# **PLANT GENETIC RESOURCES OF BHUTAN**



# Volume I: Field Crops 2008



NATIONAL BIODIVERSITY CENTRE MINISTRY OF AGRICULTURE SERBITHANG, THIMPHU BHUTAN

#### A PUBLICATION

#### IN

# DEDICATION TO THE CORONATION OF OUR BELOVED KING

#### JIGME KHESAR NAMGYAL WANGCHUCK

#### AND

#### THE CENTENARY CELEBRATIONS OF OUR BELOVED MONARCHS

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ROYAL GOVERNMENT OF BHUTAN ministry of Agriculture Thimphu : Bhutan



## FOREWORD

Biodiversity connotes the variety and richness of life on Earth. Such diversity and richness can be gauged basically at three levels: genetic variation, number of species and the extent of ecosystems. The genetic and taxonomic diversity within agricultural crops is referred to as plant genetic resources (PGR), which has largely been developed by farmers over generations as a vital resource for food and nutritional security. Plant genetic resources are a basic requirement for the continuous development of agriculture to meet the food and nutritional needs of growing populations.

Bhutan is a global hotspot of biodiversity and we have a collective obligation to study, inventorize, conserve and sustainably utilize our bio-resources. To realize this mandate, the Ministry of Agriculture has established the National Biodiversity Centre (NBC) to act as a nodal agency for biodiversity conservation and sustainable utilisation of genetic resources. Within NBC, the Royal Bhutan Gene Bank was established in 2005 for *ex situ* conservation and study of plant genetic resources. Since then, many significant initiatives have been taken towards rescue, collection, conservation, documentation and management of PGR in Bhutan. However, much remains to be done to capture the entire diversity in the field.

The present publication **Plant Genetic Resources of Bhutan : Volume I - Field Crops** is the first in the series of documentation intended to capture the agro-biological wealth of our country. Volume I covers food grain crops and legumes. Future publications will cover fruits, vegetables, spices and other crops. The present volume contains information on staple cereals such as rice, maize, wheat, millets, barley and buckwheat which provide the bulk of calories to the Bhutanese populace. It also includes the legume family such as the different beans, grams, peas and soybeans which contribute significant amount of proteins to the Bhutanese diet. These crops traditionally constituted the 'nine crops' or *Du-Na-Guu* (rice, maize, wheat, barley, buckwheat, millet, amaranth, pulses and mustard) in our food basket, and ensured food and nutritional security of our people.

This book contains information on diversity that exists in the traditional crop varieties and landraces, important characteristics and locations where such diversity is available in the field. Each variety has unique characteristics, requirements, advantages and disadvantages. Some are needed for traditional rituals and religious ceremonies. We need this diversity to overcome existing production problems and new ones as they arise in the future, and to ensure sustainability of our agriculture. The current documentation is based on information provided by farmers and not based on laboratory results or molecular analysis. As we deepen our understanding of the PGR through scientific studies, more information will be added in the future publications. I am confident, nonetheless, that this publication will prove useful to a range of readers like researchers, extensionists, students, teachers, conservationists, academicians, administrators, managers and policy makers.

Lastly, I congratulate and thank the editors, working group members from NBC, DoA, DAOs, RNR-RCs, AEOs, Gene Bank staff of NBC and all others who were involved in bringing up this important resource book on plant genetic resources.

Sherub Gyaltshen SECRETARY Ministry of Agriculture Thimphu

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# **EXECUTIVE SUMMARY**

**Bhutan has enormous floral diversity** (both wild and domestic) in the diverse ecosystems and ecological zones of the country that has regional and global importance. Agricultural biodiversity, also known as agro-biodiversity, is a sub-set of the overall biodiversity and includes all cultivated crops and their varieties. It also "encompasses the variety and variability of animals, plants and micro-organisms which are necessary to sustain key functions of the agro ecosystem in support of food production and food security".

**Value of crop plant diversity** is enormous. Genetic diversity is the key to food security and sustainable development. The wider is the diversity, lesser is the chance of total crop failure due to pest and diseases. A wider range of diversity allows a breeder in selecting the appropriate kind of materials and better is the chances for success. The value of PGR diversity in the future will be much more than what can be imagined at present, considering the global climate change and human needs.

The wealth of landraces is gradually disappearing despite the tremendous benefits and potentials we are gifted with. There are number of factors causing genetic erosion of agro-biological wealth. The various factors include displacement of indigenous landraces by new, genetically uniform cultivars, switch from diverse traditional systems to few market orientated cash crops, destruction of habitats due to urbanization, wild animal damages on crops, drought/untimely rain/shortage of irrigation facilities, change of landuse, low yield, land clearing/landslides and habitat loss/soil erosion problem, shortage of labour and erosion of food culture.

A nation wide inventory of PGRFA was carried out during 2002 and 2003 to assess and document the extent of crop genetic resources in the country. This was necessary for drawing strategic conservation and sustainable utilisation plans. Representative sites were identified cutting across the whole spectrum of agro-ecosystems present in the country, based on agro-ecological zones, other available information and in consultation with RNR-RCs. Inventory was carried in 2002 and 2003 by AEOs/JEOs of selected sites, RNRRCs and NBC. Access database was developed and demonstrated to all RNRRCs in 2002 and 2003, documentation was completed in 2005, data was analysed and gaps were identified in 2006. Incomplete and missing data were collected in 2007 and incorporated in the main database in early 2008.

The objectives of this publication are:

- 1. To document extent of crop genetic diversity The agro-biological wealth of the country.
- 2. To dedicate this work to the coronation of our beloved King Jigme Khesar Namgyal Wangchuck and the Centennial Celebrations for 100 years of Monarchy for peace and prosperity.

This book on 'Plant Genetic Resources of Bhutan: Volume I - Field Crops' is the first of its kind published by the Ministry of Agriculture. Field Crops cover cereals like rice, maize, millets, barley, wheat, buckwheat, grain legumes and oils seed crops. A second volume of 'Plant Genetic Resources of Bhutan: Volume II-Other Crops' is expected to be published in 2010. The book provides information on diversity in the field of traditional varieties/ landraces of the target crops, important characteristics where ever possible, location where these diversity are available in the field and their collection status in the gene bank. This information will be of use to a range of readers like Extensionists, researchers, students, teachers, conservationists, administrators, managers and policy makers.

It is difficult to differentiate accurately and count on exact number of landraces under each crop as it is possible that same variety probably be called by different names and different landraces called by same name in different villages. Therefore systematic characterisation using both morphological and marker techniques or DNA finger printing is crucial to ascertain actual genetic diversity of each crop in the country. However, based on folk classification in nameing of landraces and information on characteristics provided by farmers through inventory in the field in 26 Gewogs and based on passport information of accessions in the Gene bank, table below provides the total traditional varieties or landraces of different field crops that have been recorded till date. The number of landraces possibly will add on in some crops with germplasm collection from other areas and actual genetic diversity probably may shrink with characterisation of germplasm samples of these varieties.

# Total traditional varieties/landraces/farmers' varieties under each each crop recorded till date:

S1. no	Сгор	Scientific name	No. of landracs/ TVs	S1. no	Crop	Scientific name	No. of landracs/ TVs
1	Rice	Oryza sativa	281	11	Beans	Phaselus vulgaris	76
2	Maize	Zea mays	81	12	Soybean	Glycine max	11
3	Barley	Hordeum vulgare	32	13	Dal	Vigna mungo V. angularis V. umbellatta V. unguiculata	23
4	Buck wheat (Sweet)	Fagopyrum esculentum	10	14	Pegion pea	Cajanus cajan	1
5	Buck wheat (Bitter)	Fagopyrum tataricum	11	15	Peas	Pisum sativum	5
6	Finger millet	Eleusine coracana	37	16	Mustard and rapeseeds	Brasssica campestris var. toria and Brassica campestris var. sarson	26
7	Foxtail millet	Setaria italica	36	17	Niger	Guizotia abyssinica	1
8	Little millet	Panicum miliacium	4	18	Perilla	Perilla frutescens	2
9	Wheat	Triticum aestivum	26	19	Ground nut	Arachis hypogaea	1
10	Amaranthus	Amaranthus	17	20	Sesame	Sesamum indicum	1

To conserve our crop and plant varieties, the NBC is committed towards long-term preservation of genetic resources, combining a number of different approaches. Both *ex-situ* through the Gene Bank and *in-situ* or onfarm conservation that allows continuous evolution and improvement are being implemented in a complementary way to conserve PGR diversity before they are lost from the fields forever. With the establishment of Royal Bhutan Gene Bank in 2005 and as on January 2008, a total of 109 gewogs have been covered and about 2,000 samples of traditional varieties of rice,

maize, wheat, buckwheat, barley, millets, oil seed crops, legumes have been collected of which 1,000 accessions are registered in the Gene bank while other samples are being processed. Germplasm collection will continue till total crop diversity is captured from the field. Collected samples will have to characterize with the use of molecular tools to ascertain actual genetic diversity. Invitro Active (IVA) and Invitro Base (IVB) will have to be established to conserve those crops with recalcitrant seeds and those that can be propagated only through vegetative means.

# **DEFINITION OF TERMS**<sup>[13]</sup>

- 1. Field Crops: Important food grain crops comprising cereals (rice, maize, wheat, buckwheat, millets etc), oilseeds (rapeseed mustard, sunflower, niger etc) and grain legumes (mungbeans, soybeans etc).
- 2. Germplasm: It is a collective term to denote seeds, seedlings, planting materials, ex plants, or any living tissues, that are capable of reproduction or propagation.
- 3. Gene: The unit of heredity transmitted from generation to generation during sexual or asexual reproduction. More generally, the term is used in relation to the transmission and inheritance of particular identifiable traits.
- 4. Genetic Resources Conservation: The conservation of species, populations, individuals or parts of individuals, by in situ or ex situ methods, to provide a diversity of genetic materials for present and future generations.
- 5. Gene bank: The physical location where collections of genetic material in the form of seeds, tissues or reproductive cells of plants or animals are stored.
- 6. Genetic diversity: The heritable variation within and among populations which is created, enhanced or maintained by evolutionary or selective forces.
- 7. Genetic erosion: The loss over time of allelic diversity, particularly in farmed organisms, caused by either natural or man-made processes.
- 8. Gene flow: The spread of genes from one breeding population to another (usually) related population by migration, thereby generating changes in allele frequency.
- 9. Landrace: In plant genetic resources, an early cultivated form of a crop species, evolved from a wild population, and generally composed of heterogeneous mixtures of genotypes.

Note: [13]: http://www.croplifeasia.org/biotechnology-glossary.html.

- 10. Marker: An identifiable DNA sequence that is inherited in Mendelian fashion and which facilitates the study of inheritance of a trait or a linked gene.
- 11. Plant genetic resources: the reproductive or vegetative propagating material of:Cultivated varieties (cultivars) in current use and newly developed varieties; Obsolete cultivars; Primitive cultivars (landraces); Wild and weed species, near relatives of cultivated varieties; and Special genetic stocks (including elite and current breeder's lines and mutants)
- 12. *In-situ*: *In-situ* conservation is scientifically defined as the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings.
- 13. *Ex-situ: Ex-situ* conservation means the conservation of components of biological diversity outside their natural habitat.

# ACRONYMS

AEZ	Agro-ecological Zones				
AEO	Agriculture Extension Officers				
BUCAP	Biodiversity Use and Conservation in Asia Program				
СТ	Cool Temperate				
CWR	Crop Wild Relatives				
DAO	Dzongkhag Agriculture Officer				
DST	Dry Sub-Tropical				
Dzo.	Dzongkhag				
FYP	Five year plan				
GBIS	Gene Bank Information System				
GEF	Global Environment Facility				
GNH	Gross National Happiness				
HHs	Households				
HST	Humid Sub-Tropical				
HYVs	High Yielding Varieties				
IPGRI	International Plant Genetic Resources				
IVA	Invitro Active				
IVB	In-vitro Base (Cryo-preservation facilities)				
MT	Metric Ton				
masl	Meter above sea level				
NBC	National Biodiversity Centre				
NTVs	Numerous Traditional Varities				
No.	Numbers				
Nu.	Ngultrum				
PGR	Plant Genetic Resources				
P. Gatshel	el Pemagatshel				
RBGB	Royal Bhutan Gene Bank				
RNR-RC	Renewable Natural Resources Research Centres				
RAPD	Random Amplified Polymorphic DNA				
SDA	Sustainable Development Agreement				
S. Jongkhar	Samdrup Jongkhar				
TKs	Traditional knowledge				
T. Gang	Trashigang				
T. Yangtse	Trashi Yangtse				
TVs	Traditional varieties				
UNDP	United Nations Development Program				
WST	Warm Sub Tropical				
WT	Warm Temperate				



# **PART ONE:**

GENERAL INTRODUCTION TO CONSERVATION AND MANAGEMENT OF PLANT GENETIC RESOURCES IN BHUTAN





# 1.1 **BIODIVERSITY AND ITS BENEFITS**

Biodiversity is the shortened form of two words "biological" and "diversity. Biodiversity is the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems <sup>1</sup>. Nature has generated diversity in biological organisms over the millions of years of evolution. The diversity among and within the various organisms has facilitated them to acclimatize, reproduce and carry on their lives to the changing environment. Bhutan has enormous floral diversity (both wild and domestic) that has regional and global importance in the diverse ecosystems and ecological zones occurring in the country.

There are a multitude of benefits of biodiversity in the sense of one diverse group aiding another as indicated below <sup>2</sup>.

### **Resistance to Catastrophe**

Monoculture, the lack of biodiversity, was a contributing factor to several agricultural disasters in history, including the Irish Potato Famine, the European wine industry collapse and US Southern Corn Leaf Blight epidemic. Biodiversity provides the best bet for finding sources of resistance to biotic and abiotic stresses, thus ensuring food security for humankind.

### Food and drink

Biodiversity provides food for humans. About 80 percent of our food supply comes from just 20 kinds of plants. Although many kinds of animals are utilized as food, again most consumption is focused on a few species. There is vast untapped potential for increasing the range of food products suitable for human consumption, provided that the high extinction rate can be halted.

