment of climate change impacts on endemic plant diversity, (iv) Impact assessment of invasive plants in Bhutan, (v) Red listing of Bhutan's endemic plant species, and (vi) Biodiversity conservation and sustainable use in High Altitude Northern Areas of Bhutan (HANAs). Currently, the NH houses approximately 19,309 accessions of Angiosperms, Gymnosperms, Pteridophytes, and Bryophytes specimens (Table 3).

KEY ACHIEVEMENTS

ADDITIONAL SPECIES DOCUMENTED

The program collected and documented over 120 additional species of plants, which were either not collected previously or underrepresented from their natural distribution zone.

DISCOVERY OF NEW SPECIES AND NEW RECORDS

The National Herbarium either led or were instrumental in the discovery of five species new to science (*Begonia menchunaensis* P.Gyeltshen & M.Hughes, *Bulbophyllum gurungianum* P.Gyeltshen, K.Rabgay & Kumar, *Bulbophyllum punakhaense* P.Gyeltshen, K.Rabgay & Kumar, *Chiloschista bhutanensis* B.B.Ghalley & Dalström and *Impatiens darachuensis* P.Gyeltshen, W.Adamowski & Phuntsho), and 25 species new for Bhutan, namely: *Baccaurea javanica* (Blume) Müll.Arg., *Begonia picta* Sm., *Begonia rex* Putz., *Begonia roxburghii* (Miq.) A.DC., *Begonia xanthina* Hook., *Canarium strictum* Roxb., *Canthiumera glabra* (Blume) K.M.Wong & Mahyuni, *Cipadessa baccifera* (Roxb. ex Roth) Miq., *Clerodendrum japonicum* var. *japonicum, Ehretia acuminata* R.Br., *Eranthemum erythrochilum* J.R.I.Wood, *Eurycorymbus cavaleriei* (H.Lév.) Rehder & Hand.-Mazz., *Grewia asiatica* L., *Hemidesmus indicus* (L.) R.Br., *Hibiscus fragrans* Roxb., *Homalium napaulense* (DC.) Benth., *Ilex umbellulata* (Wall.) Loes., *Machilus edulis* King ex Hook.f., *Mappia nimmoniana* (J.Graham) Byng & Stull, *Phoenix loureiroi* var. *pedunculata* (Griff.) Govaerts, and *Vaccinium sikkimense* C.B.Clarke. Of the 25 new records, four species are newly naturalized in Bhutan (*Acmella radicans* (Jacq.) R.K.Jansen, *Cleome rutidosperma* DC., *Cuphea carthagenensis* (Jacq.) J.F.Macbr. and *Silene latifolia* Poir.).

Rediscovery of *Maharanga griersonii* (R.R.Mill) L.Cecchi & Hilger

Maharanga griersonii, a critically endangered plant species was rediscovered after 44 years from the type locality Nobding, Wangdue Phodrang Dzongkhag (Phuentsho, *et al.* 2022).

Current Status

A total of 19,309 specimens representing 3,739 species of Tracheophytes (angiosperms & gymnosperms), Pteridophytes (ferns & allies), and Bryophytes (mosses) are documented in the Bhutan Biodiversity Specimen Portal (see Table 1). The number of genera for Tracheophytes (angiosperms & gymnosperms) was based on the Flora of Bhutan, while the genera for Pteridophytes (Ferns & allies) and Bryophytes (mosses) were retrieved from the portal checklist.

Table 3: List of species of plants documented

List of species documented			
Taxa	Genus	Species	Specimens
Tracheophytes (angiosperms & gymnosperms)	1,429	2,897	15,738
Pteridophytes (ferns & allies)	110	553	2,376
Bryophytes (mosses)	159	289	1,195
Total	1,698	3,739	19,309

ROYAL BOTANICAL GARDEN

BACKGROUND

The Royal Botanical Garden, Serbithang (RBGS), was established in 1999 to commemorate the silver jubilee of His Majesty the Fourth Druk Gyalpo's golden reign. It is the only botanical garden in the country with its core mandate to serve as a living collection area for ex-situ conservation of native flora.

The initial establishment of the garden was facilitated through the funding support of the Bhutan Trust Fund for Environmental Conservation (BTFEC). Other donors that provided either technical or financial support to date include the Darwin Initiative project (2004-2006), Mangdechu Hydro Power Authority (MPHA 2012-13), Tangsibji Hydro Power Project Authority (2014-17), Garfield Weston Foundation Global Tree Seed Bank Project through Millennium Seed Bank, Royal Botanical Gardens (2016-2024), European Union (EU-SSP and EU-RDCCRP), UNDP, and Botanic Gardens Conservation International.

Currently, besides being an ex-situ conservation area, the garden also serves as a biodiversity educational resource and a rescue center for rare and threatened plant species of native flora. It is also a popular public recreational site. Since 2016, in collaboration with the Royal Botanic Garden, Kew, UK, the garden has initiated seed banking of tree seeds for ex-situ conservation. The other repurposed initiatives of the garden include exploring and researching the potential of the native plant species in ornamental horticulture and plant-based enterprises. Since 2015, the garden has been making significant contributions to the Royal Bhutan Flower Exhibitions and other national events like the annual National Day celebration.

KEY ACHIEVEMENTS

Revenue Generated from the sale of flowers meant for 8th Royal Bhutan Flower Exhibition:

The 8th Royal Bhutan Flower Exhibition was planned to be held in Thimphu in June 2023. However, due to some unforeseen circumstances, the Flower Exhibition was cancelled. In order to compensate for the cost of production and seeds, the garden sold some of the flowers grown for the exhibition, earning a total of Nu. 6,17,635. The unsold plants were either distributed to different agencies or used to beautify the garden areas.

INCREASING THE DIVERSITY AT THE BOTANICAL GARDEN:

A total of 22 species of live plants, ranging from trees, shrubs, and herbs of rare and threatened species, were collected from different floristic regions of the country to enhance the species and genetic diversity of ex-situ collections at the botanical garden. Based on the habit and habitat of the species, the live plants were planted in different thematic gardens like Glasshouse, Arboretum, Orchidarium, Fenery, etc. Additionally, seeds of more than 30 species of trees and shrubs were collected as part of the annual performance agreement of the "Trees species seed conservation project-GW3" implemented in partnership with the Millennium Seed Bank (MSB), Royal Botanic Gardens, Kew. All seeds were processed following MSB protocol and seeds were banked at the NBC.

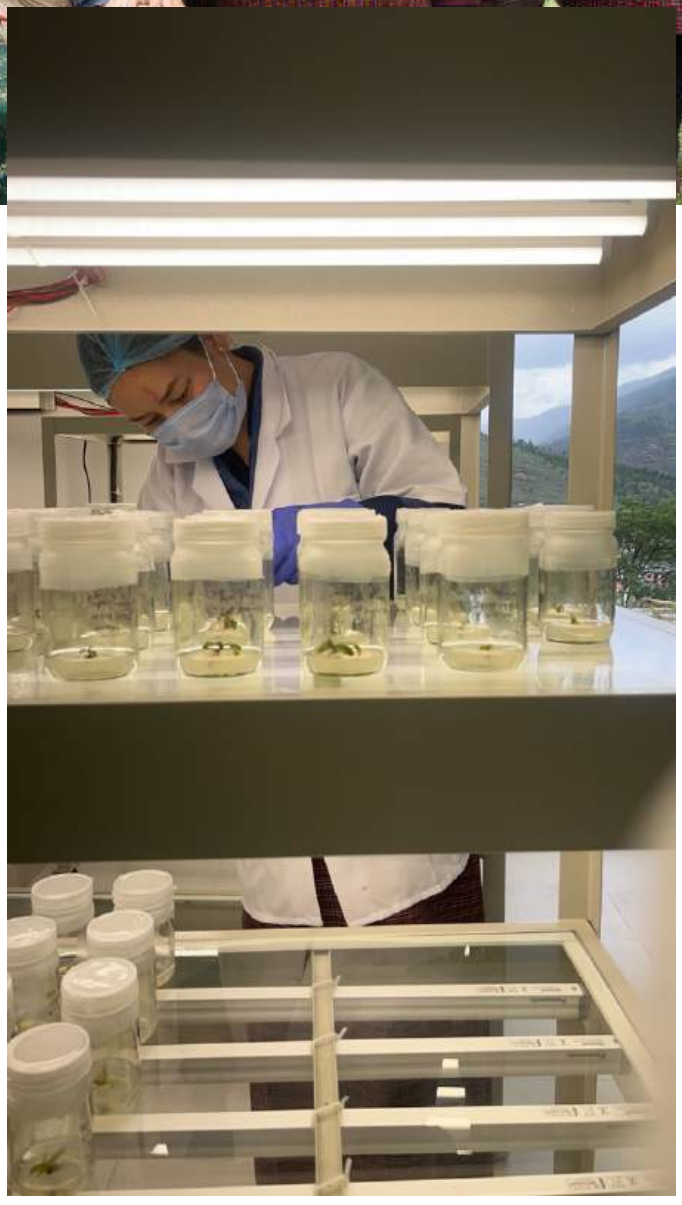
IMPROVING ACCESSIBILITY OF THE GARDEN FACILITIES:

In a continued effort to expand the accessibility of the garden for people with different disabilities, an accessible public toilet was constructed at the parking lot. The facility was developed with the funding support from UNDP and the Australian Volunteers Program Impact Fund as a part of the "Nature for All project" and in collaboration with the Zhenphen Group

SCAN TO LEARN MORE ABOUT THE PROGRAM

Formal Inaugurations of the Micropropagation Laboratory and the Native Plant Propagation Facility:

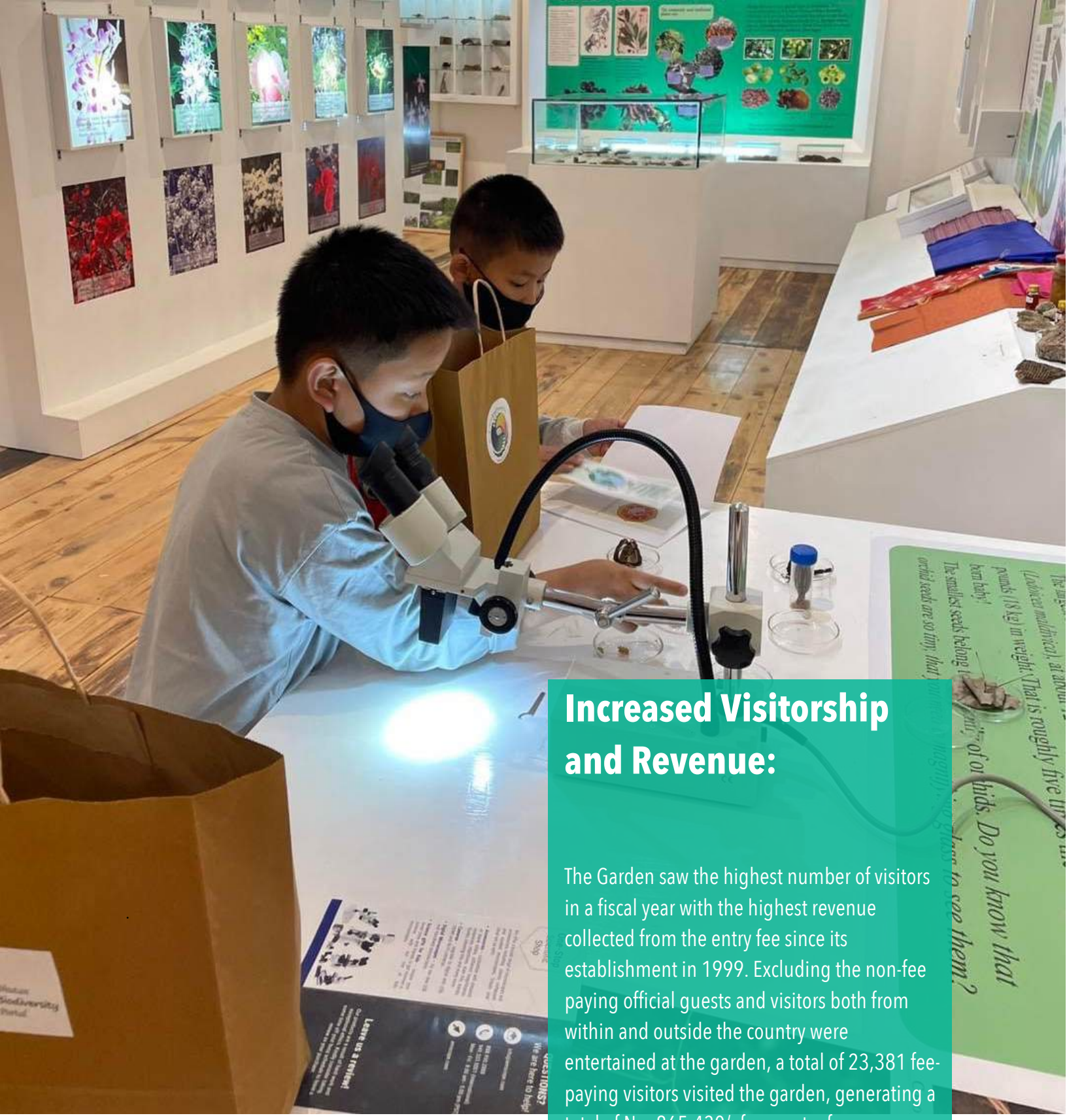
Orchid micropropagation laboratory and the Native Plant Propagation Facility (Polycarbonate house) established at the RBGS through the financial support of the European Union's Rural Development and Climate Change Response Program were officially inaugurated on 24th September 2022. The micropropagation laboratory is a significant achievement as it makes it possible for mass production of those species difficult to propagate through conventional methods, for example, orchids. The polycarbonate house equipped with temperature and moisture-controlled facility functions as a conventional native plant propagation unit as well as a facility to harden plantlets and to protect the plants during the harsh winter months. These facilities will help reduce pressure on wild populations and discourage imports of exotic species.



Together with the Royal Project Coordination Office and the Department of Agriculture, the garden was also involved in the beautification of the stadium.

115th National day celebrated at Thimphu, Changlimithang

The Royal Botanical Garden, Serbithang contributed over six thousand annual flowers and potted perennial plants for the beautification at the Changlingmithnag Stadium for the celebration of the 115th National Day on 17th December 2022.



Increased Visitorship and Revenue:

The Garden saw the highest number of visitors in a fiscal year with the highest revenue collected from the entry fee since its establishment in 1999. Excluding the non-fee paying official guests and visitors both from within and outside the country were entertained at the garden, a total of 23,381 fee-paying visitors visited the garden, generating a total of Nu. 865,430/- from entry fees.

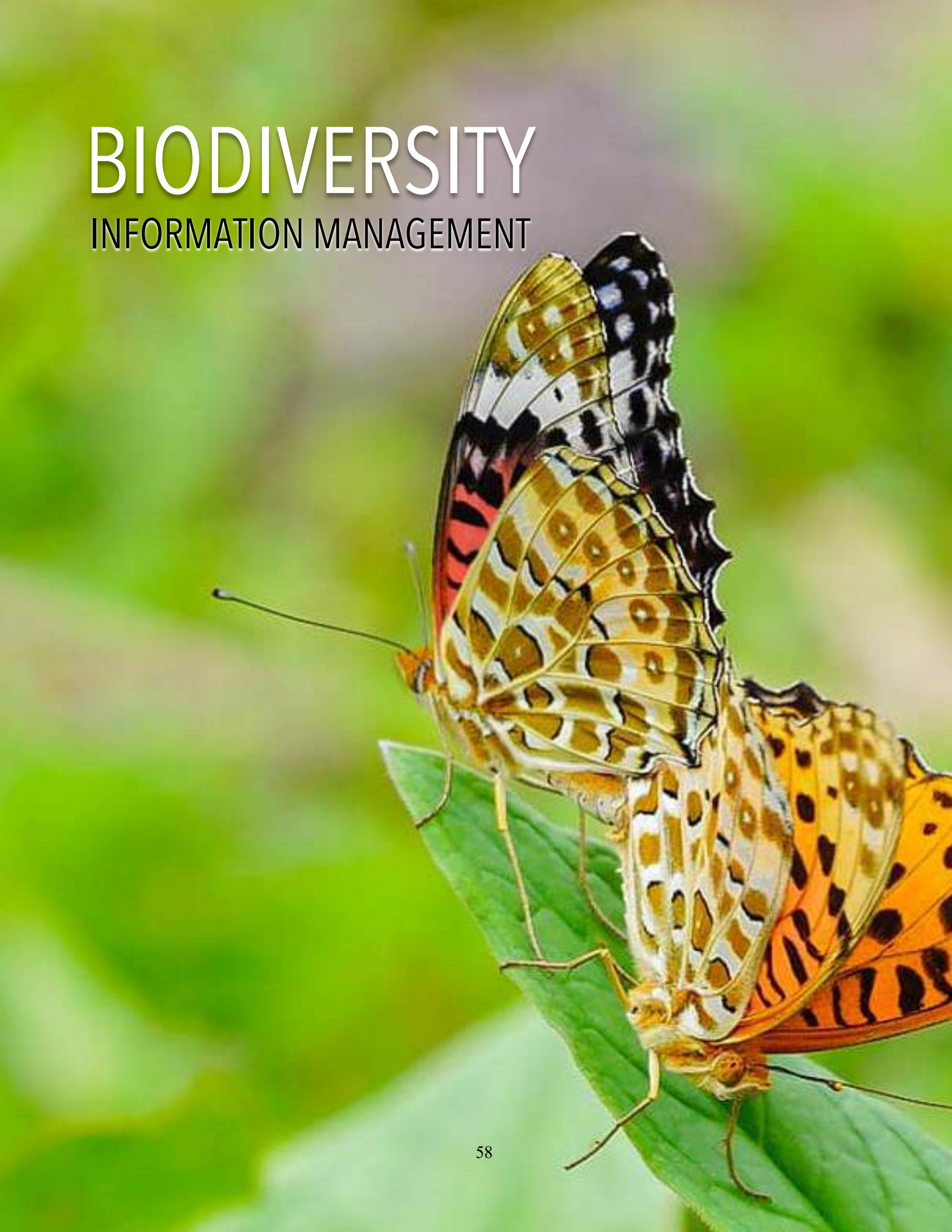
Improving and maintaining the aesthetics and amenities of the garden:

As increasing visitorship depends on the aesthetics and amenities available, the Royal Botanical Garden consistently strives to enhance the visitor experience by improving amenities. In the past year, the garden improved the public toilet facilities, children's playground, sitting areas, and interpretation signages.

Current Status

The garden currently holds a living collection of over 1000 plant species, spread over different thematic collections and gardens. The notable thematic collections are of orchids, with more than 250 species conserved in the Orchidarium and of tree species, with more than 100 species in the Arboretum. The garden also has some 20 species of ferns in the Fernery, about six out of 46 Rhododendron species, and a collection of all three species of native Roses. The other thematic collections and areas under development are the economic garden, ornamental garden, medicinal garden, and Bamboo garden.

BIODIVERSITY
INFORMATION MANAGEMENT



SCAN TO LEARN MORE ABOUT THE PROGRAM

BACKGROUND

The Biodiversity Information Management Program was initiated in 2003 to oversee and coordinate the documentation and dissemination of biodiversity information across the country. The program also coordinates the development and implementation of the National Biodiversity Strategies and Action Plans (NBSAP), contributing towards the Post-2020 Global Biodiversity Framework. Additionally, the program serves as a Biodiversity Data Publisher on GBIF and as the National Focal Point for the Biodiversity for Food and Agriculture (CGRFRA).

