** **

**Report**

**on the Establishment of the National Information**

**Sharing Mechanism on the Implementation of the**

**Global Plan of Action for the Conservation and**

**Sustainable Utilization of Plant Genetic Resources for**

**Food and Agriculture in Bhutan.**

National Biodiversity Centre

Ministry of Agriculture and Forests

Serbithang: Thimphu

BHUTAN

Table of Contents

[Acknowledgement iii](#_Toc311279617)

[Executive Summary iv](#_Toc311279618)

[List of Acronyms and Local Names v](#_Toc311279619)

[Part I 1](#_Toc311279620)

[Chapter 1: Introduction to the project 1](#_Toc311279621)

[Chapter 2: Project Implementation Process 3](#_Toc311279622)

[2.1 Formation of technical task force 5](#_Toc311279623)

[2.2 Technical task force and stakeholder consultation meetings and workshops. 6](#_Toc311279624)

[2.3: Refresher training for the data manager and data entry personnel. 8](#_Toc311279625)

[2.4: Data collection and entry process 9](#_Toc311279626)

[2.5: Data validation, analysis and report writing process 10](#_Toc311279627)

[2.6 Development of Bhutan NISM website and linkage to WISM and NBC website. 13](#_Toc311279628)

[2.7 Other activities supported by NISM project 14](#_Toc311279629)

[Part II 16](#_Toc311279630)

[Chapter 3: Status of PGRFA database in the country at the start of the project. 16](#_Toc311279631)

[Chapter 4: Current status of PGRFA diversity and programs in the country based on analysis of NISM data base 17](#_Toc311279632)

[A. *In Situ* Conservation and Development 17](#_Toc311279633)

[Priority Activity Area   1: Surveying and Inventorying Plant Genetic Resources for Food and Agriculture 17](#_Toc311279634)

[Priority Activity Area   2   Supporting On-Farm Management and Improvement of Plant Genetic Resources for Food and Agriculture 20](#_Toc311279635)

[Priority Activity Area   3   Assisting Farmers in Disaster Situations to Restore Agricultural Systems 23](#_Toc311279636)

[Priority Activity Area   4   Promoting *In Situ* Conservation of Crop Wild Relatives and Wild Plants for Food Production 24](#_Toc311279637)

[B. *Ex- Situ* Conservation 24](#_Toc311279638)

[Priority Activity Area   5   Sustaining Existing *Ex Situ* Collections 24](#_Toc311279639)

[Priority Activity Area   6   Regenerating Threatened Ex Situ Accessions 26](#_Toc311279640)

[Activity Area   7   Supporting Planned and Targeted Collecting of Plant Genetic Resources for Food and Agriculture 26](#_Toc311279641)

[Activity Area   8   Expanding *Ex Situ* Conservation Activities 26](#_Toc311279642)

[C. Utilization of Plant Genetic Resources 27](#_Toc311279643)

[Activity Area   9   Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use 27](#_Toc311279644)

[Activity Area   10   Increasing Genetic Enhancement and Base-Broadening Efforts 30](#_Toc311279645)

[Activity Area   11   Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops. 30](#_Toc311279646)

[Activity Area   12   Promoting Development and Commercialization of Under-Utilized Crops and Species 33](#_Toc311279647)

[Activity Area   13   Supporting Seed Production and Distribution 34](#_Toc311279648)

[Activity Area   14   Developing New Markets for Local Varieties and 'Diversity-Rich' Products 35](#_Toc311279649)

[D. Institutions and Capacity building 36](#_Toc311279650)

[Activity Area   15   Building Strong National Programmes 36](#_Toc311279651)

[Activity Area   16   Promoting Networks for Plant Genetic Resources for Food and Agriculture 37](#_Toc311279652)

[Activity Area   17   Constructing Comprehensive Information Systems for Plant Genetic Resources for Food and Agriculture 38](#_Toc311279653)

[Activity Area   18   Developing Monitoring and Early Warning Systems for Loss of Plant Genetic Resources for Food and Agriculture 38](#_Toc311279654)

[Activity Area   19   Expanding and Improving Education and Training 39](#_Toc311279655)

[Activity Area   20   Promoting Public Awareness of the Value of Plant Genetic Resources for Food and Agriculture Conservation and Use 41](#_Toc311279656)

[Chapter 5: Constraints in project implementation. 43](#_Toc311279657)

[Chapter 6: Conclusion and way forward 45](#_Toc311279658)

[References 46](#_Toc311279659)

[Annexure 1: Programme/project/activity relating to sustaining ex situ collection. i](#_Toc311279660)

[Annexure 2: Details of *ex situ* collections in the country. iv](#_Toc311279661)

[Annex 3: Crop breeding programs carried out in the country. xi](#_Toc311279662)

[Annex 4: Programs/projects/activities related to seed production and distribution in the country. xiii](#_Toc311279663)

[Annexure 5: List of registered, released and cultivated varieties. xvii](#_Toc311279664)

# Acknowledgement

The National Biodiversity Centre, the National Focal Point for the project “Capacity building and enhanced regional collaboration for the Conservation and Sustainable Use of Plant genetic Resources in Asia (GCP/RAS/240/JPN) would like to thank the Government of Japan for the financial support given for the project and the FAO for facilitating this project and providing technical support. This report is the outcome of inputs and support provided by various national institutions and organizations involved in PGRFA activities. Therefore, the Centre is deeply indebted to each and every staff involved in providing the data and information for this project from the following institutions:

* Department of Agriculture, MoAF, RGoB
* Horticulture Division, DoA, MoAF, RGoB
* National Organic Program, Horticulture Division, DoA, MoAF, RGoB.
* National Potato Development Program, DoA, MoAF, RGoB
* National Seed Centre, DoA, MoAF, RGOB
* RNR-RDC, Bajo, DoA, MoAF, RGoB
* RNR-RDC, Wengkhar, MoAF, RGoB
* Department of Forests and Park Services.
* Council for RNR Research of Bhutan (CoRRB)

# Executive Summary

Bhutan endorsed and signed the Government of Japan funded project “Capacity building and enhanced regional collaboration for the Conservation and Sustainable Use of Plant genetic Resources in Asia (GCP/RAS/240/JPN)” in November, 2008. This is a regional cooperative project between FAO and the member countries. The project activities are closely linked to and contribute to FAO global efforts to support the implementation, monitoring and updating the GPA-PGRFA, which is a supporting component of ITPGRFA.

Through this project, Bhutan developed the National Information Sharing Mechanism (NISM) on PGRFA programs and activities. National Biodiversity Center (NBC) as the National Focal Point for the project led the project and eight other stakeholders from within the Ministry of Agriculture and Forests collaborated in project implementation.

With the institutionalization of PGR programs in the country since 1998, Bhutan has made significant achievements in the field of PGR conservation and sustainable utilization. Country has also addressed most of the GPA-PGRFA priority areas. Noteworthy achievements are the completion of a baseline survey and inventory of field crops of the country, the establishment of a national ex-situ conservation facility (National genebank) along with more than 1100 accessions of crop landraces, promotion of on-farm conservation, promotion of development and commercialization of under-utilized crops, crop diversification, etc. Advances are made also in promoting agriculture through crop diversification. Since the first country report on PGRFA status to FAO in 1996, the research centers have released more than 145 improved crop varieties. This is however a concern from the point of view of conserving landraces as these improved varieties have led to decline in farmer’s interest in cultivating landraces.

Some of the major GPA areas that need to be addressed urgently are the development of a national action plan to address disasters situation in agriculture system, monitoring and early warning system for genetic erosion, enhancement of seed production and distribution system, including seeds of landraces, characterization and evaluation of the existing collections, and survey and inventory of Crop Wild Relatives (CWR) and wild food plants.

# List of Acronyms and Local Names

AEZ Agro-ecological zone

BAP Biodiversity Action Plan

BUCAP Biodiversity Use and Conservation Asia Program

CD Compact Disc

CGIAR Consultative Group in International Agriculture Research

CNR College of Natural resources

CWR Crop Wild Relatives

CoRRB Council for Renewable Natural Resources Research of Bhutan

DAMC Department of Agriculture Marketing and Cooperatives

DoA Department of Agriculture

DoFPS Department of Forests and Park Services

DPA Department of Public Accounts.

FAO Food and Agriculture Organization

GEF Global Environment Facility

GNHC Gross National Happiness Commission

GPA Global Plan of Action

ILCCP Integrated Livestock and Crop Conservation Project

ITPGRFA International Treaty on Plant Genetic Resources for Food and Agriculture

MoAF Ministry of Agriculture and Forests

MAP Marketing, Accessibility and Production

NBC National Biodiversity Centre

NEC National Environment Commission

NBPGR National Bureau of Plant Genetic Resources

NISM National Information Sharing Mechanism

NFP National Focal Point

NGO Non Governmental Organization

PGRFA Plant Genetic Resources for Food and Agriculture

PPD Policy and Planning Division

PGR Plant Genetic Resources

PPB Participatory Plant Breeding

PVS Participatory Varietal Selection

PAM Production, Accessibility and Marketing

RNR Renewable Natural Resources

RNRRDC Renewable Natural Resources Research and Development Centre

RGoB Royal Government of Bhutan

SAARC South Asian Association for Regional Cooperation

SH Stakeholder

TRC Technology Release Committee

TTF Technical Task Force

UNDP United Nations Development Program

**Local Terms**

Geog Block

Dzongkha National Language

Dzongkhag District

# Part I

# Chapter 1: Introduction to the project

Bhutan ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA) on 2nd September 2003 and since then the country has endeavored to abide and promote implementation of its obligations. The project “Capacity building and enhanced regional collaboration for the Conservation and Sustainable Use of Plant genetic Resources in Asia (GCP/RAS/240/JPN)” endorsed and signed in November, 2008, is one such example of Bhutan’s commitment to the effective implementation of the treaty. The project, funded by the Government of Japan, was a regional cooperative project between FAO and the member countries; members of the GCP/RAS/186/JPN project (Bangladesh, India, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam) and new member countries (Bhutan, Cambodia, Indonesia, Lao PDR, Mongolia, Myanmar, Nepal and Pakistan). The duration of the project was for two years, from 2009 to 2011. The main objective of the project was to establish a country driven, Asia wide system that assists the Global Plan of Action (GPA) on PGRFA to support sustainable agricultural development in the Asian region. The project activities are closely linked to and contribute to FAO global efforts to support the implementation, monitoring and updating of the GPA-PGRFA and the preparation of Country’s State of PGRFA report.

The expected outputs of the project were:

a) Establishment of a well-developed and functional Asia-wide coordinated National Information Sharing Mechanism (NISM) for enhancing PGRFA information sharing and collaboration in the member country.

b) Documentation and update of the past and current activities related to the 20 GPA-PGRFA priority activity areas in the project member countries, with identification of future needs and priorities.

c) Strengthening institutional capacity and collaboration amongst member countries for the conservation and sustainable use of PGRFA, including indigenous PGR.

d) Improvement of NISM-GPA computer application.

e) Provision of support to updating the Global Plan of Action.

At a national level, the member countries were to implement one component of the project- Development of National Information Sharing Mechanism for monitoring the GPA for Conservation and Sustainable Utilization of PGRFA. A total budget of USD 25,000.00 was allocated to Bhutan for this component. The objectives for implementation of the above project in Bhutan were:

1. To **establish a NISM** on PGRFA and to **share information** related to PGRFA with stakeholders.
2. To **enhance coordination** of plans and activities on conservation and sustainable utilization of PGRFA in the country.
3. To assist **decision-making** process and priority setting on PGRFA conservation and sustainable utilization in the country.
4. To establish a **monitoring framework** for the National Biodiversity Action Plan implementation, particularly in relation to PGRFA, and GPA implementation at the national level.
5. To aid in priority setting during the formulation of the third Biodiversity Action Plan, particularly in relation to PGRFA conservation and sustainable utilization and GPA.
6. To provide a basis for the preparation of the report on the state of PGRFA in Bhutan and to contribute to the state of world PGRFA report.

**Fig.1: Process of project development and signing.**

**Project document**

FAO BTN

FAO BTN

FAO

NBC Focal point

GNHC

GNHC

24th Dec 08

NBC, MoAF

29th Oct, 08

NBC, MoAF

PPD, MoAF

PPD, MoAF

21st Oct 08

GNHC

**Agreement signed on 24th Dec 08**

**Submission of interest**

# Chapter 2: Project Implementation Process

Subsequent to the signing of the above project in 2008 and as per the framework of the project agreement, the National Biodiversity Centre (NBC) was designated as the National Focal Point (NFP) for the implementation of the project. Once NBC was designated as the NFP for the project, the Centre developed a work plan for the project in consultation with the Technical Advisor, FAO Regional Office, Bangkok, Thailand, based on the activities identified in the project document towards implementing one component of the project - Development of NISM for monitoring the GPA for Conservation and Sustainable Utilization of PGRFA. The NFP/NBC submitted the work plan in August 2009 and the fund amounting to USD 8100 was released in March 2010. A balance amount of USD 2900 from the allocated budget of USD 11,000 was spent through FAO regional office in Bangkok directly for hiring an international consultant through FAO-Bangkok. The letter of agreement endorsing the budget (USD 14,000.00) and work plan for the 2nd year was signed in January 2011 and funds released in March 2011.

The following activities were identified for implementation at the country level:

**1st year activities as per work plan (Budget USD 8,100 + 2900 for TA input = 11,000)**

1. Formation of Technical Task Force (TFF) to oversee implementation of the project and convene TC meetings.
2. Hiring of a data specialist to assist data entry.
3. Procurement of computers and accessories dedicated to the NISM.
4. Training of the data manager on NISM software and data input.
5. Data entry
6. Information sharing on PGRFA through a Biodiversity fair during the celebration of International year of Biodiversity 2010.

**2nd year activities as per work plan (USD 14000)**

1. Gathering information from seven groups of stakeholders
2. Data input into the NISM-GPA database
3. Development of a webpage for NISM-Bhutan to link up to [www.nbc.gov.bt](http://www.nbc.gov.bt)
4. Assessment and improvement of quality of database. Technical Taskforce Meeting
5. Appraisal by Biodiversity Management Board (subject to schedule of 7th BMB meeting)
6. Analysis of PGRFA data including gaps and priorities
7. Finalizing information, operationalizing the web page and Report writing.
8. Publishing a country report on the state of PGRFA including priorities for the future conservation of PGRFA.

**Fig. 2. Flow chart showing the process of work plan development and fund release (1styear)**

FAO Regional Office, Bangkok

NBC, MoAF (NFP)

Nu. 376, 245 (USD 8100)

GNHC & DPA (MoF)

**Work plan**

**Fund release**

**Oct 2009**

**March 2010**

**19th Nov 09**

FAO BTN

**Aug 09**

**Sept 09**

**Sept 09**

**Sept 09**

**Oct 09**

NBC, MoAF

PPD, MoAF

GNHC

FAO BTN

FAO India

**Table 1: Process of fund release for final year activities (2nd year)**

|  |  |
| --- | --- |
| **Time line** | **Activity** |
| January 2011 | Letter of Agreement for implementation of 3rd year activities signed between GNHC and FAO |
| March, 2011 | Fund released by FAO to GNHC and subsequently to DPA |
| April, 2011 | Fund released by DPA to NBC (NFP)  USD 14000/Nu.634,200 |

## 2.1 Formation of technical task force

The establishment and sustenance of the NISM on GPA - PGRFA needs the support of a wide range of stakeholders of PGRFA. Therefore, as highlighted in the project work plan, the first activity initiated was the formation of a technical task force (TFF) in 2009, with representation from agencies dealing with different aspects of PGRFA. The following constitute the TFF members:

1. Dr. Tashi Y. Dorji, Program Director, NBC, Ministry of Agriculture and Forests (MoAF), Serbithang.
2. Mr. Chado Tenzin, FAO Bhutan Representative
3. Ms. Kezang Wangmo, ICT Officer, NBC, MoAF, Serbithang
4. Ms. Asta Tamang, Dy. Chief Biodiversity Officer, NBC, MoAF, Serbithang
5. Mr. Karma Dorji, Dy. Chief Research Officer, Council for RNR Research of Bhutan (CoRRB), MoAF, Thimphu
6. Mr. Tenzin Drugyal, Inputs Coordinator, Department of Agriculture (DoA), MoAF, Thimphu
7. Mr. Kinley Tshering, Chief Forest Officer, Department of Forests and Park Services (DoFPS), MoAF, Thimphu
8. Mr. Karpo Drukpa, Statistical Investigator, Policy and Planning Division (PPD), MoAF
9. Mr. Karma C. Nidup, Specialist, National Environment Commission

Other supporting members:

1. Mr. Singay Dorji, Deputy Chief Biodiversity Officer, NBC, MoAF, Serbithang
2. Mr. Choki Dorji, ICT Technical Associate, NBC, MoAF, Serbithang.