Ref:

<sup>[1]</sup> Convention on Biological Diversity

<sup>[2]</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

#### Medicines

A significant proportion of drugs are derived, directly or indirectly, from biological sources; in most cases these medicines can not presently be synthesized in a laboratory setting. Moreover, only a small proportion of the total diversity of plants has been thoroughly investigated for potential sources of new drugs. Many medicines and antibiotics are also derived from microorganisms.

#### **Industrial materials**

A wide range of industrial materials are derived directly from biological resources. These include building materials, fibers, dyes, resins, gums, adhesives, rubber and oil. There is enormous potential for further research into sustainably utilizing materials from a wider diversity of organisms.

## Other ecological services

Biodiversity provides many ecosystem services that are often not readily visible. It plays a part in regulating the chemistry of our atmosphere and water supply. Biodiversity is directly involved in recycling nutrients and providing fertile soils. Experiments with controlled environments have shown that humans cannot easily build ecosystems to support human needs; for example insect pollination cannot be mimicked by man-made construction, and that activity alone represents tens of billions of dollars in ecosystem services per annum to mankind.

### Leisure, cultural and aesthetic value

Many people derive value from biodiversity through leisure activities such as enjoying a walk in the countryside, bird watching or natural history programs on television. Biodiversity has inspired musicians, painters, sculptors, writers and other artists. Many cultural groups view themselves as an integral part of the natural world and show respect for other living organisms.

# 1.2 AGRO-BIODIVERSITY AND ITS SIGNIFICANCE

**Agro-biodiversity:** Agro-biodiversity is a component of biodiversity that contributes to food and agriculture production<sup>[3]</sup>. So Agricultural biodiversity is a sub-set of general biodiversity including all cultivated varieties and PGR diversity is the plant component of agro biodiversity. PGR on Agricultural and Horticultural plants include cereal crops, vegetables, fruits and nuts etc. that are native, invasive, ecological escapes or introduced long time ago that have developed unique genetic, morphological and ecological characteristics.

## Significance of Agro-biodiversity

The people of Bhutan depend on agro-biodiversity for a number of social, religious, cultural and economic activities. The main uses are food, animal feed, income generation, timber/fuel, traditional medicine, religious offerings, exchange/barter/gift, handicrafts, fencing, traditional socio-cultural use, soil and water conservation, ornamental value etc.

The value of PGR diversity in the future will be even more precious and valuable than what can be imagined at present, considering the emerging technologies, climate change and growing human needs.

The landraces and crop wild relatives are source of genes for agricultural development as stated below <sup>[5]</sup>.

 Crop diversity and food security: Cultivated varieties of crops can be broadly classified into "modern varieties" and traditional/farmers' varieties". Modern varieties are the outcome of scientific breeding and are characterized by high yield and a high degree of genetic uniformity. In contrast, farmer's varieties (also known as landraces) are the product of breeding or selection carried out by farmers. It helps to provide stability to the farming systems at local, national and regional levels by levelling yield variability, through the cultivation of wide range for crops and intra-crop diversity.

Ref:

<sup>[3]:</sup> European Community Biodiversity Clearing-House Mechanism

<sup>[5]:</sup> Tamang A.M. 2003 'Conservation Action Planning for Food Crop Wild Relatives of Bhutan.

It compensates yield of a particular variety or crop by maintaining yield of other varieties or crops. It provides a general insurance against unpredictable environmental changes. The agricultural biodiversity is the surest insurance against natural disasters.

- Genes for pest and disease resistance: Wide ranges of diversity allow breeders in selecting the appropriate kind of breeding materials so that chances for success of developing appropriate variety is higher for benefiting farmers and the consumers. Genes for pest and disease resistance contribute directly to increased crop yields and to reduced use of pesticides and fungicides. Genes that provide resistance to pests and diseases have been obtained from crop wild relatives in western countries and used in a wide range of domesticated crops, including rice to curve pest and disease problems.
- Genes that enhance nutritional quality: In a number of crops, wild relatives and land races have provided genes that enhance nutritional quality of many foods and contribute to improved human health. Genes from crop relatives have been used to improve protein content in wheat and vitamin C content in tomato.
- **Genes for abiotic stress tolerance:** Crop wild relatives and land races have also been a source for genes for abiotic stress tolerance in many crops. Genes for stress tolerance reduce the need for non-renewable inputs in marginal environments.

#### PGRFA conservation for sustainable development

PGR conservation has direct bearing on the sustainable agricultural development of any nation. The Chart 1 indicates the significance of PGRFA diversity for sustainable development.



Chart. 1. Performance of numerous TVs and 1 HYV over a number of years.

Performance of HYV may fluctuate hugely over a number of years under adverse condition where as performance of numerous traditional varieties (TVs) may resist adverse conditions and have less fluctuation on the over all production and food security. It is an established fact that the narrowness of genetic base is responsible for greater risk of crop failures.

Therefore relationship between conservation and sustainable development is like that of a lock and key. Conservation is the backbone of sustainable development. Therefore environment conservation is one of the pillars of the development philosophy of GNH which was first propounded by His Majesty the fourth King Jigme Singye Wangchuk. Bhutan has enshrined environmental conservation as a constitutional mandate.

### **PGRFA System in Bhutan**

There are primarily two levels of PGRFA system in Bhutan.

- 1. Local/Community PGRFA system
- 2. Formal PGRFA system
  - **1.** Local/Community PGRFA System: Farmers manage their plant genetic resources in an integrated and adaptive fashion. Plants are planted and harvested with multiple purposes such as to produce

for household consumption and other on-farm uses, for marketing and to produce seed, roots, tubers or stems for next season planting. The exchange and adoption of seeds is another element that adds to the dynamism of this system. Seeds are exchanged with friends, relatives or via merchants. Farmers may also use produce meant for consumption as seeds or other way around, usually if no other opportunity exists. Approximately 98% of the farmers' seed supply in Bhutan is through this 'Community PGRFA System'.

2. Formal PGRFA System: The institutional seed system primarily follows one-directional flow of germplasm and information. Germplasm is originally derived from the 'Local PGRFA System' or fromGene Banks or international research centres. Breeders recombine the genetic diversity and select a portion of this, which thereafter is multiplied and distributed by Seed Producing organization like Druk Seed Corporation. Approximately only 2% of the farmers' seed supply in Bhutan is through this 'Formal Seed System'.

Conservation for sustainable development therefore is the basis without which development in the long run will dwindle in the look out for quick and short-term benefits.

Figure 1 in page no.7 shows that the flow of PGRFA from farmers' field to research station and then back to farmers' field indicating that conservation is vital at both local and institutional level in an effort to maintain continuous flow of the diverse genes at all levels for all times for sustainable development.



# 1.3 THREAT TO PLANT GENETIC DIVERSITY

Despite the tremendous benefits we have been blessed in terms of diverse PGR as stated in earlier chapter, evidence suggests that the state of the biological wealth is being depleted at an ever increasing rate due to increasing population, economic and technological changes in Bhutan and the world at large. Genetic erosion is the loss of genetic diversity, including the loss of individual genes, and the loss of particular combinants of genes (or gene complexes) such as those manifested in locally adapted landraces. The term genetic erosion is sometimes used in a narrow sense, such as for the loss of alleles or genes, as well as more broadly, referring to the loss of varieties or even species.

Although we talk of rich agro-biodiversity in Bhutan, the threat of genetic erosion is ever present. The major driving forces behind genetic erosion in crops in Bhutan are:

- 1. Displacement of indigenous landraces by new, genetically uniform cultivars: The traditional landraces and farming systems in the country have been seriously affected since the introduction of HYVs and modern farming practices using chemical inputs. Replacement of numerous, diverse traditional cultivars by fewer modern varieties in an effort to enhance food production leads to narrowing of genetic base. For example, HYVs of rice and maize have replaced numerous and diverse local varieties in western and eastern parts of the country. Similarly, several traditional wheat varieties have been replaced by a handful of HYVs. This could pose greater risk of crop failure in the future.
- 2. Switch from diverse traditional systems to few market orientated cash crops: A switch from diverse traditional systems of sustainability to a specific few market orientated cash crops (e.g. potatoes, cabbages and apples etc) is also causing the loss of genetic diversity.
- **3.** Environmental degradation and destruction of habitats due to urbanization: e.g. Traditional varieties have been lost to some extent, due to cultivable land being lost to urbanization like in Thimphu valley, Bajothang and Tingtibi.
- 4. Wild animal damage: Some farmers have narrated that wild animal damage has been one of the factors for decline in extent of cultivation

of some of the crops and crop cultivars. E.g. Vigna at Surey Gewog under Sarpang Dzongkhag, Tsigsumpa maize at Bechamang, Lamda and Womanang villages and Khosomo finger millet at Becahmang, Tarphel and Womanang villages of Bomdeling Gewog under Trashiyangtse Dzongkhag, Bepa shawling soybean at Jalang village of Minji Gewog under Lhuntse Dzongkhag, Manath and Guentho Buckwheat at Dur of Choekhor Gewog under Bumthang Dzongkhag. Ngadpo Maize at Tali village of Nangkor Gewog under Zemgang Dzongkhag.

- **5. Drought/untimely rain/shortage of irrigation facilities:** Some farmers have narrated that drought/untimely rain/shortage of irrigation facilities have been one of the factors for decline in extent of cultivation of some of the crops and crop cultivars. E.g. Baipu ashom maize, Beans at Demkhar village of Yangneer Gewog under Trashigang Dzongkhag, Hang Gop onion at Tshongkha village of Doga Gewog under Paro Dzongkhag.
- 6. Banning of shifting cultivation: Some farmers have narrated that banning of shifting cultivation has been one of the factors for decline in extent of cultivation of some of the crops and crop cultivars. E.g. Chema yangra foxtail millet at Zobel village of Zobel Gewog under Pemagatshel Dzongkhag, Rongshung yangra and Busung yangra foxtail millet at Darjeeling village of Yangneer Gewog under Trashigang Dzongkhag, Kali kodo finger millet and Sheti maki maize at Khargoung village of Doban Gewog under Sarpang Dzongkhag, Finger millet at Buli and Tshedang villages of Nangkor Gewog under Sarpang Dzongkhag.
- 7. Low yield: Some farmers have narrated that low yield has also been one of the factors for decline in extent of cultivation of some of the crops and crop cultivars. E.g. Kurtoepa rice at Fangteng village of Bomdeling Gewog under Trashi Yangtse Dzongkhag, Jaya rice at Laring village of Hillaey Gewog under Sarpang Dzongkhag, Yurangay rice at Katchin village of Tendu Gewog under Samtse Dzongkhag.
- 8. Land clearing/landslides and habitat loss/soil erosion problem: Some farmers in Gomtu Gewog expressed that due to landslide aggravated due to mining and habitat destruction at Pugli B has resulted to the loss of some traditional rice varieties like Champa Sari and Dudh kati.

- **9.** Shortage of Labour: Some farmers have narrated that labour shortage has also been one of the factors for decline in extent of cultivation of some of the crops and crop cultivars. E.g. Woolingpa maize at Beelam village of Orong Gewog under Samdrup Jogkhar Dzongkhag, Gangkhapa maize at Tshelingkhor village of Zobel Gewog under Pemagatshel Dzongkhag, Sibsoo Bhagani finger millet at Kuwa Pani village of Hilley Gewog under Sarpang Dzongkhag, Kashhmiray rice at Allay Gang village of Ruepaisa Gewog under Wangdue Dzongkhag, Jilijum foxtail millet at Somakha village of Mewang under Thimphu Dzongkhag.
- **10. Change of food habits:** Genetic diversity of traditional crops is eroding because of change in food habits, eg. Buckwheat is replaced by potatoes. Potatoes are sold for purchasing rice and other household needs and rice is becoming staple food.

## 1.4 PLANT GENETIC RESOURCES MANAGEMENT: INITIATIVES ON CONSERVATION FOR SUSTAINABLE UTILISATION

In view of the facts mentioned in chapter 1.1, 1.2 and 1.3, conservation of PGRFA diversity has become a global and national concern. It is now well recognized that, for any given gene pool, a number of different approaches and methods are necessary for efficient and cost effective conservation. There are two basic conservation strategies, each composed of various techniques, *i.e. ex-situ* and *in-situ* conservation. Bhutan is taking integrated approach using both conservation strategies in a complementary manner.

### 1.4.1. *Ex-situ* conservation

*Ex-situ* conservation means the conservation of components of biological diversity outside their natural habitat. *Ex-situ* conservation began in wide scale in 1970's in other countries and the most prevalent *ex-situ* techniques are conservation in the seed Gene banks, field Gene banks, in-vitro repositories and cyro-preservation.

Considering all potentialities and liabilities, Royal Bhutan Gene Bank (RBGB) for ex-situ conservation of PGRFA was established under NBC in 2005 with financial support from the Royal Government of the Netherlands under the framework of SDA. This method takes care of orthodox seeds. Orthodox seeds are those that are tolerant to ultra desiccation and freezing where as the other category of seeds which lose viability under ultra desiccation and freezing are called 'recalcitrant seeds. This group of seeds can be conserved through field Gene banks, in-vitro repositories and cryopreservation. However, establishment of facilities for recalcitrant seeds in Bhutan are earmarked for future.

Since the establishment of RBGB in 2005, one of the priority activities of the Gene bank among numerous other activities has been exploration of traditional crop diversity and germplasm collection of traditional crop varieties.



Pic .1: Germplasm collection in Wangdue



Pic 2: Germplasm collection in Lhuntse

Germplasm collections from across the country are carried out immediately after the harvest of the crops in order to ensure obtaining of good quality seeds and to ensure long-term viability. Germplasm collections are taken up by the Gene bank staff in close collaboration with Dzongkhag and Gewog Agricultural staff and RNR-RCs.

As of January 2008, a total of 109 gewogs have been covered and a total of about 2,000 samples of traditional varieties/cultivars of rice, maize, wheat, buckwheat, barley, millets, oil seed crops, legumes have been collected of which 1000 accessions are registered in Gene bank while other samples are being processed as per the international Gene bank standards.



Pic 3: Checking viability





Pic. 5. Documentation in GBIS

The collected germplasm are cleaned, sample quality evaluated, processed, information documented in access database called GBIS and germplasm samples are stored in the Gene bank at -20°C.