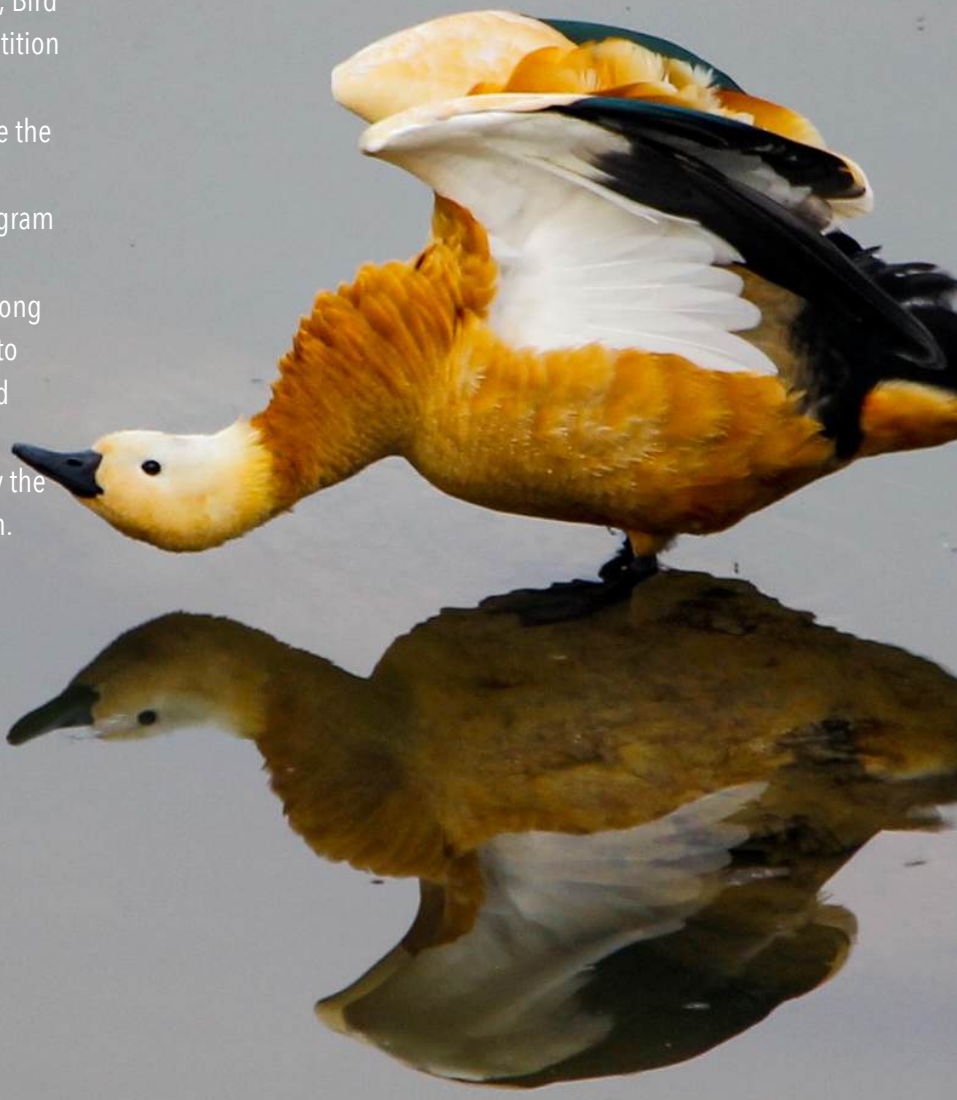
In 2008, under the framework of South-South Cooperation between Bhutan, Benin, and Costa Rica, funded through the government of the Netherlands, NBC developed the biodiversity portal. This portal currently holds information on both wild and domestic biodiversity of Bhutan. Subsequently, in 2010, the portal was upgraded to become the national portal on biodiversity, known as the Bhutan Biodiversity Portal (www.biodiversity.bt), officially launched on 17th December 2013. Since then, the portal has received funding support from various organizations including WWF Bhutan, National Geography Society, GBIF, and GEF-LDCG/NAPA III project. Technical assistance for the portal is provided by Strand Life Science in India, Ashoka Trust for Research in Ecology and the Environment, Indian Biodiversity Portal, and GovTech, Bhutan.

In 2019, the Biodiversity Statistics of Bhutan was published, which reported more than 11,000 species in the country. Plans are underway to publish subsequent statistics on biodiversity in the future.

KEY ACHIEVEMENTS

National Bird Month

The National Bird Month is designated from 17th April to 17th May 2023 to mark the importance of birds in our ecosystems, their role in maintaining ecological balance, and the need for their protection. During the National Bird Month, Bird Photography Contest along with the competition for the top bird's contributor in the Bhutan Biodiversity Portal was conducted to engage the public, students, communities, and citizen scientists in bird-related initiatives. The program aimed to foster a sense of appreciation, understanding, and active participation among individuals, motivating them to contribute to conservation initiatives. A total of 2,487 bird observations were made and subsequently contributed to Bhutan Biodiversity Portal by the participants during the National Bird Month.



Butterfly BioBlitz

The Butterfly BioBlitz, organized through a collaboration between NBC and the Bhutan Butterfly Society with support from the GEF-LDCF/NAPA 3 project, took place from June 17 to 18 in Punakha and Gasa. This initiative focused on engaging tour guides, students, and Desuungs in the exploration and documentation of the diverse butterfly species within our surroundings. The program aimed at increasing awareness about the vital role butterflies play in maintaining a healthy ecosystem. Additionally, the event sought to contribute valuable data to ongoing biodiversity conservation initiatives. Led by experienced naturalists and butterfly enthusiasts, the BioBlitz included guided walks where participants used binoculars and cameras to closely observe and learn about various butterfly species. The program also featured educational sessions on the life cycle, behavior, and ecological significance of butterflies. Hands-on activities, such as butterfly counting and data recording, actively engaged participants and resulted in the documentation of an impressive 71 butterfly species.

Scan to learn more

THE BIODIVERSITY PLAN

For Life on Earth

NATIONAL BIODIVERSITY STRATEGIES AND ACTION PLANS (NBSAP)

As the Secretariat for coordination and implementation of the NBSAP, the program coordinated the national inception workshop for development of Bhutan's 5th NBSAP. The workshop was conducted in collaboration with the Department of Environment and Climate Change (DoECC) and United Nations Development Program.

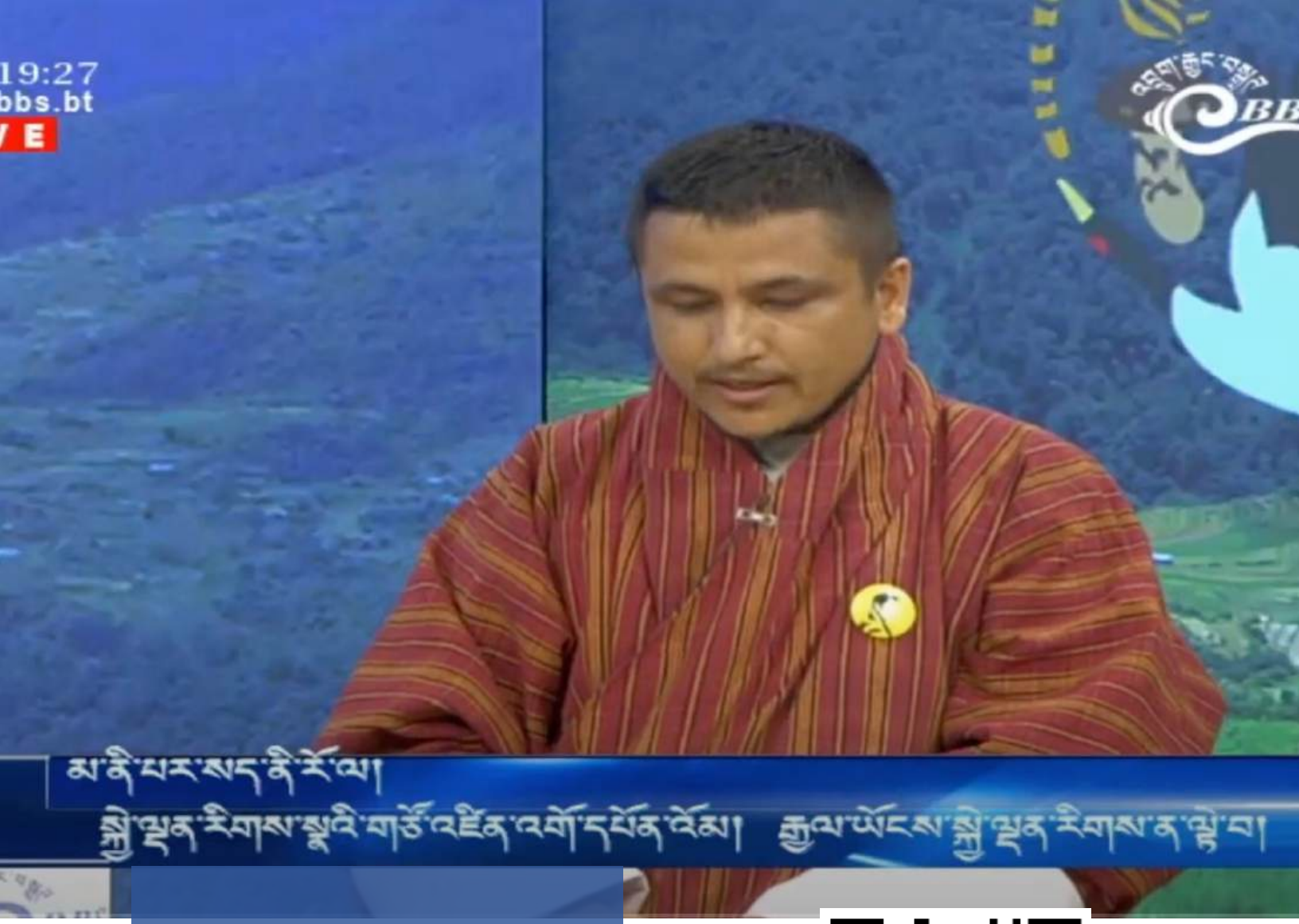
Currently, there are more than 2,300 registered users on the Bhutan Biodiversity Portal, with over 1,03,891 observations. The portal also has more than 283 documents and over 20 datasets related to the country's biodiversity.

22 MAY
INTERNATIONAL DAY FOR BIODIVERSITY

From Agreement to Action: Build Back Biodiversity

CELEBRATION OF THE INTERNATIONAL DAY OF BIOLOGICAL DIVERSITY:

International Day for Biological Diversity (IBD), with the theme "From Agreement to Action: Build Back Biodiversity", on 22nd May 2023 was celebrated at the Royal Botanical Garden, Serbithang in collaboration with the Department of Environment and Climate Changes and UNDP Bhutan.



PANEL DISCUSSION ON THE IMPORTANCE OF BIODIVERSITY CONSERVATION:

The program coordinated a panel discussion aimed at improving awareness on the importance of biodiversity conservation in Bhutan. The panel discussion was aired on the Bhutan Broadcasting Service (BBS).

Scan to watch the panel discussion

BUDGET OUTLAY FOR THE FISCAL YEAR 2022-2023

Table 4: Budget outlay for NBC for fiscal year 2022-2023 (in millions)

Budget outlay for NBC for fiscal year 2022-2023 (in millions)					
Budget (Nu)			Funding (Nu)		
Current (Nu)	Capital (Nu)	Total	RGoB	External Funding	Total
25.237	**6.745**	**31.982**	**25.237**	**6.745**	**31.982**

OVERVIEW ARTICLES

Nomadic Sheep Herders of Samtse

Beejai Darjee, Deki Gazum and Tshewang

Domestic sheep (Ovis aries) have played a vital role in human society for thousands of years, providing essential resources such as meat, skin, and wool. In Bhutan, sheep represent important animal genetic resources and are particularly rich in phenotypic diversity. The indigenous sheep population in Bhutan can be grouped into at least three distinct breeds.

The Jakar sheep of central Bhutan is a fine wool breed, smaller in body size with an adult body weight of 25–30 kg. Typically black in color with a characteristic white patch on its poll, Jakar sheep are found in Sephu, Phobjikha, Gogona areas in Wangdiphodrang, Upper Nubi in Trongsa, and in the Bumthang valley.

The Sakten sheep from Merak and Sakten valleys of Trashigang district are of medium body size, weighing 35–40 kg. These sheep have medium fine mixed wool of mostly white and brownish patterns.

On the other hand, the Sipsu sheep from the sub-tropical regions of southern Bhutan have a heavy body weight of 60–70 kg and tall stature. They exhibit longer and coarser wool fibers, a distinctive Roman nose, and short, tubular ears. Renowned for their prolificacy, Sipsu sheep often give birth to twins.

Migratory Sipsu sheepherding Tradition

Primarily consisting of migratory herds, Sipsu sheep depend on open grazing in alpine pastures during the summer and subtropical forests during the winter. An integral domestic animal for Ghallay and Gurung families, Sipsu sheep serve socio-cultural purposes. Herders rear sheep mainly to produce meat and wool for the communities to utilize and to produce wool products. Additionally, herders produce butter for domestic use, which is also sold when in excess. Sheep butter and cheese are considered delicacies and are believed to possess medicinal properties. Sheep butter, when applied to burns, is reported to heal wounds better than conventional therapy.

Journey to Zham pelri

Herders narrate that they have sustained this way of life for over six generations. In the past, there were records of more than 10 migratory sheep herders; however, now only 4 herds remain, using their income to acquire land, orchards, and houses for their families.Table 1: Present migratory herders

The migratory route to Zham Perli border from their village is a treacherous journey that takes about 10 days, with several stops along the way for sheep to graze. At each station, they halt for 7 to 30 days, allowing their sheep to graze. This practice not only supports the livelihoods of the herders and their communities but also aids forest regeneration, as sheep grazing contributes to the rejuvenation of vegetation. Notably, no deworming, vaccinations, or conventional medicine are administered to the sheep, and they are solely dependent on natural grazing.

Challenges and Resilience

In Bhutan, Sipsu sheep herding has drastically declined along with the sheep population. This decline can be attributed to multiple factors, such as depredation of sheep by wild dogs, bears, and leopards. Wild animal traps set by farmers also result in countless deaths of sheep and loss to the farmers. The difficulty in transportation of logistics (rations and other basic needs) during migration to alpine pasture makes sheep herding even more challenging. Furthermore, since the younger generation is not interested in the shepherding profession, the population of Sipsu sheep may further decline in the foreseeable future. However, despite these hardships, the sheep herders still manage to occupy the grazing land of Bhutan as of today. Each year, the only 4 remaining herders take turns occupying

the ZhamPelri pasture land for grazing their sheep for 21 days each during summer, ensuring that the land is preoccupied during this crucial season.

Conclusion

The nomadic sheep herders of Samtse exemplify the delicate balance between tradition, biodiversity, and the challenges of modern life. These herders, with their Sipsu sheep, are not only guardians of Bhutan's alpine pastures but also vital contributors to their communities and the security of the nation's border areas. Their resilience in the face of numerous challenges underscores their commitment to preserving their way of life while ensuring the sustainability of their natural environment.

Table 5: List of existing herders

List of existing herders			
Sl. no	**Farmer name**	**Gewog**	**Nos of sheep**
1	Lachu man Gurung	Norgaygang	218
2	Dal bdr. Gurung	Pemaling	300
3	Kharka Bdr. Gurung	Tendu	200
4	Shabir Ghalay	Namgaycholing	120

100 TREES SPECIES SEED CONSERVATION PROJECT IN IN PARTNERSHIP WITH MILLENNIUM SEED BANK, ROYAL BOTANICAL GARDENS, KEW, UK.

Kezang Tobgay, Nima Gyeltshen, Pem Zam, Sampa and Sangay Dema

The Global Tree Seed Bank Programme is a global initiative to safeguard some of the most threatened, rare and useful tree species. Specifically, the programme aims for the conservation of seeds to protect species from extinction, provide material for research and enhance knowledge around methods for successful species recovery and restoration of the plant's communities. The programme was initiated in 2014 and funded over several phases. It began with the establishment of the Global Tree Seed Bank at the Millennium Seed Bank (MSB), where seeds of approximately 11,000 tree and shrub species were already preserved. Since 2015, the MSB has collaborated with partner organizations from 35 countries across the globe to conserve more than 3,000 rare, threatened, and valuable trees.

Bhutan joined the initiative in March 2016 and implemented the first phase of the programme from 2016-2018. The first phase aimed to collect and conserve seeds of at least 100 native trees and shrub species in the National Seed Bank, complementing existing national efforts to conserve the genetic diversity of native plants from throughout the floristic zones of the country. During the first phase of the project, 160 accessions of seeds representing over 120 native tree species were collected and banked at the national seed bank, NBC. In 2019, the garden implemented the second phase of the project, which collected and banked 30 additional accessions of seeds from at least 25 native trees and shrub species from different floristics zones of the country (Figure 1 & Annex 9)

Currently, the garden is implementing the 3rd phase (2020-2024) titled "GW3-Tree Species Seed Conservation Project-III". It has the target to collect an additional 75 native woody species that are either Endangered, of Economic use or Endemic (EEE) and from different floristic districts to complement the national efforts to conserve the genetic diversity from all floristic zones of the country

The project also aims to build on and expand the achievements of the past two phases and has the following specific objectives.

1. To increase and diversify ex-situ conservation of biodiversity through seed banking of wild plant species;
2. To develop national capacity in seed banking of wild plant species for long-term conservation;
3. To contribute to global efforts to combat potentially catastrophic threats to human wellbeing by safeguarding wild plant diversity and enabling its sustainable use;
4. Build capacity in plant conservation assessments (Red Listing) and seed longevity testing;

5. Complete plant conservation assessments of 100 woody plant species, with a focus on Himalayan endemics.

In addition to seed banking, the seeds from temperate zones are also raised in the garden to diversify conservation methods, increase the diversity of the botanical garden and more importantly study the germination and growth status in the field.

Achievements of the 3rd phase

During this current project phase GW3, several expeditions were made for seed collection and pre-seed collection assessments. In general, a total of 87 accessions representing over 80 species of useful trees and shrubs were collected and banked at the National Seed Bank, NBC (Figure 2 & Annex 10).

The project also completed a draft assessment of 80 out of 100 target species and 75 species were further submitted to the IUCN Species Information System (SIS) for review by the IUCN committee (Annex 11) An additional 20 species were preliminarily assessed during the project workshop held in Thimphu in October 2023.

The following are the major training and workshops related to seed banking and conservation assessment conducted through the project support, either in person or online:

- Two weeks of technical training attachment for seed processing and seed banking at Millennium Seed Bank, Royal Botanic Garden, Wakehurst Place, UK (Jan- Feb 2020)
- Two weeks technical training attachment program focusing on seed conservation of exceptional species including orchids and covering aspects from collecting to processing, assessing and monitoring viability monitoring at Millennium Seed Bank, Royal Botanic Garden, Wakehurst Place, UK (January, 2023).
- Training on IUCN Red listing of Bhutan's native species (Virtual event in Jan-Feb 2021).
- Mapping course with participants from relevant agencies and stakeholders in-country and ex-countries (Online event in September 2023).
- Project workshop for the "NBC-Kew Tree Species Conservation Project - Phase 3", including review of a national Red List of the woody species of Bhutan in Thimphu, Bhutan (October, 2023).
- National workshop to review the draft assessment of 80 species, Thimphu, Bhutan (October 2023).