## 2.2 Technical task force and stakeholder consultation meetings and workshops.

The first meeting of the TFF members was held on 22nd December 2009. The objective of the meeting was to acquaint the TFF members on the genesis of the regional project on “Implementation of Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture in Asia and the Pacific region” and its relevance to Bhutan in the following context:

* Information documentation
* Development of National Action Plan on PGRFA
* Development of Global Action Plan on PGRFA
* Monitoring progress in implementation of National Action Plan
* Monitoring progress in implementation of Global Action Plan

With technical assistance from Dr. Rakesh Agarwal, NISM expert from National Bureau for Plant Genetic Resources (NBPGR), New Delhi, India, demonstration on the NISM software and its application was also made for the members to expose them to software and its use and potential as an information sharing mechanism.

The meeting also discussed the roles and responsibilities of the NFP and stakeholders and the work plan for the establishment of a NISM. The resolution from the first TFF meeting was that the National Biodiversity Centre as the NFP should take a lead role in data collection and the stakeholders would provide information relevant to them.

Subsequent to the TFF meeting, NBC conducted a series of stakeholder consultation meetings with individual stakeholders through June to August, 2011. The rationale for such small meetings was that individualized meetings were more practical for providing direct hands-on training and exposure to the NISM software while collecting data simultaneously. Such individualized meetings were also as per the recommendation made by the first TFF meeting.

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Time** | **Organization** | **Remarks** |
| 1/6/2011 | 9.30 a.m – 1.00 pm | DoA, MoAF | Thimphu |
| *,,* | *1.00 – 2.00 pm* | *Lunch break* | |
| ,, | 2 .00 -3.00 pm | CoRRB, MoAF | Thimphu |
| ,, | 3.00 - 4.00 pm | National Organic Program, DoA, MoAF | Semtokha, Thimphu |
|  | 4.00 – 5 p.m | Horticulture division, DoA, MoAF | Thimphu |
| 3/6/2011 | 9 .00– 11.30 am | National Seed Centre, DoA | Paro |
| ,, | 11.30 – 1 .00 pm | Bhutan Alpine Seeds | Paro |
| *,,* | *1.00 – 2.00 pm* | *Lunch break* |  |
| ,, | 2 pm onwards | National Potato Program | Paro |
| 6/6/2011 | 11.00 am onwards | RDC, Bajo | Bajo, Wangdue |
| 20/8/2011 | 9.00- 5 p.m | RDC, Wengkhar | Mongar |

**Table 2: Time table for individual stakeholder consultation meetings:**

In addition to the TFF and stakeholder consultation meetings, a workshop was held for two days in June 2011 (26th to 27th June, 2011) at Paro, as part of an official retreat for thirty three staff members of the National Biodiversity Centre. The objectives of the workshop were:

1. Exposure to the Global Plan of Action (GPA) for *the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*, along with 20 priority activity areas to monitor GPA.
2. Education on country’s obligations as a party to ITPGRFA of FAO and Convention on Biological Diversity.
3. Demonstration of the NISM database software and application and its potential as information sharing mechanism.
4. Strengthening of data documentation and sharing.
5. Building capacity of the staff involved in collection, entry and management of data related to PGRFA.
6. Validation of information gathered in 2010 from NBC as a Focal Point and also as a Stakeholder.



***Staff of NBC/NPF at the NISM workshop from 26th – 27th June 2011, Hotel Zhiwaling, Paro.***

## 2.3: Refresher training for the data manager and data entry personnel.

The ICT officer of the National Biodiversity Centre, who is also the data manager for the project attended the first workshop on basic aspects of the software for NISM-GPA organized by FAO- regional Office in Bangkok from 2nd to 3rd of July, 2009. However, as the workshop was only for two days, which did not provide the adequate skills in using the software, refresher training on the software was conducted from 21st to 25th of December, 2010 with technical assistance from Dr. Rakesh Agarwal of NBPGR, New Delhi, India. Since only one person attended the earlier workshop organized by FAO, this training was provided to all the various stakeholders involved in the project to enable familiarization with the software. The refresher training was also used to carry out real data entry into the common tables, especially the cultivar and organization tables.

## 2.4: Data collection and entry process

As decided during the first TFF meeting, NBC led the data collection and entry process. The first activity initiated was to enter the data into the common table. Once the common table was filled up, CD for various stakeholders were created. NBC entered the data as a stakeholder as well as the NFP. For the other stakeholders, although CDs were created to enable each stakeholder to do their own data entry, it could not be done as not all stakeholders had data managers and for those who had data managers, they had multiple responsibilities which did not enable them to dedicate their time and effort for NISM data entry within the time limit of the project duration. Therefore, as suggested during the first TFF, NBC took up the responsibility of entering the data into the database. Hence, questionnaires along with the common table from the NISM database was exported into word format and distributed to all other stakeholders to answer. Questionnaires were distributed to the following stakeholders:

1. National Potato Development Program, Department of Agriculture (DoA), Ministry of Agriculture and Forests (MoAF), Paro.
2. National Seed Centre, DoA, MoAF.
3. National Organic Program, DoA, MoAF.
4. Horticulture Division, DoA, MoAF.
5. Department of Agriculture, MoAF.
6. Renewable Natural Resource Research and Development Centre, DoA, MoAF, Bajo, Wangdue Phodrang
7. Renewable Natural Resource Research and Development Centre, DoA, MoAF, Wengkhar, Mongar.
8. Policy and Planning Division, MoAF
9. Department of Forests and Park Services.
10. Council for RNR Research of Bhutan (CoRRB)

The questionnaire was not sent to private seed companies and the National Environment Commission (NEC) due to the limited data available with them regarding the questionnaire. Private seed firms are still in their initial stages of development and mostly engaged in multiplication, packaging and sale of improved cultivars released by the government research agencies with very little or no data related to GPA indicators. Therefore it was decided that a more effective method would be to collect and enter simultaneously any data they had during the consultation workshop.

Once questionnaires were sent to all the stakeholders, a team from NFP/NBC comprising data manager, project manager for the project and officer in charge of NBC’s PGR program visited each stakeholder and held consultation meetings. The team explained the details of the NISM-GPA, clarified doubts on the questionnaire, and also demonstrated the operation of the NISM software. Data from some stakeholders were collected and entered simultaneously during these consultation meetings, while for some stakeholders additional time was provided for further data mining and collation from various sources.

Subsequent to receiving data (both common table and data for the 20 priority activity areas) from all the stakeholders in word format, the data manager at NBC entered all the data for each of them in CDs created for each of the stakeholders. Data (Zip file) from the SHs CD were then imported to the NFP version of NISM-GPA for creation of a national profile. Data provided and updated by the SHs in each table of the common table and 20 priority activity areas were then cross checked by the NPF during the process of data merging. Cross checking was necessary to avoid entry of duplicate records, especially for common table data.

## 2.5: Data validation, analysis and report writing process

As a validation mechanism for the data and information collected from various stakeholders, a national consultation workshop with participation from all the stakeholders was held from 20th to 21st July, 2011 at NBC conference hall, Serbithang, Thimphu. However, since not all data providers had provided data despite distributing the questionnaire, the workshop was also aimed at collecting data from those stakeholders. Therefore, the workshop provided a forum for both validating and collecting data.

Dr. Rakesh Agarwal of NBPGR, India who was hired from 17th to 24th July 2011 to support NFP/NBC to review, validate and assess the data quality as well as to assist in solving some of the technical problems faced during the data entry and operation of the software, helped in facilitating the validation workshop.

Once the data merging and validation were completed, the set of data from each item of the 20 priority activity areas were exported to Excel file for data analysis. The results of the analysis are used as the basis for the preparation of these reports:

1. Report on the establishment of NISM on the implementation of the GPA for Conservation and Sustainable Utilization of PGRFA in Bhutan.

2. Bhutan’s PGRFA status report.



**National consultation workshop for data validation, 20th to 21st July, 2011, NBC conference hall.**

**Table 3: Agenda for the consultative workshop for developing National Information Sharing Mechanism (NISM) on PGRFA**

**Date: 20th – 21st July, 2011**

**Venue: NBC conference hall, Serbithang, Thimphu**

**Day 1 (20th July, 2011)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Time** | **Program** | **Stakeholders** | **Remarks** |
| 09.30am | Introduction and status of the project. | NBC |  |
| 9.45-10.00 am | Introduction to NISM | Dr. Rakesh Agarwal |  |
| 10-10.30 am | Tea/Coffee Break |  |  |
| 10.30 am | Information gathering and validation from DoA and agencies under DoA and CoRRB | Representatives of DoA and agencies under DoA. | NBC will present the current information and representatives from concerned Departments and Organizations will provide additional information/validate. |
| 01.00pm | LUNCH BREAK |  |  |
| 02.00pm  to  05.00pm | Continue with information gathering and validation from DoA and agencies under DoA and CoRRB | ,, | ,, |

**Day 2 (21st July, 2011)**

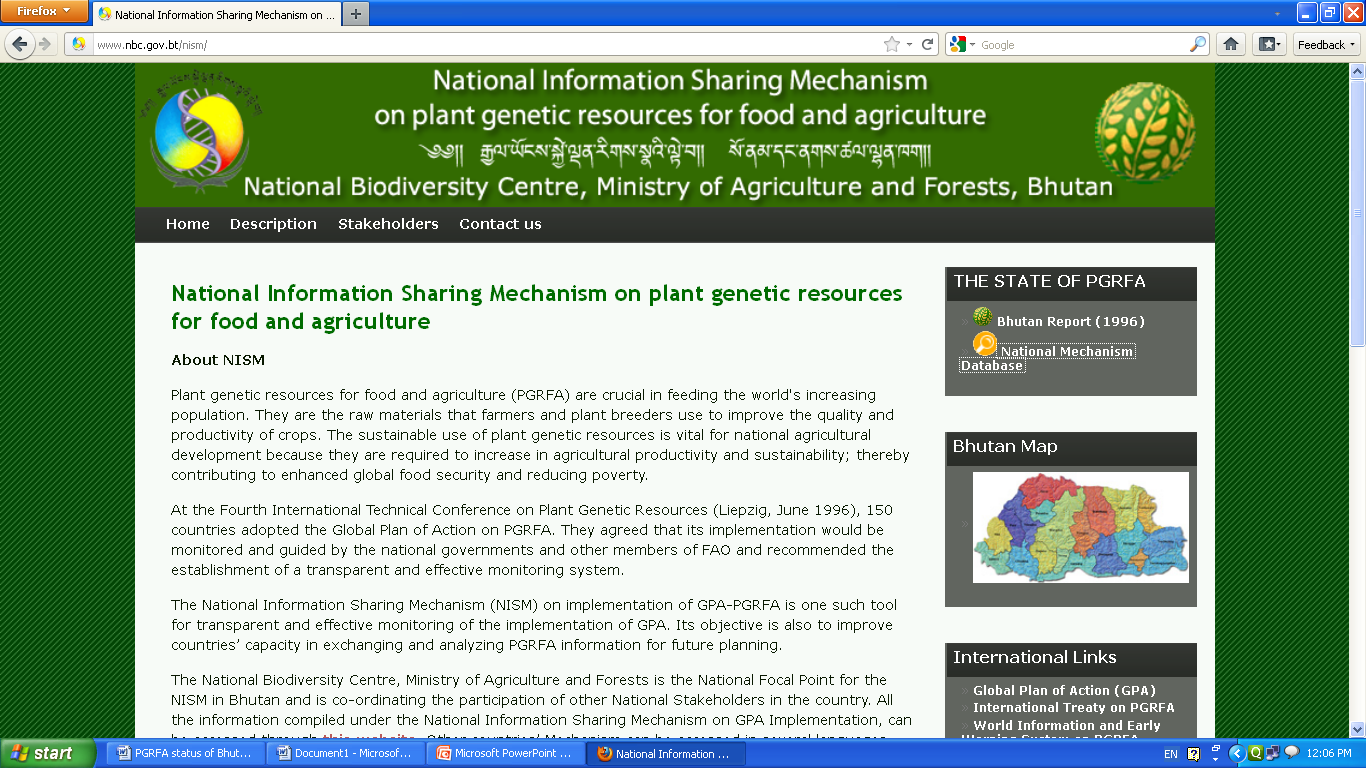
|  |  |  |  |
| --- | --- | --- | --- |
| **Time** | **Program** | **Stakehoders** | **Remarks** |
| 09.30am | Introduction and status of the project | NBC |  |
| 9.45-10.00 am | Introduction to NISM | Dr. Rakesh Agrawal |  |
| 10.30am | Tea/Coffee Break |  |  |
| 10.45am | Information gathering and validation from DoFPS, NEC, PPD, and other relevant agencies | Representatives from NEC, PPD-MoAF, DoFPS and other relevant agencies. | Representatives from concerned Departments and Organizations will provide and validate information where as NBC and Dr. Rakesh will enter into NISM system |
| 01.00pm | LUNCH BREAK |  |  |
| 02.00pm  to  05.00pm | Continue with Information gathering and validation from DFS, NEC, PPD, and other relevant agencies | ,, |  |

**Table 4: Consultation workshop participant information**

|  |  |  |
| --- | --- | --- |
| **S/N** | **Agency** | **No. of participants** |
| 1 | National Seed Centre, DoA, MoAF | 1 |
| 2 | Bhutan Potato Development Program, DoA, MoAF | 1 |
| 3 | Research and Development Centre, DoA, MoAF | 1 |
| 4 | Medicinal and Aromatic Program, Horticulture Division, DoA, MoAF | 1 |
| 5 | Council for RNR Research of Bhutan | 1 |
| 6 | Forestry Resources Development, Division, DoFPS, MoAF | 1 |
| 7 | National Organic Program, DoA, MoAF | 1 |
| 8 | NBC | 4 |
| 9 | FAO Bhutan | 1 |

## 2.6 Development of Bhutan NISM website and linkage to WISM and NBC website.

As NISM was initiated as a national information sharing mechanism for PGRFA, it was necessary to share the collated information through the most effective and widely-used medium. Therefore, concurrent to data collection and validation, a website for Bhutan NISM was developed with technical assistance from a private IT firm. However, as it was not economically justifiable to host a stand-alone website for just NISM Bhutan, it was linked as a subset of the National Biodiversity Centre’s (NFP) website. Subsequent to developing the website, the finalized version of Bhutan NISM was linked to FAO’s World Information Sharing Mechanism (WISM).



**Bhutan- NISM web page**

## 2.7 Other activities supported by NISM project

**2.7.1 Support to attend Global Strategy for Plant Conservation (GSPC) meeting.**

In addition to the development of the NISM, the project also provided partial funding support for the project manager to attend GSPC meeting in United States from 5th to 7th July, 2011. The attendance to this GSPC meeting was supported as this provided an opportunity for enhancing the knowledge and understanding on global conservation initiatives and the inter linkage between PGRFA and other global biodiversity conservation and sustainable utilization efforts.