The GBIS holds following information on germplasm being conserved and maintained in the gene bank:

- taxonomic information
- accession numbers

- storage system
- passport data
- number of packets under each system, amount of seeds available
- germination percentage at entry as well as at established intervals
- location of accessions in the Gene bank
- date of storage in the Gene bank

There are two types of collections 'Active' and 'Base' both maintained at -20°C. The samples from the 'Active Collections' are used for distribution to the users, researchers, breeders etc. The samples from the 'Base Collections' is for security and will be used only for monitoring of viability of stored seeds or for regeneration or to replenish the active collections. The process and events in the Gene bank is presented in figure 2, page 14



*Pic. 6. Base samples being taken into the Gene bank* 



*Pic.* 7: *Base collection.* 



The RBGB provides/will provide following services:

1. PGR Gene bank holds/will hold samples of diverse landraces/ traditional crops of Bhutan for immediate use by the researchers and for long term conservation for crop improvement and development programmes in future.

- 2. Gene bank will provide easy access to germplasm for future utilisation by the breeders, researchers and farmers. Without a diverse genetic reservoir to draw from, further improvement will not be possible in future. Diverse genetic resources will support industry-oriented development through enhancement of germplasm utilization.
- 3. These diverse landraces are numerous and genetically variable fulfilling a variety of needs and adapted to different conditions, even in the bad years at least some strains/varieties can survive and pass on adaptability to adverse climatic conditions, water scarcity, low fertility, problem soils and aquatic systems, pests and diseases.
- 4. These landraces will be the source for genes for pest and disease resistance which directly contribute to increased crop yields. They will be the potential source for genes that enhance nutritional quality of many foods and contribute to improved human health. They will be the source for genes for abiotic stress tolerance in many crops and reduce the need for non-renewable inputs in marginal environments.
- 5. Gene bank will contribute to sustainable utilization of agrobiodiversity resources in order to foster sustainable development practices to preserve their productive capacity in the service of present and future generation of Bhutanese people.
- 6. It will serve as a service provider to collect, conserve, characterize, evaluate, document and distribute PGR germplasm and information to the users.

#### In situ conservation: On-farm Conservation

*In-situ* conservation is scientifically defined as the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. *In-situ* conservation methods include nature reserves, managed areas and farmer's field (Maxted et al<sup>[5]</sup>)

*Ex situ* conservation in gene banks is an essential component for preserving vital crop resources but conservation must go beyond this, to maintain the evolutionary processes that create the resource. *In situ* conservation provides a way to improve conservation and to recognize the important

role of farmers in maintaining and providing resources to the world community. The maintenance of crop evolutionary process in key farming systems is important for several reasons viz. climate continues to change, pests and pathogens evolve, and physical conditions, such as soil chemistry and structure change <sup>[11]</sup>. Further, through *in situ* conservation, farmers have easy and direct access to the resources unlike the off-site collections.

In Bhutan *on-farm* conservation of crop genetic resources was initiated since 2001 by the National Biodiversity Centre in close collaboration with regional RNR-RCs and Dzongkhag Agriculture Sector as a part of Biodiversity Use and Conservation in Asia Program (BUCAP). The program is implemented in five partner countries: Bhutan, Lao PDR, Philippines, Thailand and Vietnam. In the 1<sup>st</sup> phase of the project (2001-2004), was focus on on-farm conservation of maize and rice genetic resources through participatory approaches. The on-going on-farm conservation programme (2<sup>nd</sup> phase of BUCAP) includes conservation of important food crops in the country and is carried out in 13 sites covering eight dzongkhags (Trashigang, Mongar, Trongsa, Wangdue, Thimphu, Tsirang, Sarpang and Chukha).

In the above sites, *On-farm* conservation is promoted through: (a) supporting farming communities conserving traditional crops and crop varieties through yield enhancement (b) creating awareness and

promoting seed exchange through Biodiversity Fairs (c) broadening the genetic base through participatory varietal selection (PVS) (d)capacity building in proper seed selection, maintenance and storage (e) diversification of products and marketing and (f) and strengthening farmers PGR management system through capacity development and study visits to the partner countries.

Supporting on-farm management and conservation of plant genetic resources for food and agriculture is the most direct way of reaching farmers. It forms a strong contribution to the maintenance of on-farm diversity of plant genetic resources for food and agriculture.

Ref:

<sup>[5]:</sup> Tamang A.M. 2003 'Conservation Action Planning for Food Crop Wild Relatives of Bhutan.[11] FAO, 1994
It preserves the processes of crop evolution, defined by hybridization within and between populations of wild, weedy and cultivated plants, competition among genotypes, natural and conscious selection at the local level, and exchange of different genotypes among farms. By strengthening these efforts, on-farm management of diversity complement *ex situ* conservation to address the future food needs.



Pic.8: Participatory Varietal Selection (PVS)



*Pic.* 10: *Promoting Seed Exchange for on-farm conservation* 



Pic.9: Biodiversity Fairs



*Pic.11: Addressing vareital degeneration through proper seed selection* 



# **PART TWO:**

# STATUS OF FIELD CROPS GENETIC RESOURCES OF BHUTAN





# 2.1. INVENTORY OF PGRFA

## 2.1. 1. Objectives:

- To locate, study and assess extent of crop genetic resources that are extant/present in the field in the country.
- To document extent of crop genetic resources in the country.
- To set base line for genetic erosion assessment. Information collected at HH levels will be useful to monitor the trends of genetic erosion at the community level.
- To aid in strategic germplasm collection from the field to conserve in the Gene bank.

#### 2.1. 2. Methodology

Inventory methodology and the format were developed with the aim of capturing the above-mentioned information. The methodology and the formats went through a long process of development and amendments, which was finalized by the consultant from IPGRI (now Bioversity International). The format was then discussed with the Researchers and Extension agents to test the field application of the formats. The comments and suggestions were incorporated and were finalized for use in the inventory programme.

It was not possible to go to every village or Geog in the country. Therefore, priorities and conditions/criteria were set to select representative sites/ regions for the field operation. Representative sites were identified cutting across the whole spectrum of agro-ecosystems present in the country. It was based on the agro-ecological zoning, other available information and in discussion with regional RNR-RCs.

Following were the site selection criteria used:

- Dzongkhags having maximum area under particular AEZ.
- Geog-representative of AEZ
- At least a site under each Dzongkhag
- 1 6 sites/AEZ depending upon the area covered, farming intensity, No. of Dzongkhags under each AEZ
   Sites under one AEZ cover both dry land and wetland where ever possible.
- Sites under one AEZ cover both from roadside and remote areas.

Teams comprising of members from different nodal points viz. Agriculture Extension Officers (Local Nodal Agents), RNRRCs (Regional Nodal Point), and NBC (National Nodal Agent) was

formed. A small but effective group was formed for the actual inventory in the field in view of the fact that a large team is cumbersome difficult to manage.

AEZ	Altitude (m)	Dzongkhags classification	Dzongkhag selected	Geog/ Representative sites
<b>C</b> T	Haa, Bumthang, 2600-3600 Thimphu, Paro,		Bumthang	Chokor & Tang
CI	High	Punakha, Wangdue, Trongsa	Наа	Katso & Bji
			Thimphu	Mewang
TATE	1800-2600	Haa, Thimphu, Paro,	Paro	Doga & Shaba
W I	High	Trongsa, Lhuntse, Trashigang	Trongsa	Drakten & Korpho
			Lhuntse	Menzi
	1200-1800 Mid		Punakha	Kabjisa, Teowang
		Punakha, Wangdue, Trongsa, Trashigang, Mongar, Trashi Yangtse	Wangdue	Rupaisa , Kazi
DST			Trashigang	Yangneer
			Mongar	Kengkhar
			Trashiyangtse	Bomdeling
			Pemagatshel	Zobel
	600-1200	Trachigang	Zemgang	Nangkhor
HST		Zemgang, Dagana, S/Jongkhar, Tsirang,	Tsirang	Puntenchhu, Mendaygang
	With	Pemagatshel, Samtse,	Dagana	Tseza
		Sarpang, Chinukna	Chhukha	Balujora
			Sarpang	Dovan
WCT	150-600	Samtse, Sarpang, S/	Samtse	Tendu
W51	Low	Jongkhar	S/Jongkhar	Orong

Table 1: Sites for 1 <sup>st</sup> phase of inventory of PGF
--

The inventory was conducted in 2002-2003 by different teams. The following process was followed.

#### • Meeting with Local Nodal Agents-Extension Agent:

Prior to the actual inventory, meeting and discussion was held with the concerned extension staff in order to plan the routes.

## • Household sampling:

20% of the total household per village/geog under the selected site under uniform topography condition and 30% of the total household per village/geog under the selected site under diverse topography condition was followed. Random selection of household was done for individual household interviews. But at the same time household with elderly people were interviewed in view of the fact that they are more resourceful and knowledgeable than the youngsters.

## • Village Meeting/Final Site Meeting:

Farmers Group interview / discussion was conducted to address certain issues that can be better obtained from the group meeting than individual interviews:

For final presentation to farmers and to get feedback and clarification from the farmer and to fill up the missing information during the house hold survey.



Pic.12: Inventory under process in one of the sites in Zobel Gewog, Pemagatshel

• **Collection of information and data analysis:** In order to document the information gathered during the inventory of PGRFA diversity, Access database was developed by NBC in 2002. The database was then installed and demonstrated to the Field Crop Sector of all the four RNRRCs in 2002-2003. Three RNRRCs were also provided with computer

and accessories for documentation. The documentation of information gathered during inventory was finally completed by NBC in 2004-2005. The information was then assessed to provide the extent of diversity, the extent of genetic erosion/decline, to screen out cultivars on decline for immediate rescuing, to identify cultivars cultivation of which have been stopped in the inventory and near by areas and locate the sites for immediate collection of cultivars on decline.

#### • Collection of missing information:

Data was analyzed in 2006. Upon analysis of data, certain information particularly elevation data were missing. The missing information was provided by most Dzongkhags in 2007 which was updated in the main database in early 2008.

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# 2.2. RESULTS: INVENTORY OF FIELD CROPS GENETIC RESOURCES

The crop plants of Bhutan are grouped under the four main categories of use: Group 1: The Food Crops (Cereals, Legumes (grain & vegetables), Oilseeds, Vegetables, Fruits and nuts, Root crops, Sugar crops, Herbs and spices, Beverage crops) Group 2: Fodder crops Group 4: Ornamental crops Group 3: Industrial crops

This 'Volume I focuses only on 'Field Crops' which includes cereals, legumes and oilseeds of Group 1 above. The Volume II will be published in 2010 which will include other components of crop plants categorized under group 1 above.

#### Basis for the diversity assessment:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famers through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under each crop as it is probable that same variety or landraces of crop is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity in the country for each crop.

## 2.2.1 RICE

# CLASSIFICATION AND ORIGIN OF RICE

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Subclass	Commelinidae
Order	Cyperales
Family	Poaceae
Genus	Oryza L.
Species	<i>O. sativa</i> L.

#### Classification<sup>[2]</sup>

#### Origin:

In the beginning rice grew wild, but today most countries cultivate varieties belonging to the *Oryza* type which has around twenty different species. Only two of them offer an agricultural interest for humans <sup>[2]</sup>:

- *Oryza sativa*: Common Asian rice found in most producing countries which originated in the Far East at the foot of the Himalayas. *O. sativa* form *japonica* grew on the Chinese side of the mountains and *O. sativa* form *indica* on the Indian side. Bhutan being in the Himalaya, the foot hills of Bhutan could also be claimed to be centre of origin of common Asian rice.
- *Oryza glaberrima*: Originated in West Africa, covering a large region extending from the central Delta of the Niger River to Senegal.

*Ref:* [2] Wikipedia, the free encyclopedia) http://en.wikipedia.org

# RICE CULTIVATION IN BHUTAN

In Bhutan, rice is cultivated in all the agro-ecological zones of Bhutan except the alpine zone in the north. It is cultivated from humid sub-tropical zones at an elevation of 150m in the southern foot hills to warm temperate zones in the north at an elevation of 2,600 masl. In recent times rice rice is grown in Bumthang Dzongkhag also at an atitude of 2780 masl. Now rice is grown in all 20 Dzongkhags. At least 47,000 acres of irrigated land are known to be under rice cultivation, and contribute to 42 percent of the cereal production in the country. Rice is cultivated in terraces and about 60-70 percent of the rice fields are irrigated following a rice-maize, rice-potato, rice-another field crop or rice- fallow system of farming.

Area under rice cultivation has been reduced as a result of loss to urban expansion, industries and government infrastructure developments on irrigated lands.

## RICE AND ITS SOCIO-ECONOMIC IMPORTANCE

In 2006 rice production was 74, 38 457 MT. Samtse, Sarpang, Punakha and Dagana have the largest cultivation areas and highest production with an area of 11,008, 10,134, 5,574 and 5,466 acres respectively and production of 8, 542, 7, 510, 9,229 and 3,959 MT respectively<sup>[6]</sup>. Rice cultivation in high altitudes of Bumthang Dzongkhag commenced since 2004. Major Rice cultivation areas are found in the west and south where terrain is gentler and more accessible to streams and river valley irrigation systems<sup>[6]</sup>.

Rice production in Bhutan is largely used for domestic consumption. The census date for 2001 reported one percent of rice being marketed. However, based on the farmers' survey, about 15 percent goes to the market <sup>[12].</sup> According to the Commodity Chain Analysis on rice, done by the MOA about 49 percent of the rice consumed in the country is produced domestically, whereas 51 percent is imported from neighboring countries<sup>[12].</sup>

Ref:

<sup>[6]</sup> Agriculture Statistics 2006

<sup>[12]</sup> Bhutan Observer: 18 September 2008

Rice is the preferred staple food of the Bhutanese and often consumed thrice or at least twice daily. There are >10 different menus that represent different ways of cooking rice into various dishes. Rice is consumed in form of boiled rice, boiled and fried rice, *Zaw*, *Thyup*, *Desi*, *Khir*, *Chamray*, *Roti*, *Sip/Chewra*, *Mekhu*, *Changkay*, Beer etc. Straw is used as cattle feed, for making roof, and also for making mats. Rice bran is used as livestock feed.