The project also provided opportunities for additional exploration and discovery of species. Through the tree seed collection and floral exploration expeditions, a team from the NBC rediscovered numerous species new to science, for example, *Spathoglottis jetsuniae, Chiloschista himalaica, Chiloschista densiflora*, *Chiloschista gelephuens*, *Bulbophyllum gurungianum* and *Bulbophyllum punakhaense*. The rediscovery of the endemic *Rhododendron pogonophyllum* after 84 years from central Bhutan also happened during one of the tree seeds collection expeditions. In addition to the seeds, the project contributed to building the herbarium collections as the project collected and deposited vouchers of the target species in the National Herbarium. The project also contributed to global data accessibility since the data of 100 tree species accessioned were deposited at Kew's BRAHMS data portal (Annex 8 & 9).

Project Challenges

The most common challenges faced during the implementation of the project include the following:

- Inaccessibility to target species sites due to rugged terrain and unpredictable natural calamities like landslides and flash floods.
- Lack of adequate knowledge of the seeding pattern of target species (seed gap year) and population status.
- Inadequate appropriate literature on germination protocol, seed collection season, nature of seed and seed handling of the target tree species of Bhutan.
- Difference in flowering and fruiting season of even the same species based on a specific locality, making it difficult to predict fruiting season based on species knowledge, thus involving repeated fieldwork.

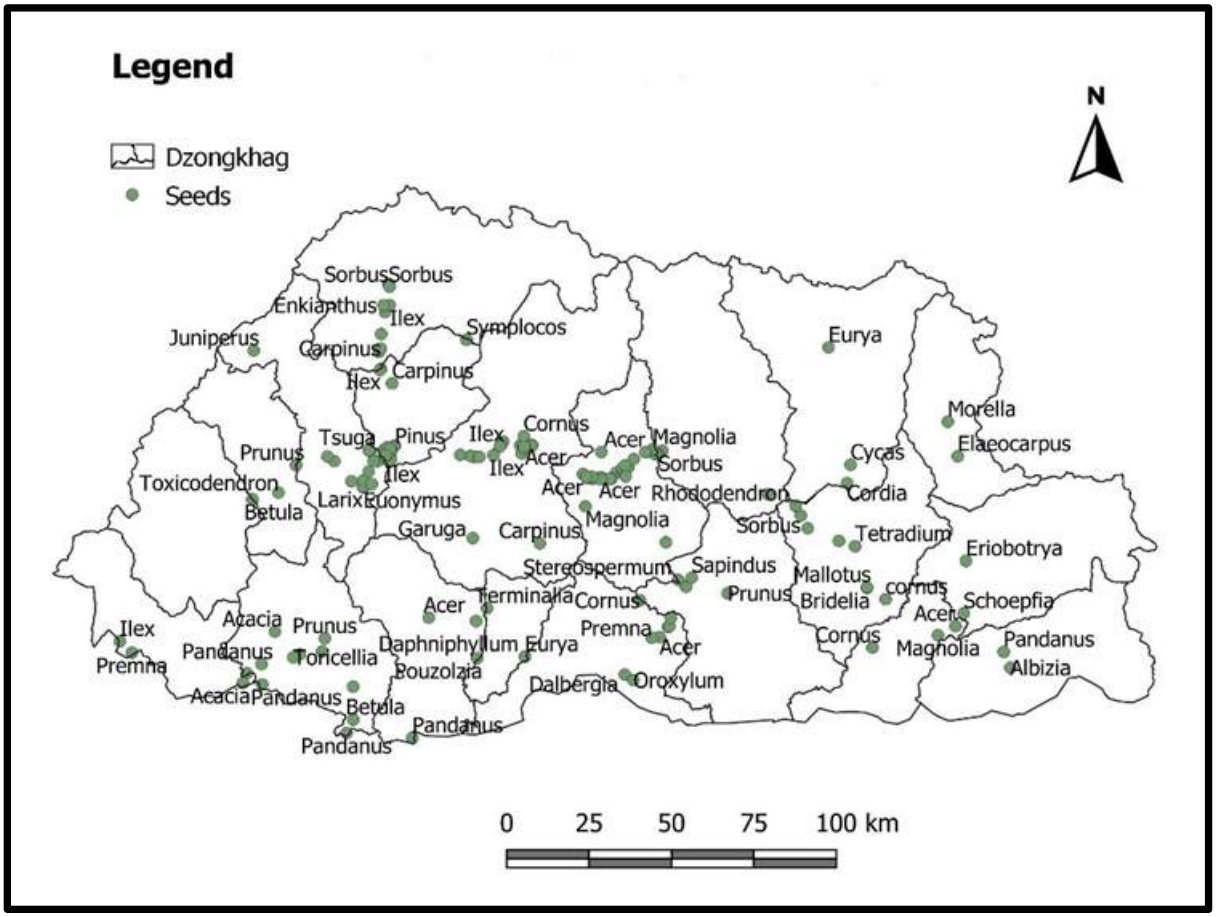


Fig 1: Green dots represent seed collection and survey sites (2016-2019)

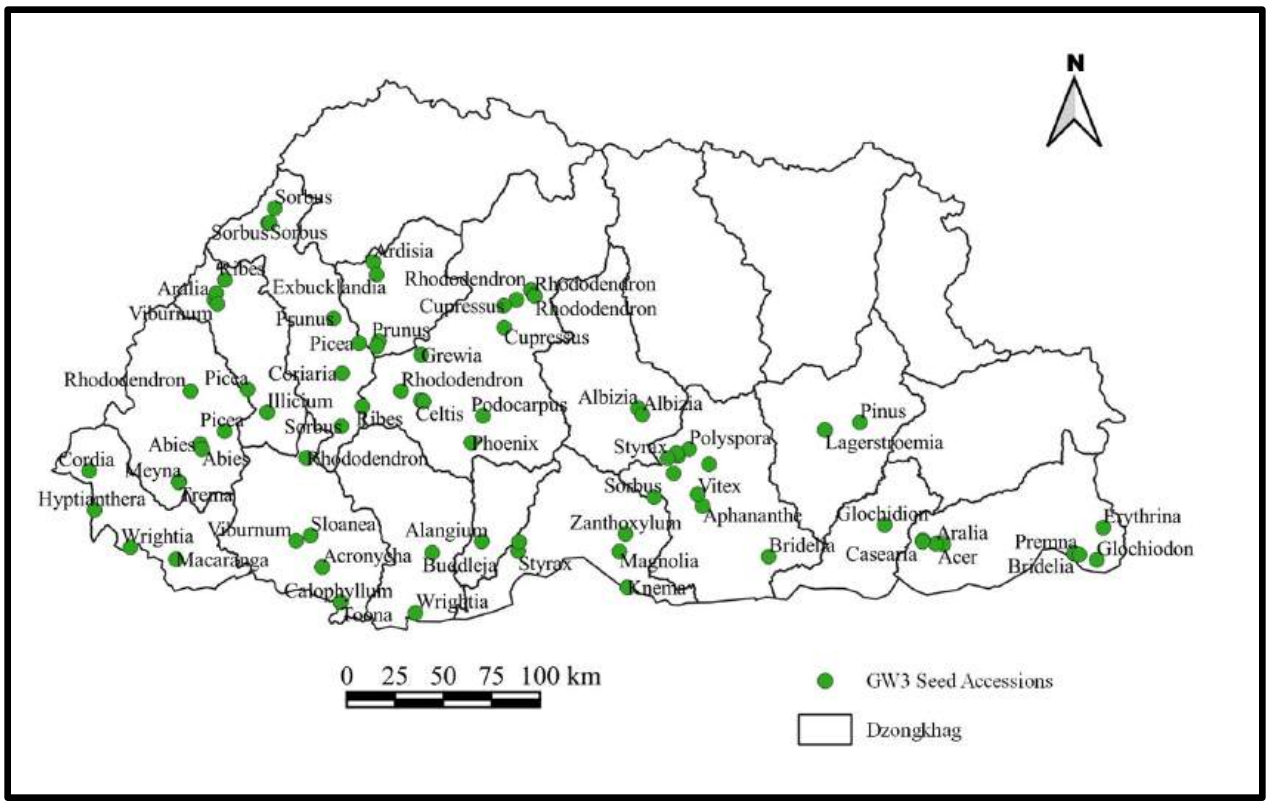


Fig 2: Green dots represents seed collection and survey sites (2019-2023).

REVIVING THE SAPHA PIG POPULATION: A BEACON OF HOPE IN ATHANG GEWOG

Deki Gazum, Beejai Darjee and Tshewang

Preserving the biodiversity of livestock resources is crucial for securing global food sources and combating poverty, especially as the world's population continues to grow. In this context, indigenous pigs, specifically the resilient Sapha breed of *Sus scrofa*, play a vital role in improving the livelihoods of numerous rural communities. Unfortunately, the population of the Sapha pig is declining, largely due to the intrusion of high-yielding exotic breeds. The Sapha pig, known for its toughness, resistance to diseases, and ability to thrive in challenging environments, holds significant value within the socio-economic and cultural fabric of rural communities in our country.

Fig 3: Sapha pig

Importance of Sapha Pig

The indigenous pigs of Bhutan play a multifaceted role in the lives of rural communities. From providing highly nutritious meat to serving as a source of financial security, these pigs are deeply woven into the fabric of Bhutanese culture. The decline of the Sapha pig not only threatens the livelihoods of rural communities but also puts at risk the genetic diversity that these hardy animals contribute to the nation's livestock resources.

Factors Contributing to Decline

The decline in the population of indigenous pigs, mainly the Sapha breed, can be attributed to several factors. The introduction of exotic pig breeds, societal pressures, religious disapproval, and challenges faced by smallholder livestock keepers all contribute to this decline. The prevailing farming practice that favors exotic breeds of European origin has notably reduced the population of indigenous pigs, witnessing a substantial 42% decrease from 2010 to 2020. This is a serious concern as the threat of potential extinction within the next decade looms large given the estimated count of a meager 500 Saphas in the entire country.

Conservation Efforts

Acknowledging the impending threat to the Sapha pig's existence, it is imperative to prioritize conservation efforts. NBC, in this regard, has taken the initiative in ex-situ conservation by cryo-preserving semen in the Genebank. However, collection of boar semen using conventional methods is not only risky but also labor-intensive and requires technical proficiency. An alternative approach is to collect semen surgically.

Fig:4: Cryopreservation of semen in National Genebank

In-situ conservation initiatives have been implemented to protect local pig populations and their habitats.

Udozorong in Trashigang and Gomdar in Samdrup Jongkhar were identified as Sapha conservation pocket areas for the sustainable utilization of local pigs in the past. However, after the decline in the population in these sites, the focus shifted to Athang Gewog in Wangdue, where three nucleus Sapha pig breeding farms have been established with funding support from the GEF small grants program.

Nucleus Sapha Breeding Farm at Athang Gewog

The Rukha-Samthang community in Athang Gewog has been identified as a potential site for the conservation and revitalization of the Sapha pig. This project, initiated in 2022 and completed in 2023, aimed to conserve the genetic pool of the Sapha population and promote sustainable utilization through niche product diversification and marketing.

Collaborating with the Dzongkhag Livestock Sector of Wangdue Phodrang, the project has successfully established a 20-sow level farm unit for three households. The funding not only supported the construction and supply of breeding stock but also supported awareness programs, training in animal husbandry, record-keeping, financial management, and product development.

Conclusion

The successful implementation of the nucleus Sapha breeding farm in Athang Gewog is a ray of hope for the conservation of Sapha genetic resources in Bhutan. As the Sapha pig finds a sanctuary in Athang Gewog, it not only secures the livelihoods of local communities but also safeguards a crucial component of Bhutan's cultural and genetic heritage.

EVOLUTIONARY PLANT BREEDING (EPB) PROJECT: USE OF GENETIC DIVERSITY AND EVOLUTIONARY PLANT BREEDING FOR ENHANCED FARMER RESILIENCE

Rinchen Dorji and Thirtha Katwal

Driven by modern plant breeding and seed systems, alongside the dynamics of global markets, agricultural production and food systems have undergone significant changes in the past decades. This transformation has led to a trend towards uniformity at the cost of reduced crop and genetic diversity. Unfortunately, this reduced diversity has negative repercussions, affecting the performance and resilience of farming systems and human health.

Farming communities are most vulnerable to the effects of climate change, facing challenges such as unpredictable and severe weather patterns, droughts and floods, low soil fertility, and land degradation. The resilience of these communities is dependent on the diversity present within their production systems and their access to seeds adapted to yield under changing weather conditions and with low inputs.

To address these trends and gaps and to confront the challenges, the PGR Program of the National Biodiversity Centre sought project funding support (grant) from the International Fund for Agricultural Development (IFAD) through Bioversity International (2018-2023) to implement the evolutionary plant breeding project (EPB). EPB is an alternative crop improvement strategy to enhance the resilience of farming communities. EPB involves the development of evolutionary populations with higher and stable yield under local farm agronomic conditions and various stressors, such as drought, pests, and diseases.

Evolutionary Plant Breeding

In Evolutionary Plant Breeding, seeds are sown and harvested in a mixed manner allowing for natural crossing among crops. This process results in continuous transformation in the genetic composition of the harvested crop population. This dynamic process fosters genetic diversity and adaptability within the crop population. Genotypes that are better suited to adapt to changing climate trends and local environmental and farming conditions - including soil fertility, pest and disease prevalence, agronomic practices, droughts, floods, temperature fluctuations, photoperiod, and more - will gradually become more prevalent due to natural selection, further supported by farmers' selection practices. As a result, crop populations evolve over time, continuously adapting to their environment and enhancing their resilience.

The adoption of the EPB approach was based on the successful experience from IFAD supported projects in Italy, Ethiopia, and Iran. These projects have shown that under low input conditions, evolutionary populations (EP) of wheat, barley, rice, and vegetables can achieve higher yields compared to landraces and improved varieties used in the same locations. Recent molecular studies on EPs of barley in Italy have confirmed their yield stability over time and under different agro-ecological conditions. Field observations from Italy, France, Iran also suggest that the EPs exhibit superior quality characteristics such as protein content, cooking quality, taste, reduced gluten intolerance. Additionally, EPs require fewer chemical inputs and are well adapted to organic farming practices.

Bhutan's Scenario

The EPB project focused on producing evolutionary populations on rice and beans, and participatory on-farm trials were carried out in Tsento (Paro), Kabjisa (Punakha), Tsangkha (Dagana), Mendrelgang (Tsirang),

and Singgye (Sarpang). The project was implemented with technical support from the NCOA in Yusipang)the Agricultural Research and Development Centres ARDC in Bajo and Samtenling and in collaboration with the Agriculture Sectors of Paro, Punakha, Dagana, Tsirang, and Sarpang Dzongkhag.

A total of 25 pure stand rice varieties were used to evaluate the yield, adaptation, and nutritional values while 19 bean varieties (including both dwarf and climbing types) were used in the trial. Agronomic data for both crops were collected and shared with international experts for analysis

Table 6: Composition of EPB mixture and Pure line varieties for Rice

Composition of EPB mixture and Pure line varieties for Rice			
Project site	**Crop**	**Variety name**	**Remarks**
Tsento (Paro)	Rice	Dumja Yusiray Maap 1 Jakar Ray Naab Yusiray Kaap 3 Khangma Maap	Pure line varieties
		Janam, Dumbja, Themja, Zhuchum, Shabjakuchum, Hungrel Maap	Dynamic evolutionary populations/mixture
Kabjisa (Punakha)	Rice	Dawa (local) Bajo Maap-1 Tan-tshering IR 64 Bonday (local) Nabja (local)	Pure line varieties
		Mixture of all above varieties	Dynamic evolutionary populations/mixture
Mendrelgang (Tsirang)	Rice	Gawri Mashinu Chottey Mashinu Wengkhar Ray Kaap II Attey IR 64	Pure line varieties
		Mixture of all above varieties	Dynamic evolutionary populations/mixture
Singgye (Sarpang)	Rice	Mansara Khamti Choti Masino Bhur Kamja 1 Bhur Raykaap 2	Pure line varieties
		Mixture of all above varieties	Dynamic evolutionary populations/mixture

Table 7: Composition of EPB mixture and Pure line varieties of Bean

Composition of EPB mixture and Pure line varieties of Bean			
Project site	**Crop**	**Variety name**	**Remarks**
Tsangkha (Dagana)	Dwarf Bean (Determinate)	Gew Bori	Pure line varieties
		Azuki	
		Sheto Potharay	
		Rajma Bean	
		Boshi Bori	
		Mixture of all above varieties	Dynamic evolutionary populations/mixture
Tsangkha (Dagana)	Climbing Bean (Indeterminate)	Kalo Chapto	Pure line varieties
		Kanchi	
		Pilow Bori	
		Gew Bori	
		Kalo Gew Bori	
		Mixture of all above varieties	Dynamic evolutionary populations/mixture
Mendrelgang (Tsirang)	Dwarf Bean (Determinate)	Pink Rajma	Pure line varieties
		Rajma	
		Gew Bori	
		Azuki Bean	
		Mixture of all above varieties	Dynamic evolutionary populations/mixture
Mendrelgang (Tsirang)	Climbing Bean (Indeterminate)	Pole Bean (White)	Pure line varieties
		Gew Bori	
		Pole Bean (Grey)	
		Boshi Bori	
		Kalo Gew Bori	
		Mixture of all above varieties	Dynamic evolutionary populations/mixture

Trial Data Collection and Results

The evolutionary plant breeding trial was carried out for both crops, rice and beans, during the cropping season of 2022. The EPB rice trial took place in four sites (Tsento, Kabjisa, Mendrelgang, and Singye), while the beans trial, which included both dwarf and climbing beans, was conducted in two sites, Tsangkha and Mendrelgang.

For the rice trials, the following data were collected for assessment and further analysis: mean plant height (PH) from 5 randomly selected plants each from all replications (cm); mean number of tillers (T) randomly selected from 5 hills each from all replications; mean panicle length (PL) selected from 5 random plants each from all replications; 1000 grain weight (GW); grain Yield (Yield) in kilograms per acre.

The data collected under these key parameters are presented in Table.