**2.7.2. Celebration of International Biodiversity Year and day**

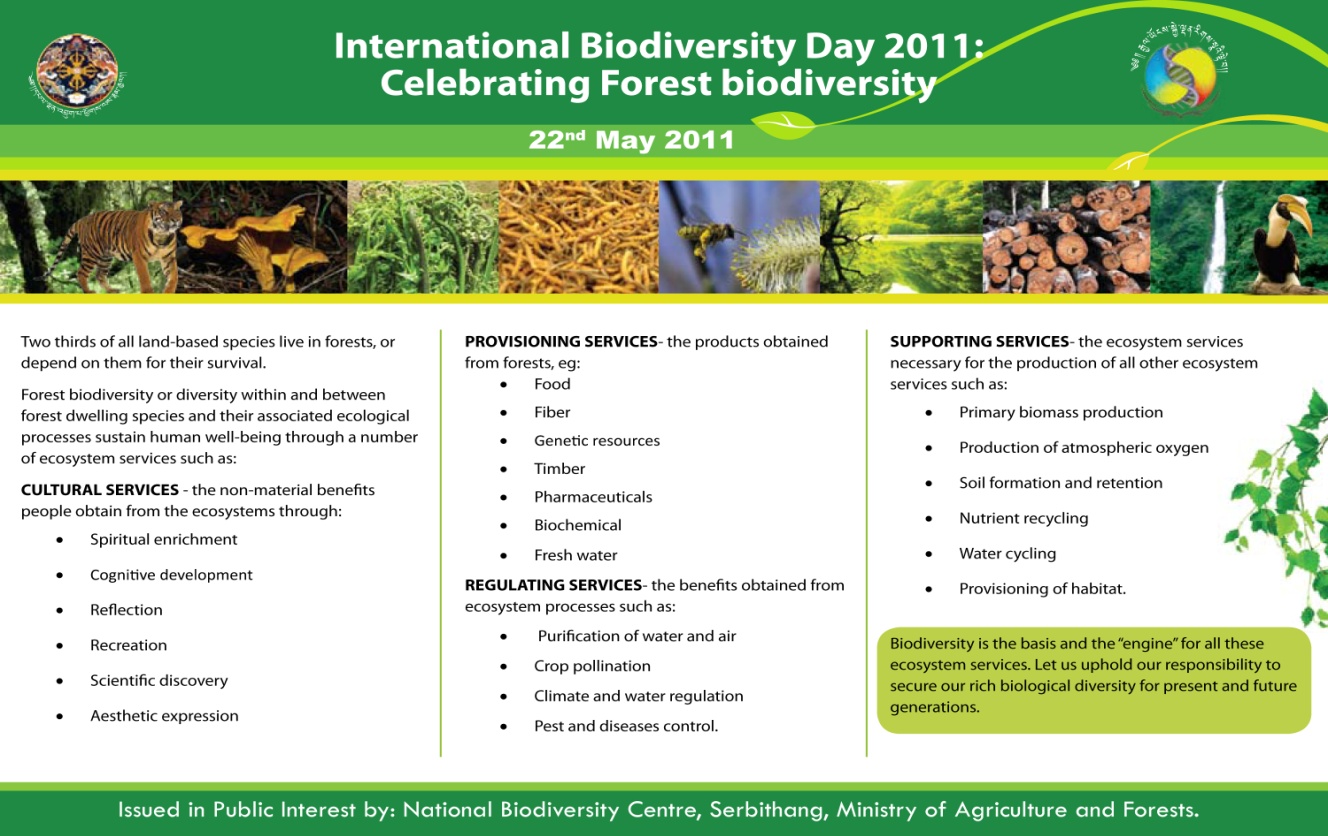
The National Biodiversity Center, the NFP for NISM-GPA on PGRFA has the national mandate to coordinate biodiversity conservation initiatives in the country, including promotion of awareness on importance of biodiversity. Therefore, the Centre organized a biodiversity fair to mark the International Biodiversity Year (2010) as well as the international biodiversity day (22nd May, 2010). This fair was used as a platform to educate the general public on the importance of biodiversity, especially the conservation and sustainable use of traditional agro-biodiversity, which is one of the 20 priority activities of GPA. In 2011, public awareness on importance of biodiversity was made through issuance of publications in the national print media on the international biodiversity day (22nd May, 2011).

**2.7.3. Support to data analysis and report designing and formatting training.**

As it was felt necessary to enhance the capacity of NFP in data analysis and report designing and formatting, a small portion of project fund was utilized to support in-country training in these components.

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**Biodiversity fair 2010: Promoting public awareness on the importance of PGRFA**



**A sample of public awareness promotion on importance of biodiversity/PGRFA through print media**

# Part II

# Chapter 3: Status of PGRFA database in the country at the start of the project.

Bhutan with its wide range of climatic and altitudinal variations within a small distance or area has allowed Bhutanese inhabitants from different ethnic back grounds to grow a variety of crops (BAP, 2009). Further, this relatively difficult terrain with natural isolation of one area from another has allowed the natural selection and localized adaptation of crops and crop relatives. Bhutan’s relative isolation from the other parts of the world until very recent has also provided an opportunity for Bhutanese farmers to select and develop their own locally adapted crops and crop varieties, resulting in this wide array of land races and varieties in the country. For example, Bhutan has more than 280 landraces of paddy and more than 80 land races of maize (NBC, 2008) and about 80 species of agricultural crops are expected to occur in the country (BAP, 2009). This diversity is significant for a country with less than 3 % cultivated agriculture land from a total land area of 38,396 km2 (LCMP, 2010).

The diversity reported is however based only on the published statistics and from few scattered databases. Therefore, it is possible that this statistic is either underestimating or over estimating the diversity, because not all institutions and agencies working with PGRFA have a comprehensive database maintaining records of the survey and inventory of PGR diversity they have carried out. This drawback was made apparent especially during the NISM data collection process. Except for the National Gene Bank database, no other stakeholders had any formal and electronic database system in place. The records were either kept in manual ledgers or in Excel sheets, which proved very difficult in data mining and collating.

# Chapter 4: Current status of PGRFA diversity and programs in the country based on analysis of NISM data base

The country report to FAO International Technical Conference on Plant genetic Resources (Pradhan, 1996) is the only status report of the country’s PGR submitted to FAO till now. The report covers the country’s overall plant diversity and general conservation measures. However, since that report, Bhutan has embarked on many new conservation programs in the country, including the establishment of the National Biodiversity Centre (NBC) in 1998, with a mandate to coordinate overall biodiversity conservation programs in the country. Since its establishment, the Centre has initiated PGR conservation and development programs, along with a dedicated division to coordinate the activities. This report summarizes the achievements made in PGRFA activities after the first Country report of 1996.

## A. *In Situ* Conservation and Development

### Priority Activity Area   1: Surveying and Inventorying Plant Genetic Resources for Food and Agriculture

The National Biodiversity Centre has conducted a major survey and inventory of field crops from 2002- 2003. The inventory has covered at least one representative site from all the major Agro-Ecological Zones (AEZ) of the country. The inventory has used qualitative and quantitative survey techniques including individual interviews, village meetings, PGR mapping, and Participatory Rural Appraisal. The results of the survey are published as “Plant Genetic Resources of Bhutan, Vol. 1: Field Crops, 2008”. The inventory has identified the following threats to PGRFA diversity in the country:

1. Displacement of land races by new and genetically uniform cultivars.
2. Switch from diverse cropping system to few market oriented cash cropping system.
3. Environmental degradation and destruction of habitats due to urbanization.
4. Wild animal damage.
5. Drought/untimely rain/shortage of irrigation facilities.
6. Banning of shifting cultivation.
7. Low yield.
8. Land clearing/landslides and habitat loss/soil erosion problem.
9. Shortage of farm labour.
10. Change of food habits.

In addition to the above survey and inventory, PGR diversity assessment was also carried out at Biodiversity Use and Conservation in Asia Program (BUCAP) project sites of the country. The project is coordinated by the On-farm Conservation unit under the PGR program of the National Biodiversity Centre (NBC) and is implemented by the RNR Research and Development Centres (RNR-RDCs) and Dzongkhag Agriculture Sector. Table 5 shows the sites of the survey carried out through the BUCAP project. This survey has identified access to improved varieties and change in food habitats as threats to traditional crop varieties. Details of the survey report can be found in the BUCAP project annual reports from NBC. Other SHs- Horticulture Division, RNR-RDCs (Wengkhar and Bajo) have also carried out survey and inventory of horticultural crops and wild edible plants (Table 6). Comprehensive survey and inventory of horticultural crops are planned from 2012.

**Table 5: Areas of BUCAP project sites surveyed for PGRFA diversity assessment**

|  |  |
| --- | --- |
| **Area** | **District/Dzongkhag** |
| Dramitse | Mongar |
| Kanglung | Trashigang |
| Khaling | Trashigang |
| Geyne | Thimphu |
| Dopshari | Paro |
| Goenshari | Punakha |
| Damji | Gasa |
| Thedtsho | Wangduephodrang |
| Samthang | Wangduephodrang |
| Rukha | Wangduephodrang |
| Taksha | Wangduephodrang |
| Silli | Wangduephodrang |
| Barshong | Sarpang |

**Table 6: PGRFA diversity survey and inventory carried out by other agencies of the Ministry of Agriculture and Forests and the areas covered.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lead agency of the survey** | **Title of survey/inventory** | **Name of area surveyed/inventoried** | **Reference** | **Description of major findings** |
| Horticulture Division,  DoA, MoAF | Survey on Wild Edible Plants | Different parts of Bhutan | Wild Edible Plants and their Traditional Knowledge in Bhutan |  |
| Horticulture Division,  DoA, MoAF | Identification of Mandarin in Bhutan by using Morphological Characteristics and AFLP Analysis | Samtse Dzongkhag;  Sarpang Dzongkhag;  Tsirang Dzongkhag;  Dagana Dzongkhag;  Trongsa Dzongkhag;  Zhemgang Dzongkhag;  Mongar Dzongkhag | Identification of Mandarin in Bhutan by using Morphological Characteristics and AFLP Analysis |  |
| Horticulture Division,  DoA, MoAF | Phylogenetic relationships of Citrus and its relatives based on rbcL gene sequences | Mongar Dzongkhag;  Punakha Dzongkhag;  Lhuentse Dzonkhag;  Trashi yangtse Dzongkhag;  Trashigang Dzongkhag | Phylogenetic relationships of Citrus and its relatives based on rbcL gene sequences |  |
| Renewable Natural Resources Research and Development Centre - Wengkhar | Survey on local pear types available in the region | Pear growing regions in the country | RDC Wengkhar Annual Report 2005-2006 | Local pear diversity observed to be grown from 755m asl in the south to as high as 2700m asl in the north.  About 11% of the pear fruits were found to be good in size. Majority of the local fruits were either acidic or astringent in nature. Local pears can be profitably employed as rootstock for multiplication of improved cultivars. |
| Renewable Natural Resources Research and Development Centre - Wengkhar | Survey on Wild Kiwi available in Bhutan | Khaling,Trashigang;Sengor, ;Wengkhar, Mongar;Korila;Phongmey, Trashi gang | RDC Wengkhar Annual Report 2005-2006 | Wild kiwi was found in elevation range of 1500-3000m asl. The plant seems to require lot of sun shine and was observed growing in areas receiving adequate sunshine as in the open road side, open sites in the forest and among small trees and shrubs. The plant was observed to be grown naturally in the cloud forest area with high humidity. |

*Constraints and comments in carrying out the survey and inventory of PGRFA*

The major constraints identified in carrying out the survey and inventory of PGRFA in the country are:

1. Insufficient funds
2. Insufficient number of staff
3. Staff without adequate skills such as lack of adequate taxonomic skills

The first PGRFA survey and inventory led by NBC had covered only the grains and legume crops, as such the need for survey of other groups of crops have been identified as a priority. However, development of technical skills of the staff involved, refinement of the survey methodology and fund sourcing are the prerequisites identified before embarking on the second phase survey.

Survey and inventory of indigenous vegetables and fruits, along with characterization (morphological, molecular, phyto-nutrient) of wild fruits and nuts, domestication, conservation and crop development are other priorities identified by Horticulture Division of the Department of Agriculture. Documentation and maintenance of Community Biodiversity Register is also a priority to understand the diversity at community level.

### Priority Activity Area   2   Supporting On-Farm Management and Improvement of Plant Genetic Resources for Food and Agriculture

Currently, as per the data collected from NISM stakeholders, there are about 10 programs and projects in place supporting the on-farm management and improvement of PGRFA. Table 7 shows the details of the projects/programs in the country.

**Table 7: Programs and projects supporting on-farm management and improvement of PGRFA in the country.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lead agency** | **Name of on-farm conservation programme/project** | **Local farmer community involved** | **Activities include:** | **Other activities** |
| National Biodiversity Center | Integrated Livestock and Crop Conservation Program | Farmer's Community of: Chhoekhor,Bumthang;  Dechheling,Pema Gatshel;  Dungtoe,Samtse;  Gakiling,and Sombaykha,Haa;  Mendrelgang and Semjong, Tsirang;  Nangkor,Zhemgang; | 1.Pilot sites established in areas of high diversity;  2.Studies on local varieties population structure and dynamics;  3.Assessment of local varieties utilization and management;  4.Socio-economic assessment of PGRFA on-farm management and improvement | 1. Seed selection and maintenance  2. Enhancing production through organic farming.  3. Value addition, marketing & income generation.  4. Community empowerment through trainings.  5. Restoration/maintenance of diversity and enhancing resilience of production system. |
| National Organic Program | Organic Buckwheat Program | Farmer's Community of: Chhoekhor,Bumthang;  Sombaykha,Haa | Seed multiplication and distribution of bred varieties | Value addition and marketing |
| National Organic Program | Organic Rice Program | Tsirang Farmers;  Bumthang farmers | Studies on local varieties population structure and dynamics | value addition and marketing |
| National Organic Program | Organic Vegetable Program | Samdrup Jongkhar Farmers;  Gasa Farmers;  Paro farmers;  Tsirang Farmers | 1.Assessment of local varieties utilization and management;  2.Assessment of improved varieties utilization and management |  |
| Renewable Natural Resources Research and Development Centre - Bajo | Biodiversity Use and Conservation in Asia Program | Farmer's Community:  Samthang and Thedtsho,Wangdue Phodrang | 3.Characterization and evaluation of local varieties;  4.On-farm breeding;  5.Seed multiplication and distribution of bred varieties;  5.Assessment of local varieties utilization and management | 1.Broadening of genetic base of food crops  2.Training and empowerment of community  3*.In situ* conservation of food crops  4.PVS on rice and maize  5.Training on seed selection  6.Vegetables production and nutrition |
| Renewable Natural Resources Research and Development Centre (RNR-RDC) Wengkhar | On-farm vegetable seed production program | Samdrup Jongkhar Dzongkhag;  Pemagatshel Dzongkhag;  Trashiyangtse Dzongkhag;  Lhuntse Dzongkhag;  Mongar Dzongkhag;  Trashigang Dzongkhag | Seed multiplication and distribution of bred varieties | Transfer of knowledge to the farmers on vegetable seed production and maintenance techniques. |
| RNR-RDC, Wengkhar | Improvement / rejuvenation of local fruits and nuts with improved cultivars through top-working techniques | Samdrupjongkhar Dzongkhag;  Pemagatshel Dzongkhag;  Trashiyangtse Dzongkhag;  Lhuntse Dzongkhag;  Mongar Dzongkhag;  Trashigang Dzongkhag | Assessment of improved varieties utilization and management | Hands on practice on top-working technique. |
| RNR-RDC, Wengkhar | Community Based Seed Bank Tshogpa, | Phuntshothang, Samdrup Jongkhar | 1.Pilot sites established in areas of high diversity;  2.Assessment of farmers' knowledge;  3.Seed multiplication and distribution of bred varieties |  |
| RNR-RDC, Wengkhar | Community Based Seed Production Group |  | Seed multiplication and distribution of bred varieties |  |
| RNR-RDC, Wengkhar | Upland Paddy Cultivation Tshogpa | Farmers community of :  Decheling and Norbugang, Samdrup Jongkhar.  Silambe and Gongdue, Mongar | Seed multiplication and distribution of bred varieties |  |

On-farm conservation and development programs in the country are fairly integrated into national programs and in some cases supplemented by government fund. There is policy and institutional support for on-farm management of PGRFA in the country. Currently, economic incentives such as support to product diversification, marketing, seed production and distribution services are provided through donor supported projects. Some of the major constraints to on-farm management and improvement of PGRFA are inadequate incentives to farmers, poor quality planting materials, insufficient skills and training, and financial support. Additional limitations pointed out by SHs in on-farm PGRFA management are:

* Famers’ illiteracy resulting in difficulty in convincing them about the values of managing diverse PGRFA on-farm;
* Lack of awareness;
* Out crossing resulting in degeneration of the varieties;
* Lack of information on functional component and nutritive value of local germplasm;
* Transition from subsistence agriculture (diverse cropping) to semi - commercial or mono cropping culture;
* Undesirable horticultural characteristics of local PGR (low yield, astringency, small size, seediness etc).