Rice is the most important component of *Dru-na-gu* (nine different types of crops) for religious performances. It is used in any rituals and religious functions in the form of *Trashi dru*. *Torm* (cake like) is one such important form for religious offerings.

# **RICE DIVERSITY**

Generally cultivars with round/bold seeds (japonic type) are predominant in higher altitude areas and slender seeds (indica type) in lower altitudes. All cultivars could be divided into indica or japonica types. Cultivars predominant in high land could be japonica types and cultivars predominant in lowland could be indica types. The diversity in morphotypes and the genotypes within these two groups are numerous including intermediate types and are invaluable genetic resources for various agricultural development programmes of the country. The high altitude red rices are neither japonicas nor indicas (Ref: chetri, G.B. 1992).

Farmers have acquired good experience of rice cultivation for ages to test, improve and produce varieties that are adaptable to different micro climatic conditions of Bhutan. Approximately 80% of the total rice growing area in the country is covered by landraces. There are rice varieties grown at an altitude of 150 m to 3000 m, from fully irrigated condition to completely dry land conditions. There are basically 3 groups of rice in Bhutan viz. wild relatives of rice (*Oryza rufipogon* Griff. & *Oryza minuta* J. Presl), traditional landraces and improved/HYVs/modern rice varieties.

The pictures below present a unique rice cultivars grown in Bhutan



Pic.13: Wetland rice Zurchum in Thimphu



Pic 14: Upland rice: Pang bara in Trashi Yangtse



Pic. 15. Bonday rice in Wangdue



Pic. 17. Choti-aromatic rice in Tsirang



Pic. 16. Rice field in Bumthang



Pic. 18. Attay rice in Sarpang

#### A summary list of traditional rice varities are presented in Table 1

#### Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces of rice as it is probable that same variety or landraces of rice is called by different names and different varieties or landraces called by same name in different villages.

3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of rice in the country.

Sarpang	T. Gang	T. Yangtse	Thimphu	Trongsa	Tsirang
Attay	Asu Bara	Khaktang/ Wangkharpa	Aurzom	Baybupa	Attay
Assam Choti	Bidungpa Bara	Khangpa Dep	Chumro	Budilingpa	Aunadhi
Baragoti Masino	Brena Bar	Pashi Deb	Dago Zam	Bunalingpa Zintee	Champa Dhan
Bhudume	Bomdhilingpa bara	Tshangapa	Dumja	Chakharpa	Choti
Bhog Dhan	Chung Bara	Bartshampa	Ja Maap	Epa Kharti	Chhoti Masino
Champa Dhan	Deletumo	Chalangpa	Jachum	Epa Lambu	Kalo Chhoti
Choti	Khardungpa Bara	Chunglo	Jamija	Kamthey Korma	Kalo Chhoti Masino
Chhoti Masino	Naning Bara	Dakpai Dep	Kawalosum	Krulum	Kalo Jera
Masino	Ngera bara	Kamdep	Lham zim	Samkharpa	Karangla
Gauri Dhan	Pang bara	Karma Tekpa	Zuchum	Tenzin Bondey	Kati Dhan
Jaya	Pho Bara (Red V)	Kem Dep	Total 10	Zhenti/ Zhinti/Zindi	Khu Tsalu
Katikey Dhan	Phongmipu Bar	Khengpa		Total 11	Khudami/ Khudumay
Khudumay/ Phudungney	Rangshikharpu Bara	Khoptang Tsalu			Ruduwa
Mama Dhan	Shingkharpa Bar	Kontonsala			Sukhimay
Muray Dhan	Sung Sung Bara	Machum			Tagmaro
Moshiri	Takulung Bara	Maydeep			Tapray
Mawali	Zu Bara	Naypa			Total 16
Rato Dhan	Total 17	Ngumlingmo/ Nurlingbo			
Sheto Dhan		Pangshing Dep			
Sukhemey		Shang Eepa			
Takmaru		Sonala			
Tapray		Wang Bara			
Temburay Dhan		Total 22			
Total 23					

#### Table 1: Summary of traditional rice diversity under each Dzongkhag

Chukha	Dagana	Lhuntse	Wangdue	Zemgang	P. Gatshel
Bangayray Dhan	Atay	Auling Bra	Agay Dawa	Bogarma	Aring Bar
Bihari Dhan	Batham	Bochola bra	Apa Dago	Chakharpa Epa	Tshewang bara
Bhujuray Dhan	Masino	Bra marpo	Apa Dawa	Epa Khartila	Bedpu Bara
Champa Sari Dhan	Chubja/Ray kaam	Bumdelingpa	Awa Bja	Epa Nanjee	Pang bara
Dollay Dhan	Dungchum	Chungkharpa Bra	Boktom	Epa Pagchila	Rashu Bara
Dudu Masee	Naam (Ray Naam)	Dhakpa Bra	Maap/ Machum	Epa Singye Namgay	Sam bara
Hola Paray	Ray Kaap/ Ray Kaam	Domkharpa Bra	Hamjim	Epa Zhentila	Total 6
Kalo Nuniya	Total 7	Dukpa Zama	Hogchum	Golingpa Ray	
Krishna Bhog		Hang bra	Jana Thrachum	Kezang/ Kezangla Epa	
Makhan Puray Dhan		Kalifupa	Ja Maap	Maray	Mongar
Pakhay Dhan		Kam bra	Japhu Maap/ Machum	Sonam Kelzang	Trongsarpa Bara
Pailo Bujuri		Karma Tekpa	Jala Machum	Yunti Epa	Tsirang Zam
Pyjam Dhan		Kurtoepa Bra	Janam	Zangkar	Woopkharpa /Sungsung
Rato		Ma Bra	Kaap Phuchum	Total 11	Total 3
Throsara Dhan		Wangdi Karma	Kachum		
Total 15		Zakha	Kashmiray		
		Zangpo Bra	Kongtse		Gasa
		Bra Hamzaywa	Ma Phogom		Gherugam
		Butshula Bra	Maap		Total 1
		Ngingpa Zakha	Machum		
		Ola Bra	Mamphum		
		Total 21	Ray Naap		
			Sep Bja		
			Silly Karchum		
			Tan Tsheing		
			Wangda Kaam		
			Total 28		

Paro	Pun	lakha		Samtse		S. Jongkhar
Dhumja	Agay Dawa	Gyemj	a Maap	Atay	Katikey Dhan	Ardi Bara
Hasay	Aza Dogo	Ja Hin	gsam	Achami	Katusay Dhan	B.R.Attey
Jana	Bjaze Kaap	Jarey		Babu Dhan	Khudungay/ Khudunay	Bashmuthi
Janam	Bonday	Jamja I	Maap	Babu Jasuwa	Malaning	Churae
Jhumja	Botoli	Jangka	L	Bayarni Dhan	Malingay	Dhorae Dhan
Kuchum	Bunap	Maap		Baharing Dhan	Murungay	Gauri Mashino
Local Kaap	Chelep/ Chelep Maap	Nabja		Charinangray	Musuli Dhan	I Jung
Naam	Chekhim	Rewa Machu Zama	ım	Chota kati	Malchira Dhan	Jagurtalay Masino
Ola Ja	Chumja/ Chumja Maap/ Maap Terem	Sep Bja		Chulthray Dhan	Chetri Monsara	Kongkar
Themja	Mapterem/ Chumja	Silim Kaap		Duday Tulasi	Onepaky	Kongkus
Tshemja (Maam)	Mapterem	Tan Tsering		Gurulay	Phaodel Dhan	Momo
Zhechum	Chumja Maap	Tolly Shakha		Fudungey	Pharangay	Ranjit/ Ranjita
Total 12	Chumja/ Dawa Maap	Tow		Harin Tol Dhan	Rambough	Rato Churae Dhan
	Dawa Maap	Tsekhi	m	Jai Bangla Dhan	Ram Tulasi Dhan	Robtang Bara
	Maap Zhongja	Tsenar	n	Japaka Dhan	Rani Gaza	Tsho Bara
	Dasum	Uma n	naap	Japaka Dhan	Tagmara Dhan	Yangtsepa
	Dawa yangkum/ Map Dawa Yangkum	Wango	la Kaam	Jasuwa Dhan	Tagmaru	Bara Kaytsalu
	Gomchay Zakha	Zakha		Juwa Dhan	Tauli	Bepu Bara
	Gunja	Zama	Maap	Jera Sari	Timuray	Galingpa
	Gyemja	Zaray		Kalo Nunya	Tulasi dhan	Pangbara balingbi
	Tota	Total 40		Kalo Urangay	Wairangay Dhan	Sam Bara
				Kal Toray Dhan		Wangdi Karma
				Tota	1 43	Total 21

Variety	Variety/breeding line name/ original	Year release	Releasing Agency
RICE			
IR 64	IR 64	1988	RC- Bajo
Milyang 54	Milyang 54	1989	RC -Bajo
IR 20913	IR 20913-B-26-1-2-2-3	1989	RC -Bajo
No 11	No 11	1989	RC -Bajo
BR 153	BR 153-2B-10-1-3	1989	RC -Bajo
BW 293	BG293-2	1990	RC -Bajo
Barket	K-78-13	1992	RC -Bajo
Khangma Maap	Chummro	1999	RC-Wengkhar
Bajo Maap 1	CARD21-10-1-1-3-2-1	1999	RC-Bajo
Bajo Maap 2	CARD21-14-1-1-3-2-1B	1999	RC-Bajo
Bajo Kaap 1	IR61331-2-148-B	1999	RC-Bajo
Bajo Kaap 2	IR61328-1-136-2-1-2-3	1999	RC-Bajo
PP4-8-1-1 (red)	Yusi Ray Maap	2002	RC-Yusipang
PP3-31-2-1 (white)	Yusi Ray Kaap	2002	RC-Yusipang
Khumal-2	Khangma Kaap	2002	RC-Wengkhar

#### National list of notified rice varieties

#### Analysis of Rice Diversity

- 1. Punakha, Samtse, Trashi Yangtse, Zhemgang, Wangdue Phodrang and Sarpang are 6 top Dzongkhags exhibiting highest diversity with 49, 42, 32, 30 and 26 landraces respectively. This is followed by Samdrup Jongkhar, Trashigang, Lhuntsi, Trongsa, Tsirang and Chukha with 25, 22, 21, 20, 17, and 16 landraces respectively. Mongar, Paro, Pema Gatshel and Dagana exhibited 14, 13, 10, 8 and 7 landraces respectively. Haa and and Gasa exhibited lowest diversity with one landraces. Total of 384 landraces of rice have been recorded till date.
- 2. Traditional rice varieties generally grown at lower elevation below 1000 masl are Atay, Achami, Ardi Bara, Assam Choti, B.R.Attey, Babu Dhan, Babu Jasuwa, Baragoti, Masino, Bayarni Dhan, Bihari Dhan, Bhog Dhan, Chota kati, Chulthray Dhan, Choti, Chhoti Masino, Dhorae Dhan, Dollay Dhan, Dudu Masee, Gauri Dhan, Gauri Mashino, Hola Paray, Jagurtalay Masino, Jai Bangla Dhan, Japaka Dhan, Jasuwa Dhan, Juwa Dhan, Jaya, Jera Sari, Kal Toray Dhan, Katikey Dhan, Kongkar, Kongkus, Kongtse, Mama Dhan, Momo, Makhan Puray Dhan, Malchira Dhan, Pakhay Dhan, Ram Tulasi Dhan, Rani Gaza, Ranjit/Ranjita, Rato Churae Dhan, Ruduwa, Sheto Dhan, Throsara Dhan, Temburay Dhan, Tsirang Zam and Tulasi dhan.

- 3. Traditional rice varieties generally grown in mid elevation between 1000 to 1500 masl are Attay, Aring Bar, Aunadhi, Apa Dago, Apa Dawa, Aza Dogo, Awa Bja, Bangayray Dhan, Baybupa, Baharing Dhan, Baiyerney Bara, Kaytsalu, Bepu Bara, Bhujuray Dhan, Bogarma, Boktom, Bonday, Botoli, Brena Bar, Budilingpa, Bunalingpa, Zintee, Chakharpa Epa, Charinangray, Chelep/ Chelep Maap, Champa Dhan, Chekhim, Churae, Chhoti Masino, Chumja/ Chumja Maap/ Maap Terem, Maap Zhongja, Daksaila, Duday Tulasi, Dungchum, Epa Khartila, Epa Lambu, Epa Singye Namgay, Galingpa, Gomchay Zakha, Gurulay, Fudungey, Ja Hingsam, Jarey, Japhu Maap/ Japhu Machum, Jangka, Jera Sari, Kalifupa, Kalo Chhoti, Masino Kalo, Jera, Kam Thaygom, Kati Dhan, Karangla, Katusay Dhan, Kezang/ Kezangla Epa, Khu Tsalu, Khudami/ Khudumay, Maray, Mawali, Nabja, Onepaky, Pharangay, Robtang Bara, Sam Bara, Sonala, Sukhimay, Tagmaro, Tan Tsering, Tapray, Tauli, Tenzin Bondey, Timuray, Tolly Shakha, Tshewang bara, Woopkharpa /Sungsung, Wangdi Karma, Yangtsepa and Zakha.
- 4. Traditional rice varieties generally grown at higher elevation above 1500 masl are Aring Bar, Apa Dago, Apa Dawa, Asu Bara, Auling Bra, Aurzom, Batham, Bjaze Kaap, Bochola bra, Botoli, Bumdelingpa, Bunap, Chelep/ Chelep Maap, Chungki Bara, Chubja/Ray kaam, Chumja/ Chumja Maap/ Maap Terem, Chumja Maap, Chumro, Chungkharpa Bra, Chunglo, Dago Zam, Dawa yangkum/ Map Dawa Yangkum, Deletumo, Dhakpa Bra, Dukpa Zama, Dumja, Epa Kharti, Golingpa Ray, Gyemja, Hamjim, Hang bra, Hogchum, Ja Maap, Japhu Maap/ Japhu Machum, Jala, Machum, Jamja map, Jangka, Kalifupa, Kam bra, Kamdep, Khangpa Dep, Kawalosum, Karma Tekpa, Kem Dep, Kezang/Kezangla Epa, Khoptang Tsalu, Kontonsala, Kurtoepa Bra, Lham zim, Ma Bra, Ma Phogom, Machum, Mamphum, Maydeep, Nabja, Naypa, Naam, Naning Bara, Ngera bara, Ola Ja and Pangbara balingbi.