Table 8: Mean data for the key parameters of the EBP rice trial

Mean data for the key parameters of the EBP rice trial						
Site	**Entries**	**PH (cm)**	**T (No)**	**PL (cm)**	**GW (g)**	**Yield Kg/Acre**
Tsento (Paro)	Yusiray Kaap 3	85.87	6.0	20	39.3	1706.9
	Yusiray Maap 1	105.4	9.0	20.9	41.7	1830.93
	Mixture	116.1	11.0	21.5	42.9	1672.73
	Jakar Ray Naab	84.9	12.0	15.7	31.5	1447.3
	Dumbja	126.1	7.0	24.4	48.8	1640.53
	Khangma Maap	97.0	11.0	19.47	38.9	1774.37
Kabjisa (Punakha)	IR 64	125.0	18.0	23.66	19.49	2055.56
	Bajo Maap-1	138.53	14.13	21.51	19.48	2157.78
	Dawa (local)	119.53	14.53	23.47	18.95	2153.33
	Nabja (local)	115.87	13.46	23.2	21.42	2324.44
	Tan-tshering	130.8	13.8	22.93	20.14	1966.67
	Bonday (local)	122.07	14.53	22.27	17.81	2122.22
	Mixture	143.6	16.0	22.73	20.18	2111.11
Mendrelgang (Tsirang)	Attey	141.13	11.93	25.8	21.33	1264.33
	Chottey Mashinu	158.2	11.0	25.53	14.67	1355.68
	Gawri Mashinu	152.6	10.93	25.67	17.0	1524.33
	Wengkhar Ray Kaap II	104.13	10.66	23.87	20.33	1153
	IR 64	94.9	10.8	24.87	22.0	1060
	Mixture	140.73	11.47	24.67	22.67	1043
Singgye (Sarpang)	Mansara	116.0	7.0	22.23	10.78	873.3
	Khamti	124.17	6.67	24.97	10.29	873.93
	Choti Masino	146.0	6.0	23.03	10.93	717.3
	Bhur Kamja 1	91.43	8.0	20.9	10.33	732.8
	Bhur Raykaap 2	84.73	8.67	23.2	11.53	862.5
	Mixture	128.27	6.33	22.97	10.53	881.33

For the beans trial conducted during the cropping season of 2022, both climbing (indeterminate) and dwarf (determinate) types were utilized. Randomization and field maps were provided by technical experts from the Diversity International Headquarters, and the randomization process was facilitated using Digger software.

In the beans trial, data were collected for both climbing and dwarf types for assessment and further analysis. The following key parameters were recorded: mean number of pods per plant (NP) from 5 randomly selected plants; days to Maturity (DM); mean pod length (PL) of 5 randomly selected pods from 5 randomly selected plants; number of seeds per pod (S) from 5 pods randomly selected from 5 randomly selected plants; 1000 grain weight (GW) in grams; yield in kilograms per

acre. Comprehensive data for both crops have already been submitted to international experts for analysis. The mean data for the key parameters of the EBP beans trial are presented in Table 4.

Table 9: Mean data for the key parameters of the EBP beans trial

Mean data for the key parameters of the EBP beans trial							
Site	**Entries**	**NP (No)**	**DM (Days)**	**PL (cm)**	**NS (No)**	**GW (g)**	**Yield Kg/Acre**
Mendrelgang (Tsirang) Climbing Beans	Gew Bori	12.6	111.67	12.6	4.33	486.0	608.43
	Kalo Gew Bori	19.67	112.0	12.57	3.0	501.0	795.17
	Pole Bean (White)	26.33	106.33	16.53	8.33	243.0	721.63
	Pole Bean (Grey)	24.33	101.33	17.57	8.33	303.77	805.3
	Boshi Bori	22.33	106.67	21.97	9.33	364.0	955.0
	Mixture	19.67	112	17.37	6.0	415.33	857.0
Mendrelgang (Tsirang) Dwarf Beans	Rajma	8.4	104.67	9.97	4.33	377	169.93
	Gew Bori	7.0	118.33	6.2	3.67	378.33	133.5
	Azuki Bean	15.0	111.67	9.77	7.67	141.33	179.27
	Pink Rajma	10.77	108.67	10.73	6.0	292.0	206.4
	Mixture	9.33	108.33	9.93	6.0	313.67	211.33
Tsangkha (Dagana) Climbing Beans	Kanchi	21.67	109.33	10.67	6.0	308.33	339.9
	Kalo Gew Bori	19.0	110.0	11.67	5.13	400.0	248.2
	Pilow Bori	27.0	108.0	12.67	7.0	510.67	447.8
	Gew Bori	20.33	111.67	11.33	5.0	490.0	520
	Boshi Bori	61.33	108.0	15.5	6.0	251.0	430.3
	Mixture	18.33	112.0	14.67	6.0	348.33	785.1
Tsangkha (Dagana) Dwarf Beans	Sheto Potharay	10	109	13.33	6.33	239.0	230.27
	Rajma Bean	8.67	102.67	15.33	5.0	416.0	472.33
	Mixture	7.67	104.33	11.33	5.67	311.67	239.03
	Gew Bori	16.0	1130	13.67	6.0	362.0	247.93
	Azuki	12.0	109.67	10.33	6.33	217.0	182.9

SAFEGUARDING OUR DIVERSITY: THE ROLE OF ON-STATION FIELD GENEBANK IN EX-SITU CONSERVATION

Thukten Sherab and Choki Wangmo

The on-station field Genebank undertakes various activities each year to preserve biodiversity and ensure the availability of diverse seed resources. These activities include Seed Multiplication, Phenotypic Characterization, Regeneration of Repatriated Accessions, and Maintenance of Recalcitrant Crops. The quantity of samples cultivated annually for seed multiplication depends on demand and seeds gathered during germplasm exploration expeditions across the country.

A selection of crops with insufficient seed samples, such as Sorghum, Beans, Finger Millet, and Chilies, were collected from Lumang and Phongme Gewogs in Trashigang Dzongkhags. These crops were cultivated for multiplication to ensure the preservation of diverse seeds maintained by farmers. Additionally, repatriated crop samples, including Beans, Wheat, Barley, Buckwheat, Soya beans, and Cucumber, were successfully cultivated and multiplied. These crops, repatriated in 2014 and preserved in the Genebank, exhibited a 100 percent germination rate and adaptability to local environmental conditions.

The Genebank currently maintains a diverse collection of samples, including potato samples, Allium species, Chayote, Chive, Dioscorea species, and Colocasia samples, collected from various regions. Phenotypic data is collected whenever feasible, using the Bioversity International Descriptor list as a reference guide, and maintained in the Germplasm Bank Information System (GBIS). Pictorial descriptions are included to complement textual data, providing a comprehensive understanding of crop varieties.

The program aims to contribute to the global knowledge base of crop diversity by supporting research and innovation in agriculture. The methodology involves the selection of seed materials based on annual germplasm collection trips, field design tailored to crop varieties, and data collection using standardized descriptors. Repatriated seeds are grown in individual pots due to limited seed sample size.

In summary, the program's objectives include initial seed increase for conservation, phenotypic data collection, seed multiplication of repatriated samples, and maintenance of recalcitrant crops in the field Genebank. Through these efforts, the program continues to preserve agricultural biodiversity and support future crop improvement initiatives.

Table 10: List of crops cultivated for small sample multiplication:

Crops	Quantity/Samples/ Accessions	Remarks
Finger millet	1	From Lumang Gewog. Harvested and enough for packing for conservation
Sorghum	1	From Lumang Gewog. Harvested and enough for packing for conservation
Beans	2	From Phongmae Gewog. Harvested and enough for packing for conservation
Total	4	

Table 11: Repatriated Accessions

Repatriated Accession			
Crops	**Quantity/Samples/Accessions**	**Result**	**Place of Repatriation**
Wheat	24 Accessions	Out of 24 Accessions, 10 needs to be multiplied further	USDA, ARS, USA
Barley	5 Accessions	Still needs further multiplication	USDA, ARS, USA
Beans	12 Accessions	Completed (enough for active and base collection).	CIAT, Columbia
Soyabean	2 Accessions	Completed	AVRDC, Taiwan
Cucumber	2 Accessions	Only one accession adapted and successful in multiplication	AVRDC, Taiwan
Sweet Buckwheat	7 Accessions	Still needs further multiplication	Czech Republic
Bitter Buckwheat	11 Accessions	Still needs further multiplication	Czech Republic
Total:	**63 Accessions**		

Table 12: Recalcitrant Crops: On Station Field Genebank

Recalciltrant Crops: On Station Field Genebank			
Crop	**Species**	**No. of Samples**	**Remarks**
Potato	*Solanum tuberosum*	15	**On station continuation**
Garlic	*Allium sativum*	7	
Onion	*Allium cepa*	4	
Chives	*Allium schoenoprasum*	1	
Chayote	*Sechium edule*	3	
Yam	*Dioscorea* sp.	3	
Taro	*Colocasia esculenta*	3	
	Total:	**36**	

Result:

i. **Small Sample Multiplication**:
Small samples of Sorghum, Beans, and Finger Millet were successfully multiplied, producing sufficient quantities for packaging and conservation in the Genebank.

ii. **Repatriated Accessions**:

- Wheat and Barley: Out of 24 accessions grown, 14 wheat accessions had adequate seed quantity for conservation, while 5 barley and 5 wheat accessions require further multiplication.
- Sweet and Bitter Buckwheat: 7 accessions of sweet buckwheat and 11 accessions of bitter buckwheat were grown, but further multiplication is needed in the upcoming season.
- Legumes: 12 accessions of beans and 2 accessions of soya beans successfully completed multiplication and are ready for packaging.
- Cucumber: Although 2 accessions were grown, only one accession matured fully, while the other accession failed to adapt and mature.

iii. **Recalcitrant Crops**:

- Potato: 15 samples are planned to be planted in the coming season (February 2024).
- Garlic & Onion: 7 garlic and 4 onion samples were already sown and germinated, and they will be maintained in the field.
- Chives: Being perennial, chives will be maintained in the field Genebank.
- Chayote, Yam, and Taro: These crops will also be maintained in the field Genebank.

.

UNEARTHING BHUTAN'S RICH AGRICULTURAL HERITAGE THROUGH ON-FARM CROP DIVERSITY INVENTORY

Dr. Asta M. Tamang, Choki Wangmo, Wang Tshering, and Rinchen Dorji

Agrobiodiversity, particularly in the form of crops, has been the bedrock of our food and nutritional security since the dawn of civilization. Our farmers, the true inventors and guardians of seeds and planting materials, have cultivated, evaluated, selected, and perpetuated this crop diversity. Despite the existence of a formal seed sector, research and development system, the farmers' seed system remains the primary source of seeds. However, not much information exists regarding the state of crop diversity maintained by farming communities in the country. Therefore, it is imperative to conduct an inventory to document the crop diversity and its status for record-keeping and as a reference for future developmental plans.

The practice of on-farm conservation and maintenance of crops and varieties is of great importance, as it allows for natural evolution to occur within the fields. This process promotes the development of adaptive mechanisms, which in turn enhance resilience against climate change and contribute to the sustainability of farming systems. These adaptive traits, evolved in the field, are crucial in equipping crops to withstand varying climatic conditions, thereby playing a pivotal role in ensuring the longevity and productivity of our agricultural systems.

On-farm Crop Diversity Inventory in Kengkhar, Phongmey, and Lumang

The Plant Genetic Resources Program of the NBC conducted on-farm crop diversity inventory of Kengkhar under Monggar Dzongkhag, Phongmey and Lumang Gewog under Trashigang Dzongkhag on 7th, 9th and 12th of January 2023 respectively. It was carried out in collaboration with the respective Local Governments and Agriculture Extension of the respective Gewogs.

The Primary objectives of carrying out Crop Diversity Inventory was:

- To create education and awareness among the farming communities on the importance of maintaining crop diversity for food and nutritional security, building resilient farming systems, raw material for future crop breeding and improvement programs and enhancing livelihood.
- To assess the extent of crop diversity existing in the farmers' field.
- To identify crops and varieties and the donor farmer for germplasm collection.
- Awareness raising about NBC and the importance of conserving biodiversity in general.

During the inventory, representatives from various Chiwogs were educated about the concept of "Biodiversity, Agrobiodiversity," and more specifically, crop biodiversity and its significance for livelihood. They were also introduced to the current global trends and developments related to crop diversity. The participants were also informed about the government's plans to secure diversity in the Genebank and maintain on-farm diversity. This general education and awareness session was followed by an inventory of crop and varietal diversity cultivated by the farmers in the three respective gewogs. This exercise helped farmers understand and realize the current status and trends of crop diversity in individual households and the community at large. It was alarming to note that a significant amount of crop diversity has been lost, and more on the decline.

On-Farm Crop Diversity in Kengkhar Gewog

The on-farm crop diversity Inventory of Kengkhar Gewog was documented with the farmers representatives from

different agro-ecological zones within the Gewog. 30 farmers comprising 15 male and 15 female and Agriculture Extension as well as local government leaders of the Gewog participated in the program. The inventory exercise revealed a total of 68 crop and 132 varieties namely, Amaranth, Beans, Black gram, Cow pea, Chenopodium, Coriander, Dioscorea, finger millet, Foxtail millet, Ginger, Groundnut, Little millet, Maize, Mustard green, Perilla, Pumpkin, Sorghum, Soya bean, sweet buckwheat, tamarillo (Tree tomato).

On-Farm Crop Diversity in Phongmey Gewog

Similar to Kengkhar Gewog, participants for the on-farm crop diversity inventory from Phongmey Gewog were also represented from different villages and agro-ecological zones within the Gewog. The team from the PGR Program of NBC carried out an education and awareness session on the importance of biodiversity, focusing on crop diversity in particular and its benefits when maintained on-farm, as well as the impacts if it becomes extinct from the field.

Education and awareness program was followed by inventorying of crop and varietal diversity of the Gewog. The On-farm crop diversity inventory revealed the existence of a total of 55 crops 120 crop varieties including 23 Cereal crops, 9 varieties of legumes and rests all consisting of horticultural crops (Vegetables and Fruits). 57 collection samples of germplasm were collected by the team for conservation in the national genebank, which mostly consisted of cereals, legumes and vegetables. Additionally, several varieties of Yam (pink) and red sweet potato, 3 varieties of Chayote and 2 varieties of potato, one garlic and onion were also collected to maintain a recalcitrant crop at the station. Few varieties of paddy and local wheat were found to be extinct due to low yield, lack of labour, market and wild animals.

On-farm Crop Diversity in Lumang Gewog

the farmers' representatives were briefed on the importance and benefits of maintaining on-farm diversity in the field and its impacts if it becomes extinct from the field. The education and awareness, and the inventory exercise was attended by the local government leader, farmer representatives along with the Agriculture Extension of the Gewog. The On-farm crop diversity inventory revealed rich crop diversity maintained by the farmers in the gewog. The inventory recorded 52 different types of crops and 121 varieties.

Table 13 Summary of number of participants and crop diversity during inventory

Summary of number of participants and crop diversity during inventory					
Sl.no	**Dzongkhag**	**Gewog**	**No. of participants**	**No of crop diversity**	**No. of crop varietal diversity**
1	Monggar	Kengkhar	30	68	132
2	Trashigang	Phongmey	12	55	120
3	Trashigang	Lumang	23	52	121

The Diversity Wheel analysis was also conducted with the germplasm samples brought by the farmers to assess the status of cultivation and the level of threat of extinction of varieties. This exercise has helped farmers to further realize that the crop diversity has declined from their communities and need to conserve and utilize for their food and nutritional security.

BIODIVERSITY FOR OPPORTUNITIES, LIVELIHOODS, AND DEVELOPMENT (BOLD) PROJECT WORK PACKAGE 3- GENEBANK AND SEED SYSTEMS. BRIDGING THE GAP: STRENGTHENING CONNECTIONS BETWEEN GENEBANKS AND SEED SYSTEMS

Thukten Sherab, Dr. Asta M. Tamang, Rinchen Dorji, Wang Tshering, Ugyen Phuntsho, Choki Wangmo, and Dophala

BOLD (Biodiversity for Opportunities, Livelihoods, and Development) is a 10-year project to strengthen food and nutrition security worldwide by supporting the conservation and sustainable use of crop diversity. The project works with national Genebanks, pre-breeding and seed system partners globally. Funded by the government of Norway, BOLD is led by the Global Crop Diversity Trust in partnership with the Norwegian University of Life Sciences (NMBU) and the ITPGRFA.

The overall goal of the project is to strengthen food and nutrition security by supporting the conservation and use of crop diversity in Genebanks. One of the five work packages in BOLD, Genebanks and Seed Systems (WP3), led by NMBU, aims to strengthen the linkages between national Genebanks and other seed system actors.

Genebanks and Seed Systems

Genebanks serve as a rich source of diversity for farmers, researchers, and plant breeders to utilize in an effort to produce more and superior food, especially in light of challenges such as those posed by the climate crisis. However, they often prioritize the preservation aspects of their work. Genebanks should not simply serve as 'museums' where seeds are frozen in time. They should instead play an active role in the seed systems that farmers use to broaden their crop choices, which in turn supports robust production systems and diverse diets.

While some of the crop diversity in Genebank collections has been utilized by plant breeders and researchers, and some Genebanks have interacted directly with farmers, there is a greater need for active distribution of these precious resources. This is made complex by the fact that around 80% of seed exchanges in developing countries take place in the informal sector – such as local markets or exchanges between farmers – which is not sufficiently catered to by current research or formal plant breeding and seed systems. Currently, the diversity from Genebanks is predominantly directed through formal breeding. This involves the development of varieties, their release, seed multiplication, certification, and then distribution to farmers – a process that is quite extensive. The Genebanks and Seed Systems segment of the BOLD Project is dedicated to enhancing the connections between Genebanks and other elements of seed systems.

This initiative, spearheaded by the Norwegian University of Life Science (NMBU), will initially focus on determining the most effective ways to fortify the relationship between Genebanks and other stakeholders in seed systems in developing nations. The objective is to ensure that farmers have access to the crop diversity they require. This necessitates technical and institutional innovations that are specific to each context. These could vary from setting up new partnerships for seed multiplication between Genebanks and entities like farmer cooperatives or commercial seed companies, to reassessing the roles of Genebanks in relation to other organizations in the seed sector.

Objective

The primary objective of the research was to identify options (technical and institutional) for supporting Genebanks to proactively work with seed system actors as a sustainable pathway to enhance farmers' access to and uptake of crop diversity. The research findings will be used to design pilot projects that will be implemented in Phases 2 and 3. A research report will be prepared summarizing the findings. This will be used to develop and publish peer audience -reviewed journals to reach out to a broader and to influence policies and actions.

Country Workplan

The Project is collaborating with partners in Bhutan, Ecuador, Tanzania, and Uganda to comprehend their seed systems. This involves analyzing existing and potential channels for providing farmers with access to a broader range of crop diversity, both directly and through plant breeding and seed production initiatives. NMBU, along with its network of partners and collaborators, will utilize this knowledge to create models of Genebank engagement that can be used and adapted by other countries.

The goal of WP3 is, therefore, to investigate both existing and potential ways to link Genebanks to seed systems used by farmers and to support innovative pilot efforts to test these. Bhutan is selected as one of the four countries to implement WP3. In this joint venture, NMBU and NBC, explored different, complementary ways in which farmers can readily access crop diversity by developing models for strengthening collaboration between Bhutan's Genebank and other seed systems actors in the country. Provided continued funding, the models identified in the research phase will be tested in Phase 2 (2025-2027) and Phase 3 (2028-2030) of the BOLD project. This will be done through support for innovative pilot efforts to actively deploy crop diversity to farmers by engaging national seed system actors in the four partner countries. Lessons learned from the WP3 will be broadly disseminated regionally and internationally through scientific publications, learning events, and other communications strategies.

Fig 5: Conceptual framework identifying five factors to describe seed systems. The three in light green are basic "functions" that seed systems deliver. These are activities that seed system actors are engaged with. The two in dark green (seed governance and food system drivers) are broader contextual factors that influence how the seed system functions. Graphic © NMBU.

Methodology

A participatory research approach was used to engage Genebanks and seed system actors in analyzing current and potential pathways for deploying diversity to farmers. Doing so will help build mutual awareness between Genebanks and seed system actors, identify context-specific institutional and technical changes to link Genebanks with seed system actors, and motivate key actors to engage in pilot projects. The main components of the research include:

i. National seed system characterization: National seed systems were characterized by identifying key actors and their roles/mandates, activities, and performances as well as the legal/institutional frameworks influencing farmers' access to seeds and crop varieties.

ii. Local seed system characterization: Local seed systems were characterized by mapping and

assessing the seed systems farmers use, seed sources, including varietal preferences, seed use, exchange, and sale as well as these systems' seed security outcomes.

iii. Analysis of potential Genebank-seed system linkages: Practical ways of linking Genebanks with selected seed system actors will be identified during the research process and used to develop a draft "Theories of Change" to be further developed and validated by seed system actors in a roundtable workshop.