Conservation is a long term effort. In order not to negate the momentum the country has gained in on-farm management and improvement of PGRFA, it is imperative that the efforts and support be continued. The future focus of the country identified for successful on-farm management of PGRFA in the country is in the following areas:

1. Development of national policy on PGRFA.
2. Institutionalizing and strengthening of on-farm conservation unit at NBC.
3. Mainstreaming PGRFA into national plans and programs.
4. Capacity development of the local communities in on-farm management of PGRFA.
5. Strengthening community seed systems.

### Priority Activity Area   3   Assisting Farmers in Disaster Situations to Restore Agricultural Systems

Till date Bhutan has been fortunate that it has not faced any disasters requiring acquisition or reintroduction of germplasm from outside the country. However, as a precautionary measure for such situations, Bhutan is already on its path to establish mechanisms to facilitate rapid acquisition, multiplication, distribution and cultivation of reintroduced germplasm. In addition, NBC has also initiated discussions with the Department of Agriculture to look into the possibilities of setting up a National Seed Reserve within the scope of SAARC Seed Reserve Program. Till date three community based seed banks have already been established; two in the east and one in the south. However, as Bhutan does not have a national action plan to assist farmers to recover and preserve PGRFA following disasters, this need has to be urgently addressed by concerned agencies. Further, currently no assessments have been carried out on seed security in the country. There is a need to identify relevant agencies to conduct seed security assessment to enable formulation of effective measures and interventions to ensure national seed security. Bhutan also needs to draw agreements with regional and international organizations for rapid acquisition of PGRFA should any disaster befall the country. Further, there is also a need to strengthen the information system and information sharing mechanism on the local seed supply system and germplasms currently available in the national gene bank or in the community seed banks.

### Priority Activity Area   4   Promoting *In Situ* Conservation of Crop Wild Relatives and Wild Plants for Food Production

Along with the rich diversity of domesticated crops, Bhutan is considered rich in wild relatives of many crops and wild food plants. Tamang (2003) reports 230 species of Crop Wild Relatives (CWR) belonging to 120 genera under 51 families. The strong and sound conservation policy of Bhutan with more than 50% of the country under a protected area system has led to the conservation of CWR and wild edible plants by default. However comprehensive surveys and inventory of crop wild relatives and wild edible plants and their conservation have not been carried out in the country due to the lack of taxonomic expertise, inadequate staff and lack of funding support. In comparison, *in situ* conservation of wild food plants fares better than the crop wild relatives. For example, the organic mushroom program promotes *in-situ* conservation of wild mushroom (e.g [*Pleurotus ostreatus* ([Jacq.](http://en.wikipedia.org/wiki/Nikolaus_Joseph_von_Jacquin) ex [Fr.](http://en.wikipedia.org/wiki/Elias_Magnus_Fries)) [P.Kumm.](http://en.wikipedia.org/wiki/Paul_Kummer))](javascript:displayrefreport('taxtab','75658','S-18-13'))  through the implementation of sustainable management practices and involvement of local communities. Scattered records of wild edible plants are also available. Stronger programs focusing on the comprehensive inventory and survey of both Crop Wild Relatives (CWR) and wild food plants are needed to formulate *in-situ* conservation programs and to strengthen Environmental Impact Assessments (EIA). The need to inventory and survey these important resources has been identified in the National Biodiversity Action Plan (BAP, 2009) and in the National Action Plan for Biodiversity Persistence and Climate Change (NBC, 2010).

## B. *Ex- Situ* Conservation

### Priority Activity Area   5   Sustaining Existing *Ex Situ* Collections

The two major *ex situ* collection methods practiced in Bhutan are field gene bank and seed banks. Field gene banking has been practiced in Bhutan since agriculture development started in the late sixties to early seventies. Most collections in the field gene banks are of native fruit trees maintained for selection of better quality fruits or to provide scion wood for production of seedlings, while some collections are of improved cultivars. Seed banking with long term storage facility started very recently in Bhutan with the establishment of the National Gene bank at NBC in 2005. Seed banks maintained in other agencies are mostly short to medium term and only for evaluation and maintenance of basic seeds and seed multiplication to supply to commercial seed supplier. Annex I provides the details of *ex situ* collections programs in the country and Annex II provides the details of collections in *ex situ* holdings.

Bhutan currently has little more than 1100 accessions from 45 taxa at the National Genebank within the country, which is a huge achievement from 1996 stage when in-country *ex situ* collection was non-existent. IPGRI had collected 465 accession of 33 taxa in 1981 and IRRI had collected 217 accession of rice from 1976 to 1984 (Pradhan, 1996) which were all held outside Bhutan.

The major constraints expressed by the SHs in implementing *ex-situ* conservation programs in the country are the lack of funding, training and facilities, insufficient staff and equipment. Some have also expressed occurrence of pest and disease and irregular electrical supply as the constraints in implementing *ex situ* conservation programs.

*Needs and priorities to sustaining ex situ collections in the country.*

1. Improvement of germplasm quarantine facilities.
2. Building capacity in taxonomy, quarantine, characterization, seed storage behavior and equipment maintenance.
3. Development of an alternative arrangement to store duplicate accessions.
4. Expansion of the current mandates of field gene banks to include conservation concerns.
5. Improvement of PGR documentation and information sharing system.

### Priority Activity Area   6   Regenerating Threatened Ex Situ Accessions

Since germplasm collection for *ex situ* conservation started very recently, towards the end of 2005, the priority has been to build up accession. In addition, a***s*** most of the accessions in the gene bank are fresh accessions with the oldest collection being only five years old, no regeneration has been carried out except for the on-station multiplication of ‘small samples’ obtained during germplasm exploration and collection for temperate cereal crops. In addition, when the sample quantity is inadequate and considered threatened, the donor farmers are asked to multiply the seed of target taxon in the target AEZ and provide sufficient quantity of seed to the Gene Bank. However, in order to initiate systematic regeneration, there is a need to improve the genebank monitoring system and develop capacity in regeneration and documentation.

### Activity Area   7   Supporting Planned and Targeted Collecting of Plant Genetic Resources for Food and Agriculture

*Ex situ* collections of PGRFA germplasm are being carried out from different AEZ cross the country. However, the current collection is limited to only grain and legume crops. Annexure 2 shows the details of *ex-situ* collections of PGRFA. Therefore, there is a need to carry out comprehensive exploration and collection of crop diversity, including horticultural crops, wild relatives and rare and endangered species. In addition, building technical capacities, expanding facilities for recalcitrant seeds and sourcing additional funding support are the priorities to enable comprehensive *ex-situ* collection and management of PGRFA.

### Activity Area   8   Expanding *Ex Situ* Conservation Activities

*Ex situ* conservation of PGRFA with orthodox seeds started in 2005. The current Gene Bank provides facilities for processing and preservation of only the crops with orthodox seeds. There are no facilities for other group of crops with recalcitrant seeds and those crops that require vegetative propagation techniques, emphasizing the need for the establishment of a Cryo Bank and an In-vitro Bank. To enable implementation of up scaled *ex situ* conservation activities, there is a strong need for adequate number of trained staff in this field and funding support.

## C. Utilization of Plant Genetic Resources

The utilization of plant genetic resources is very high in Bhutan. About 69 percent of our rural population depends directly on natural resources for their livelihood (NBC, 2010). The National Mushroom Centre has documented more than 90 species of forest mushroom in the country. Several of these species such as *Catherellus cibarius, Clavaria botrytis, Auriculari auricula* are very popular in local cuisine. Many wild plants such as *Elastostema lineolatum, Laportea terminalis, Diplazium esculentum, Cymbidium spp., Dioscorea sp.* andmany species of Bamboos and Canesare sources of alternative food for the local communities and are also found in local food markets. From the point of view of *ex situ* collection and utilization, though the accessions in the Gene Bank are minimal and collections are on-going, utilization of accessions from the gene bank has already been initiated. The re-introduction and rehabilitation of germplasm samples from the Gene Bank into the field for some crops like maize and buckwheat are some examples.

### Activity Area   9   Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use

Out of 43 taxa held in collections by five SHs, most taxa are characterized based only on morphological traits. Except for rice, which has been evaluated for abiotic and biotic stresses to some extent, most taxa are evaluated only for agronomic traits.

**Table 8: Percent of accession characterized and/or evaluated for different types of descriptors.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Stakeholder** | **Name of taxon** | **Name of crop/crop group** | **Percent of accessions characterized** | | **Percent of accessions evaluated** | | | |
| **Morpho. traits** | **Mol. Markers** | **Agro. Traits** | **Biochem traits** | **Abiotic stress** | **Biotic stress** |
| NBC | *Eleusine coracana* | Field Crops | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Amaranthus sp.* | Minor crops | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Hordeum vulgare* | Field Crops | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Phaseolus sp.* | Beans/Legumes | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Zea mays* | Maize/Field Crops | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Brassica campestris var. toria* | Mustard/Oil seeds | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Oryza sativa* | Rice/Field Crops | 5 | 0 | 5 | 0 | 5 | 5 |
| NBC | *Pisum sativum* | Green peas/Legumes | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Glycine max* | Soybean/Legumes | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Vigna sp.* | Mung bean/Legumes | 0 | 0 | 0 | 0 | 0 | 0 |
| NBC | *Triticum aestivum* | Wheat/Field Crops | 0 | 0 | 0 | 0 | 0 | 0 |
| BPDP | *Solanum tuberosum* | Potato | 100 |  |  |  |  |  |
| RNR-RDC-Bajo | *Oryza sativa* | Rice | 10 | 0 | 10 | 0 | 5 | 10 |
| Horticulture Division | *Citrus reticulata* | Mandarin (Local) |  | 0 |  |  |  |  |
| RNR-RDC-Wengkhar | *Citrus reticulata* | Mandarin | 60 | 0 | 90 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus medica* | Citron | 30 |  | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus aurantiifolia* | Lime | 30 |  | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus ichangensis* | Papeda | 30 |  | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus limon* | Wild Lemon | 30 |  | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Diospyros sp.* | Persimmon | 0 | 0 | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Juglans regia* | Walnut | 90 | 0 | 60 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus reticulata* | Ponkan Mandarin | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus unshiu* | Satsuma Mandarin | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus reticulata* | Tangelo Mandarin hybrids | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus reticulata* | Common Mandarin | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus reticulata* | Clemmentine Nules | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus limon* | Lemon | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus sinensis* | Orange | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Pyrus pyrifolia* | Asian Pear | 60 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Diospyros kaki* | Persimmon | 60 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Prunus persica* | Peach | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Prunus sp.* | Plum | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Malus domestica* | Apple | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Olea europaea* | Olive | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Prunus cerasus* | Cherry | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Vitis vinifera* | Grapes | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Actinidia chinensis* | Kiwifruit | 50 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Persea americana* | Avocado | 20 | 0 | 50 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Mangifera indica* | Mango | 60 | 0 | 60 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Juglans regia* | Walnut | 50 | 0 | 70 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Castanea sp.* | Chesnut | 40 | 0 | 60 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Corylus avellana* | Hazelnut | 50 | 0 | 60 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Brassica oleracea var. botrytis* | Cauliflower | 100 | 0 | 100 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Brassica juncea* | Mustard Green | 100 | 0 | 100 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Daucus carota* | Carrot | 100 | 0 | 100 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Capsicum annuum* | chilli | 100 | 0 | 100 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Cucurbita maxima* | Pumpkin | 100 | 0 | 100 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Citrus paradisi* | Wild Grapefruit | 30 |  | 0 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Poncirus trifoliata* | Citrus Rootstocks | 70 | 0 | 80 | 0 | 0 | 0 |
| RNR-RDC-Wengkhar | *Fortunella japonica* | Kumquat |  |  |  |  |  |  |
| RNR-RDC-Wengkhar | *Citrus maxima* | Pomelo |  |  |  |  |  |  |

In terms of technical capacity in characterization and evaluation, only two SHs and the NFP have some capacity in morphological characterization and evaluation for agronomic traits. Except for one staff of the NFP who has basic knowledge on molecular characterization, none of the SHs have capacity to perform molecular characterization. This emphasizes the need for enhancement of technical capacity to perform characterization and evaluation for various traits. There is also a need to establish a central/common laboratory facility for molecular characterization to assess and quantify genetic diversity at molecular level. As the Genebank is new, the accessions are limited in number because of which development of core collections are yet to be initiated in the country. The Horticulture Division has also indicated the need for support in expanding characterization, evaluation and development of core collection for Citrus and other horticultural crops.

Some of the constraints reported in the characterization and evaluation of germplasm are the insufficient number and inadequate skills of the staff and lack of financial support.

### Activity Area   10   Increasing Genetic Enhancement and Base-Broadening Efforts

All four SHs who responded had indicated that their capabilities to perform breeding were declining. Annex 3 shows the plant breeding programs reported by SHs. Four genetic enhancement programs are reported. Genetic enhancement of rice was carried out through introgression for specific traits and for pear, walnut and persimmon, top working for population improvement was conducted. PVS is also under way in rice in some of the BUCAP project sites for broadening the genetic base.

Breeding is the mandate of research centers in the country and the priorities are to genetically improve the existing local materials so that they become more productive (high yields), resistant to prevailing pests and disease and tolerant to abiotic stress such as cold and drought. Since the capability to perform breeding is declining in general, there is a need for more collaboration with CGIAR centers and regional research centers for developing and exchanging expertise, as well as in germplasm exchange.

Needs and priorities in genetic enhancement and base-broadening efforts:

* PVS and PPB needs to be upscaled to link famers and researchers to enhance/ broaden genetic base and utilization of locally adapted traditional varieties and improve their traits as per the felt need of the farmers.
* Capacity building in PVS and PPB.

### Activity Area   11   Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops.

Five SHs are involved in implementing/coordinating programs and projects related to assessment or improvement of diversity within and amongst crops or crop production systems to promote sustainable agriculture. Three grain crops and other horticultural crops, including mushroom are the taxa involved in these projects. Increasing intra-specific diversity and increasing diversity in agricultural systems are the two most prominent issues addressed by these programs and projects. The incentive mechanisms to promote crop diversification include supply of locally adapted seeds, training on improved agronomic practices to enhance production, product development and diversification, supply of product processing equipment, and marketing.