Detailed information on rice varieties is presented in Annexure 1.

# 2.2.2 MAIZE

# MAIZE CLASSIFICATION AND IT'S ORIGIN

#### Classification<sup>[2]</sup>

Kingdom	Plantae
Division	Magnoliophyta
Class	Liliopsida
Order	Poales
Family	Poaceae
Genus	Zea
Species	Z. mays

Maize is divided into seven groups based on different studies. Classification based largely on the character of the kernels by Kipps, 1959 are<sup>[2]</sup>:

- 1. *Zea mays* indurata or 'Flint corn': This is the type of maize that farmers commonly grow in Bhutan
- 2. *Zea mays* everta or 'Pop corn' is also found in Bhutan but are rare and very few farmers grow in their kitchen garden.
- 3. Zea mays indentata or 'Dent corn':
- 4. Zea mays saccharata or 'Sweet corn'
- 5. Zea mays amylacea or 'Soft corn'
- 6. Zea mays tunicata or 'Pod corn'
- 7. Zea mays Ceratina Kulesh or 'Waxy corn':

# Origin:

Maize was domesticated in Mesoamerica and then spread throughout the American continents. Maize spread to the rest of the world after European contact with the Americas in the late 15th century and early 16th century <sup>[2]</sup>. In 1956 two Japanese scientists Suto and Yoshida referred to the statement recorded by the famous Chinese naturalist, Li Shih-Chen that a pod like corn was introduced to China from India via Tibet in 1368. During this period, Buddhist Missionaries, both Indians and Tibetans traveled between India and Tibet across the Himalayas, and commodities also traveled from India to Tibet<sup>[2]</sup>. It is not known when maize was first introduced to Bhutan though it was present during Bogle's visit in 1774 <sup>[4]</sup>. No matter when and how maize was introduced in Bhutan, it is an important cultivated crop from time immemorial in Bhutan.

Ref:

<sup>[2]</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

# MAIZE CULTIVATION IN BHUTAN

Maize is a major food crop in Bhutan. It is cultivated across the country and it ranks first among the food crops in terms of area cultivated and production. Over 70% of the household cultivate maize mainly for subsistence and this cereal plays a critical role in household food security. As per the RNR 2000 statistics, out of 202 Geogs, 189 plant maize. Although, the extent of cultivation varies, maize is cultivated in all the 20 Dzongkhags.

Maize crop in Bhutan is grown at altitude levels ranging from less than 300 masl upto 3000 masl. Planting time widely varies with altitude. Generally the planting of the main crop starts by end of February or the beginning of the first Bhutanese month and the harvesting begins by the end of August. In some environments the second crop is sown in early September and harvested in December. The dry-land agriculture (33%) is the most dominant land use system for agricultural production in the country. Maize is predominantly a dry land crop and is totally rainfed. Some maize is grown in the wetland as pre-rice crop particularly in the southern belt. Maize is also grown as a second crop in approximately 15% of the maize area, mostly in the lower altitude zones [14]. Maize is also invariably intercropped with different crops. Where land is a limitation intercropping provides a very good opportunity for maximization of output per unit area. Some of the most common intercropping practices are maize and potato, maize and soybean, maize and vegetables, maize and millet, maize and ginger and maize and tuber crops (tapioca, yam) and many others. The choice of intercrops is influenced by the altitude.

Ref:

<sup>[4]:</sup> Flora of Bhutan 2000

<sup>[6]</sup> Agriculture Statistics 2006

<sup>[14]</sup> Commodity chain Analysis for maize (MoA 2008)

# MAIZE AND ITS SOCIO-ECONOMIC IMPORTANCE

Maize is cultivated by over 37 000 households in over 75, 413 acres majority of which live in far flung marginal areas. The gross national income from maize is estimated at Nu.729 million while the total value added is Nu. 376 million. It is estimated that 80% of the total production is consumed at the household level; about 6% is sold which serves as an important source of household income. The processed maize products are also important source of household income while maize by products is an important source of feed for livestock. Maize crop provides a good source of employment for rural population mobilizing about 38, 639 numbers of employment opportunities and about 37,099 micro enterprises are engaged in the maize commodity chain <sup>[14]</sup>. Samtse, Sarpang, Dagana and Mongar have the largest cultivation areas and production with an area of 11,981, 8,444, 8,026 and 7,360 acres respectively while Mongar, Samtse and Samdrup Jongkhar top the production with 10,200, 9, 452, and 7,415 MT respectively.

Another very important role of maize in food security is that it serves as an important source of feed for household livestock. The latter in turn are the primary source of household cash income and manure for crops. Maize combines very well with other crops like potatoes, legumes and vegetables and allows high land use intensity through intercropping. Despite the change in food habits and preference for rice, still 24% of the households prefer maize as their first staple. Although, the consumption of sole *kharang* has gone down yet maize still continues to significantly substantiate the food needs as it is mixed with rice in various ratios. Although it is generally perceived that the country is self sufficient in maize, Maize Impact Assessment study has indicated that 32% of the surveyed households still do not have sufficient maize to meet their annual household requirement. About 57% households that did not adopt improved technologies faced maize shortages against 43% households growing improved varieties. Another advantage of maize is that it can be produced in large volumes in relatively small areas. It is easy to grow and can be readily be stored over the seasons and has multiple uses. In hot humid areas maize storage is a problem.

Maize is a nutritious crop and a wholesome food. On an average maize kernel contains about 71.3% starch, 9.9% protein and 4.45% fat (Watson, 1977). In Bhutan, it is consumed mainly in the form of *Kharang* (grits) and *Tengma* (roasted and pounded maize) and *Ashom mungnang* (local term for popcorn). Maize is also brewed into *Bangchang* and *Ara* (local drinks) which are indispensable for religious and traditional chores. Maize grits are also consumed by mixing it with rice. The green immature cobs are eaten

by boiling or roasting. Corn flour and other residues are excellent feed for cattle. The husk part is used as a raw material to make mats. Maize is one of the important components of *Dru-na-gu* (nine different types of crops) for religious performances. Maize flour has special usage as *Sur* and also used as substitute for wheat and barley flour for making *Torm*. The young green maize stalk is used as fodder for cattle. Green Stover is an excellent source of feed for cattle in the critical feed shortage winter months.

## MAIZE DIVERSITY

Farmers have developed good experience of maize cultivation for ages to test, improve and produce varieties that are adaptable to different microclimatic conditions. Approximately 50% of the total maize growing area in the country is covered by landraces. There are numerous traditional varieties adapted to diverse micro climatic conditions with ear numbers ranging from 1-5 and adaptable from an altitude of 150-2600 masl. There are basically 3 groups of maize in Bhutan viz. the Primitive group-pop corn, traditional landraces and improved/HYVs.



Pic.19: Traditional landrace





Pic. 21: Setimakai(left) & Yangtsepa (right)

The table 2 below shows traditional rice varieties per Dzongkhag.

Pic. 20: Pop corn group

# Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces of maize as it is probable that same variety or landraces

of maize is called by different names and different varieties or landraces called by same name in different villages.

3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of maize in the country.

Lhuntse	Pemagatshel	Mongar
Ashom Karpo	Ashom Daza	Ashom Balingbi
Ashom Marpo	Ashom Khandha	Ashom Barmu
Baipo Ashom marpo	Chema Ashom	Baipo Ashom
Baipo/Bepo Ashom	Raba Tsalu Asham	Barkong Ashom
BaipoAshom karpo	Tekharpo Ashom	Bethpa Ashom
Ma Ashom	Thon Asham	Pema Kota Asham
Pema Lingpa Ashom	Ashom Balingbi	Rala Ashom
Rala Ashom	Chungkharpa/ Chungkharpali	Samchelingpa Ashom
Tegksumpa	Gangkhapa	Themnangpa Ashom
Jangala Karpo	Gonpali	Thumuli
Jangala Serpo	Lani Sampa	Tshigsumpa Ashom
Ningpa	Monpa	Warong Asham
Pema Koepa	Narphungpa	Total 12
Jangala Serpo	Ozorongpa	
Ningpa	Phophar Ashom	Chukha
Pema Koepa	Tsigsumpa	Makai
Temchila	Total 16	Pahali
Total 14		Seti Makai
	Paro	Total 3
Bumthang	Gayza	
Local	Meto/Jitsi so/Shechhu Gum	
Pemalingpa	Patshikap Geyza	
Total 2	Talop Gayza	
	Total 4	

## Table 2: Summary of traditional maize diversity in each Dzongkhag

Trongsa	S. Jongkhar	Trashigang
Ashom	Berkhala Ashom	Dorjilingpa Ashom
Ashom Kharti	Dremtsepa ashom	Khalingpa Ashom
Ashom Zinti	Janapa ashom	Kokti Ashom
Chadomo	Kharpa Ashom	Romangpa Asham
Chakharpa	Lauripa Ashom	Tholongpa Ashom
Changrep/ Changreypa	Mepala ashom	Ashom Kaap
Chodom Zinti	Murchupa Ashom	Baipa Ashom
Teksumpa	Pakaling Ashom	Mangdipa
Total 8	Serthigpa Ashom	Total 8
	Ashom Barmu	
Samtse	Baipo Ashom	Tsirang
Kali Makia	Bayupu/ Bayupu Ashom	Chepti Makai
Paheli	Rala Ashom	Pachautay Makai
Seti Makai	Woolingpa	Paheli
Total 3	Zerpo Ashom	Raja makai
	Total 15	Rongthungpa
Sarpang		Sanu Makai/Sathriya
Kalo Makai	Zemgang	Seti
Makai	Chazam/ Chazam Ngadpo	Total 6
Paheli	Domba Kharti	
Seto Makai	Domba Sertila	Thimphu
Total 4	Serpaguto/ Tsepaguto/ Tshipaguto	Geyza
	Teksumpa	Meto Gayza
T.Yangtse	Total 5	Yangzom
Baipo Ashom		Total 3
Tsigsumpa		
Total 2		

# National list of Notified Varieties of maize

Maize	Variety/breeding line name/original	Year release	Releasing Agency
Yangtsipa	Suwon 1	1992	RC-Wengkhar
Khangma Asom 1	Palmirah8529	1999	RC-Wengkhar
Khangma Asom 2	Suwon8528	1999	RC-Wengkhar

#### Analysis of maize diversity based on survey

- 1. Pemagatshel, Samdrupjongkhar, Lhuntsi, Mongar and Trashigang and Trongsa Dzongkhags exhibited highest diversity with 16, 15, 14 12 and 8 traditional varieties respectively. Trashigang and Trongsa exhibited same level of diversity with 8 landraces. This is followed by Tsirang, Zemgang, Sarpang, Thimphu/Chukha and Bumthaang/ Trashi Yangtse with 6, 5, 4, 3 and 2 landraces respectively. Total of 81 landraces of maize have been recorded till date. Maize is grown in Haa, Wangdue, Dagana and Punakha Dzongkhags also though landraces are not listed in the report.
- 2. Traditional maize varieties generally cultivated at low elevation below 1000 masl are Barkong Ashom, Dremtsepa Ashom, Tshigsumpa Ashom, Paheli and Seti Makai.
- 3. Traditional maize varieties cultivated in mid elevation between 1000-2000m asl are Ashom Barmu, Ashom Khandha, Ashom Kaap, Ashom Kharti, Ashom Zinti, Baipa Ashom, Barkong Ashom Bethpa Ashom, Berkhala Ashom, Chadomo, Chakharpa, Chepti Makai, Chodom, Zinti, Chungkharpa/ Chungkharpali, Domba Sertila, Domba Kharti, Serpaguto, Tegksumpa, Janapa ashom, Kali Makia, Kharpa Ashom, Kokti Ashom, Ma Ashom, Mangdipa, Mepala Ashom, Murchupa Ashom, Pachautay Makai, Pahali, Pema Kota Asham, Pema Lingpa Ashom, Raja makai, Rala Ashom, Romangpa Asham, Sanu Makai/Sathriya, Seti, Themnangpa Ashom, Tholongpa Ashom, Thon Asham, Thumuli, Warong Asham, Woolingpa, and Zerpo Ashom.
- 4. Traditional maize varieties cultivated at higher elevation above 2000 masl are Ashom Barmu, Baipa Ashom, Dorjilingpa Ashom, Tegksumpa, Meto Gayza/ Gayza Jitsi so/Shechhu Gum, Jangala Karpo, Khalingpa Ashom, Pahali and Tekharpo Ashom.

A detail of maize diversity is given in Annex 2

# 2.2.3 FINGER MILLET

# FINGER MILLET CLASSIFICATION AND IT'S ORIGIN

Kingdom	Plantae		
Subkingdom	Tracheobionta		
Superdivision	Spermatophyta		
Division	Magnoliophyta		
Class	Liliopsida		
Subclass	Commelinidae		
Order	Cyperales		
Family	Poaceae		
Genus	Eleusine Gaertn.		
Species	Eleusine coracana (L.) Gaertner (CWR)		

#### Classification<sup>[2]</sup>

## Origin:

Finger Millet is originally native to the Africa and was introduced into India approximately 4000 years ago<sup>[2].</sup> It is probable that finger millet were introduced into Bhutan from India through the neighbouring states of Assam, Bengal and Sikkim.

# 2.2.3.2. FINGER MILLET CULTIVATION IN BHUTAN

Finger Millet has very wide adaptability, growing from humid sub-tropical condition at an elevation of 150 masl to warm temperate condition at an elevation of 2,300 masl. It is cultivated in dry land and shifting cultivation system (tseri) as sole crop or intercropped with maize perilla, amaranth, millet-legumes, millet-legumes or millet-other crops cropping systems.

# FINGER MILLET AND ITS SOCIO-ECONOMIC IMPORTANCE

Finger millet is categorized under the group 'Minor cereals' based on the area under cultivation and its contribution to the national food

basket. However, minor cereals are important for household food selfsufficiency and food security of farmers particularly in marginal areas. Samtse, Sarpang, Tsirang and Samdrup Jongkhar tops cultivation area with area of 5,484, 4,52, 1,650 and 1,017 acres respectively while Samtse and Sarpang top production with 1, 841 and 1, 702 MT respectively<sup>[6]</sup>.