National Seed System Characterization:
Bhutan Conducted key informant surveys with the National seed system stakeholders starting with the Genebank, breeding programs of ARDCs, ARED, NCOA, national seed certification services (BFDA), Ministry of Agriculture and Livestock, seed companies, NGOs, and farmers. Prepared a study report on national seed system characterization.

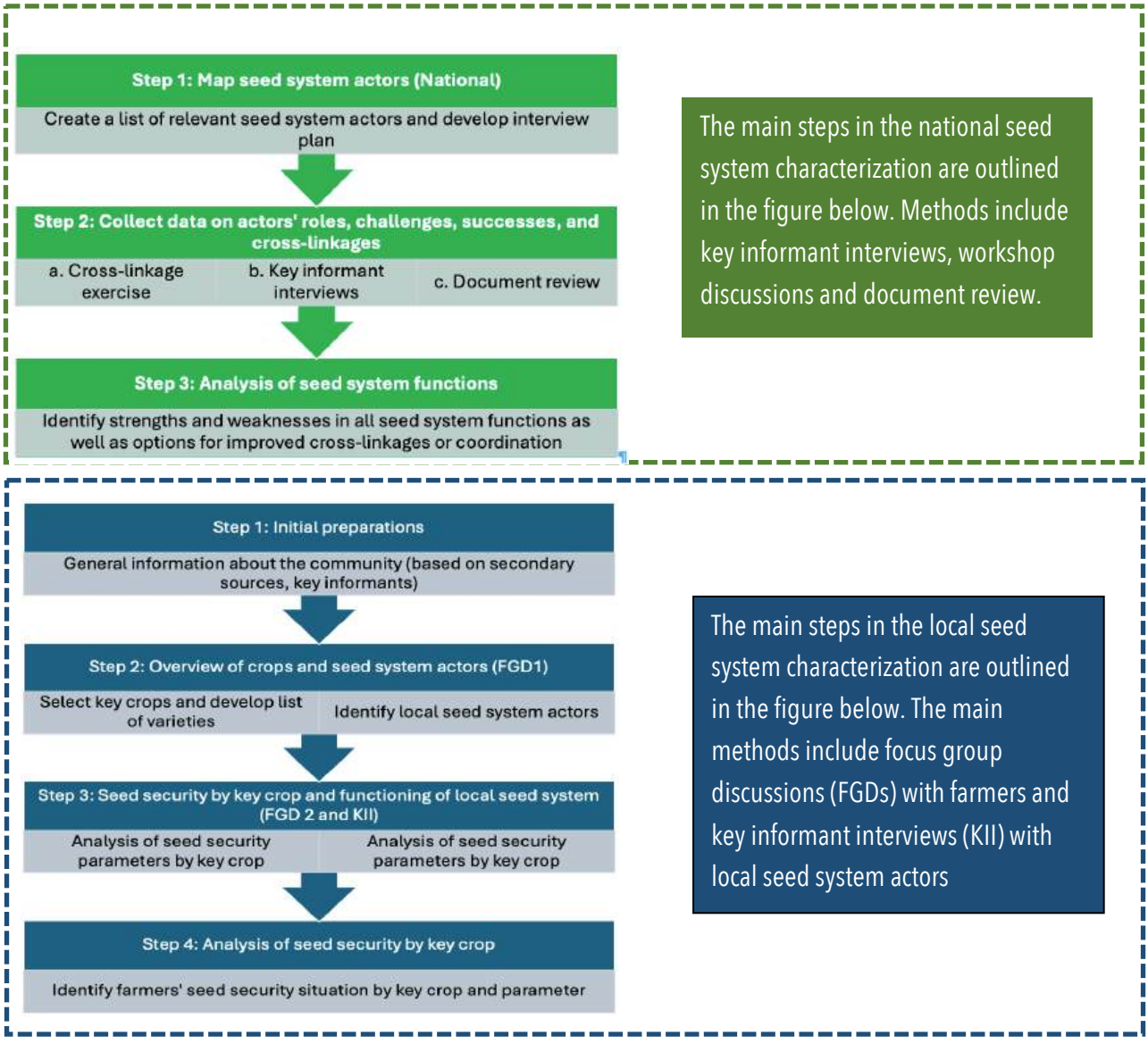


Fig 6: Schematics of steps involved in the national seed system characterization

Table 14: Key Informant Interview (KII) conducted with various Institutions

Key Informant Interview (KII) conducted with various Institutions		
Sl. No	**KII* Tool Kit**	**Institution Interviewed**
1.	KII Checklist #1- Farmers Group engaged in seed systems	• Farmers group of Community Seed Bank, Bumthang • Registered Seed Growers Group of Tang Gewog, Bumthang • Farmers of Dungsam community Seed bank, Dewathang, Samdrup Jongkhar
2.	KII Checklist #2- Agro-dealers and Grain Traders	• Food Corporation of Bhutan (FCB), Phuntsholing
3.	KII Checklist #3- Local Organizations supporting farmers	• Samdrup Jongkhar Initiative (SJI), Samdrup Jongkhar
4.	KII Checklist #4- Agro-processors or distributers	• Bhutan Agro-Industries Limited (BAIL), Thimphu
5.	KII Checklist #5 – National and International Genebank	• National Biodiversity Centre (NBC), Thimphu
6.	KII Checklist #6- National and International Breeding Programs	• Agriculture research and development Centre (ARDC)- Yusipang, Bajo, Samtenling and Wengkhar. • Agriculture Research and Development Sub-Centre (ARDSC)- Tsirang, Lingmethang and Khangma.
7.	KII Checklist#7- Private and Public Seed Companies/ Seed Production Units	• National Seed Centre (NSC), Paro, NSC Regional Centre for East, Trashi Yangtse, Bhutan Alpine Seed, Paro and Reva seeds, Thimphu.
8.	KII Checklist #8- National agricultural extension agencies or programs	• Department of Agriculture (DoA) and Extension officer/supervisor of Orong, Phuntsothang and Bongo
9.	KII Checklist #9- National regulatory agencies responsible for variety release, seed certification, and seed marketing	• Bhutan Food and Drug Authority (BFDA).
10.	KII Checklist #10- National authorities engaged in seed policy formulation and coordination	• Legal Division, MoAL.

11.	KII Checklist #11- National or International Organizations supporting seed systems	• Tarayana Foundation

Local Seed System Characterization

Conducted FGDs with farmers separately in each Gewog/community/village and follow up with key informant interviews with experts working in local breeding/adaptation, extension, and service-providing institutions. This activity will also be followed by a key informant survey with other seed system actors, such as seed producers and distributors (private, public, and community-based actors) operating in the study sites. Data will then be analyzed, and a study report of local seed system characterization will be produced and submitted to NMBU.

Table 15: Focused Group Discussion (FGD) conducted in Bhutan

Focused Group Discussion (FGD) conducted in Bhutan		
Sl. No	Focused Group Discussion (FGD) Toolkit	FGD Location/site conducted
1.	FGD 1 – Overview of Crops and Seed system FGD 2 – Seed security by Key crops (3 key crops)	Tsento Gewog, Paro Samar and Sangbay Gewog, Haa Bongo Gewog, Chhukha Kabjisa Gewog, Punakha Tsangkha Gewog, Dagana Mendrelgang Gewog, Tsirang Singye Gewog, Sarpang Choekhar Gewog, Bumthang Bumdeling Gewog, Trashi Yangtse Gomdar, Orong, Wangphu and Phuntshothang Gewog, Samdrup Jongkhar.

Table 16. Seed security parameters and definitions. Based on FAO (2016).

Seed security parameters and definitions. Based on FAO (2016).	
Parameter	Definition
Varietal Suitability	Extent to which available crop varieties are preferred and adapted to farmer conditions
Seed Availability	Quantity of seed available (from all sources) is sufficient to meet farmers' needs
Seed Access	Farmers have the means to obtain seeds through cash, loan, barter, or gift. It can also include having access to information about the seed and where to obtain it.
Seed Quality	Quality attributes such as germination, physical purity, moisture content, seed health, and – for some crops – genetic/varietal and physical purity are acceptable to farmers.

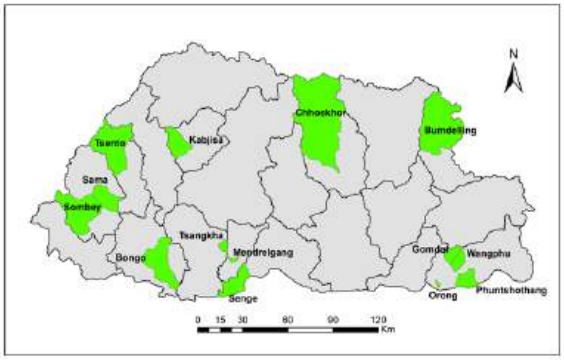


Fig 7: Sites for FGD conducted

Justification for Seed System Research in Bhutan:
Bhutanese seed system assessment at the local and national levels is at the core of the project's research activities to identify farmers' needs and preferences and analyze them against institutional and policy practices at the national level. To this date, a national seed system assessment has not been conducted, which the BOLD project can use as a baseline for practical project implementation in Bhutan. This will be done through key informant interviews and focus group discussions with farmers in select agroecological areas. The outcome of the research will be used to plan a practical project to strengthen Bhutan's seed system between 2025 and 2030.

Analysis of Potential Genebank-Seed System Linkages:
An analysis of technical and institutional gaps in linking genetic resource conservation (ex-situ and on-farm) with national seed systems will be examined. Specifically, governance and coordination issues in plant genetic resource conservation, plant breeding/variety improvement, seed production, and seed dissemination will be analyzed based on information collected and potential linkages identified and proposed. This will be validated through consultation and collaboration with key seed system actors, including the Genebank and beneficiaries. This will be done at a workshop with a wider audience to get feedback. The potential linkages identified will be the basis for drafting a theory of change and proposing intervention strategies during the pilot project phase of WP3.

Conduct Roundtable Meetings/workshops to Validate Assessment Findings and Co-develop Intervention Strategies:
Invite previous workshop attendees and new stakeholders to validate a theory of change and identify intervention strategies. Develop a report and a technical/policy brief based on the above research on actual and potential Genebank and seed system linkages in Bhutan.

Develop project proposals to deploy Genebank materials to farmers:
Based on the validated theory of change and identified intervention strategies, a call for working proposals will be forwarded to selected stakeholders. The submission(s) will be reviewed, and a proposal chosen for the pilot project to be implemented during phase II of the BOLD project in Bhutan.

CAPACITY BUILDING AT THE BIOPROSPECTING LABORATORY

Barbara Meurer, Jamyang Choden, Kezang Wangchuk, Leki Wangchuk, Karma Dema Dorji

The Bioprospecting Program has in recent years completed a comprehensive documentation of traditional knowledge associated with the use of medicinal and food plants in Bhutan. Many of Meurerants were collected and extracted by the Bioprospecting team giving rise to a collection of over 300 extracts housed at the Bioprospecting Laboratory. The time has now come to strengthen the capability to analyze these extracts to determine the chemicals that endow these plants with their amazing activities and health benefits. Phytochemical research explores the type and abundance of bio-actives in medicinal and food plants opening up more opportunities to develop new products under the well-established ABS Regime.

A laboratory facility at the NBC was already established in 2012 providing essential capacity for plant drying, maceration, and extraction, as well as essential oil distillation. The analytical capabilities in the laboratory were rarely used and much of the analytical work was outsourced to international partner organisations. To enable the next phase of exploring the use of medicinal and food plants in Bhutan, the NBC successfully recruited a mentor for the Bioprospecting Laboratory in 2023 to train staff in the basic methods of phytochemical analysis and expand equipment capabilities.

Dr. Barbara Meurer joined the Bioprospecting Group from the Australian Volunteers Program in May 2023. Barbara is a natural products chemist with extensive professional experience in academic and commercial research in the food and biotechnology sectors in Europe, the US, and Australia. Barbara will work with the Bioprospecting team for one year. The capability strengthening is supported by the acquisition of new small equipment items that have been made possible by the Chanel fund.

The focus for the capability expansion in the Bioprospecting Program will be to establish 1) Phytochemical profiling and quantitative analysis of plant extracts and 2) Compound isolation from crude plant extracts. This involves setting up the equipment and procedures, training staff in the Bioprospecting Team in the use of these phytochemical methods, and

Fig 8: Australian volunteer, Dr. Barbara Meurer, on her first day at the NBC. International Biodiversity Day on 22 May 2023.

preparation of Standard Operating Procedures (SOPs) and Work Instructions for each step. Dr. Barbara started with an extensive review of phytochemical literature on ten plants that the Bioprospecting Team has prioritized for phytochemical exploration and product development.

The implementation of the new methods and procedures will mark a significant step forward in the exploration of medicinal and food plants: It will enable the

Bioprospecting team to determine what the important compounds are in a plant extract, how much is present, what are the potential health benefits of these compounds and what are the conditions that influence the abundance of these compounds. This information adds substantial value because it helps to provide consistency, high quality, and scientific evidence of effectiveness to medicinal, nutraceutical, or cosmetic products made from Bhutanese plants.

Another aspect of Dr. Barbara's volunteer assignment is to assist with the planning of future capability development and the introduction of new phytochemical technologies that will make the profiling and characterization of plant extracts more efficient. On the top of the wish list is the introduction of a plate reader to conduct bioassays monitoring various pharmacological activities of plant extracts and pure phytochemical compounds. Followed by the introduction of LC-MS (Liquid Chromatography coupled with Mass Spectrometry), a technology that is nowadays widely used to characterize complex mixtures of metabolites. This state-of-the-art technology is expensive and will involve the submission of grant applications. In the meantime, the BP team aims to access LC-MS through the establishment of collaborations with international academic research institutions.

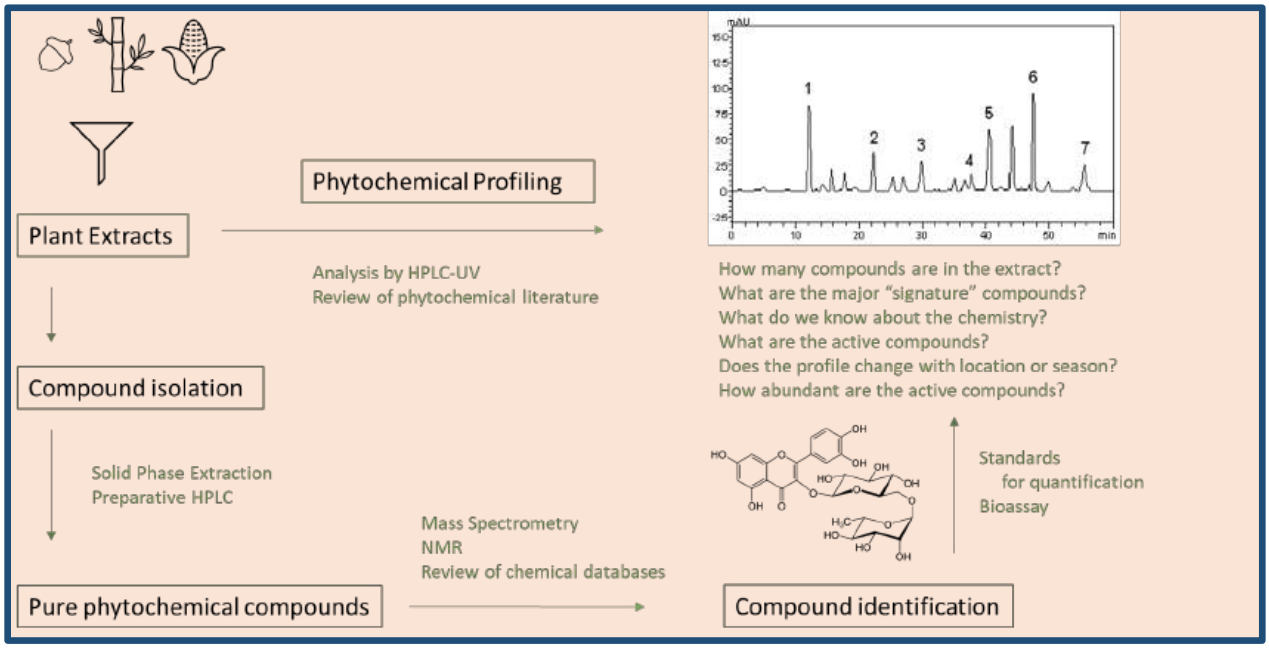


Fig 9: Outline of phytochemical analysis workflow: phytochemical profiling and compound isolation are the major steps in phytochemical analysis.

REVIVING PANGTSE MAKHU AND INVESTIGATING ITS HEALTH BENEFITS AND NUTRITIONAL VALUE

Leki Wangchuk, Barbara Meurer, Kezang Wangchuk, Jamyang Choden, Karma Dema Dorji

The Bioprospecting and ABS Program (BP & ABS), with funding from the UNDP Small Grant Program (SGP) embarked on a project to revive the dying art of Pangtse Makhu (oil from the seeds of *Symplocus paniculata*) production in Petari Chiwog under Kabjisa gewog in Punakha Dzongkhag. The following is a sample of the nutritional information of Pangtse Makhuroduct as a high-value, traditional cooking oil in Bhutan and in export markets in the future. The project started on 25th October 2022 with the formation of a 32-member Community-Based Natural Resources Management group, named 'Petari Pangtse Zhinchong Detshen', who was interested in the sustainable management of *Symplocos paniculata* (Pangtse) and revival of oil production (Pangtse Makhu)

The project also aimed to improve oil extraction method to ensure the safety, shelf life and consistency of the product quality. During the first year of the project, the BP team investigated processing methods using oil-pressing equipment. Inspired by the manufacturing process of olive oil, the project aims to explore additional techniques to produce a high-value cold-pressed virgin Pangtse oil and refined Pangtse oil.

Phytonutrient analysis of Pangste Makhu

The additional objective of the project was to investigate the health benefits and nutritional value of the product and communicate these to the consumers. The preliminary analysis shows high amounts (77%) of healthy omega 3-6-9 unsaturated fatty acids in Pangtse Makhu. This is in the same range as olive oil, which is valued by consumers for its significant health benefits. It also contains high amounts of vitamins A and E and beta-carotene. The following is a sample of the nutritional information of Pangtse Makhu.

Table 17 Phytonutrient analysis of Pangtse makhu

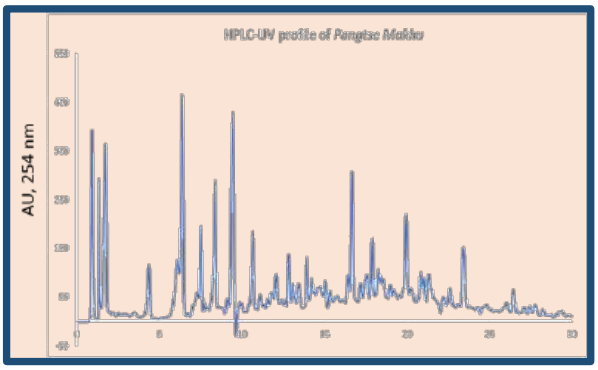
Phytonutrient analysis of Pangste Makhu	
Nutrition Information **Serving size: 1 tbsp (15 mL)**	**Amount per serving**
Total energy	130 kcal
Total fat	14 g
Saturated fat	3.5 g
[Unsaturated fat	77%
Omega-3	95 mg
Omega-6	2.75. g
Omega-9	6.66 g
Cholesterol	0
Protein	0
Total carbohydrate	0
Dietary fiber	0
Sugars	0
Sodium	0
Vitamin A	24.11 mg
Beta-carotene	144.63 mg
Vitamin B1	0
Vitamin B2	0
Vitamin D	0
Vitamin E	0
Calcium	1.13 mg
Iron	0.03 mg
Potassium	0
Tested by Central Laboratory (Thailand) Co. Ltd.	