Major constraints listed by SHs in diversification of crops and crop production systems are:

1. Marketing/commercial obstacles;
2. Obstacles to officially released heterogenic material as cultivars;
3. Manpower and financial shortage;
4. Transition from subsistence farming (diversity in farming) to semi -commercial or mono cropping culture;
5. Limited access to germplasm;
6. Lack of scientific evidences (R&D) to support traditional knowledge on nutritive properties of traditional PGRFA.
7. Lack of value addition/processing facilities for traditional PGRFA for product development, product diversification and marketing.
8. Lack of technical capacity to assess ecosystem services of sustainable/diversity rich agriculture system versus monocropping/modern agriculture.
9. Lack of adequate research on production economy of diversity- rich agriculture systems/organic agriculture versus modern agriculture.

**Table 9: Programme/project/activity related to assessment or improvement of diversity within and among crops or crop production**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SH** | **Name of programme/project/activity** | **Name of taxon** | **Name of crop** | **Topics covered** |
| NBC | *In-situ*/On-farm Conservation Program, Agro-Biodiversity Conservation & Utilization Program | *Oryza sativa* | Rice | 1.Increasing intra-specific diversity in crops;  2.Assessing/monitoring diversity in agricultural systems;  3.Increasing diversity in agricultural systems |
| NBC | *In-situ*/On-farm Conservation Program, Agro-Biodiversity Conservation & Utilization Program | *Zea mays* | Maize | 1.Increasing intra-specific diversity in crops;  2.Assessing/monitoring diversity in agricultural systems;  3.Increasing diversity in agricultural systems;  4.Participatory diversity methods applied |
| NBC | *In-situ*/On-farm Conservation Program, Agro-Biodiversity Conservation & Utilization Program | *Fagopyron esculentum* | Buckwheat | 1.Assessing/monitoring intra-specific diversity in crops;  2.Increasing intra-specific diversity in crops;  3.Assessing/monitoring diversity in agricultural systems;  4.Increasing diversity in agricultural systems;  5.Participatory diversity methods applied |
| NOP | Organic Vegetable Program | *Solanum tuberosum* | Potato | Increasing diversity in agricultural systems |
| NOP | Organic Vegetable Program | *Asparagus officinalis* | Asparagus | Increasing diversity in agricultural systems |
| NOP | Organic Vegetable Program | *Capsicum annuum* | Chilli | Increasing diversity in agricultural systems |
| NOP | Organic Vegetable Program | *Brassica oleracea* | Broccoli | Increasing diversity in agricultural systems |
| NOP | Organic Vegetable Program | *Zingiber officinale* | Ginger | Increasing diversity in agricultural systems |
| NOP | Organic Mushroom Program | *Pleurotus ostreatus (jacq.P.Kumm)* | Straw mushroom | Increasing diversity in agricultural systems |
| BPDP | Potato Development Program | *Solanum tuberosum* | Potato | 1.Increasing intra-specific diversity in crops;  2.Increasing diversity in agricultural systems |
| RNR-RDC, Bajo | Rice breeding | *Oryza sativa* | Rice | 1.Increasing intra-specific diversity in crops;  2.Increasing diversity in agricultural systems |
| RNR-RDC, Bajo | Maize Development Program | *Zea mays* | maize | 1.Increasing intra-specific diversity in crops;  2.Increasing diversity in agricultural systems |
| RNR-RDC, Wengkhar | Research Outreach Program |  | Fruits and Vegetables | 1.Assessing/monitoring diversity in agricultural systems;  2.Increasing diversity in agricultural systems |

The diverse topography, micro-environment and agro-ecological zones of Bhutan requires farmers to grow diverse crops. This provides an opportunity to promote on-farm conservation and management of this diversity. However, for farmers to continue maintaining this diversity there are priorities and needs to be addressed, some of which are listed below:

* Create an enabling policy environment to support diversification of crops and agriculture system.
* Promote utilization of local diversity through value additions, product development and diversification.
* Improve market accessibility and marketing.
* Promote farmers organization/groups for product diversification and marketing.
* Promote awareness amongst consumers through different forms of media (Print, biodiversity and food fairs, TV shows in Dzongkha and English) on the importance of local crops and their significance.
* Make information on collected germplasm accessions accessible to researchers, extension officers and farmers to promote utilization of *ex-situ* conserved materials.
* Promote seed exchange by providing different forums e.g: biodiversity fairs.
* Improve informal/farmers’ seed system.
* Research and training support in PVS/PPB/GXE experiments.

### Activity Area   12   Promoting Development and Commercialization of Under-Utilized Crops and Species

17 under-utilized taxa are identified in the country, out of which nine are identified as medium priority for development and sustainable use. There are four on-going projects for development and commercialization of three taxa, viz: *Fagopyrum esculentum, Pyrus communis* and *Juglans regia.* Although there are some on-going post harvest and marketing activities for some taxa, other activities such as mapping geographical distribution, characterization/evaluation, multiplication of seed/planting materials and development of a documentation system are only at the planning stage for most of the taxa. However, development and commercialization of under-utilized crops are included in the Biodiversity Action Plan and Draft Food and Nutrition Security Policy of Bhutan, indicating strong policy support in the country.

Some of the constraints faced in promoting development and commercialization of under-utilized crops and species are:

1. Insufficient number of staff
2. Lack of sufficient skills in product development and diversification
3. Low yield and low volume of production to meet the economy of scale
4. Shortage of man power in the field
5. Lack of expertise in product diversification

Priorities and needs to promote development and utilization of under-utilized crops and crop species

1. Exploration and collection of diverse under-utilized crop and crop species
2. Building technical capacity in value addition, characterization and evaluation
3. Setting up of small agro-industries/explore private firms to promote product development and diversification.

### Activity Area   13   Supporting Seed Production and Distribution

The National Seed Centre (NSC) is the main SH involved in seed production and distribution of all released crop varieties in the country. Other SHs are involved with seed production and distribution of only specific crop groups related to their mandates. Annexure 4 shows the details of the programs/projects/activities related to seed production and distribution in the country. In terms of legal requirement for variety registration, all crops are required to follow the standard procedure of varietal evaluation and registration. Distinctness, Uniformity and Stability (DUS) and Value for Cultivation and Use (VCU) are the criteria used for registration. Council for RNR Research of Bhutan (CoRRB) with technical support and guidance from Technology Release Committee (TRC) of the MoAF is responsible for variety registration in the country.

Major constraints in the country in making seeds of new varieties available in the market are:

1. Availability and cost of required production inputs;
2. Distance to seed supplier;
3. Inadequate seed distribution systems;
4. Inadequate seed production systems;
5. Availability of basic/foundation seed;
6. Insufficient availability of commercial seed;
7. Insufficient availability of disease-free planting material;
8. Insufficient availability of registered/certified seed;
9. Low seed physical purity;
10. Poor seed germinability;
11. Poor seed storage facilities;
12. Seed price too high as compared to commodity price.

Despite the mechanism in place to support local seed growers associations, the seed sector in Bhutan is under-developed, because of which farmers face the problems of getting timely and affordable seeds and planting materials. Government supports promotion of local varieties but there are no firms multiplying and supplying seeds of local varieties. As seen in annexure 5, most of the varieties registered and supplied are of improved varieties. More than fifty percent of the area under rice, wheat and maize and 100% under potato and cardamom cultivation are with modern varieties.

In Bhutan about 98% of the seeds used by our farmers are informal seeds or seeds of traditional crop varieties maintained by the farmers themselves. Therefore, in a way, our farmers are seed secure and not controlled by externalities that is being confronted by farmers in other regions. However, the seed quality is one of the major constraints of the informal seed system. Therefore, there is a need for intervention to improve both the informal and the formal seed systems in the country.

### Activity Area   14   Developing New Markets for Local Varieties and 'Diversity-Rich' Products

Policy documents such as Economic Development Policy of Bhutan 2010, Cooperative Act of Bhutan 2009, and National Organic Program Strategy (Draft) support the development of new markets for local varieties and product diversification. However, since these policy documents and strategies are still at an initial stage, only attempts such as promotion of organic farming, Biodiversity fairs/Food fairs, and formation and strengthening of farmers’ groups to link scattered productions are under way. Value addition and processing are initiated in rice, maize and buck wheat while the National Organic Program has initiated packaging and marketing of organic vegetables in Gasa and Bumthang on a small scale.

Major constraints to up scaling these initiatives include:

1. Emphasis on modern cultivars of staple crops.
2. Lack of financial support and trained personnel.
3. Industrial processing limitations.
4. Insufficient seed or planting material.
5. Lack of consumer demand.
6. Inconsistent volume of production.
7. Lack of linkage between producer and consumer.
8. High transportation costs.
9. Lack of awareness on the importance of local varieties (eg: health benefits, culinary, local adaptation, etc).
10. Shortage of man power in the field.
11. Lack of expertise in product diversification.

In addition to product development and marketing, other opportunities such as development of agro-based tourism and health food industry exists in the country to promote sustainable utilization of the local crops and crop varieties. However, to enable realization of these opportunities, regional and international support are required in capacity development in product diversification and value addition; setting up small scale agro-industries; formation of farmers groups and cooperatives; awareness raising and education and in germplasm exchange.

## D. Institutions and Capacity building

### Activity Area   15   Building Strong National Programmes

The National Biodiversity Centre (NBC) established in 1998, is the national agency responsible for coordinating and facilitating PGRFA activities in the country. The Biodiversity Management Board, which constitute of representatives from various agencies under the Ministry of Agriculture and Forests, Health, Education, Economic Affairs and National Environment Commission provides policy level guidance and oversight to NBC. The programs of NBC are also guided by the Biodiversity Action Plan (s) and the Biodiversity Act of Bhutan 2003, enacted to regulate access to genetic resources in the country. The Agro biodiversity Conservation and Utilization program under NBC takes the lead role in coordinating and facilitating PGRFA activities in the country. The other participating stakeholders include various agencies under Department of Agriculture (DoA), Dzongkhag and Geog Agriculture Sectors, Council of RNR Research of Bhutan (CORRB), Department of Forests and Park Services (DoFPS), Department of Agriculture Marketing and Cooperatives (DAMC), Local Government and the farming communities.

Bhutan is party to the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The NBC is the implementing agency for CBD and focal point for the ITPGRFA. Therefore, Centre has endeavored to address most of the GPA activities. However, due to the disproportion in the number of professionals involved and the increasing PGRFA mandates, programs and activities, the need for strengthening capacity in terms of infrastructure, human resources, technical expertise and financial support are crucial to strengthen national PGRFA program in the country.

### Activity Area   16   Promoting Networks for Plant Genetic Resources for Food and Agriculture

Bhutan is a member of the South Asia Network of Plant Genetic Resources (SANPGR) and collaborates with South East Asia Regional Initiatives for Community Empowerment (SEARICE) in implementing BUCAP projects, which focuses in on-farm conservation of PGRFA and supports community seed systems. Bhutan supports participation in the network activities by providing institutional infrastructure to implement joint activities, organization and hosting of network meetings and providing information management support. Currently, there is only one active network project, implemented in collaboration with SEARICE. By being a member of such a network, Bhutan has gained benefits such as transfer of technology; increased stakeholder participation; access to financial resources; exchange of technical expertise; training for national scientists; exchange of information and increased awareness of PGRFA. SHs like Bhutan Potato Development Program (BPDP) and National Seed Centre (NSC) who do not have any current collaboration with PGRFA network have also expressed their interest in joining the network and in promoting active collaboration specific to their area of activity. However, lack of financial resources, difficulty in finding suitable partner for networking, and lack of clarity in benefits of participating in network are some of the constraints faced by the country in promoting networking in PGRFA.

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### Activity Area   17   Constructing Comprehensive Information Systems for Plant Genetic Resources for Food and Agriculture

Bhutan currently does not have standardized data management and information system between and amongst different organizations working on PGRFA. Different organizations maintain their data in their own isolated way, for example, either by storing them in MS spread sheet or in physical stock ledgers. The National Genebank Information System is the only computerized PGRFA information system in the country, documenting and maintaining data using MS Access based program. As 30 to 60% of the SHs have computers and access to internet, there is an opportunity to develop a standardized PGR information system in the country. Many SHs have also expressed their need and interest in developing information system to manage their data. However, prior to the development and standardization of PGR information system in the country, there is a need to strengthen technical capacity of the staff involved in data and information system. Lack of technical expertise in PGR data management and dedicated staff for PGR data management are some of the constraints to the development of PGR information system. In addition to building capacity in information systems, there is also a need to build analytical/statistical skill of technical staff involved in PGR data management to optimize the utilization of the data. The compatibility and applicability of GRIN-Global that will be made available to all Gene Banks through Bioversity International is also an issue.

### Activity Area   18   Developing Monitoring and Early Warning Systems for Loss of Plant Genetic Resources for Food and Agriculture

Bhutan recognizes the threat of genetic erosion and genetic vulnerability and the need to assess them. There is a mechanism in place to assess genetic erosion for both *in situ* and *ex situ* collection. Field surveys and inventories, gene bank monitoring and monitoring of reports of land use changes are the mechanisms used for monitoring genetic erosion in the country. However, lack of skilled personnel, appropriate technology and financial resources have limited the development of a quantitative monitoring mechanism and early warning system for loss of PGRFA. The linkage between the genetic erosion and the causes also needs to be studied to develop appropriate interventions. Moreover, the concept of early warning system on the loss of PGRFA being new to Bhutan, there is a strong need to propound this concept and concurrently develop capacity to institute such a system. Monitoring and early warning systems for loss of PGRFA is crucial from the seed security perspective. Currently 98% of the seed needs are met from the informal or farmers’ seeds and formal seeds accounts to only 2% of the total seed system. Therefore, loss of any indigenous crops and their varieties is likely to cause many adverse effects on the seed system as well as on the food, landscape, social and ecological systems as a whole. Development of such a system is also crucial in this era of accelerated development which is further exacerbated by impacts of climate change.

### Activity Area   19   Expanding and Improving Education and Training

Till date a total of 77 staff personnel have been trained through six training programs addressing most of the GPA areas (Table 10).

**Table 10: Training addressing GPA priority activity areas**

|  |  |  |  |
| --- | --- | --- | --- |
| **SH** | **Training course** | **GPA activity areas addressed** | **No. of part.** |
| NBC | Training of the Trainers on PGR Conservation and Sustainable Agriculture | 1. Surveying and Inventorying PGRFA;  2. Supporting On-Farm Management and Improvement of PGRFA;  7. Supporting Planned and Targeted Collecting of PGRFA;  12. Promoting Development and Commercialization of Under-Utilized Crops and Species;  13. Supporting Seed Production and Distribution;  14. Developing New Markets for Local Varieties and 'Diversity-Rich' Products;  15. Building Strong National Programmes;  19. Expanding and Improving Education and Training;  20. Promoting Public Awareness of the Value of PGRFA Conservation and Use | 22 |
| NBC | Training on PGR Conservation and Sustainable Use | 1. Surveying and Inventorying PGRFA;  2. Supporting On-Farm Management and Improvement of PGRFA;  7. Supporting Planned and Targeted Collecting of PGRFA;  11. Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;  13. Supporting Seed Production and Distribution;  19. Expanding and Improving Education and Training;  20. Promoting Public Awareness of the Value of PGRFA Conservation and Use | 22 |
| NBC | Training of Trainers on Maize Conservation, Breeding and Management | 1.4. Agro-ecological and ecoregional surveying;  1.5. Indigenous knowledge;  9.1. Germplasm characterization and/or evaluation;  9.2. On-farm evaluation;  10.1. Plant breeding;  11. Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops;  13. Supporting Seed Production and Distribution;  19. Expanding and Improving Education and Training |  |
| NBC | Organic Seed Production and Post Harvest technology | 13. Supporting Seed Production and Distribution | 1 |
| RNR-RDC, Bajo | Rice Germplasm Collection training | 1. Surveying and Inventorying PGRFA;  8. Expanding *Ex Situ* Conservation Activities | 30 |
| RNR-RDC, Wengkhar | Vegetable seed production techniques | 13. Supporting Seed Production and Distribution | 2 |

Currently, education and training on PGRFA is not incorporated in the formal education curricula. Therefore, this limits the opportunity to expand PGRFA education and training in the country. Further, lack of trained personnel in the country to provide training, inadequate financial resources, and paucity of resource materials have also aggravated the situation. There is also no adequate training program available in the regions. Therefore, SHs have indicated the need to incorporate PGRFA trainings in the university curricula, especially in the curricula of the College of Natural Resources (CNR) of Bhutan or to identify and strengthen some national agencies to provide specialized training in PGRFA. SHs have also recommended setting up a network of regional and national expertise with curriculum vitae to enable countries to access their expertise. The following are the training prioritized by the SH.