*Ref:* [2]: Wikipedia, the free encyclopedia: http://en.wikipedia.org

It is consumed in form of *keptang/roti* and *dengo*. Even the better-off farmers consume it as *keptang/roti* (traditional pan cakes) for their breakfast. The most common use is brewing *bangchang* and *Ara* (traditional alcoholic preparations). It is also used as animal feed. Millet is one of the important components of *Dru-na-gu* (nine different types of crops) for religious performances. Straw is used as cattle feed.

# MILLET DIVERSITY

There are numerous traditional varieties of millets in Bhutan adapted to diverse micro climatic conditions with fingers ranging from fully compact to completely free and adaptable under wide range of altitudinal variation from humid sub-tropical condition at an elevation ranging from 150-2300 masl. There are basically 3 groups of Finger millet in Bhutan viz. wild species (*Eleusine indica* (L.) Gaertner, traditional landraces and no improved varieties.



Pic. 22: Completely closed type



Pic. 23: Completely open type

The table 3 below presents summary of traditional finger millet diversity by dzongkhags.

#### **Remarks:**

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under finger millet as it is probable that same variety or landraces of finger millet is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of finger millet in the country.

# Table 3: Summary of traditional finger millet diversity under eachDzongkhag

Chukha	Samtse	Sarpang
Fangray Kodo	Atta Kodo	Baganey/ Bangarey
Kali Kodo	Barkhay Kodo	Bhagam
Lurkay Kodo	Chendurey Kodo	Jhamkey
Murkay	Dolay Kodo	Jhungay Kodo
Thackray Kodo	Fangray Kodo	Kali/Kalo Kodo
Mangshiray Kodo	Kalo Kodo	Katekey
Total 6	Mongseray Kodo Seto	Mangshirey Kodo
	Murkay Kalo Kodo/ Murkay Kodo	Murkay
Lhuntshi	Pahelo Kodo	Paheli Kodo
Gunamo Thray	Seto/Shetay Kodo	Rato kodo
Mathray	Total 10	Seto kodo
Ngaza Thray		Sibsoo Bhagani
Ngathray	Trashiyangtse	Thangrey
Yangtsepa Thray	Khosomo	Total 13
Total 5	Khrae	

	Prangpo	Tsirang
S.amdrupjongkhar	Thray Local	Pangdur kodo
Kongpu Balingmi	Total 4	Katikey kodo
Kongpu Changlu		Mangshiray Kodo
Murkay Kodo		Total 3
Sharpa Kongpu		
Total 4		

### National list of notified varieties of finger millet

Minor cereals	Variety/breeding line name/original	Year release	Releasing Agency
Finger Millet			
3459	Limithang Kongpu-1	2002	RC-Wengkhar
5459	Limithang Kongpu-2	2002	RC-Wengkhar

## Analysis of Finger Millet Diversity

- 1. Sarpang, Samtse and Chukha Dzongkhags exhibited highest landrace 13, 10 and 6 landraces respectively. This is followed by Lhuntsi, Samdrup Jongkhar/Trashi Yangtse and Tsirang with 5, 4 and 3 respectively. Total of 37 landraces of millets have been recorded till date. However, this does not imply that there is no finger millet cultivation in other dzongkhags.
- Finger millet landraces that are cultivated in lower elevation below 1000 masl are Atta Kodo, Baganey/ Bangarey, Bhagam, Dolay Kodo, Fangray Kodo, Kali/Kalo kodo, Kongpu Balingmi, Kongpu Changlu, Mangshirey/Mungseray, Murkay, Paheli Kodo, Rato kodo, Seto/ Shetay Kodo, Sibsoo Bhagani, Thackray Kodo and Pahelo Kodo.
- 3. Finger millet landraces that are cultivated in mid elevation between 1000- 2000 masl are Barkhay Kodo, Chendurey Kodo, Dolay Kodo, Fangray Kodo, Kali/Kalo kodo, Katekey, Khrae, Lurkay Kodo, Mangshirey /Mungsaray, Murkay Kalo Kodo/ Murkay Kodo, Mathray, Ngathray, Prangpo, Seto/Shetay Kodo, Thray Local, and Pangdur kodo.
- 4. Finger millet landraces that are cultivated in higher elevation above 2000 masl are Fangray Kodo, Khosomo, Ngathray, Yangtsepa and Thray.

A detail of Finger Millet diversity is illustrated in Annex 3.

# 2.2.4 FOXTAIL AND COMMON MILLET

# FOXTAIL AND COMMON MILLET CLASSIFICATION AND ORIGIN

Chabolification		
	FOXTAIL MILLET	COMMON MILL
Kingdom	Plantae	Plantae
Division	Magnoliophyta	Magnoliophyta
Class	Liliopsida	Liliopsida
Order	Poales	Cyperales
Family	Poaceae	Poaceae
Subfamily	Panicoideae	
Genus	Setaria	Panicum L.
Species	S. italica (L.) P. Beauv.	<i>Panicum sumatrense</i> Roth ex Roem. & Schult/ <i>Panicum miliare</i> auct. non Lam Little millet P

#### Classification<sup>[2]</sup>

# Origin:

Foxtail millet has the longest history of cultivation among the millets, having been grown in China since the sixth millennium BC<sup>[2]</sup>. It is said to have originated in China and from China it spread westward towards Europe. There is no record whether the crop is introduced or native to Bhutan.

# CULTIVATION IN BHUTAN

Foxtail millet is cultivated from humid sub-tropical condition at an elevation of 150 masl to dry sub-tropical condition at an elevation of 2,000 masl. It is cultivated as a rainfed crop in dry land, wetland and tseri/shifting cultivation as sole crop or intercropped with maize. It is grown as spring and summer crops. Most of the farmers cultivate it as the spring crop since the spring sown crop can be harvested during the lean season, thus reducing the risk of food insecurity. It is cultivated in dry land as sole crop or intercropped with maize.

Little millet/Common millet: It is also cultivated in similar climatic conditions as that of foxtail millet. It is cultivated in eastern part of the country in a very small scale in the dry land. It is associated with shifting cultivation in the eastern Bhutan like Samdrup Jongkhar and Pemagatshel.

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

# SOCIO-ECONOMIC IMPORTANCE

Foxtail millet is a common crop in shifting cultivation commonly practiced in the eastern and east central region of Bhutan. It is primarily cultivated for food purposes and consumed as *thueb* (porridge) and with rice and maize. Foxtail millet is also used for preparing *ara*, *bangchang* and *changkay* (alcoholic preparations). It is consumed by mixing with rice. In southern Bhutan, farmers use it during their fasts. It's most common usage is in brewing of *ara* (traditional alcohol). Samdrup Jongkhar, Pema Gatshel and Zhemgang top cultivation area with 931, 895 and 868 acres while Pema Gatshel, Samdrup Jongkhar and sarpang has the highest production of 517, 343, and 332 MT respectively.<sup>[6]</sup>.

Little millet: It is an important crop in shifting cultivation. It is grown for its grain.

## FOXTAI MILLET DIVERSITY

Foxtail millet: There are numerous traditional varieties of foxtail millets in Bhutan. There are basically 2 groups of Foxtail millet in Bhutan viz. wild species (*Setaria viridis* (L.) P. Beauvois & *Seteria pumila* (Pioret) Roemer & Schultes) <sup>[5]</sup>, and traditional landraces.



5 Pic. 24: Fox tail millet



Pic 25: Variation in foxtail millet

*Ref:* [6]: Agriculture Statistics 2006 The table 4 below shows traditional foxtail millet diversity reorded till date by dzongkhags.

Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under foxtail millet as it is probable that same variety or landraces of foxtail millet is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of foxtail millet in the country.

Table 4:	Summary	of foxtail	millet	diversity	under	each I	Dzongkhag
	j						

Samdrup Jongkhar	Lhuntsi
Apchi Yangra	Bangala Run
Bagi Yangra	Cha Run
Bepu Yangra	Yangra Balingmi
Champang Yangru	Total 3
Crab	
Dagor Tsalu/ Dagor Yangra Tshalu	Paro
Dani shampi/ Yangra	Khey
Desa Yangra	Total 1
Drukjay/Dujaymo Yangra	
Duksumpu Yangra	Samtse
Khang Yangra	Agtshag
Khosoktang/ Khosoktang Yangra	Total 1
Khotsha Yangra	
Khuchanglu	Trashigang
Lanisampa Yangra	Chema Yangra
Nangkorpa Yangra	Rongshung/Bushung.
Nera Yangra	Yangra

Total 3
Thimphu
Jili Jum
Total 1
Tsirang
Kaguni
Total 1
Zemgang
Ran
Total 1

# Analysis of Foxtail Millet diversity

- 1. Samdrup Jongkhar Dzongkhag has record of highest landrace diversity of foxtail millet with 27 landraces followed by Lhuntsi and Trashigang Dzongkhags with 3 landraces each where as Pemagatshel, Paro, Samtse, Tsirang and Zemgang Dzongkhags has record of one landrace each of foxtail millet. Total of 36 landraces of foxtail millets have been recorded till date.
- 2. Foxtail millets that are cultivated at lower elevation below 1000 masl are Agtshag, Apchi Yangra, Drukjay Yangra and Topo Yangra.
- 3. Foxtail millets generally cultivated at mid elevation 1000-2000 masl are Bagi Yangra, Bepu Yangra, Chema Yangra, Crab, Dagor Tsalu/ Dagor Yangra Tshalu, Dani shampi Yangra, Desa Yangra, Dujaymo Yangra, Kaguni, Khosoktang/ Khosoktang Yangra, Khotsha YangraKhuchanglu, Lanisampa YangraNangkorpa Yangra, Nera Yangra, Pusoktang Yangra, Rongshung/Bushung, Shorpo Yangra, Shumarpa Yangra, Yangra Balingmi, Yangra Changlu, Yangra Chenumey and Yangra Serbu.
- 4. Foxtail millet generally cultivated at higher elevation above 2000 masl are Bangala Run, Cha Run, Khey and Jili Jum.

However, with agricultural transition from subsistence farming to more productive farming systems and banning of *tseri* cultivation, extent of cultivation and utilisation is on decline. Therefore, germplasm collection is being carried out so as to rescue those that are threatened in the field.

# 2.2.5 BUCKWHEAT

# BUCKWHEAT CLASSIFICATION AND IT'S ORIGIN

#### Classification<sup>(2)</sup>

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Caryophyllales
Family	Polygonaceae
Genus	Fagopyrum
Species	<i>F. esculentum</i> (Common or Sweet buckwheat) <i>F. tataricum</i> Gaertn.(Tartary or Bitter buckwheat)

# Origin:

*Fagopyrum* in the flowering plant family Polygonaceae contains 15 to 16 species of plants, which includes two important crop plants, the common buckwheat (*Fagopyrum esculentum*), and the Tartary buckwheat (*Fagopyrum tataricum*). They have similar uses, and are classed as pseudo-cereals, i.e. they are used in the same way as cereals but do not belong to the grass family Gramineae <sup>(2)</sup> Buckwheat is originally native to Southeast Asia (approximately 6000 BC), and from there spread to Europe and to Central Asia and Tibet. Bitter buckwheat must have been introduced to Bhutan from Tibet. The wild ancestor of bitter buckwheat is *F. tataricum*. The crop then spread from China to Japan, Europe and other countries. Allozyme assays (Onishi, 1992) and RAPD markers (Ohnishi & Murai, 1996) revealed that both species of buckwheat were introduced into Bhutan from southern China through northern Myanmar and the Naga Hills and diffused further west to Nepal and Indian Himalayas.

#### **BUCKWHEAT CULTIVATION**

It also has a very wide adaptability growing from humid sub-tropical condition at an elevation of 150 masl to cool temperate condition at an elevation of 3000 masl. It is cultivated in dry land as sole crop under potatobuckwheat in the cool temperate region and maize-buckwheat under lower elevations. However, the planting season varies across the AEZ of Bhutan under rain fed condition. In higher elevation, it is cultivated in early part of the year where as in southern Bhutan at lower elevation, it is grown towards the later part of the year after maize so as to coincide with the blooming season with cool weather. This is one of the pseudo-cereals that has adaptability to very high elevation.

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

## SOCIO-ECONOMIC IMPORTANCE

Buckwheat also comes under minor cereals in Bhutan. However, it is a very important staple crop in the high altitude areas where farmers cannot grow rice and maize. It is a very important crop in high elevations like Bumthang. It is used in the form of a wide range of products like *Khuli* (Pan cake), *keptang/roti* (flat bread), *dengo* (cooked flour), *puta* (noodles) etc. Bitter buckwheat contains more rutin (antioxidant). It is also used as animal feed. Buckwheat is also one of the important components of *Dru-na-gu* (nine different types of crops) for religious performances.

For sweet Buckwheat Samtse, Samdrup Jongkhar, Chukha, Tsirang and Mongar top cultivation area with 2,127, 1,787, 1,422 1,077 and 1,014 acres while Samdrup Jongkhar, Chukha and Samtse has the highest production of 790, 531, and 614 MT respectively. For Bitter Buckwheat Samdrup Jongkhar and Chukha top cultivation area with 2,134 and 1,104 acres while Samdrup Jongkhar, Chukha and Pemagatshel top the production with 889 and 555 and 508 MT respectively.<sup>[6]</sup>

#### **BUCKWHEAT DIVERSITY**

There are numerous traditional varieties of buckwheat in Bhutan adapted to diverse micro climatic conditions from an altitude of 500-3500 masl. There are basically 2 groups of buckwheat in Bhutan. The wild relatives (*Fagopyrum dibotrys* (D. Don) Hara and traditional landraces of both bitter and sweet buckwheat.



Pic. 26: Sweet buckwheat



Pic.27: Bitter buckwheat



Pic. 28. Seeds of sweet buckwheat (left) and bitter buckwheat (right)

The table 5.1 and 5.2 next page presents summary of traditional sweet buckwheat and bitter buckwheat diversity recorded from the survey.