As the deep green-yellow colour and a nutty aroma of Pangtse Makhu are the indicators for the presence of potential antioxidants and other phytonutrients, the preliminary HPLC analysis of the phytochemical profile of Pangtse Makhu was carried out at the Bioprosecting lab of NBC and the profile is similar to that of olive oil, which also contains trace amounts of over 30 different

components such as tyrosol, which are potent antioxidants.

The future priority activities of the project is to select the best oil extraction technique, confirm the identity of the major phytochemicals found in Pangtse Makhu profile and improve product development and marketing.

Fig 10: HPLC-UV profile of Pangtse Makhu – the peaks in the chromatogram indicate the presence of over 25 minor phytonutrient compounds in the oil



HANDING OVER THE NATURAL PRODUCT DEVELOPMENT FACILITY AND ZHINOR PRODUCTION TO DZEDOKHA PHACHENG DETSHEN IN LOGGCHINA GEWOG

Barbara Meurer, Jamyang Choden, Kezang Wangchuk, Leki Wangchuk, Karma Dema Dorji

The 8th of June 2023 marked an important milestone in the successful implementation of the ABS Agreement between the Dzedokha community and the NBC in partnership with UNDP. Initiated in 2014, this ABS agreement focused on the development and commercialization of the ZHINOR products made from the native wild ginger species *Zingiber cassumunar* using traditional local knowledge and research expertise from the Bioprospecting team at the NBC.

The final milestone in the implementation of the ABS agreement was the formal handing over of the Natural Product Development Facility and ZHINOR production to a local entrepreneur (operator from the community group), who will operate the facility on behalf of the Community group (Dzedokha Phancheng Detshen). The operator of the Natural Product Development Facility will pay 8% of the total net profit generated annually to the Dzedokha Phacheng Detshen social enterprise and 2% of the total net profit generated to the Bhutan Access and Benefit Sharing Fund (BABS Fund) managed by the NBC for future investment into sustainable utilization of the natural resources of Bhutan. The group now handles the whole value chain of ZHINOR product manufacturing, encompassing cultivation of *Z. cassumunar*, distillation of oil, formulation of the ZHINOR brand balm and liniment, and finally the marketing of the products. The products have been widely available in Bhutan for a couple of years and plans to take to the international market are under way.

The handing over ceremony was attended by the Program Director of the NBC, Dr. Karma Dema Dorji, and the Gewog Administration (Gup, Mangmi & Gewog Administration Officer). The Gewog Agriculture Extension Officer officially handed over the Natural Product Development Facility to the Dzedokha Phachen Detschen and the operator Mr. Hari Ram (operator).

The NBC is the National Focal Point for the Nagoya Protocol and its implementation through ABS Agreements. Dzedokha is located in the southern part of Bhutan under the Loggchina Gewog. The gewog consists of 5 Chiwogs with a population of little over 2,500. Dzedokha Chiwog was chosen as the site to implement the project based on Participatory Rural Appraisal.

In the past, the main source of income for the Dzedokha community was from citrus, cardamom, and ginger. However, due to the emergence of pests and diseases affecting the cultivation of citrus and cardamom, the only source of stable income was reduced to ginger. The wild ginger, locally known as "Phachang" has traditionally been used by the local communities of Loggchina to alleviate joint and muscle pain. Phytochemical analysis of the essential oil revealed valuable compounds responsible for the analgesic, anti-inflammatory, and anti-spasmodic activity.

UNDP supported a product development project, that included the sustainable cultivation of wild ginger and the formulation of a massage balm and liniment. The farmers' group and social enterprise

'Dzedokha Phachang Detshen' consisting of 49 members was established in 2015 to develop products from the local ginger and provide a new source of income for the local community. The ZHINOR brand was created from the Dzongkha word "zhidey-gi-norbu" which means, a precious jewel for peacefulness. The two products under ZHINOR brand were launched in 2018.

The communities involved in the ZHINOR manufacturing were trained in sustainable cultivation, processing, product development, packaging, and marketing. The handing over of the Natural Product Development Facility built at Dzedokha village and its social enterprise marks the full implementation of the ABS agreement. This initiative serves as an excellent example of sustainable management of traditional knowledge and associated genetic resources for generating new sources of income for small rural communities.

WORKSHOP ON RAISING AWARENESS FOR THE BIODIVERSITY ACT OF BHUTAN 2022, BIODIVERSITY RULES AND REGULATIONS 2023, AND STANDARD OPERATING PROCEDURES (SOP)

Kezang Wangchuk, Jamyang Choden, Leki Wangchuk and Karma Dema Dorji

The Biodiversity Act of Bhutan 2022, a revised version of the Biodiversity Act of Bhutan, 2003, was passed by the 7th session of the third parliament and received Royal assent on 15 July 2022. Subsequently, in February 2023, an executive order was issued to implement Biodiversity Rules and Regulations 2023 within the Biodiversity Act of Bhutan 2022.

To ensure smooth enforcement of the new rules and regulations, a sensitization program was carried out for enforcement officers at the main entry and exit points of Bhutan. This program took place in Thimphu on 21st April 2023, in Paro from 27th to 28 April 2023, and in the southern regions of Bhutan from June 12th to June 19th, 2023.

Table 18 Number of participants in different places

Number of participants in different places		
Place	**Participants**	**Date**
Thimphu	14	21st April 2023
Paro	18	27-28th April 2023
Samdrup Jongkhar	24	12th June 2023
Gelephu	15	14th June 2023
Phuentsholing	17	16th June 2023
Samtse	16	19th June 2023
Total	**104**	

The participants in these sensitization programs represented a range of organizations, including the Integrated Check Post (ICP), the Department of Revenue and Customs (DRC), the Department of Immigration (DoI), the Food Corporation of Bhutan (FCB), the Department of Forest and Park Services (DoFPS), Bhutan Post, Druk Air, Dalsey Hillblom Lynn (DHL), the Department of Media Creative Industry and Intellectual Property (MoICE), the Department of Air Transport (DoAT), Bhutan Airlines, and the Bhutan Food and Drug Authority (BFDA). In total, 104 participants attended the sensitization workshop.

During these workshops, the participants were provided with information on various aspects, including the historical context and relevance of the Biodiversity Act, the specifics of the Biodiversity Act of Bhutan 2022, the Biodiversity Rules and Regulations 2023, the roles and responsibilities of enforcement officers, and the issue of invasive species. The participants were also sensitized on the different mechanisms of conservation and utilization of biological resources under the Access and Benefit Sharing Regime and on the plant variety protection and farmer's rights under the Sui Generis system in the Biodiversity Act of Bhutan 2022.

The sensitization workshops was financially supported by the Evolutionary Plant Breeding Project funded by the International Fund for IFAD through Biodiversity International which is implemented by the NBC.

JOURNAL ABSTRACTS

One New Species and Four New Records of *Begonia* (Begoniaceae) from Bhutan
Phub Gyeltshen, Mark Hughes, Pema Zangpo, Sherab Jamtsho, Tashi Phuntsho, Tshering Choden, Cheten La & Tandin Wangchuk

Begonia menchunaensis P.Gyeltshen & M.Hughes is described from the cool broadleaved forest of Punakha District in Bhutan. It is assigned to *Begonia* sect. *Diploclinium* because it has a tuberous habit and bifid placentae, and is allied to *B. picta*. Based on its restricted distribution, *Begonia menchunaensis* is assessed as Critically Endangered under the IUCN Red List Categories and Criteria. *Begonia picta*, *Begonia rex*, *Begonia roxburghii* and *Begonia xanthina* are reported as new records for Bhutan.
Published in *Published in Edinburgh Journal of Botany 79: 1–18, 2022. DOI: https://doi.org/10.24823/EJB.2022.1922*

A New Early Flowering Spotted *Chilochista* (Aeridinae) from Bhutan
Bhakta Bdr. Ghalley, Stig Dalström, Laxmi Sagar & Mer Man Gurung

A new species of *Chiloschista* from a restricted area in Bhutan is described and illustrated. It is featured with colour photos and a map showing its only known locality. The new species is compared with the other three spotted *Chiloschista* species from Bhutan: *C. densiflora*, *C. gelephuense*, and *C. himalaica*, which have similarly coloured flowers, but different lip structure and the differences are explained and illustrated.
Published in Lankesteriana, 22(2): 117–122, 2022.
DOI: http://dx.doi.org/10.15517/lank.v22i2.51751

Nineteen new records of plant species including two new genera recorded from the Bhutan Himalayas
Rinchen Dorji, Phuentsho Phuentsho, Kencho Dorji, Sangay Tshewang, Phuntsho Wangdi, Kezang Tobgay, Nima Gyeltshen & Choki Gyeltshen

Through the collection of herbarium specimens in Bhutan over the years, new plant species are discovered nearly annually. Thus, this paper reports two new genera and 19 new records of flowering plant species from Bhutan. The new genera include *Eurycorymbus* of the family Sapindaceae and *Homalium* of the family Salicaceae. The new records of plant species are *Eranthemum erythrochilum* (Acanthaceae), *Hemidesmus indicus* (Apocynaceae), *Ilex umbellulata* (Aquifoliaceae), *Canarium strictum* (Burseraceae), *Ehretia acuminata* (Boraginaceae), *Vaccinium sikkimense* (Ericaceae), *Nothapodytes foetida* (Icacinaceae), *Machilus edulis* Lauraceae), *Grewia asiatica* (Malvaceae), *Hibiscus fragrans* (Malvaceae), *Cipadessa baccifera* (Meliaceae), *Baccaurea javanica* (Phyllanthaceae), *Canthiumera glabra* (Rubiaceae), *Homalium napaulense* (Salicaceae), *Eurycorymbus cavaleriei* (Sapindaceae), *Acmella radicans* (Asteraceae), *Silene latifolia* (Caryophyllaceae), *Cleome rutidosperma* (Cleomaceae), and *Cuphea carthagenensis* (Lythraceae). Morphological determinations of the genera and species were carried out at the National Herbarium (THIM) of the National Biodiversity Centre of Bhutan. Brief descriptions of the species, phenology, and photo plates are provided in this annotated checklist.
Published in Korean Journal of Plant Taxonomy, 52(3): 173–183, 2022. DOI: https://doi.org/10.11110/kjpt.2022.52.3.173

Two New Species of *Bulbophyllum* from Bhutan

Phub Gyeltshen, Kinley Rabgay, Kezang Tobgay, Choki Gyeltshen, Karma Sangay, Chencho, Karma Tenzin, Phuentsho & Pankaj Kumar

Two new species of *Bulbophyllum*, namely, *B. gurungianum* (sect. *Biseta*) and *B. punakhaense* (sect. *Brachyrantha*) are described and illustrated. *Bulbophyllum gurungianum* is similar to *B. brevispicatum* and *B. sonii* but differs strikingly by having pseudobulbs placed distantly on the rhizome, a shorter peduncle, and oblong petals with a ciliated margin. *Bulbophyllum punakhaense* is morphologically similar to *B. farreri*, *B. thaiorum*, and *B. mamillatum*, but can be easily distinguished by its larger leaves, pseudobulbs distantly placed on the rhizome, longer peduncle, and oblong-lanceolate petals with shortly papillate margin towards the apex. We provide a detailed description of each species, and information on their distribution, ecology, and conservation status.

Published in Lankesteriana, 23(1): 109–120, 2023. DOI:http://dx.doi.org/10.15517/lank.v23i1.54911

Impatiens darachuensis (Balsaminaceae), A New Species from Bhutan Himalaya

Phub Gyeltshen, Wojciech Adamowski, Tashi Phuntsho & Kinga Thinley

Impatiens darachuensis, a new species from Sarpang district in southern Bhutan, is described and illustrated. Detailed photographs of plants and dissected flowers are provided, as is information on phenology, distribution, habitat and ecology. The new species is assessed as Endangered using IUCN categories and criteria.

Published in Edinburgh Journal of Botany 80: 1–12, 2023. DOI: https://doi.org/10.24823/EJB.2023.1939

Occurrence of *Clerodendrum japonicum* (Lamiaceae) and *Phoenix loureiroi* (Arecaceae) in Bhutan

Phub Gyeltshen, Dhan Bdr. Gurung, Rinchen Dorji, Sangay Tshewang, Phuentsho, Krishna P. Dhimal, Dechen Yangdon, Sangay Choden & Ngawang Dorji

Occurrence of two species, *Clerodendrum japonicum* var. *japonicum* and *Phoenix loureiroi* var. *pedunculata*, which are poorly known in Bhutan are discussed. Their occurrence in Bhutan is not published in journals except for a few incidental sightings noted in social media. These species were collected from Athang Gewog in Wangdue Phodrang District and Sergithang Gewog in Tsirang District. *Clerodendrum japonicum* var. *japonicum* is similar to variety *C. japonicum* var. *bethuneanum*, but can be distinguished from it by the uniformly red corolla. *Phoenix loureiroi* var. *pedunculata* differs from *P. loureiroi* var. *loureiroi* by the absence of a continuous

strip of sclerotic, tannin-filled cells along the leaflet margins, and by its unique geographical distribution. Detailed morphological description, distribution, and ecology along with photographs of the species are provided.

Published in BJNRD, 10(1): 50–56, 2023. DOI: https://doi.org/10.17102/cnr.2023.84

Maharanga griersonii (R.R.Mill) L.Cecchi & Hilger: A Critically Endangered Plant Rediscovered after 44 years

Phuentsho, Krishna Prasad Dhimal & Nima Dorji

During a recent botanical excursion, *Maharanga griersonii* (R.R.Mill) L.Cecchi & Hilger formerly *Onosma griersonii* R.R.Mill was rediscovered in its type locality after a gap of 44 years. Despite the huge habitat destruction and disturbance caused by the widening of the northern east-west highway, this critically endangered endemic plant was found thriving in the location where it was first collected in 1979. Detailed description and photographic illustrations are provided. However, detailed studies regarding its habitat and distribution are required in the future to better understand this rare species.

Published in BJNRD, 10(1): 57–59, 2023. DOI: https://doi.org/10.17102/cnr.2023.85

Restoration of the Traditional High Altitude Rice Variety Dumbja in Bhutan

Tirtha Bdr Katwal, Stefania Grando, Jambay Cheda, Rinchen Dorji, Yenten Namgay, Dejene K. Mengistu, Salvatore Ceccarelli.

Farmers and consumers in Bhutan perceive that the quality traits of the popular, local, high-altitude rice variety Dumbja, which has been cultivated since ancient times, has deteriorated in terms of its phenotypic characteristics, particularly its taste and aroma. This four-year study therefore aimed to agronomically evaluate and compare accessions of the traditional Bhutanese rice variety Dumbja and a commonly grown improved cultivar with what is considered to be the official Dumbja variety. Fifteen accessions of the Dumbja variety–nine conserved in-situ by farmers and six conserved ex-situ by the National Gene Bank–were evaluated agronomically in a partially replicated design over four cropping seasons. The trials were conducted in Tshento, Paro district, a high-altitude rice-growing area, 2400 m.a.s.l., where the variety has been grown since ancient times. Trials identified significant differences for 1000 kernel weight, plant height,

and tiller number, but not for grain yield. Compared with the improved cultivar used as a control, all 15 accessions were taller, with smaller kernels and, in some cases, with more tillers. As a group, the in-situ accessions were significantly shorter, with more tillers than the ex-situ accessions. Only one of the ex-situ accessions held by the National Gene Bank was recognized by farmers as the original Dumbja variety. The results are discussed in relation to in-situ vs ex-situ agrobiodiversity conservation strategies and also highlight the key role of farmers' knowledge in restoring a traditional variety.

Published in Genet Resour Crop Evol (2024) https://doi.org/10.1007/s10722-023-01848-6

ANNEXURES

Annex 1: Summary of the On-farm Crop Diversity Inventory under 3 sites

Summary of the On-farm Crop Diversity Inventory under 3 sites					
Sl.No	Dzongkhag	Gewog	No. of participants	No. of crop diversity	No. of crop varietal diversity
1	Monggar	Kengkhar	15	68	132
2	Trashigang	Phongmey	12	55	120
3	Trashigang	Lumang	23	52	121

Annex 2: List of varieties used in EPB

List of varieties used in EPB				
Site	**Rice varieties used in EPB**		**Bean varieties used in EPB**	
Tsento	1.Dumja 2.Yusiray Maap 1 3.Jakar Ray Naab 4.Yusiray Kaap 3 5.Khangma Maap			
Kabjisa	1.Dawa (local) 2.Bajo Maap-1 3.Tan-tshering 4.IR 64	6.Bonday (local) 7.Nabja (local)		
Tsangkha			1.Gew Bori **(Dwarf)** 2.Azuki 3..Sheto Potharay 4.Rajma Bean 5.Boshi Bori	1.Kalo Chapto **(climbing)** 2.Kanchi 3.Pilow Bori 4.Gew Bori 5.Kalo Gew Bori
Mendelgang	1.Gawri Mashinu 2.Chottey 3.Mashinu 4.Wengkhar Ray Kaap II	5.Attey. 7.IR 64 8.Gawri Mashinu 9.Chottey Mashinu	1.Pink Rajma **(Dwarf)** 2.Rajma 3.Gew Bori 4.Azuki Bean	1.Pole Bean (White) **(climbing)** 2.Pole Bean (Grey) 3.Boshi Bori 4.Kalo Gew Bori
Singay	1. Mansara 2.Khamti 3.Choti Masino 4.Bhur kamja 1 5.Bhur Raykaap 2			

Annex 3: Crop wise germplasm processed and conserved in the Genebank during the current fiscal year.