**Table 11: Priority trainings in PGRFA**

|  |  |  |
| --- | --- | --- |
| **Stakeholder** | **Training topic** | **Training not available at:** |
| NSC | Vegetable seed production | National level |
| NSC | Fruit plant production technique | at National level |
| RNR-RDC-Bajo | Participatory Plant Breeding | at National level |
| RNR-RDC-Bajo | Taxonomy of food crops | at National level |
| RNR-RDC-Bajo | Exploration and Survey of Crop wild relatives | at National level |
| Horticulture Division | Molecular and Morphological characterization | at National level |
| RNR-RDC, Wengkhar | Breeding | at National level |
| RNR-RDC, Wengkhar | Surveying and inventorying PGRFA | at National level |
| CoRRB | Monitoring and evaluation of PGRFA | at National level |
| CoRRB | Advanced technologies to enhance sustainable production and use of PGRFA | at National level |
| CoRRB | PGRFA database development and data management | at National level |
| NBC | Surveying and inventorying PGRFA | at National level |
| NBC | Spatial analysis and mapping of genetic resources using GIS program | NBC |
| NBC | PVS and value addition | at National level |
| NBC | Exploration and Collecting of Plant Genetic Resources particularly CWR and Horticultural crops | at National level |
| NBC | Taxonomy of legumes and Crop Wild Relatives | at National level |
| NBC | Germplasm quarantine | NBC |
| NBC | *In Situ* Conservation of Crop Wild Relatives | at National level |
| NBC | Characterization, Evaluation and development of core collection | at National level |
| NBC | Statistical analysis of PGRFAdata | at National level |
| NBC | *Ex-situ* conservation of horticultural crops | NBC |
| NBC | PGRFA database maintenance | NBC |
| NBC | PGRFA Monitoring and development of Early Warning Systems | at National level |
| NBC | Genetic erosion and genetic drift assessment | NBC |
| NBC | Field Gene Bank Management | At National level |
| NBC | Cryo and In-vitro preservation | NBC |
| NBC | Gene Bank equipment maintenance | NBC |

### Activity Area   20   Promoting Public Awareness of the Value of Plant Genetic Resources for Food and Agriculture Conservation and Use

Since the institutionalization of PGR program in the country and establishment of NBC in 1998, concerted efforts have been made in promoting awareness on the value of diverse PGRFA as foundation for promoting sustainable agriculture and food security. The NBC has been successful in garnering support from many agencies such as Dzongkhag Agriculture Sector/Agriculture Extension officials and RNR-RDC in promoting public awareness at community level. The Centre continues to enhance public awareness every year by using different tools such as meetings, village gatherings, students’ visits to NBC facilities, seminars, brochures, leaflets, posters, biodiversity fairs, food fairs, etc. RNR conferences and sectoral workshops are also used as opportunities to sensitize stakeholders and the public at large to issues surrounding PGRFA.

NBC received initial support from Bioversity International (the then IPGRI) in 1999 for promoting public awareness on the value of PGRFA and currently, the Centre receives support for these activities under the BUCAP (under the SEARICE network) and UNDP-GEF funded Integrated Livestock and Crop Conservation Project (ILCCP).

However, despite the fact that awareness on the value of PGRFA has advanced compared to a decade ago, it is still inadequate. This could be due to limited coordinated and complementary activities and lack of integration of PGRFA education into school and university curricula in the country. The role of NGOs has also been very minimal. Expect for Tarayana Foundation, a national NGO, which has some activities involving the utilization of PGRFA and thereby promoting awareness to some extent, there are no national NGOs involved in promoting public education on PGRFA. The situation is further aggravated by insufficient number of staff, fund and skill and knowledge in conducting public awareness programs.

The need to enhance public awareness on the value of maintaining diverse PGRFA is becoming more critical because of the emerging threats to PGRFA such as replacement by improved cultivars with uniform genetic base, dwindling farm labour in managing diverse agriculture systems, land use change, etc. Since diversity serves as insurance against impacts of climate change on agriculture as well as food security, raising public awareness on the value of PGRFA from this angle is yet another important issue to be addressed.

The drawback and the need to raise public education are however acknowledged by many SHs and have recommended seeking support to develop public education materials and education through diverse media such as national TV and radio, targeting different groups of audiences.

# Chapter 5: Constraints in project implementation.

Bhutan started the process of NISM-GPA implementation through formation of TFF towards the end of 2009. The preparatory activities such as procurement of equipments, identification of SHs, awareness raising on PGRFA and GPA, familiarization with the database and collection and documentation of easily accessible data were implemented from March through December 2010. The major portion of the project activity, data collection and documentation from all SHS, data validation, merging, analysis, etc could be implemented only during the 2nd year, after the release of funds in April, 2011.

The following are some of the constraints faced in the implementation of the project:

* Most of the data on PGR from SHs as well as NFP were not in electronic format which had to be digitized and this activity took time.
* Lack of man power and skill.
  1. No SH had a dedicated staff for PGR data management. Further, all representative of SH had their own normal workload, which did not give adequate time even to collate data and provide it to NFP. Therefore, all data had to be entered by NFP’s data manager.
  2. Many SH could not provide data to the NFP because of lack of time and communication as most SHs did not understand the concept and importance of NISM-GPA. Therefore, the picture of PGRFA status in the country is still incomplete.
  3. There was no adequate time to provide trainings to SHs on the use of NISM software. Further, since there was no dedicated staff for data management within all SHs, training was not feasible.
* The data manager of NFP was not exposed or trained in PGR issues, therefore independent data encoding and entry was not feasible.
* The training provided to the data manager by the regional office in Thailand was not adequate as training duration was too short and was provided only to one person while data is held by many organizations.
* Inadequate technical back stopping from the NISM experts. For example, the regional expert on NISM, Dr. Rakesh Agarwal had a very tight schedule because of which he could not be hired on time to assist in solving some of the problems NFP faced in understanding and using the software as well as in data encoding. Therefore, this delayed the whole process of data collection and analysis.
* Change in project management- The project at the initial phase was managed by the manager of the PGR program of NFP. However, as the manager had many other responsibilities, the responsibility of NISM project management was transferred to Biodiversity Information Management Section (BIMS). Since the manager of BIMS was new to this whole concept of NIMS-GPA on PGRFA, it took time for the manager to fully comprehend the project and its activities. Further, the BIMS manager also had other responsibilities because of which the NISM activities could not be implemented with hundred percent time allocation.

# Chapter 6: Conclusion and way forward

The picture of current PGRFA activities in the country is incomplete because of the above mentioned constraints in project implementation. However, as this is only the first attempt in the country in developing such a system where all PGRFA data would be available from one source, Bhutan is confident that it can move forward in developing and improving the system. However, to accelerate and facilitate development of a comprehensive and complete NISM on PGRFA for Bhutan, the following actions need to be taken:

* + Longer trainings for data mangers of NFP and SHs.
  + Dedicated staff for data management for all SHs.
  + A standardized PGR database for all SHs, along with facilities such as dedicated computers for PGR database.
  + More exposure and workshops for PGR researchers and program manager on GPA for Conservation and Sustainable Utilization of PGRFA, as well as on the importance of maintaining and sharing information.

Since this project was the first attempt, the NISM data base could not be institutionalized within the SHs’ normal programs. Therefore, in order to integrate the NISM database and the activities needed in populating and maintaining the database, the above mentioned actions must be implemented for which support is required. Further, as indicated above, there is a real necessity for enhancing the awareness on the GPA – PGRFA and the use and importance of an information sharing mechanism. As a national sustenance effort in maintaining and updating the NIMS on PGRFA, the NFP would continue to collect data from SHs on annual basis and integrate the NISM activities into the normal work program of the National Biodiversity Information Section of NFP/NBC.

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# Annexure 1: Programme/project/activity relating to sustaining ex situ collection.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Stakeholder** | **Ex situ conservation programme/project/activity** | **Type of activity** | **Other activity type** | **Number of professionals involved** |
| National Biodiversity Center | Agrobiodiversity Conservation Project | Seed genebank (long term collections);  Seed genebank (medium term collections);  Seed genebank (short term collections);  Botanical garden |  | 5 |
| Bhutan Potato Development Program | Potato Seed Production | In vitro conservation | Field Assessment and Multiplication | 8 |
| RNR-RDC- Wengkhar | Field genebank of local citrus cultivars collected from citrus growing region in Bhutan | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 5 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of wild citrus species and its relatives. | Field genebank |  | 1 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of wild persimmon species | Field genebank | To study the graft compatibility with the improved cultivars | 5 |
| RNR-RDC- Wengkhar | Germplasm collection of local soft-shell walnut selections | Field genebank | Source of scion wood for seedling production | 2 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 5 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Asian pears | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 4 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Persimmon | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 4 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 3 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Avocado | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 1 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Mango | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 1 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Exotic walnut varieties | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 2 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Chestnut | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 2 |
| RNR-RDC- Wengkhar | Germplasm collection of Hazelnut varieties | Field genebank | Source of planting material | 2 |
| RNR-RDC- Wengkhar | Evaluation and germplasm collection of Cherry cultivars | Field genebank | Germplasm collection, Evaluation and selection of better quality fruits, Source of scion wood for production of seedlings | 2 |
| RNR-RDC- Wengkhar | Maintenance of basic seed of released varieties of vegetables | Seed genebank (short term collections) | Seed production and maintenance, supply to National Seed Centre every year for further multiplication | 3 |
| RNR-RDC- Wengkhar | Evaluation and maintenance of maize germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds | 4 |
| RNR-RDC- Wengkhar | Evaluation and maintenance of rice germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds |  |
| RNR-RDC- Wengkhar | Evaluation and maintenance of Legumes germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds |  |
| RNR-RDC- Wengkhar | Evaluation and maintenance of Finger millet germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds |  |
| RNR-RDC- Wengkhar | Evaluation and maintenance of Wheat germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds |  |
| RNR-RDC- Wengkhar | Evaluation and maintenance of Barley germplasm at RDC Wengkhar | Seed genebank (medium term collections) | Evaluation and maintenance of basic seeds |  |

# Annexure 2: Details of *ex situ* collections in the country.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Stakeholder** | **Name of ex situ collection** | **Name of taxon** | **Status of accessions** | **Geog.origin** | **Number of accessions** | **Number of accessions safety-duplicated at other genebanks** | **Genebank holding safety-duplicate** |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Amaranthus L | Traditional cultivar/Landrace | Different locations in Bhutan | 10 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Hordeum vulgare | Traditional cultivar/Landrace | Different locations in Bhutan | 30 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Phaseolus vulgaris | Traditional cultivar/Landrace | Different locations in Bhutan | 57 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Fagopyron esculentum | Traditional cultivar/Landrace | Different locations in Bhutan | 74 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Eleusine coracana | Traditional cultivar/Landrace | Different locations in Bhutan | 70 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Zea mays | Traditional cultivar/Landrace | Different locations in Bhutan | 80 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Brassica campestris var. toria | Traditional cultivar/Landrace | Different locations in Bhutan | 40 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Oryza sativa | Traditional cultivar/Landrace | Different locations in Bhutan | 338 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Pisum sativum | Traditional cultivar/Landrace | Different locations in Bhutan | 3 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Glycine max | Traditional cultivar/Landrace | Different locations in Bhutan | 20 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Vigna sp. | Traditional cultivar/Landrace | Different locations in Bhutan | 40 | 0 | National Biodiversity Center |
| NBC | Ex-situ/Gene bank Program, Agro-Biodiversity Conservation & Utilization Section | Triticum aestivum | Traditional cultivar/Landrace | Different locations in Bhutan | 23 | 0 | National Biodiversity Center |
| Bhutan Potato Development Program | Potato Seed Production | Solanum tuberosum | Advanced/Improved cultivar |  |  |  | Bhutan Potato Development Program |
| RNR-RDC, Bajo | Rice genepool strengthening project | Oryza sativa | Traditional cultivar/Landrace | Bhutan | 150 | 150 | International Rice Research Institute |
| RNR-RDC,Wengkhar | Local Mandarin germplasm collection | Citrus reticulata | Traditional cultivar/Landrace | Citrus growing region of Bhutan | 57 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of wild citrus species and its relatives. | Citrus sp. | Traditional cultivar/Landrace | Native to Bhutan | 5 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of wild persimmon species | Diospyros sp. | Wild | Native to Bhutan | 1 |  |  |
| RNR-RDC,Wengkhar | Germplasm collection of local soft-shell walnut selections | Juglans regia | Traditional cultivar/Landrace | Eastern region of Bhutan | 24 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus reticulata | Advanced/Improved cultivar | Japan | 3 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus unshiu | Advanced/Improved cultivar | Japan | 6 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus reticulata | Advanced/Improved cultivar | Japan | 3 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus reticulata | Advanced/Improved cultivar | Nepal, Bhutan | 4 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus reticulata | Advanced/Improved cultivar |  | 1 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus limon | Advanced/Improved cultivar | Japan | 1 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus sinensis | Advanced/Improved cultivar | Japan | 2 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus maxima | Advanced/Improved cultivar | Japan | 1 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Asian pears | Pyrus pyrifolia | Advanced/Improved cultivar | Japan | 11 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Persimmon | Diospyros kaki | Advanced/Improved cultivar | Japan | 7 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Prunus persica | Advanced/Improved cultivar | Japan | 7 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Prunus sp. | Advanced/Improved cultivar | Japan | 8 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Malus domestica | Advanced/Improved cultivar | RDC Bajo | 2 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Prunus cerasus | Advanced/Improved cultivar | Japan | 5 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Vitis vinifera | Advanced/Improved cultivar | Japan | 3 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Olea europaea | Advanced/Improved cultivar | Japan | 4 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of peach, plum, apricot, loquat, apple, olive, grapes, cherry,kiwifruit | Actinidia deliciosa | Advanced/Improved cultivar | Semtokha | 5 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Mango | Mangifera indica | Advanced/Improved cultivar | India | 4 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic walnut varieties | Juglans regia | Advanced/Improved cultivar | India, Holland | 19 |  |  |
| RNR-RDC,Wengkhar | Germplasm collection of Hazelnut varieties | Corylus avellana | Advanced/Improved cultivar | Germany | 6 |  |  |
| RNR-RDC,Wengkhar | Maintenance of basic seed of released varieties of vegetables | Brassica oleracea var. botrytis | Advanced/Improved cultivar | Japan | 2 |  |  |
| RNR-RDC,Wengkhar | Maintenance of basic seed of released varieties of vegetables | Brassica juncea | Advanced/Improved cultivar | Japan | 2 |  |  |
| RNR-RDC,Wengkhar | Maintenance of basic seed of released varieties of vegetables | Daucus carota | Traditional cultivar/Landrace | Japan | 1 |  |  |
| RNR-RDC,Wengkhar | Maintenance of basic seed of released varieties of vegetables | Capsicum annuum | Traditional cultivar/Landrace | Japan and landrace | 2 |  |  |
| RNR-RDC,Wengkhar | Maintenance of basic seed of released varieties of vegetables | Cucurbita maxima | Traditional cultivar/Landrace | Japan | 1 |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Zea mays | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Oryza sativa | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Phaseolus sp. | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Eleusine coracana | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Triticum sp. | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Ex-situ conservation of PGRFA using conventional seed storage methods | Hordeum vulgare | Traditional cultivar/Landrace |  |  |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Citrus paradisi | Advanced/Improved cultivar |  | 2 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Poncirus trifoliata | Advanced/Improved cultivar |  | 3 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Exotic citrus cultivar | Fortunella japonica | Advanced/Improved cultivar | Japan | 1 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Avocado | Persea americana | Advanced/Improved cultivar |  | 4 |  |  |
| RNR-RDC,Wengkhar | Evaluation and germplasm collection of Chestnut | Castanea sp. | Advanced/Improved cultivar | Holland | 5 |  |  |