#### **Rrmarks:**

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under buckwheat as it is probable that same variety or landraces of crop is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of buckwheat in the country.
# Table 5.1: Summary of traditional Sweet buckwheat diversity under each Dzongkhag

Bumthang	Trashi Yangtse	Lhuntse	Sarpang
Chakharpa/Sonampa	Bremo Local	Jara	Methey Phapar
Charay	Total 1	Total 1	Total 1
Charay Ser nguel			
Charay Zing	Trashigang	Mongar	Samtse
Charay Zungna	Gunchung/Bremo	Brema	Methey Phapar
Total 5	Total 1	Total 1	Total 1
Chukha	Haa	Pemagatshel	Thimphu
Methey Phapar	Garay	Bremo	Gayray
Total 1	Total 1	Total 1	Total 1
Wangdue	Paro	S. Jongkhar	Zemgang
Gayray	Garey	Bremo	Charay
Total 1	Total 1	Total 1	Total 1

#### Analysis of Sweet buckwheat diversity

- 1. Bumthang Dzongkhag has the record of highest bitter buckwheat diversity with 5 landraces followed by other 15 Dzongkhags with 1 landrace each. Total of 10 landraces have been recorded till date.
- 2. Methey Phapar of Hilley and Tendu are generally cultivated at low elevation below 1000 masl.
- 3. Brema of Kengkhar, Zobel, Orong and Bomdeling, Charay of Tang, Choekhor and Nangkor, Garay of Rupaisa, Gunchung/Bremo of Yangneer, Jara of Minji and Methey Phapar of Tendu are cultivated in mid elevation between 1000-2000 masl.
- 4. Chakharpa/Sonampa, Charay of Choekhor, Garay of Katsho and Rupaisa, Gayray of Mewang, Gunchung/Bremo of Yangneer and Jara of Minji are cultivated at high elevation above 2000 masl.

# Table 5.1: Summary of traditional Bitter buckwheat diversity under each Dzongkhag

Bumthang	Paro	Lhuntsi	Samtse
Bradhma	Вјо	Braw	Cheneya Phapar
Guentho	Bjo Kagam	Khala	Tethey Phapar
Haapa Bradhma	Bjo Naap	Khalu	Total 2
Jhar Korpa	Total 3	Total 2	
Total 4			Thimphu
	Pemagatshel	Sarpang	Вјо
Наа	Khala Changlu	Tethey Phapar	Total 1
Вјо	Khala	Total 1	
Total 1	Total 2		
		Zemgang	
Lhuntsi	Mongar	Bradhma	
Braw	Khala	Total 1	
Total 1	Total 1		

# Analysis of Bitter Buckwheat

- 1. Bumthang and Paro Dzongkhags have the record of highest bitter buckwheat diversity with 4 and 3 landraces respectively followed by Lhuntsi, Samtse and Pemagatshel with 2 landraces each. Thimphu, Sarpang, Zemgang, Mongar, Haa and Lhuntsi have least record of 1 landrace each. Total of 11 landraces have been recorded till date.
- 2. Titey Phapar of Hilley, Bhalujora and Tendu are generally cultivated at low elevation below 1000 masl.
- 3. Bradhma of Nangkhor, Braw of Minji and Yangneer, Khala of Yangneer, Khalu/Khala of Yangneer, Khala of Bomdeling and Kengkhar and Tethey Phapar of Hilley, Doban and Tendu are generally cultivated in mid elevation between 1000-2000 masl.
- 4. Bjo of Katsho and Mewang, Bradhma of Choekhaor, Braw of Minji and Yangneer, Guentho of Choekhaor and Tang, Haapa Bradhma, Jhar, Korpa, Khala of Yangneer and Bomdeling are generally cultivated at high elevation above 2000 masl.

A detail of sweet and bitter buckwheat diversity is illustrated in Annex 8.

# 2.2.6 BARLEY

# BARLEY CLASSIFICATION AND IT'S ORIGIN

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Liliopsida
Order:	Poales
Family:	Poaceae
Genus:	Hordeum
Species:	H. vulgare l.

#### Classification<sup>[2]</sup>

# Origin<sup>[2].</sup>

The exact origin of barley is debatable, possibly originating in Egypt, Ethiopia, the Near East or Tibet. Barley cultivation was introduced in the Indus valley in 6th and 5th B.C. and to China in 1000 B.C. (Saucer, 1994). Isozyme studies have revealed that Bhutanese barley varieties were similar to those from Tibet and Ladakh (Konishi, 1992). Therefore, based on the results and historical evidence, the author reported that barley was introduced into Bhutan from Tibet.

# BARLEY CULTIVATION IN BHUTAN

Barley is a high altitude crop grown by the farmers in warm temperate and cool temperate regions of the country. It is a staple crop for farmers in cool temperate regions. Like buckwheat, barley is cultivated in early part of the year in higher elevation and later part of the year in lower elevation. It is predominantly grown in rotation with wheat and potato in the higher elevation and with rice-maize in lower elevation.

# BARLEY AND ITS SOCIO-ECONOMIC IMPORTANCE

Barley too is grouped under minor cereals as it is cultivated in relatively less area compared to maize and rice. However, it is an important staple crop in the higher elevation particularly in cool temperate region of the country. Barley is grown in spring and winter seasons. Mongar, Pema Gatshel and Paro top cultivation area with 1,223, 1,691, and 1, 02 acres respectively while with 829, 597 and 55 MT respectively<sup>[6]</sup>. Barley is used for both human

[2]: Wikipedia, the free encyclopedia: http://en.wikipedia.org

[6]: Agriculture Statistics 2006

Ref:

consumption and for animal feed. It is used for brewing *bangchang* and *Ara* (traditional alcoholic drinks), hulled type-Shofu/sofa is for making 'napchi' (roasted and powdered), hulless type-karfemung and zufemung is used for making *napchi* and roasted grains, making *torm* for religious offerings. Barley is also one of the important components of *Dru-na-gu* (nine different types of crops) for religious performances.

# BARLEY DIVERSITY

In Bhutan, there are two categories of barley genetic resources; traditional landraces and Improved/exotic varities. The traditional land races that are found in Bhutan are naked or hulless type and hulled type of barley. The lemma and palea remain attached to the seed at maturity in hulled type where as the seed threshes free of the lemma and palea hull) in naked type. These ecotypes of barley are further classified into winter type and spring type, which are grown in winter and spring respectively. They are also classified based on number of rows as 6 and 2 rowed. The picture below shows morphological variations of barley viz. 1. Six rowed with awns on only two rows, 2. Awns very short and hooded and 3. six rowed with long awns on all six rows.



Pic. 29. Variation of barley in Tang, Bumthang.



Pic.30. Hulled type grains (left) Naked or hulless type barley type grains (right)

The table 6 below presents traditional barley diversity recorded till date.

Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under barley as it is probable that same variety or landraces of barley is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of barley in the country.

Bumthang	Samdrup Jongkhar	Mongar	Haa
Janath	Shophu	Dukha Femong	Na
Kam Nath	Zhung Femong	Femong	Total 1
Kharti	Total 2	Kar Femong	
Ma Nath		Total 3	Samtse
Nath	Tsirang		Jaun
Nath (awnless)	Na Kar	Pemagatshel	Total 1
Nath (awns)	Thonglay	Zu Femung	
Nath Naap	Total 2	Jabu Shophu	Sarpang
Noenti		Shophu/ Kar shophu	Jaun
Poktola	Thimphu	Total 3	Total 1
Pranath/Ranath	Gudum		
Prokto	Na	Paro	Trashi Yangtse
Total 12	Total 1	Beygina	Na
		Na	Total 1
Wangdue	Zemgang	Total 2	
Gayna	Bro		Trashigang
Na	Tongola	Trongsa	Na
Jana Chukum	Total 2	Nas	Total 1

#### Table 6: Summary of traditional barley diversity under each Dzongkhag

Na Gurdum		Total 2	
Naa Henchum	Punakha		
Sha Nay	Na		
Total 6	Total 1		

#### Analysis of Barley diversity

- 1. Bumthang and Wangdue Dzongkhags exhibited highest barley diversity with 12 and 6 landraces respectively followed by Pemagatshel and Mongar Dzongkhags with 3 varieties each. This is followed by Samdrup Jongkhar, Zemgang, Paro, Trongsa and Tsirang Dzongkhags with 2 varieties each. Punakha, Thimphu, Haa, Samtse, Sarpang, Trashi Yangtse and Trashigang have record of one variety each. Total of 32 varieties has been recorded till date.
- 2. Bro of Nangkhor, Dukha Femong, Jaun of Tendu and Hilley, Kar Femong, Na of Kabji, Na of Yangner, Na Kar, Nas, Shophu, Tongola, Thonglay and Zu Femung are cultivated at an elevation below 2000 masl.
- 3. Gudum, Gayna, Janath, Jana Chukum, Kam Nath, Kharti, Na of Katsho, Na of Rupaisa, Nath of Tang, Na of Bomdeling, Na of Doga and Shaba, Na of Katsho and Rupaisa, Nath of Choekhor, Na Gurdum, Naa Henchum, Ma Nath, Nath Naap, Noenti, Poktola, Prokto, and Pranath/Ranath are generally cultivated at higher elevation of above 2000 masl.

A detail of barley diversity is illustrated in Annex 6.

# 2.2.7 WHEAT

# WHEAT CLASSIFICATION AND IT'S ORIGIN

#### Classification<sup>(2).</sup>

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Liliopsida
Order:	Poales
Family:	Poaceae
Subfamily:	Pooideae
Tribe:	Triticeae
Genus:	Triticum L.

# Origin:

Wheat originated in Southwest Asia in the area known as the Fertile Crescent <sup>(2)</sup> 5,000 years ago, wheat had reached Ethiopia, India, Great Britain, Ireland and Spain <sup>(2)</sup>. Wheat must have been introduced into Bhutan from India.

# WHEAT CULTIVATION IN BHUTAN

Wheat is cultivated by farmers all across the AEZ of Bhutan but in a very limited extent. There are two types of wheat viz. spring and winter wheat. In the warm temperate and cool temperate AEZs, where other main cereals like rice and maize cannot be cultivated, spring wheat is grown on dry lands. In the lower elevations under the rice based system, spring wheat is commonly grown.

# SOCIO-ECONOMIC IMPORTANCE

Wheat is cultivated in relatively lesser area than maize or rice. However, it is an important crop in the higher elevations as well as in lower altitudes.

Samtse, Paro, and Wangdue top cultivation area 2,844, 2,541 and 2,004 acres respectively while Paro, Samtse and Wangdue has highest production of 1,602, 1,374, and 1,218 MT respectively<sup>[6]</sup>.

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

<sup>[6]:</sup> Agriculture Statistics 2005

Like barley, wheat is used for both human consumption and for animal feed. It is used for brewing *bangchang* and *Ara* (traditional alcoholic drinks), for making *kapchi* (roasted and powdered), for making *torm* for religious offerings. Wheat is also one of the important components of *Dru-na-gu* (nine different types of crops) for religious performances.

## WHEAT DIVERSITY

In Bhutan, there are two categories of genetic resources of wheat; traditional landraces and improved/exotic varieties. Out of 5 wheat species, common wheat or Bread wheat -(T. aestivum) is cultivated in Bhutan. There are different landraces within in traditional wheat varieties viz. Dubi ka, Byo Ka etc.



Pic 31: Wheat field in Bumthang



Pic 32: Dubi Ka(left) and Byo Ka (right)from Haa

The table 7 presents summary of traditional wheat diversity recorde till date.

#### Rrmarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of wheat landraces as it is probable that same variety or landraces is called by different names and different varieties or landraces called by same name in different villages.

3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity of wheat in the country.

Bumthang	Wangdue	Paro	Samtse
Goo	Bjhoka	Bjokam	Gaun
Ка	Bjhoma/ Ka Bjoma	Bjonam	Kalo Gawn
Komal	Boe Ka	Gudum	Sheto Gawn
Krachain	Ka Doma	Ka/Jho	Total 3
Kradum	Ка Маар	Yueka	
Yunangma	Total 5	Total 5	Trashigang
Total 6			Bong
	Thimphu	Zemgang	Total 1
Chukha	Bjaka kaap	Goo	
Gaun	Bjaka Maap/Local Maap	Kar Tongla	Trashi Yangtse
Dube Ka	Gudam	Total 2	Ка
Jabab Ka	Ka kaap		Total 1
Jangwab Ka	Ка Маар	Trongsa	
Khotoeb Ka	Total 5	Kar	Lhuntse
Local (Habi Ka)		Total 1	Dho
Total 6			Total 1

#### Table 7: Summary of traditional wheat diversity under each Dzongkhag

#### List of notified wheat varieties

Wheat	Variety/breeding line name/original	Year release	Releasing Agency
Sonalika	Sonalika	1988	RC-Bajo
Bajoka 1	HD 2380	1991	RC-Bajo
Bajoka 2	BL1093	1994	RC-Bajo

#### Analysis of wheat diversity

1. Chukha and Bumthang Dzongkhag exhibited highest diversity with 6 varieties each followed by Paro, Wangdue and Thimphu with 5 varieties each. This is followed by Samtse and Zemgang with 2 varieties each. Trashigang, Trashi Yangtse, Lhuntse and Trongsa have record of one variety each. Total of 26 varieties have been recorded till date.

- 2. Gaun of Tendu and Bhalujora are generally cultivated at low elevation of below 1000 masl.
- 3. Bjoma, Bong of Yangneer, Dho, Goo, Ka Maap, Ka of Bomdeling, Kalo Gawn, Kar of Trongsa, Kar Tongla and Sheto Gawn are cultivated at mid elevation between 1000 to 2000 masl.
- 4. Bjhoma, Bjhoka, Bjaka kaap, Boe Ka, Dube Ka, Goo of Choekhor and Tang, Gudam, Jabab Ka, Jangwab Ka, Ka Doma, Ka kaap, Ka Maap, Ka of Choekhor, Khotoeb Ka, Komal, Krachain, Kradum and Habi Ka are generally cultivated at higher elevation above 2000 masl.

A detail of wheat diversity is illustrated in Annex 7.

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# 2.2.8 SORGHUM

# SORGHUM CLASSIFICATION FOUND IN BHUTAN AND IT'S ORIGIN

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Liliopsida
Order:	Poales
Family:	Poaceae
Genus:	Sorghum
Species:	S. bicolor (L.) Moench.