Crop wise germplasm processed and conserved in the Genebank during the current fiscal year.		
Sl.no	Crop name	No of accessions
1	Adzuki bean	7
2	Amaranth	9
3	Barley	8
4	Bean	41
5	Bitter buckwheat	35
6	Chia	1
7	Chilli	8
8	Coriander	8
9	Cow pea	5
10	Finger Millet	22
11	Foxtail millet	17
12	Maize	43
13	Mustard	13
14	Mustard green	5
15	Niger	1
16	Paddy	91
17	Perilla	17
18	Rice bean	12
19	Soya bean	14
20	Sweet Buckwheat	25
21	Sweet buckwheat (CWR)	1
22	Turnip	5
23	Wheat	3
24	Vigna (CWR)	4
Total accessions accredited into the National Plant Genebank (July 2022 to June 2023): 395 accessions		

Annex 4: Germplasm samples multiplied on-station

Germplasm samples multiplied on-station (Small samples)			
Sl.no	Crop	Small samples	Seeds enough/not enough
1	Sorghum	1	Enough
2	Beans	2	Enough
3	Finger millet	1	Enough

Total "small samples" multiplied =4

Annex 5: Germplasm samples multiplied on-station (Repatriated samples)

Germplasm samples multiplied on-station (Repatriated samples)			
Sl.no	Crop	Repatriated samples	Seeds enough/not enough
1	Wheat	14	Enough: 14
2	Barley	5	Not enough: 5
3	Sweet buckwheat	7	Not enough : 7
4	Bitter buckwheat	11	Not enough: 11
5	Beans	12	Enough: 12
6	Soybean	2	Enough: 2
7	Cucumber	2	Enough: 1
Total 'repatriated' samples multiplied: 27			

Total "Small samples" and "Repatriated samples" multiplied: 31 samples

Annex 6: Clonally propagated germplasm maintained in the Mini Field Genebank

Clonally propagated germplasm maintained in the Mini Field Genebank		
Crop	Species	No.of Samples
Potato	*Solanum tuberosum*	15
Garlic	*Allium sativum*	7
Onion	*Allium cepa*	4
Chives	*Allium schoenoprasum*	1
Chayote	*Sechium edule*	3
Yam	*Dioscorea* sp.	3
Taro	*Colocasia esculenta*	3
	Total	35 samples of 7 species

Annex 7: Total revenue generated through visitorship

Total revenue generated through visitorship				
	Visitor Type	Rate	No of Visitor	Total Amount (Nu.)
N	National	Nu.40	19,530	7,81,200
S	SAARC National	Nu.50	7	350
F	Foreigners	Nu.100	25	2,500
C	Children	Nu.20	3,819	76,380

	Filming	Nu.1000 per day	5	5,000
	Total visitor and amount		**23,381**	**8,65,430**
	No of free visitors for study trip			
	Free Entry	Parents/Driver/Helper		
		Students	927	
		Teachers	78	
	Total Free Entry		**1005**	

Annex 8: List of new collections at the RBGS (FY 2022-2023)

List of new collections at the RBGS (FY 2022-2023)					
SL. No.	Species Name	Family	Place of Collection	Place where it is planted/ stored	Collected by
	Tree and shrub				
1	*Erythrina stricta*	Fabaceae	Manjong, S/jongkhar	Genebank	Kezang et al.
2	*Bridelia assamica*	Euphorbiaceae	Kherkheri, S/jongkhar	Genebank	Kezang et al.
3	*Premna esculenta*	Lamiaceae	Kherkheri, S/jongkhar	Genebank	Kezang et al.
4	*Glochiodon sp.*	Euphorbiaceae	Gawailing, S/jongkhar	Genebank	Kezang et al.
5	*Acer oblongum* var. *oblongum*	Sapendaceae	Morong, S/jongkhar	Genebank	Kezang et al.
6	*Heteropanax fragrans*	Araliaceae	Jangchubling, Orong	Genebank	Kezang et al.
7	*Casearia glomerata*	Flacourtiaceae	Mandar, Orong	Genebank	Kezang et al.
8	*Revessia wallichii*	Malvaceae	Shapshing, Orong	Genebank	Kezang et al.
9	*Albizia sherriffii*	Fabaceae	Larong, Orong	Genebank	Kezang et al.
10	*Aralia foliolosa*	Araliaceae	Gonminang, Orong	Genebank	Kezang et al.
11	*Bauhinia variegata*	Fabaceae	Dungmin, P/gatshel	Genebank	Kezang et al.
12	*Lagerstroemia parviflora*	Lythraceae	Sunkosh, Tsirang	Genebank	Kezang et al.
13	*Hymenodictyon flaccidum*	Rubiaceae	Sunkosh, Tsirang	Genebank	Kezang et al.
14	*Dalbergia rimosa*	Fabaceae	Sarpang Tar, Sarpang	Genebank	Kezang et al.
15	*Trema orientalis*	Ulmaceae	Gakiling, Haa	Genebank	Kezang et al.
16	*Neolamarckia cadamba*	Rubiaceae	Tamangdangra, Samtse	Genebank	Kezang et al.
17	*Balakata baccata*	Euphorbiaceae	Yoseltse, Samtse	Genebank	Kezang et al.
18	*Symplocos dryophila*	Symplocaceae	Ganglakha, Chukha	Genebank	Kezang et al.
19	*Viburnum erubescens*	Caprifoliaceae	Microtop, Chukha	Genebank	Kezang et al.
20	*Acronycha pedunculata*	Rutaceae	Senchikha, Chukha	Genebank	Kezang et al.
21	*Toona ciliata*	Meliaceae	Alay & Kezari	Genebank	Kezang et al.
22	*Ilex fragilis*	Aquifoliaceae	Microtop, Chukha	Genebank	Kezang et al.
23	*Schima khasiana*	Theaceae	Buli, Zhemgang	Genebank	Kezang et al.
24	*Vitex quinata*	Praling, Zhemgang	Alay	Genebank	Kezang et al.
25	*Rhododendron pogonopyllum*	Ericaceae	Kyitsugang	Genebank	Kezang et al.

26	*Rhododendron nivale*	Ericaceae	Kyitsugang	Genebank	Kezang et al.
27	*Rhododendron seutosum*	Ericaceae	Kyitsugang	Genebank	Kezang et al.
28	*Rhododendron anthopogon*	Ericaceae	Kyitsugang	Genebank	Kezang et al.
29	*Rhododendron lanatum*	Ericaceae	Kyitsugang	Genebank	Kezang et al.
30	*Grewia eriocarpa*	Malvaceae	Rubesa, Wangdue	Genebank	Kezang et al.
31	*Calophyllum polyanthum*	Calophyllaceae	Kelzari, Chukha	Genebank	Kezang et al.
32	*Dobinea vulgaris*	Anacardiaceae	Darachu, Sarpang	Genebank	Kezang et al.
33	*Diospyros lanceifolia*	Ebenaceae	Yebilabtsa, Zhemgang	Genebank	Kezang et al.
34	*Bridelia pubescens*	Phyllanthaceae	Panbang, Zhemgang	Genebank	Kezang et al.
35	*Glochidion heyneanum*	Euphorbiaceae	Mandi, P/gatshel	Genebank	Kezang et al.
	Live collection				
1	*Agrostophyllum planicauli*	Orchidaceae	Manjong, S/jongkhar	Orchidarium	Kezang et al.
2	*Begonia* cf. *sikkimensis*	Begoniaceae	Manjong, S/jongkhar	Orchidarium	Kezang et al.
3	*Rhaphidophora* cf. *calophylla*	Araceae	Nechenphug, Orong	Orchidarium	Kezang et al.
4	*Cliloschista* cf. *himalaica*	Orchidaceae	Nechenphug, Orong	Orchidarium	Kezang et al.
5	*Begonia* cf. *josephii*	Begoniaceae	Dugposa, Orong	Orchidarium	Kezang et al.
6	*Bulbophyllum* sp.	Orchidaceae	Dugposa, Orong	Orchidarium	Kezang et al.
7	*Peliosanthes* sp.	Asparagaceae	Dugposa, Orong	Orchidarium	Kezang et al.
8	*Hoya* sp.	Apocynaceae	Dugposa, Orong	Orchidarium	Kezang et al.
9	*Calanthe* sp.	Orchidaceae	Gonminang, Orong	Orchidarium	Kezang et al.
10	*Eria paniculata*	Orchidaceae	Gonminang, Orong	Orchidarium	Kezang et al.
11	*Gastrochilus calceolaris*	Orchidaceae	Gonminang, Orong	Orchidarium	Kezang et al.
12	*Begonia megaptera*	Begoniaceae	Saserba, Orong	Orchidarium	Kezang et al.
13	*Dendrobium terminale*	Orchidaceae	Yuri, Dungmin	Orchidarium	Kezang et al.
14	*Bulbophyllum* cf. *leopardinum*	Orchidaceae	Wongborang, Dungmin	Orchidarium	Kezang et al.
15	*Cleisostoma* sp.	Orchidaceae	Wongborang, Dungmin	Orchidarium	Kezang et al.
16	*Vanda bicolor*	Orchidaceae	Dungmin, P/gatshel	Orchidarium	Kezang et al.
17	*Begonia* cf. *baccata*	Begoniaceae	Panbang, Zhemgang	Orchidarium	Kezang et al.
18	*Phrynium placentarium*	Marantaceae	Tingtibe, Zhemgang	Glasshouse/F	Kezang et al.
19	*Calanthe sylvatica*	Orchidaceae	Phaktshoding, Chukha	Orchidarium	Kezang et al.
20	*Ceropegia bhutanica*	Apocynaceae	Tshachilakha, Chukha	Orchidarium	Kezang et al.
21	*Begonia* sp. (Orange)	Begoniaceae	Alay, Chukha	Glass House	Kezang et al.
22	*Monolophus secunda*	Zingiberaceae	Alay, Chukha	Glass House	Kezang et al.
23	*Begonia menchunaensis*	Orchidaceae	Menchuna, Punakha	Orchidarium	Kezang et al.
24	*Aristolochia assamica*	Aristolochiaceae	Deezama, P/gatshel	Glass House	Kezang et al.
25	*Crawfurdia campanulacea*	Gentianaceae	Bensingonpa, P/gatshel	Glass House	Kezang et al.

Annex 9: List of seeds collected and banked at the National Seed Bank from 2016-2019

List of trees and shrubs collected and banked at the National Seed Bank				
Sl.No	Acc.No	Coll.No	Genus	Species
1	BTNT01K	BT09TO	*Magnolia*	*campbellii*
2	BTNT02K	BT11TO	*Magnolia*	*campbellii*
3	BTNT05K	BT01BU	*Sorbus*	*thibetica*
4	BTNT06K	BT36TA	*Cornus*	*capitata*
5	BTNT07K	BT36PG	*Cornus*	*capitata*
6	BTNT08K	BT08BU	*Magnolia*	*globosa*
7	BTNT09K	BT40TS	*Terminalia*	*chebula*
8	BTNT10K	BT56TH	*Ligustrum*	*compactum*
9	BTNT11K	BT33SA	*Acer*	*thomsonii*
10	BTNT13K	BT57TH	*Ligustrum*	*compactum*
11	BTNT14K	BT16TO	*Carpinus*	*viminea*
12	BTNT15K	BT38TA	*Acer*	*cappadocicum*
13	BTNT16K	BT39PG	*Magnolia*	*cathcartii*
14	BTNT17K	BT51PU	*Juniperus*	*recurva*
15	BTNT18K	BT53TH	*Juniperus*	*recurva*
16	BTNT19K	BT07TO	*Sorbus*	*kurzii*
17	BTNT20K	BT12TO	*Magnolia*	*lanuginosa*
18	BTNT21K	BT05BU	*Gamblea*	*ciliata*
19	BTNT22K	BT06BU	*Sorbus*	*rufopilosa*
20	BTNT23K	BT10TO	*Sorbus*	*wallichii*
21	BTNT24K	BT13TO	*Magnolia*	*doltsopa*
22	BTNT25K	BT19TO	*Docynia*	*indica*
23	BTNT26K	BT35SJ	*Pandanus*	*furcatus*
24	BTNT27K	BT27WA	*Tetracentron*	*sinense*
25	BTNT28K	BT69TH	*Pinus*	*wallichiana*
26	BTNT29K	BT29WA	*Tetracentron*	*sinense*
27	BTNT30K	BT02BU	*Sorbus*	*arachnoidea*
28	BTNT31K	BT47PU	*Ilex*	*dipyrena*
29	BTNT32K	BT32WA	*Tetracentron*	*sinense*
30	BTNT33K	BT17TO	*Carpinus*	*viminea*
31	BTNT34K	BT18TO	*Carpinus*	*viminea*
32	BTNT35K	BT49TH	*Ilex*	*dipyrena*
33	BTNT36K	BT15TO	*Sorbus*	*wallichii*
34	BTNT37K	BT14TO	*Tetracentron*	*sinense*
35	BTNT38K	BT20TO	*Docynia*	*indica*
36	BTNT39K	BT21TO	*Docynia*	*indica*

37	BTNT40K	BT22TO	*Docynia*	*indica*
38	BTNT41K	BT41PU	*Acer*	*campbellii*
39	BTNT42K	BT42TH	*Acer*	*campbellii*
40	BTNT43K	BT43TO	*Acer*	*oblongum*
41	BTNT44K	BT44ZH	*Acer*	*oblongum*
42	BTNT45K	BT45TH	*Euonymus*	*lucidus*
43	BTNT46K	BT46TH	*Euonymus*	*lucidus*
44	BTNT47K	BT23BU	*Sorbus*	*rufopilosa*
45	BTNT48K	BT24WA	*Sorbus*	*rufopilosa*
46	BTNT49K	BT25GA	*Sorbus*	*rufopilosa*
47	BTNT50K	BT26WA	*Sorbus*	*thibetica*
48	BTNT51K	BT31WA	*Tetracentron*	*sinense*
49	BTNT52K	BT52TH	*Juniperus*	*recurva*
50	BTNT53K	BT34SJ	*Albizia*	*chinensis*
51	BTNT54K	BT54TH	*Larix*	*griffithii* var. *griffithii*
52	BTNT55K	BT55TH	*Larix*	*griffithii* var. *griffithii*
53	BTNT56K	BT37PU	*Magnolia*	*globosa*
54	BTNT57K	BT62PU	*Symplocos*	*kuroki*
55	BTNT58K	BT63CH	*Symplocos*	*kuroki*
56	BTNT59K	BT59PU	*Pinus*	*bhutanica*
57	BTNT60K	BT64PU	*Toxicodendron*	*hookeri*
58	BTNT61K	BT65TH	*Toxicodendron*	*hookeri*
59	BTNT62K	BT66TH	*Tsuga*	*dumosa*
60	BTNT63K	BT67TH	*Tsuga*	*dumosa*
61	BTNT64K	BT68PU	*Tsuga*	*dumosa*
62	BTNT65K	BT70CH	*Pandanus*	*furcatus*
63	BTNT66K	BT71DA	*Pandanus*	*furcatus*
64	BTNT67K	BT72CH	*Pandanus*	*furcatus*
65	BTNT68K	BT73CH	*Pandanus*	*furcatus*
66	BTNT69K	BT60TH	*Symplocos*	*paniculata*
67	BTNT70Ka	BT 81CH	*Prunus*	*cerasoides*
68	BTNT70Kb	BT100GA	*Ilex*	*dipyrena*
69	BTNT71K	BT86PU	*Osmanthus*	*suavis*
70	BTNT72K	BT91TS	*Daphniphyllum*	*himalayense* subsp.
71	BTNT73K	BT40TS	*Terminalia*	*chebula*
72	BTNT74K	BT74CH	*Tetrameles*	*nudiflora*
73	BTNT75K	BT75CH	*Tetrameles*	*nudiflora*
74	BTNT76K	BT76CH	*Acacia*	*gageana*
75	BTNT77K	BT77SA	*Acacia*	*gageana*

76	BTNT78K	BT78CH	*Betula*	*alnoides*
77	BTNT79K	BT79CH	*Toricellia*	*tiliifolia*
78	BTNT80K	BT80CH	*Toricellia*	*tiliifolia*
79	BTNT81K	BT03BU	*Sorbus*	*thibetica*
80	BTNT82K	BT82PU	*Toricellia*	*tiliifolia*
81	BTNT83K	BT83LH	*Eurya*	*cerasifolia*
82	BTNT84K	BT84PU	*Prunus*	*rufa*
83	BTNT85K	BT85TH	*Prunus*	*rufa*
84	BTNT86K	BT04BUR	*Sorbus*	*arachnoidea*
85	BTNT87K	BT87PU	*Ilex*	*fragilis*
86	BTNT88K	BT88PA	*Toxicodendron*	*hookeri*
87	BTNT89K	BT89PA	*Betula*	*utilis*
88	BTNT90K	BT90GA	*Sorbus*	*karchungii*
89	BTNT91K	BT97GA	*Symplocos*	*ramosissima*
90	BTNT92K	BT92GA	*Sorbus*	*rufopilosa*
91	BTNT93K	BT93GA	*Betula*	*utilis*
92	BTNT94K	BT94GA	*Acer*	*caudatum*
93	BTNT95K	BT95GA	*Sorbus*	*wallichii*
94	BTNT96K	BT96GA	*Enkianthus*	*deflexus*
95	BTNT98K	BT98GA	*Meliosma*	*pinnata*
96	BTNT99K	BT99GA	*Erythrina*	*arborescens*
97	BTNT101K	BT101GA	*Carpinus*	*viminea*
98	BTNT102K	BT102GA	*Ilex*	*excelsa*
99	BTNT103K	BT103GA	*Carpinus*	*faginea*
100	BTNT104K	BT104PU	*Carpinus*	*faginea*
101	BTNT105K	BT105WA	*Acer*	*caudatum*
102	BTNT106K	BT106TO	*Ilex*	*kingiana*
103	BTNT107K	BT107TO	*Acer*	*sikkimense*
104	BTNT108K	BT108TO	*Sorbus*	*griffithii*
105	BTNT109K	BT109TO	*Ilex*	*excelsa* var. *excelsa*
106	BTNT110K	BT110TO	*Ilex*	*excelsa* var. *hypotricha*
107	BTNT111K	BT111TO	*Radermachera*	*sinica*
108	BTNT112K	BT112ZH	*Callicarpa*	*vestita*
109	BTNT113K	BT113ZH	*Stereospermum*	*colais*
110	BTNT114K	BT114ZH	*Sapindus*	*rarak*
111	BTNT115K	BT115SA	*Ilex*	*venulosa*
112	BTNT116K	BT116SA	*Dalbergia*	*sissoo*
113	BTNT117K	BT117SA	*Wendlandia*	*budleioides*
114	BTNT118K	BT118SA	*Oroxylum*	*indicum*

115	BTNT119K	BT119TS	*Eurya*	*cerasifolia*
116	BTNT120K	BT120TS	*Pouzolzia*	*rugulosa*
117	BTNT121K	BT121DA	*Acer*	*oblongum*
118	BTNT122K	BT122PU	*Fraxinus*	*floribunda*
119	BTNT123K	BT123PU	*Daphniphyllum*	*himalense*
120	BTNT124K	BT124PU	*Acer*	*sterculiaceum*
121	BTNT125K	BT125PU	*Tetracentron*	*sinense*
122	BTNT126K	BT126PU	*Ilex*	*rotunda*
123	BTNT127K	BT127PU	*Ilex*	*sikkimensis*
124	BTNT128K	BT128PU	*Polygala*	*arillata*
125	BTNT129K	BT129SM	*Ilex*	*godajam*
126	BTNT130K	BT130SM	*Premna*	*bengalensis*
127	BTNT131K	BT131TR	*Schoepfia*	*fragrans*
128	BTNT132K	BT132TR	*Eriobotrya*	*hookeriana*
129	BTNT133K	BT133LH	*Cordia*	*obliqua*
130	BTNT134K	BT134LH	*Cycas*	*pectinata*
131	BTNT135K	BT135MO	*Eurycorymbus*	*cavaleriei*
132	BTNT136K	BT136MO	*Populus*	*glauca*
133	BTNT137K	BT137WA	*Garuga*	*floribunda*
134	BTNT140K	BT140WA	*Taxus*	*wallichiana*
135	BTNT138K	BT138TH	*Juniperus*	*indica*
136	BTNT139K	BT139BU	*Rhododendron*	*hodgsonii*
137	BTNT141K	BT141MO	*Sorbus*	*thibetica*
138	BTNT142K	BT142MO	*Rhododendron*	*kesangiae* var. *alba*
139	BTNT143K	BT143BU	*Larix*	*griffithii* var. *griffithii*
140	BTNT144K	BT144TO	*Acer*	*pectinatum*
141	BTNT145K	BT145TO	*Corylopsis*	*himalayana*
142	BTNT146K	BT146TO	*Ilex*	*excelsa* var. *excelsa*
143	BTNT147K	BT147TO	*Acer*	*sikkimense*
144	BTNT148K	B148TO	*Rhododendron*	*grande*
145	BTNT149K	BT149TO	*Sorbus*	*wallichii*
146	BTNT150K	BT150TO	*Acer*	*pectinatum* subsp. *taronense*
147	BTNT151K	BT151WA	*Larix*	*griffithii* var. *griffithii*
148	BTNT152K	BT152WA	*Acer*	*campbellii*
149	BTNT153K	BT153WA	*Meliosma*	*dilleniifolia*
150	BTNT154K	BT154WA	*Cornus*	*capitata*
151	BTNT155K	BT155WA	*Magnolia*	*doltsopa*
152	BTNT156K	BT156WA	*Ilex*	*excelsa* var. *hypotricha*
153	BTNT157K	BT157WA	*Ilex*	*kingiana*
154	BTNT158K	BT158WA	*Cupressus*	*corneyana*