# Annex 3: Crop breeding programs carried out in the country.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name of crop** | **Trait(s)/charac.** | **Agroeco.zone(s)/Farm. Sys.** | **Estimated imp. of the improv.** | **Germplasm source(s)** | **Farmers invol. in** | **No. of proff. Staff** | **Output produced** | **Output prod. Yr.** |
| Potato | Yield, pest and disease resistance, maturity, tuber quality. | Dry land farming system in High and mid altitude zones. | High | Regional/International network;CGIAR genebank;Public organization from developed country | Selecting from fixed lines or finished varieties (participatory varietal selection) | 8 | 4 varieties released (Desiree - 1988, Kufri Jyoti- 1988, Yusi Kaap- 1988, Khangma Kaap- 2002) | 2002 |
| Rice | High yield Disease resistance Drought tolerance Grain quality | Rice based system High and mid altitude areas | High | Regional/International network;CGIAR genebank | Selecting from fixed lines or finished varieties (participatory varietal selection) | 4 | 6 HYVs  The program commenced from 1988 and continued till 2010. |  |
| Maize | Yield, disease resistance, crop duration, height, husk cover, lodging tolerance. | High, mid and low altitude zones | High | Regional/International network;CGIAR genebank | Selecting from fixed lines or finished varieties (participatory varietal selection) | 5 | 3 varieties (Yangtsipa, Khangma Ashom 1 and Khangma Ashom 2) released between 1988 to 1990 | 1990 |
| Wheat | Yield, Rust resistance. | Rice based farming system | Medium | Regional/International network;CGIAR genebank | Selecting from fixed lines or finished varieties (participatory varietal selection) | 4 | 3 varities released (Sonalika in 1988, Bajo Ka 1- 1991, Bajo Ka 2- 1994) | 1994 |
| Mustard | Yield, oil recovery, pest and disease resistance. | Wet land and dry land farming systems | Medium | Regional/International network;CGIAR genebank | Selecting from fixed lines or finished varieties (participatory varietal selection) | 4 | 4 varities released (Type 9- 1989, M 27- 1989, Bajo Peka 1- 1994 and Bajo Peka 2- 1994) | 1994 |

# Annex 4: Programs/projects/activities related to seed production and distribution in the country.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SH** | **Name of programme/project/activity** | **Name of crop/crop group** | **Name of taxon** | **Topics covered** | **Reference** |
| NSC | Contract Growers | Rice/Cereals | *Oryza sativa* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NSC | Contract Growers | Maize/Cereal | *Zea mays* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NSC | Contract Growers | Soya/Legume | *Glycine max* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | Major vegetable crop and seed production guidebook |
| NSC | Contract Growers | Seed potato | *Solanum tuberosum* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NSC | Contract Growers | Pea/Legumes | *Pisum sativum* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | Major vegetable crop and seed production guidebook |
| NSC | Contract Growers | Beans/Legume | *Phaseolus vulgaris* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | Major vegetable crop and seed production guidebook |
| NSC | Farm production | Radhis/Root crops | *Raphanus sativus* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | Major vegetable crop and seed production guidebook |
| NSC | Contract Growers | Broccoli/Cole crops | *Brassica oleracea var. italica* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NSC | Contract Growers | Cauliflower/Cole Crops | *Brassica oleracea var. botrytis* | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors. |  |
| NOP | Organic Vegetable Program | Vegetables | *Lycopersicon esculentum* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Spinacia oleracea* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Capsicum annuum* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Daucus carota* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards. |
| NOP | Organic Vegetable Program | Vegetables | *Lactuca sativa* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Beta vulgaris* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Amaranthus sp.* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | *Chenopodium quinoa* | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | Ocimum basilicum | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | Atriplex hortensis | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | Cucumis melo | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | Solanum melongena | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Vegetable Program | Vegetables | Cucumis sativus | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors | A Guide to Organic Agriculture in Bhutan;National Framework for Organic farming in Bhutan;Training Manual;National Organic Standards |
| NOP | Organic Fruit Program | Fruits | Cucurbita pepo | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NOP | Organic Fruit Program | Fruits | Cucurbita moschata | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| NOP | Organic Maize Program | Cereal | Zea mays | Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| BPDP | Potato Seed Production | Seed potato | Solanum etuberosum | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors |  |
| Hot. Div | Citrus rootstock seed production and distribution | Fruits | Poncirus trifoliata | Seed production;Seed processing;Seed distribution |  |
| RNR-RDC-Wengkhar | Maintenance of basic seed of released varieties of vegetables | Vegetables |  | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution | Annual Reports |
| RNR-RDC-Wengkhar | On-farm vegetable seed production program | Vegetables |  | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution;Participatory community-based activities;Linkages between formal and informal seed sectors. | Horticulture Research and Development Project Report |
| RNR-RDC-Wengkhar | Citrus rootstock seed production and distribution | USDA trifoliate orange | Poncirus trifoliata | Seed production;Seed storage;Seed processing;Seed quality control;Seed distribution |  |