155	BTNT159K	BT159WA	*Dalbergia*	*sericea*
156	BTNT160K	BT160WA	*Photinia*	*integrifolia*
157	BTNT161K	BT161PU	*Cladrastis*	*sinensis*
158	BTNT162K	BT162PU	*Acer*	*sikkimense* subsp. *sikkimense*
159	BTNT163K	BT163MO	*Cornus*	*oblonga*
160	BTNT164K	BT164MO	*Bridelia*	*retusa*
161	BTNT165K	BT165MO	*Eurycorymbus*	*cavaleriei*
162	BTNT166K	BT166MO	*Mallotus*	*philippensis*
163	BTNT167K	BT167TY	*Morella*	*esculenta*
164	BTNT168K	BT168TY	*Morella*	*esculenta*
165	BTNT169K	BT169TY	*Elaeocarpus*	*lanceifolius*
166	BTNT170K	BT1170SA	*Premna*	*barbata*
167	BTNT171K	BT171ZH	*Prunus*	sp.
168	BTNT172K	BT170	*Myrsine*	*semiserrata*
169	BTNT173K	BT171	*Bauhinia*	*purpurea*
170	BTNT174K	BT172	*Bauhinia*	*purpurea*
171	BTNT175K	BT173	*Archidendron*	*bigeminum*
172	BTNT176K	BT174	*Prunus*	*carmesina*
173	BTNT177K	BT175	*Bauhinia*	*variegata*
174	BTNT178K	BT176	*Bauhinia*	*variegata*
175	BTNT179K	BT177	*Vitex*	*burmensis*
176	BTNT180K	BT178	*Sorbus*	*insignis*
177	BTNT181K	BT179	*Balakata*	*baccata*
178	BTNT182K	BT180	*Sorbus*	*foliolosa*
179	BTNT183K	BT181	*Balakata*	*baccata*
180	BTNT184K	BT182	*Hymenodictyon*	*flaccidum*
181	BTNT185K	BT183	*Cotoneaster*	*frigidus*
182	BTNT186K	BT184	*Cotoneaster*	*bacillaris*
183	BTNT187K	BT185	*Antidesma*	*montanum*
184	BTNT188K	BT186	*Symplocos*	*dryophila*
185	BTNT189K	BT187	*Ilex*	*hookeri*
186	BTNT190K	BT188	*Albizia*	*saman*
187	BTNT191K	BT189	*Crateva*	*religiosa*
188	BTNT192K	BT190	*Crateva*	*religiosa*
189	BTNT193K	BT191	*Senegalia*	*catechu*
190	BTNT194K	BT192	*Senegalia*	*catechu*

Annex 10: List of seeds collected and banked at the National Seed Bank from 2022-2023

List of trees and shrubs collected and banked at the National Seed Bank					
Sl.No	Acc.No	Coll.No	Family	Genus	Species
1	BTNT202K	BT202	Primulaceae	*Ardisia*	*macrocarpa*
2	BTNT203K	BT203	Rubiaceae	*Meyna spinosa*	*spinosa*
3	BTNT204K	BT204	Salicaceae	*Casearia*	*graveolens*
4	BTNT206K	BT205	Scrophulariaceae	*Buddleja*	*bhutanica*
5	BTNT 207K	BT206	Scrophulariaceae	*Buddleja*	*bhutanica*
6	BTNT208K	BT207	Elaeagnaceae	*Elaeagnus*	*caudata*
7	BTNT209K	BT208	Cupressaceae	*Cupressus*	*torulosa*
8	BTNT210K	BT209	Cupressaceae	*Cupressus*	*torulosa*
9	BTNT211K	BT210	Araliaceae	*Aralia*	*leschenaultii*
10	BTNT212K	BT211	Rosaceae	*Prunus*	*buergeriana*
11	BTNT213K	BT212	Rosaceae	*Prunus*	*cornuta*
12	BTNT214K	BT213	Coriariaceae	*Coriaria*	*nepalensis*
13	BTNT215K	BT214	Ericaceae	*Rhododendron*	*Campanulatum* subsp. *aeruginosum*
14	BTNT216K	BT215	Pinaceae	*Pinus*	*bhutanica*
15	BTNT217K	BT216	Boraginaceae	*Cordia*	*grandis*
16	BTNT219K	BT217	Theaceae	*Polyspora*	*excelsa*
17	BTNT220K	BT218	Theaceae	*Schima*	*khasiana*
18	BTNT221K	BT219	Leeaceae	*Leea*	*asiatica*
19	BTNT222K	BT220	Cannabaceae	*Aphananthe*	*cuspidata*
20	BTNT223K	BT221	Schisandraceae	*Illicium*	*griffithii*
21	BTNT224K	BT222	Lythraceae	*Lagerstroemia*	*speciosa*
22	BTNT225K	BT223	Fabaceae	*Albizia*	*julibrissin*
23	BTNT226K	BT224	Fabaceae	*Albizia*	*lucidior*
24	BTNT227K	BT225	Ericaceae	*Rhododendron*	*wallichii*
25	BTNT228K	BT226	Euphorbiaceae	*Macaranga*	*denticulata*
26	BTNT229K	BT227	Rubiaceae	*Hyptianthera*	*stricta*
27	BTNT230K	BT228	Grossulariaceae	*Ribes*	*luridum*
28	BTNT231K	BT229	Grossulariaceae	*Ribes*	*himalense*
29	BTNT232K	BT230	Rosaceae	*Sorbus*	*microphylla*
30	BTNT233K	BT231	Cannabaceae	*Celtis*	*tetrandra*
31	BTNT234K	BT232	Rhamnaceae	*Ziziphus*	*incurva*
32	BTNT235K	BT233	Cornaceae	*Alangium*	*alpinum*
33	BTNT236K	BT234	Euphorbiaceae	*Antidesma*	*acidum*
34	BTNT237k	BT235	Pinaceae	*Abies*	*densa*
35	BTNT238K	BT236	Pinaceae	*Abies*	*densa*

36	BTNT239K	BT237	Magnolaceae	*Magnolia*	*champaca*
37	BTNT240K	BT238	Pinaceae	*Picea*	*spinulosa*
38	BTNT241K	BT240	Myristicacea	*Knema*	*tenuinervia*
39	BTNT242K	BT241	Elaeocarpaceae	*Eleocarpus*	*floribundus*
40	BTNT243K	BT242	Styracaceae	*Styrax*	*grandiflorus*
41	BTNT244K	BT243	Styracaceae	*Styrax*	*serrulatus*
42	BTNT245K	BT244	Rosaceae	*Sorbus*	*microphylla*
43	BTNT246K	BT245	Rosaceae	*Sorbus*	*prattii*
44	BTNT247K	BT246	Rosaceae	*Sorbus*	*himalaica*
45	BTNT248K	BT247	Rosaceae	*Sorbus*	*lingshiensis*
46	BTNT249K	BT248	Rosaceae	*Sorbus*	*rinzenii*
47	BTNT250K	BT249	Pinaceae	*Picea*	*spinulosa*
48	BTNT251K	BT250	Pinaceae	*Picea*	*spinulosa*
49	BTNT252K	BT251	Rutaceae	*Skimmia*	*arborescens*
50	BTNT254K	BT253	Caprifoliaceae	*Viburnum*	*mullaha*
51	BTNT253K	BT252	Rubaceae	*Phoenix*	*acaulis*
52	BTNT255K	BT254	Euphorbiaceae	*Glochiodon cf.*	*zeylanicum var. tomentosum*
53	BTNT256K	BT256	Fabaceae	*Erythrina*	*stricta*
54	BTNT257K	BT257	Fabaceae	*Albizia*	*sherriffii*
55	BTNT258K	BT258	Araliaceae	*Heteropanax*	*fragrans*
56	BTNT259K	BT255	Sapindaceae	*Acer*	*oblongum var. oblongum*
57	BTNT260K	BT259	Araliaceae	*Aralia*	*foliolosa*
58	BTNT261K	BT260	Salicaceae	*Casearia*	*glomerata*
59	BTNT262K	BT262	Phyllanthaceae	*Bridelia*	*assamica*
60	BTNT263K	BT263	Lamiaceae	*Premna*	*esculenta*
61	BTNT264K	BT264	Celastraceae	*Euonymus*	*tingens*
62	BTNT265K	BT265	Lamiaceae	*Vitex*	*quinata*
63	BTNT266K	BT267	Fabaceae	*Dalbergia*	*rimosa*
64	BTNT267K	BT268	Cannabaceae	*Trema*	*orientalis*
65	BTNT268K	BT269	Caprifoliaceae	*Viburnum*	*erubescens*
66	BTNT269K	BT270	Rutaceae	*Acronycha*	*pedunculata*
67	BTNT270K	BT271	Elaeocarpaceae	*Sloanea*	*dasycarpa*
68	BTNT271K	BT272	Rutaceae	*Zanthoxylum*	*myriacanthum*
69	BTNT272K	BT274	Apocynaceae	*Wrightia*	*coccinea*
70	BTNT273K	BT275	Apocynaceae	*Wrightia*	*arborea*
71	BTNT274K	BT276	Ericaceae	*Rhododendron*	*pogonopyllum*
72	BTNT275K	BT277	Ericaceae	*Rhododendron*	*nivale*
73	BTNT276K	BT271	Ericaceae	*Rhododendron*	*seutosum*
74	BTNT277K	BT272	Ericaceae	*Rhododendron*	*anthopogon*

75	BTNT278K	BT274	Ericaceae	*Rhododendron*	*lanatum*
76	BTNT279K	BT275	Malvaceae	*Grewia*	*eriocarpa*
77	BTNT280K	BT276	Phyllanthaceae	*Bridelia*	*pubescens*
78	BTNT281K	BT277	Anacardiaceae	*Dobinea*	*vulgaris*
79	BTNT282K	BT271	Ebenaceae	*Diospyros*	*lanceifolia*
80	BTNT283K	BT272	Euphorbiaceae	*Glochidion*	*heyneanum*
81	BTNT284K	BT274	Phyllanthaceae	*Antidesma*	*montanum* var. *montanum*
82	BTNT285K	BT275	Podocarpaceae	*Podocarpus*	*neriifolius*
83	BTNT286K	BT276	Calophyllaceae	*Calophyllum*	*polyanthum*
84	BTNT287K	BT277	Ericaceae	*Rhododendron*	*griffithianum*

Annex 11: List of species with draft assessment of red listing based on IUCN categories and criteria completed from 2021-2023

List of species assessed for IUCN Red List		
SL.No	Scientific Name	Red list status
1	*Acer oblongum* var. *oblongum*	NT
2	*Acrocarpus fraxinifolius*	LC
3	*Aglaia edulis*	NT
4	*Aglaia lawii*	LC
5	*Aglaia perviridis*	NT A1ace
6	*Alchornea mollis*	NT
7	*Allaeanthus kurzii*	LC
8	*Amblyanthopsis bhotanica*	EN B
9	*Antidesma montanum* var. *montanum*	LC
10	*Aphananthe cuspidata*	LC
11	*Aralia foliolosa*	NT
12	*Archidendron bigeminum*	NT
13	*Aristolochia acuminata*	LC
14	*Aristolochia assamica*	EN B2ab (i,iv,v)
15	*Brassaiopsis hainla*	LC
16	*Brassaiopsis hispida*	LC
17	*Bridelia assamica*	LC
18	*Buddleja colvilei*	NT B2b (i,iii,v)
19	*Buddleja macrostachya*	NT
20	*Buddleja paniculata*	NT
21	*Calamus erectus*	NTB2b (iii,v)
22	*Caryota maxima*	NT B2a

23	*Casearia graveolens*	LC
24	*Debregeasia wallichiana*	LC
25	*Decaisnea insignis*	NT
26	*Dillenia pentagyna*	LC
27	*Diploknema butyracea*	NT
28	*Drimycarpus racemosus*	LC
29	*Dysoxylum gotadhora*	LC
30	*Dysoxylum grande*	LC
31	*Elaeocarpus lanceifolius*	LC
32	*Elaeocarpus tectorius*	LC
33	*Euphorbia royleana*	LC
34	*Euptelea pleiosperma*	LC
35	*Eurycorymbus cavaleriei*	LC
36	*Gynocardia odorata*	NT
37	*Helwingia himalaica*	LC
38	*Heteropanax fragrans*	LC
39	*Hippophae salicifolia*	LC
40	*Hymenodictyon flaccidum*	LC
41	*Hyptianthera stricta*	LC
42	*Itea macrophylla*	LC
43	*Licuala peltata*	LC
44	*Livistona jenkinsiana*	NT
45	*Macaranga peltata*	LC
46	*Machilus edulis*	NT
47	*Macropanax undulatus*	LC
48	*Mallotus roxburghianus*	LC
49	*Mallotus tetracoccus*	LC
50	*Meliosma dilleniifolia*	LC
51	*Meliosma pinnata*	LC
52	*Merrilliopanax alpinus*	LC
53	*Meyna spinosa*	LC
54	*Murraya paniculata*	LC
55	*Myrica esculenta*	LC
56	*Myrsine capitellata*	LC
57	*Nayariophyton zizyphifolium*	LC
58	*Neolamarckia cadamba*	LC
59	*Nyssa javanica*	LC
60	*Pandanus furcatus*	LC
61	*Pandanus unguifer*	EN B2a

62	*Piliostigma malabaricum*	LC
63	*Pinanga gracilis*	NT
64	*Protium serratum*	LC
65	*Pterygota alata*	LC
66	*Reevesia wallichii*	NT
67	*Sarcococca hookeriana*	LC
68	*Searsia paniculata*	NT
69	*Senegalia rugata*	LC
70	*Sorbus kurzii*	NT
71	*Terminalia myriocarpa*	LC
72	*Tetradium glabrifolium*	LC
73	*Torricellia tiliifolia*	LC
74	*Toxicodendron acuminatum*	NT
75	*Ulmus lanceifolia*	LC
76	*Viburnum cotinifolium*	LC
77	*Viburnum erubescens*	LC
78	*Viburnum grandiflorum*	LC
79	*Wallichia disticha*	VU B2a
80	*Wightia speciosissima*	LC
81	*Xantolis hookeri*	NT
82	*Boehmeria listeri*	LC
83	*Breynia quadrangularis*	LC
84	*Brucea mollis*	LC
85	*Falconeria insignis*	LC
86	*Heptapleurum elatum*	LC
87	*Neonauclea griffithii*	LC
88	*Oreocnide integrifolia*	LC
89	*Picrasma quassioides*	LC
90	*Tarennoidea wallichii*	LC
91	*Dysoxylum pallens*	NT
92	*Salix psilostigma*	NT
93	*Walsura robusta*	NT
94	*Boehmeria penduliflora*	LC
95	*Drypetes assamica*	LC
96	*Mappia nimmoniana*	LC
97	*Meliosma simplicifolia*	LC
98	*Salix daltoniana*	LC
99	*Syzygium praecox*	LC

ANNEX 12: List of contributors to the status report

List of contributors to the status report			
SL.No	**Name**	**Designation**	**Program**
1	Dr. Karma Dema Dorji	Program Director	NBC
2	Dr. Asta Maya Tamang	Executive Specialist	Plant Genetic Resources
3	Dr. Sangay Dema	Principal Biodiversity Officer	National Herbarium
4	Barbara Meurer	Australian Volunteer	Bioprospecting & ABS
5	Beejai Darjee	Biodiversity Officer	Animal Genetic Resources
6	Choki Wangmo	Senior Biodiversity Officer	Plant Genetic Resources
7	Deki Gazom	Biodiversity Supervisor	Animal Genetic Resources
8	Karma Wangchuk	Dy. Chief Biodiversity Officer	Biodiversity Information Management
9	Pem Zam	Senior Biodiversity Officer	Royal Botanical Garden
10	Phub Gyeltshen	Biodiversity Officer	National Herbarium
11	Rinchen Dorji	Senior Biodiversity Supervisor	Plant Genetic Resources
12	Kezang Tobgay	Biodiversity Officer	Royal Botanical Garden
13	Kezang Wangchuk	Biodiversity Officer	Bioprospecting & ABS
14	Leki Wangchuk	Senior Biodiversity Supervisor	Bioprospecting & ABS
15	Thukten Sherab	Biodiversity Officer	Plant Genetic Resources
16	Tshering Dorji	Senior Biodiversity Officer	Animal Genetic Resources
17	Tshering Pem	Biodiversity Officer	Biodiversity Information Management
18	Tshering Wangmo	Biodiversity Technician	Royal Botanical Garden
19	Tshewang	Senior Biodiversity Officer	Animal Genetic Resources
20	Ugyen Phuntsho	Senior Biodiversity Officer	Plant Genetic Resources
21	Wangmo	Biodiversity Technician	Royal Botanical Garden
22	Wang Tshering	Senior Biodiversity Officer	Plant Genetic Resources

Medicinal Meals of Millet (International Year of Millet 2023)

Cultivated and preserved by our farmers for Very Long
Was an important cereal for some and consumed it for Yearlong

It is an integral part of Bhutanese culture and Tradition
Rich in numerous nutrients that improve health Conditions.

Internet sources say it is rich in calcium, magnesium, and protein,
Packed with iron, phosphorous, dietary fiber, zinc, and vitamins,

When consumed regularly, maintains body- healthy and Elegant
Good for the heart, nerves, bones, and kidney

Millet crops are so generous and bountiful
Is a climate-resilient crop that makes farmers delightful

However, evidence suggests millet diversity is declining
Loss of crop diversity, erosion of culture and cuisine is the meaning

Welcome to Biomodelling to observe NBC-ARDC-Dzongkhag Millet initiatives
for livelihood and resilience, progress is appreciative.

These initiatives have contributed to maintaining/restoring diversity
contributing to increasing resilience to climate change Adversity.

Restoring diversity is preserving cuisine and culture
Contributing to income generation and sustainable agriculture

They are grown using organic practices free of chemicals
good for the environment, and human health both physical and mental

Join us to contribute to food security through enhanced production
Join us to maintain millet diversity through value addition.

NATIONAL BIODIVERSITY CENTRE
MINISTRY OF AGRICULTURE AND LIVESTOCK
SERBITHANG, 11001, THIMPHU, BHUTAN

+ 975 -2-351417

www.nbc.gov.bt

www.biodiversity.bt