# Annexure 5: List of registered, released and cultivated varieties.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name of crop** | **Name of cultivar** | **Type** | **Year of regis.** | **Year of release** | **Target agro-ecological environment(s)** | **Important characteristics** |
| Ladies Finger/Okra | Kranti | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:600-1500 | Yield Potential (t/acre)-: 3.0 - 5.0 Maturity (days after sowing)-70-80 |
| Bulb Onion | Bajogop 1 | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<2200 | Yield Potential (t/acre)-: 7.0 - 8.0 Maturity (days after sowing)-120 - 140 |
| Bulb Onion | Bombay Red | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<2200 | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-110-160 |
| Bunching Onion | No 21 | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 1.0 - 3.0 Maturity (days after sowing)-80-90 |
| Bulb Onion | Senshu Red | Improved variety | 1994 | 1994 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 7.0 Maturity (days after sowing)-120 - 170 |
| Bulb Onion | White Creole | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-120 - 160 |
| Garlic (bulb) | Local Selection | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:<2000 | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-230-250 |
| Cardamom | Bharlangey | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:900 - 1600 | Yield Potential (t/acre)-: 0.25 - 0.35 Maturity (days after sowing)-Sept-Oct |
| Cardamom | Golsey | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:900 - 1200 | Yield Potential (t/acre)-: 0.25 - 0.35 Maturity (days after sowing)-August-Sept |
| Almonds | Dhebhar Badhan | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:1302 - 2500 | Yield Potential (t/acre)-: 2.5 kg/tree Maturity (days after sowing)-Late August |
| Almonds | Drake | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:1301 - 2500 | Yield Potential (t/acre)-: 0.45 kg/tree Maturity (days after sowing)-Late August |
| Almonds | Kagzi | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:1303 - 2500 | Yield Potential (t/acre)-: 1.6 kg/tree Maturity (days after sowing)-Early August |
| Almonds | Texas | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:1300 - 2500 | Yield Potential (t/acre)-: 0.12 kg/tree Maturity (days after sowing)-Late August |
| Celery | Cornel | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 5.0 - 6.0 Maturity (days after sowing)-120-160 |
| Fodder peanut | Fodder peanut | Improved variety | 2001 | 2001 | Recommended Agro-ecology (MASL)-:<1500 | Yield Potential (t/acre)-: 1.1 - 2.0 Maturity (days after sowing)-1yr (Perennial ) |
| Arecanut | Bhur selection | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:<1000 | Yield Potential (t/acre)-: 3.0 - 5.0 Maturity (days after sowing)-Dec-March |
| Asparagus | Mary Washington | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:1000-2500 | Yield Potential (t/acre)-: 0.5 - 1 Maturity (days after sowing)-2-3 yrs |
| Asparagus | UC-157 (Hybrid) | Improved variety | 2006 | 2006 | Recommended Agro-ecology (MASL)-:1000-2600 | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-2-3 yrs |
| Oat (FOB) | Oat (FOB) | Improved variety | 2001 | 2001 | Recommended Agro-ecology (MASL)-:20 - 4000 | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)- 1 yr (Annual) |
| Oat (Naked) | Oat (Naked) | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:200-4000 | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-1 yr (Annual) |
| Oat (Stampede) | Oat (Stampede) | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:200-4000 | Yield Potential (t/acre)-: 2.2 - 4.0 Maturity (days after sowing)-1 yr (Annual) |
| Beetroot | DDR\* | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:<2500 | Yield Potential (t/acre)-: 4.0 - 5.0 Maturity (days after sowing)-70-80 |
| Fodder Beet (Alba) | Fodder Beet (Alba) | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:2000-3500 | Yield Potential (t/acre)-: 1.5 - 3.0 Maturity (days after sowing)-1 yr (Annual) |
| Palisade Grass | Palisade Grass | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:<1500 | Yield Potential (t/acre)-: 3.2 - 3.6 Maturity (days after sowing)-1 yr (Perennial) |
| Ruzi | Ruzi | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:500-2000 | Yield Potential (t/acre)-: 2.8 - 3.2 Maturity (days after sowing)-1 yr (Perennial) |
| Turnip | Local Purple | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:>1000 | Yield Potential (t/acre)-: 8-12 t/ac Maturity (days after sowing)-70-90 |
| Turnip | PTWG | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:>1000 | Yield Potential (t/acre)-: 8.0 - 12.0 Maturity (days after sowing)-60-70 |
| Mustard Oil Seed | Bajo Peka 1 | Improved variety | 1994 | 1994 | Recommended Agro-ecology (MASL)-:< 2000 | Yield Potential (t/acre)-: 0.5 Maturity (days after sowing)-145-155 |
| Mustard Oil Seed | Bajo Peka 2 | Improved variety | 1994 | 1994 | Recommended Agro-ecology (MASL)-:< 2000 | Yield Potential (t/acre)-: 0.4 Maturity (days after sowing)-120-130 |
| Mustard Green | Him Beauty | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:1200 - 2600 | Yield Potential (t/acre)-: 2.5 - 4.0 Maturity (days after sowing)-50-60 |
| Mustard Oil Seed | M-27 | Improved variety | 1989 | 1989 | Recommended Agro-ecology (MASL)-:< 2000 | Yield Potential (t/acre)-: 0.4 Maturity (days after sowing)-85-90 |
| Mustard Green | Takana Red | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:1200 - 2600 | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-50-60 |
| Mustard Green | Wengkhar Petshe 1\* | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:600 - 2600 | Yield Potential (t/acre)-: 3.5 - 4.0 Maturity (days after sowing)-100-120 |
| Mustard Green | Wengkhar Petshe 2\* | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:600 - 2600 | Yield Potential (t/acre)-: 3.5 - 4.0 Maturity (days after sowing)-100-120 |
| Rapeseed | Jakar pekha\* | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:2600-3200 | Yield Potential (t/acre)-: 0.4 - 0.5 Maturity (days after sowing)-110-130 |
| Swede Var. Ostega | Swede Var. Ostega | Improved variety | 2001 | 2001 | Recommended Agro-ecology (MASL)-:2500-2700 | Yield Potential (t/acre)-: 2.0 - 2.5 Maturity (days after sowing)-1 year (annual) |
| Cauliflower | 19905 | Improved variety | 2002 | 2002 | Recommended Agro-ecology (MASL)-:1500-2200 | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-120 |
| Cauliflower | Khangma Kopi 1 | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:600 to 2500 | Yield Potential (t/acre)-: 7.0 - 8.0 Maturity (days after sowing)-90 |
| Cauliflower | Khangma Kopi 2 | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:600 to 2500 | Yield Potential (t/acre)-: 10.0 - 12.0 Maturity (days after sowing)-120 |
| Cauliflower | White Summer | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:1500-2000 | Yield Potential (t/acre)-: 10.0 - 12.0 Maturity (days after sowing)-90-100 |
| Cauliflower | White Top | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:1500-2600 | Yield Potential (t/acre)-: 10.0 - 15.0 Maturity (days after sowing)-100 |
| Cabbage | Bonday Cross (Hybrid) | Improved variety | 2006 | 2006 | Recommended Agro-ecology (MASL)-:Across all AEZ | Yield Potential (t/acre)-: 10.0 - 11.0 Maturity (days after sowing)-90-110 |
| Cabbage | Copenhagen Market | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 9.0 - 10.0 Maturity (days after sowing)-75-85 |
| Cabbage | Gianty (Hybrid) | Improved variety | 2006 | 2006 | Recommended Agro-ecology (MASL)-:Across all AEZ | Yield Potential (t/acre)-: 11.0 - 12.0 Maturity (days after sowing)-70-80 |
| Cabbage | Golden Acre | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 5.0 - 6.0 Maturity (days after sowing)-70-80 |
| Cabbage | Green Coronate (Hybrid) | Improved variety | 2006 | 2006 | Recommended Agro-ecology (MASL)-:Across all AEZ | Yield Potential (t/acre)-: 12.0 - 13.0 Maturity (days after sowing)-80-90 |
| Chinese Cabbage | Kyoto 1 | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:1500-2200 | Yield Potential (t/acre)-: 12.0 - 16.0 Maturity (days after sowing)-60-85 |
| Cabbage | Lucky Ball (Hybrid) | Improved variety | 2007 | 2007 | Recommended Agro-ecology (MASL)-: | Yield Potential (t/acre)-: 9.0 - 10.0 Maturity (days after sowing)-80-100 |
| Cabbage | T1-163 (Hybrid) | Improved variety | 2006 | 2006 | Recommended Agro-ecology (MASL)-:Across all AEZ | Yield Potential (t/acre)-: 10.0 - 11.0 Maturity (days after sowing)-65-75 |
| Broccoli | Desico | Improved variety | 1994 | 1994 | Recommended Agro-ecology (MASL)-:600-2600 | Yield Potential (t/acre)-: 0.8 - 1.0 Maturity (days after sowing)-100-110 |
| Japanese Green | Mibuna | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-40-50 |
| Japanese Green | Taisai | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:<2600 | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-40-50 |
| Capsicum | California Wonder | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:700-2000 | Yield Potential (t/acre)-: 4.0 - 5.0 Maturity (days after sowing)-75-80 |
| Chilli | Sha Ema | Improved variety | 1990 | 1990 | Recommended Agro-ecology (MASL)-:600-2000 | Yield Potential (t/acre)-: 15.0 - 20.0 Maturity (days after sowing)-90-100 |
| Chilli | Super Solo \* | Improved variety | 2004 | 2004 | Recommended Agro-ecology (MASL)-:700 to 2500 | Yield Potential (t/acre)-: 19.0 Maturity (days after sowing)-90-10 |
| Chilli | Yangtse aeyma | Improved variety | 2007 | 2007 | Recommended Agro-ecology (MASL)-:1000-2000 | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-90-100 |
| Centro | Centro | Improved variety |  |  |  |  |
| Lime | Bears (Swingle) | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-Aug-January |
| Lime | Rangpur lime (as rootstock) | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)-Rootstock |
| Mandarin/Orange | Dorokha Selection\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 4.0 - 5.0 Maturity (days after sowing)-Oct-December |
| Mandarin/Orange | Wengkhar Tshalu 1 | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: >3.0 Maturity (days after sowing)-Mid November |
| Mandarin/Orange | Wengkhar Tshalu 2 | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: >3.0 Maturity (days after sowing)-Mid November |
| Mandarin rootsock | Carrizo citrange | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Mandarin rootsock | Cleopatra mandarin | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Mandarin rootsock | Troyer citrange | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Mandarin rootsock | Wengkhar Tshalu Rhato 1 | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Musk Melon | Honey Dew | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 4.0 Maturity (days after sowing)-90-110 |
| Cucumber | Bajogenchu-1 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 - 4.0 Maturity (days after sowing)-70-85 |
| Cucumber | Shabi Genchu | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 1.2 - 2.0 Maturity (days after sowing)-70 - 100 |
| Pumpkin | Rongthong Brumsha | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 4.0 Maturity (days after sowing)-100-140 |
| Pumpkin | Summer Squash | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-60-80 |
| Pumpkin | Tetsu Kabuta | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-90-100 |
| Pumpkin | Wengkhar Kakur1 | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-90-100 |
| Cocks foot., Var Amba | Cocks foot., Var Amba | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 0.8 - 1.2 Maturity (days after sowing)-1 yr (Perennial) |
| Carrot | All Seasens Cross (Hybrid) | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 8.0 - 10.0 Maturity (days after sowing)-110-120 |
| Carrot | Early Nantes | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-80-90 |
| Carrot | Wengkhar laphu maap | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 14.0 Maturity (days after sowing)-105 |
| Carrot | New Khuruda | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 8.0 - 9.0 Maturity (days after sowing)-100-110 |
| Carrot | Nisa | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-90-100 |
| Greenleaf desmodium | Greenleaf desmodium | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 2.0 - 2.5 Maturity (days after sowing)-1 yr (Perennial) |
| Persimom | Fuyu\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-Mid November |
| Persimom | Jiro\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-Early October |
| Persimom | Wengkhar anday 1 | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-Mid October |
| Finger millet | Lingmithang Kongpu-1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.7 - 0.8 Maturity (days after sowing)-120 |
| Finger millet | Lingmithang Kongpu-2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.84 - 0.85 Maturity (days after sowing)-140 |
| Tall Fescue Var. Barcel | Tall Fescue Var. Barcel | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 1.5 - 3.0 Maturity (days after sowing)-1 yr (Perennial) |
| Fig | Fig | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 3.0 - 3.5 Maturity (days after sowing)-2-3 yrs (Fodder Tree) |
| Straw berry | Yusi sagong 1 | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 0.7 Maturity (days after sowing)-8 months |
| Soybean | Bragg | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.6 - 1.0 Maturity (days after sowing)-130-140 |
| Soybean | Khangma Libi-1 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 0.4 - 0.6 Maturity (days after sowing)-140 |
| Soybean | Khangma Libi-2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.3 - 1.2 Maturity (days after sowing)-130 |
| Soybean | One Daughter | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 0.3-0.4 Maturity (days after sowing)-160 |
| Walnut | Kanthel | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.0 - 1.5 Maturity (days after sowing)-September |
| Walnut | Yusipang 2 | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 0.5 - 1.0 Maturity (days after sowing)-September |
| Lettuce | Great Lake | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-70-80 |
| Bottle Gourd | Mindapur Round | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 6.0 - 7.0 Maturity (days after sowing)-85-95 |
| Litchi | Bhur selection-1\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 9.0 -10.0 Maturity (days after sowing)-June-July |
| Litchi | Early Bedana | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 8.0 - 9.0 Maturity (days after sowing)-Early June |
| Litchi | Shahi\* | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 10.0 - 12.0 Maturity (days after sowing)-Late June |
| Italian Rye grass Var. Lipo | Italian Rye grass Var. Lipo | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 1.2 - 2.2 Maturity (days after sowing)-1 yr (Perennial) |
| Tomato | Bajo Lambenda 1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 9.0 - 10.0 Maturity (days after sowing)-80-90 |
| Tomato | Cherry Tomato | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 8.0 - 12.0 Maturity (days after sowing)-60-70 |
| Tomato | Nozomi | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 4.5 - 6.0 Maturity (days after sowing)-90-100 |
| Tomato | Roma | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-90-150 |
| Apple (Scion) | Bajo Apple | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 2.5 Maturity (days after sowing)-Mid July |
| Apple (Scion) | Fuji | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-October |
| Apple (Scion) | Golden Delicious | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 3.7 Maturity (days after sowing)-Sept-Oct |
| Apple (Scion) | Jonathan | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 5.0 Maturity (days after sowing)-October |
| Apple (Scion) | Lobo | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.2 Maturity (days after sowing)-Late September |
| Apple (Scion) | Mutsu | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-Early October |
| Apple (Scion) | Red chief | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-Sept October |
| Apple (Scion) | Red Delicious | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 7.0 Maturity (days after sowing)-Sept-October |
| Apple (Scion) | Red Free | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 3.8 Maturity (days after sowing)-Mid August |
| Apple (Scion) | Rich-a-Red | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 3.5 Maturity (days after sowing)-August-Sept |
| Apple (Scion) | Royal Delicious | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 7.0 Maturity (days after sowing)-Sept-Oct |
| Apple Root Stock | MM-106 | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Apple Root Stock | MM-111 | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Apple Root Stock | MM9 | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: Rootstock Maturity (days after sowing)- |
| Mango | Chausa | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-August |
| Mango | Bajo Aumchu-kali 1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-July-August |
| Mango | Bajo Aumchu-kali 2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-July-August |
| Lucerne Var. Eureka | Lucerne Var. Eureka | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 1.6 - 2.5 Maturity (days after sowing)-1 yr (Perennial) |
| Molasses grass | Molasses grass | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 1.6 - 2.4 Maturity (days after sowing)-1 yr (Perennial) |
| Banana | Chinichampa | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.0 - 5.0 Maturity (days after sowing)-Sept - April |
| Banana | Gheukola | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-Sept - April |
| Banana | Jazi | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 7.0 Maturity (days after sowing)-Sept - April |
| RICE | Bajo Kaap 1 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 - 3.4 Maturity (days after sowing)-145-155 |
| RICE | Bajo Kaap 2 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 - 3.4 Maturity (days after sowing)-150-165 |
| RICE | Bajo Maap 1 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 - 3.2 Maturity (days after sowing)-150-155 |
| RICE | Bajo Maap 2 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-145-155 |
| RICE | BR 153 | Improved variety | 1989 | 1989 |  | Yield Potential (t/acre)-: 1.2 - 1.6 Maturity (days after sowing)-140-150 |
| RICE | BW 293 | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 1.2 - 1.8 Maturity (days after sowing)-140-150 |
| RICE | IR 20913 | Improved variety | 1989 | 1989 |  | Yield Potential (t/acre)-: 1.6 - 2.4 Maturity (days after sowing)-130-140 |
| RICE | IR 64 | Improved variety | 1988 | 1988 |  | Yield Potential (t/acre)-: 2.0 - 3.2 Maturity (days after sowing)-140-155 |
| RICE | Jakar Rey Naab\* | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 1.5 - 2.0 Maturity (days after sowing)-180-195 |
| RICE | Khangma Maap | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 1.6 - 2.4 Maturity (days after sowing)-120-130 |
| RICE | No 11 | Improved variety | 1989 | 1989 |  | Yield Potential (t/acre)-: 1.6 - 2.4 Maturity (days after sowing)-160 |
| RICE | Wengkhar Rey Kaap 2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 1.7 - 1.9 Maturity (days after sowing)-160-165 |
| RICE | Wengkhar Rey Kaap-6 | Improved variety | 2006 | 2006 |  | Yield Potential (t/acre)-: 1.7 - 1.9 Maturity (days after sowing)-160-165 |
| RICE | Yusi Ray Kaap | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 2.5 - 3.5 Maturity (days after sowing)-170-180 |
| RICE | Yusi Ray Maap | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 2.5 - 3.5 Maturity (days after sowing)-170-180 |
| Guinea grass | Guinea grass | Improved variety | 2007 | 2007 |  | Yield Potential (t/acre)-: 2.4 - 3.2 Maturity (days after sowing)-1 yr (Perennial) |
| Paspalum Atratum Var. CIAT 26986 | Paspalum Atratum Var. CIAT 26986 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 2.0 - 3 Maturity (days after sowing)-1 yr (Perennial) |
| Kikuyu grass | Kikuyu grass | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-1 yr (Perennial) |
| Napier | Napier | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-1 yr (Perennial) |
| Parsley | Paramount | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.5 - 3.5 Maturity (days after sowing)-130-160 |
| Beans | Borloto | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 4.0 Maturity (days after sowing)-65-70 |
| Beans | Green Arrow | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 Maturity (days after sowing)-60 |
| Beans | Pusa Parvati | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.5 - 3.5 Maturity (days after sowing)-50-60 |
| Beans | Rasma | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 2.5 Maturity (days after sowing)-80-90 |
| Beans | Selection 9\*\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.5 - 3.0 Maturity (days after sowing)-70-80 |
| Beans | Top Crop | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-70-85 |
| Beans | White no.1\*\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.5 - 2.5 Maturity (days after sowing)-70-80 |
| Pea | Arkel | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-65-75 |
| Pea | Usui | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-90-100 |
| Apricot | Bajo Khamchung 1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 2.5 - 4.8 Maturity (days after sowing)-Mid May |
| Apricot | Shakapara | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-May |
| Plum | Jambay Lhakhang Chuli\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 4.0 - 5.0 Maturity (days after sowing)-July-August |
| Plum | Oishiwase | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 6.0 Maturity (days after sowing)-May-June |
| Plum | Santa Rosa | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.0 - 5.0 Maturity (days after sowing)-May-June |
| Peach | Bajokham 1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 3.0 - 4.0 Maturity (days after sowing)-Mid May |
| Peach | Bajokham 2 | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 2.9 - 3.7 Maturity (days after sowing)-July |
| Peach | Bathpala Super\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 4.0 - 6.0 Maturity (days after sowing)-July-August |
| Peach | Nonomiwase | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 8.0 Maturity (days after sowing)-June-July |
| Pomegranate | Bedana\* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 2.5 - 4.0 Maturity (days after sowing)-Late August |
| Passion fruit | Local | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-May-June |
| Pear | Bajo Lhee 1 | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-August |
| Pear | Hosui | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 6.0 - 7.0 Maturity (days after sowing)-Mid August |
| Pear | Kosui | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 5.0 - 6.0 Maturity (days after sowing)-July-Early August |
| Pear | Zhey Lhee \* | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 4.8 - 5.5 Maturity (days after sowing)-Early October |
| Radish | Bajo Laphu 1 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 12.0 - 20.0 Maturity (days after sowing)-45 |
| Radish | Minowase | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 9.0 - 10.0 Maturity (days after sowing)-50-60 |
| Radish | Spring Tokanashi | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 8.0 - 10.0 Maturity (days after sowing)-50-80 |
| Sugarcane | Sugarcane | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 16.0 - 20.0 Maturity (days after sowing)-1 yr (Annual) |
| Willow | Willow | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 0.8 - 2.2 Maturity (days after sowing)-3 yr (Fodder tree) |
| Brinjal | Big Round | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 4.0 Maturity (days after sowing)-75-90 |
| Brinjal | Paro Local | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 1.0 - 2.0 Maturity (days after sowing)-90-100 |
| Brinjal | Pusa Purple Long | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 2.0 - 3.0 Maturity (days after sowing)-90-110 |
| Potato | Desiree | Improved variety | 1989 | 1989 |  | Yield Potential (t/acre)-: 15.0 - 18.0 Maturity (days after sowing)-90 |
| Potato | Khangma Kaap | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 16.0 - 20.0 Maturity (days after sowing)-100-105 |
| Potato | Kufri Jyoti | Improved variety | 1989 | 1989 |  | Yield Potential (t/acre)-: 20.0 - 23.0 Maturity (days after sowing)-100-120 |
| Potato | Yusikap | Improved variety | 1988 | 1988 |  | Yield Potential (t/acre)-: 20.0 - 25.0 Maturity (days after sowing)-100-120 |
| Spinach | All Green | Improved variety | 1990 | 1990 |  | Yield Potential (t/acre)-: 4.0 - 10.0 Maturity (days after sowing)-50-60 |
| Spinach | Leaf Beet | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 4.0 - 10.0 Maturity (days after sowing)-50-70 |
| Stylo Var. CIAT 184 | Stylo Var. CIAT 184 | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 4.0 - 12.0 Maturity (days after sowing)-1 yr (Perennial) |
| White Clover Var. Ladino | White Clover Var. Ladino | Improved variety | 2001 | 2001 |  | Yield Potential (t/acre)-: 3.2 - 4.4 Maturity (days after sowing)-1 yr (Perennial) |
| Gautemala Grass | Gautemala Grass | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.2 - 2.4 Maturity (days after sowing)-1 yr (Annual) |
| Bajoka 1 | Bajoka 1 | Improved variety | 1991 | 1991 |  | Yield Potential (t/acre)-: 1.2 Maturity (days after sowing)-151-155 |
| Bajoka 2 | Bajoka 2 | Improved variety | 1994 | 1994 |  | Yield Potential (t/acre)-: 1.2 Maturity (days after sowing)-150-155 |
| Sonalika | Sonalika | Improved variety | 1988 | 1988 |  | Yield Potential (t/acre)-: 1.0 Maturity (days after sowing)-160-180 |
| Hairy vetch | Hairy vetch | Improved variety |  |  |  |  |
| Mungbean | Bari Mung -2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.3 Maturity (days after sowing)-120-130 |
| Mungbean | KPS-2 | Improved variety | 2002 | 2002 |  | Yield Potential (t/acre)-: 0.3 Maturity (days after sowing)-120-130 |
| Table Grapes | Muscate of Alexandria | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 3.0 Maturity (days after sowing)-August |
| Table Grapes | Perlette | Improved variety | 2004 | 2004 |  | Yield Potential (t/acre)-: 1.0 Maturity (days after sowing)-June |
| Maize | Khangma Ashom 1 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 2.0 Maturity (days after sowing)-140-160 |
| Maize | Khangma Ashom 2 | Improved variety | 1999 | 1999 |  | Yield Potential (t/acre)-: 1.6 - 2.0 Maturity (days after sowing)-110-120 |
| Maize | Yangtsipa | Improved variety | 1992 | 1992 |  | Yield Potential (t/acre)-: 1.2 - 1.6 Maturity (days after sowing)-120-130 |
| Mango | Bajo aumchu-kali 3 | Improved variety | 2010 | 2010 |  | The mother blocks are located in Lingmethang, Bhur, Nangkhor and Bajo. |
| Guava | Bajobab-zeow 1 | Improved variety | 2010 | 2010 |  | The mother blocks are located in Bajo. |
| Guava | Bajobab-zeow 2 | Improved variety | 2010 | 2010 |  | The mother blocks are located in Bajo. |
| Chestnut | Wengkhar Sokey | Improved variety | 2007 | 2007 |  | The mother blocks are located in Wengkhar, Khangma and Yusipang. |
| Walnut | Kagzi | Improved variety | 2002 | 2002 |  | The mother blocks are located in Paro. |
| Walnut | Yusipang 1 | Improved variety | 2004 | 2004 |  | The mother blocks are located in Yusipang , Khangma and Jakar |
| Walnut | Yusipang 2 | Improved variety | 2004 | 2004 |  | The mother blocks are located in Yusipang. |
| Cherry | Seneka | Improved variety | 1994 | 1994 |  | The mother blocks are located in Paro. |
| Cherry | Jabouny | Improved variety | 1994 | 1994 |  |  |
| Broccoli | Centauro | Improved variety |  |  |  | This is heading type of brocolli. Heads mature at the same time and is more suitable for commercial production. |
| Chilli | Yangtse Ema | Improved variety | 2007 | 2007 |  |  |