Classification<sup>[2]</sup>:

# Origin:

Sorghum originated in northern Africa<sup>[2]</sup>. Domesticated rye appeared relatively late, and far from the Near East, in Bronze Age. Sorghum and rye in Bhutan probably have been either introduced via India during early modern developmental stage or through fodder seed distribution.

# SORGHUM CULTIVATION IN BHUTAN

Sorghum in Bhutan is cultivated on a very small scale at the side of the kitchen garden just in few clumps. Sorghum is typically annual but sorghum cultivars found in Bhutan are perennial. It is seen growing under a very diverse elevation starting from as low as 500m under Sarpang Dzongkhag to as high as 3000m amsl under Thimphu Dzongkhag.

**Rye:** Rye in Bhutan is cultivated in a very small quantity in high altitude areas of Bumthang.

# SOCIO-ECONOMIC IMPORTANCE

Sorghum is a traditional food in some African countries, very little is known about this crop in Bhutan. Therefore, sorghum in Bhutan is cultivated in a very small scale for human consumption in the form of popped sorghum and as animal feed. Pink type of sorghum is used in coloring *Ara* (local alcoholic drink). In other countries, sorghum is cultivated as a source of bio-fuel. In Bhutan too this crop could have potential for contributing to agricultural development in the country particularly in dry parts of the

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

country as it can grow even under very harsh dry conditions. Usage as *Dru-Na-Gu* is not seen anywhere in Bhutan.

#### SORGHUM AND RYE DIVERSITY

Availability of sorghum has been reported only from Tersheri and Pheluma villages of Orong Gewog under Samdrup Jongkhar Dzongkhag. Sorghum has also been seen in small clumps in other places like Tsirang, Thimphu, Mongar and Trashigang Dzongkhags. Since, sorghum has been reported only from one site, extent of diversity is not clear. However, morphologically, sorghum found in Bhutan are of two colours viz. white and pink. The sorghum from different places may definitely vary in their sugar content.



Pic. 33: Pink grained sorghum



Pic. 34. White grained sorghum



Pic. 35. Rye germplasm from Bumthang.

# 2.2.9. AMARANTHUS

# CLASSIFICATION AND ORIGIN<sup>[2]</sup>

#### Classification<sup>[2]</sup>

Family	Amaranthaceae
Genus	Amaranthus L.
Species used for grain purpose	A. caudatus A. cruentus A.hypochondriacus

# CULTIVATION IN BHUTAN

Amaranths: Amaranth has been cultivated as a grain in the eastern Bhutan in a very small scale by the side of the kitchen garden. In some places it is seen as voluntary crops.

## SOCIO-ECONOMIC IMPORTANCE

People around the world value amaranths as cereals, ornamentals and leaf vegetables. Several species are often considered weeds. Grain amaranth is also grown as a food crop in eastern Bhutan where it is used to make local drinks '*ara*' and also cooked with rice. Amaranths can be explored to contribute to food security as it is easily harvested, produces a lot of seeds to be used as grains, is highly tolerant of dry areas and contains large amounts of protein and essential amino acids. Amaranths used for grains are also used as ornamental plants. However, it's usage as *Dru-Na-Gu* is not seen anywhere in Bhutan.



Pic 36: Amaranthus cruentus L.



*Pic.37: Amaranthus caudatus* L.(*pendent inflorence*)

# AMARANTHUS DIVERSITY

The table 10 below presents summary of Amaranthus diversity recorded till date.

Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under each crop as it is probable that same variety or landraces of crop is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity in the country for each crop.

Samdrup Jongkhar	Lhuntshi	Pemagatshel	Trashigang
Banzar Mo	Lhasomo	Lhasamo Balingbi	Lhasamo
Las Mo	Moo Marpo	Lhasomo	Mo Tsalu
Lhasomo	Muth Ngapo	Mo Balingbin	Моо
Moo Tsalu	Shar Muth	Total 3	Total 3
Sharang Mo	Total 4		
Total 5		Tsirang	Trashi Yangtse
	Paro	Latay	Moo Balingbin
Wangdue	Allay	Total 1	Total 1
Mao/Zhimtshi	Total 1		
Zhimtshi Kaap		Punakha	Thimphu
Total 2		Zimtshi Kaap	Zimtsi
		Total 1	Total 1

# Table 10: Summary of diversity of Amaranthus under each Dzongkhag

# Analysis of amaranthus

1. Samdrup Jongkhar, Lhuntse and Pemagatshel/Trashigang has highest record of amaranths with 5, 4 and 3 landraces respectively followed by Wangdue Dzongkhag with record of 2 landraces. This is followed by Paro, Tsirang, Punakha, Trashi Yangtse and Thimphu with record of one landrace each.

A detail of Amaranthus diversity is illustrated in Annex 10

# 2.2.10 LEGUMES/BEANS/PULSES

# 2.2.9.1. CLASSIFICATION OF LEGUMES FOUND IN BHUTAN AND IT'S ORIGIN <sup>(2).</sup>

Family:	Subfamily	Tribe	Genus	Species
Fabaceae	Faboideae	Phaseoleae	Phaseolus	P. vulgaris L. Common bean p. coccineus Runner bean/Scarlet P. lunatus L. or Lima bean P. tetragonolobus (reported in National Legume survey 1999)
"	"	Phaseoleae	Vigna	Vigna radiate var. radiataor Mung bean (L.) R. Wilczek Vigna mungo or Urad bean/black gram (L.) Hepper V. angularis or azuki bean (Willd.) Ohwi & H. Ohashi V. umbellatta or rice bean (Thunb.) Ohwi & H. Ohashi V. unguiculata or cowpea (L.) Walp.
	"	Phaseoleae	Lablab	<i>L. purpureus</i> or hyacinth bean (L.) Sweet
	"	Phaseoleae	Macro tylema	<i>M. uniflorum</i> (Lam.) Verdc. Or Horse gram
"	"	Vicieae	Vicia	Vicia Faba or broad bean
"	"	Vicieae	Pisum	P. sativum L.or Pea
"	"	-	Glycine	<i>G.max</i> or soybean (L.) Merr
"	"	-	Cajanus	<i>C. cajan</i> (L) Millsp. Or Pegion pea or redgram, <i>C. scarabaeoides</i> (L.)
11	"	-	Cicer	<i>C. arietinum L.</i> or Chick pea

# Origin:

*Phaseolus vulagris*: is native to the New World, probably Central Mexico and Guatemala. They were taken to Europe by the Spaniards and Portuguese who also took them to Africa and other parts of the Old World. Now they are widely cultivated in the tropics, subtropics and temperate regions.

*Ref:* [2] Wikipedia, the free encyclopedia: http://en.wikipedia.org

*P.lunatus* is of Andean and Mesoamerican origin. Two separate domestication events are believed to have occurred. The first, taking place in the Andes around 2000 BC, produced a large-seeded variety (Lima type), while the second, taking place most likely in Mesoamerica around 800 AD, produced a small-seeded variety (Sieva type). By 1301 AD, cultivation had spread to North America, and in the sixteenth century the plant arrived and began to be cultivated in the Eastern Hemisphere<sup>[2]</sup>.

P. coccineus: This species originated from the mountains of Central America<sup>[2]</sup>.

*Vigna radiata*: This species originated from Southeast Asia. The first domestication of mung bean is believed to have been done in India from where it was disseminated to other parts of Asia.

*Vigna mungo:* Black gram originated in India where it has been in cultivation from ancient times and is one of the most highly prized pulses of India. It has also been introduced to other tropical areas mainly by Indian immigrants<sup>[2]</sup>.

*V. angularis*: its centre of origin is presumed to be China, India or Japan <sup>[8]</sup>. Azuki bean was first domesticated in the Himalayas <sup>[2]</sup>.

*V. umbellatta*: The centre of diversity and presumably of origin of rice bean is Indo-China<sup>[8]</sup>.

*V. unguiculata:* Major diversity in cowpea is found in Asia and Africa but the precise origin of cowpea has been a matter of speculation and discussion for many years. Early observations showed that cowpeas in Asia were very diverse and morphologically different from those in Africa. Therefore, both Asia and Africa were thought to be independent centers of origin of cowpea. However, in the absence of wild cowpeas in Asia as possible progenitors, Asian center of origin has recently been questioned <sup>[9]</sup>.

*L. Purpureus* or hyacinth bean (L.) Sweet: It is native to Africa.

*M. uniflorum* (Lam.) Verdc. Or Horse gram: It is native to Asia: Bhutan, China, India, Indonesia (Java), Nepal, Pakistan, Philippines, Sri Lanka, Taiwan. Australasia and Africa.<sup>[10]</sup>

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

<sup>[8]:</sup> www.grainlegumes.com

<sup>[9]:</sup> www.cowpea.org

 $<sup>[10]:</sup> www.tropicalforages.info/key/Forages/Media/Html/Cajanus_cajan.htm$ 

*P. sativum* L.or Pea: Its origin is not known but Centre of diversity is in Near East to Central Asia.

*G.max* or soybean (L.) Merr: China is its Centre of Origin.

*C. cajan* (L) Millsp. Or Pegion pea or redgram: It is native to Asia: Afghanistan, Bangladesh, Bhutan, India, Sri Lanka & Africa <sup>[10]</sup>

*C. arietinum L.* or Chick pea: van der Maesen (1972) believed that the species originated in the southern Caucasus and northern Persia. However, Ladizinsky, (1975) reported the center of origin to be southeastern Turkey.

A. hypogaea L.: Central Brazil is its probable center of origin.

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org

<sup>[10]:</sup> www.tropicalforages.info/key/Forages/Media/Html/Cajanus\_cajan.htm



Pic 38. Phaseolus vulgaris pods



*Pic.* 40. *Vigna radiata intercropped on rice bunds.* 



Pic.39. Vigna angularis grains



Pic .41. Lab purpureus pods



*Pic.* 42. *Pisum with mixed flowers of white and pink* 



Pic.43. Vigna umbellate on maize plant

## LEGUMES CULTIVATION IN BHUTAN

Different types of legumes are cultivated all across Bhutan. These legumes are a good source of protein for the Bhutanese and thus legumes are extremely useful plants for Bhutanese. They are cultivated in a wide range of agro-climatic conditions from 150m amsl to 3000m amsl. Most common of all the legumes are Phaseolus sp. which are an important legume crop grown for green vegetable and dry seeds in Bhutan. Vigna radiate is cultivated under rain fed condition on dry land after maize. Vigna mungo is cultivated on the ridges of rice fields after the rice has been transplanted or in dry land under rain fed condition like Vigna radiate. Vigna mungo, Vigna radiate, Vigna unguculata, vigna angularis and Vigna umbellata are grown for dry seeds and are usually cultivated at an elevation of 150m amsl to 2500m amsl. Vigna unguculata and Vigna umbellata are most widely grown as an intercrop, particularly with maize because of their indeterminate type of growth. Vigna angularis and Lablab purpureus are usually grown from dry-subtropical to warm temperate AEZ. Macrotylema uniflorum is cultivated mostly in low altitude of southern Bhutan. Pisum sativum and G.max are grown all across Bhutan like Phaseolus sp. Cajanus cajan is grown in the lower elevation in eastern and southern Bhutan.

#### LEGUMES AND SOCIO-ECONOMIC IMPORTANCE

Legumes are cultivated in Bhutan for use as grains, as green pods for human consumption as well as for animal feed. However, this report covers only the legumes used for human consumption. Beans make an essential contribution to nutritional diet of Bhutanese. *Vigna angularis* beans are very critical for the preparation of 'Dyonm' for religious offerings. Farmers in southern Bhutan say that *Macrotylema uniflorum* has medicinal value to cure measles. Legumes are important components of *Dru-na-gu* (nine different types of crops) for religious performances.



Pic. 44. Lab lab beans growing from garden through the kwindow into the kitchen in Punakha

For Kidney/Rajma beans Mongar, Dagana and Samdrup Jongkhar top cultivation areas with 660, 508 and 382 acres respectively while Mongar, Samdrup Jongkhar and Pema Gatshel has the highest production of 337, 171 and 161 MT respectively<sup>[6]</sup>.

For Soya Bean Mongar, Samdrup Jongkhar and Trashigang top cultivation area with 863, 557 and 422 acres respectively while Samdrup Jongkhar, Mongar and Tsirang has highest production of 249, 238 and 228 MT respectively.<sup>[6]</sup>.

For other beans, Dagana/ Trsahigang, Sarpang and Samtse top cultivation area with 225, 201, 165 acres respectively while Mongar, Trashigang and Dagana top production with 220, 193, 187 MT respectively <sup>[6]</sup>.

## LEGUMES DIVERSITY

There are basically 3 groups of legumes in Bhutan. The wild relatives, traditional landraces and improved/HYVs. Many well-known bean, dal, soybean and pea cultivars are found all across the country. *Vigna radiate var. sub-lobata, Vigna vexillata* (L.), *Vigna pilosa* (Willdenow), *Vigna trilobata* (L.) are CWR of genus *Vigna. C. grandiflorus* (Baker) van der Maesen, *C. mollis* (Bentham) van der Maesen, *C. elangatus* (Bentham) van der Maesen are the CWR of genus *Cajanus*. Both determinate/bush and indeterminate or running on pole exist. There are wide variation in terms of shapes and colors of both pods and seeds including variation in degree of mottles. The colours range from white, black, red, yellow, grey, white etc.

Ref:

<sup>[6]:</sup> Agriculture Statistics 2006



Pic. 41 Colour variation in legume seeds

The table 8.1, 8.2, 8.3 and 8.4 presents summary of diversity of Genus phaseolus, Vigna, Glysine, and pisum.

#### Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under each crop as it is probable that same variety or landraces of crop is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity in the country for each crop.

# Table 8.1: Summary of traditional varieties of Genus Pahseolus undereach Dzongkhag

Chukha	Pemagatshel	Samdrup Jongkhar
Haray Bori	Abi Lhazom Oray	Ambarma oray
Rato Bori	Brokchinang Oray	Choktola Oray
Total 2	Bumthang Oray	Dungdungma oray
	Khachi Oray	Gakpu oray
Paro	Kharshing Oray	Gasa Sey Oray

Brocaling	Oray Changlu	Haray Bori
Total 1	Oray Serbu	Kengma Oray
	Oray Tsalu	Kenter
Lhuntshi	Patang Oray	Langnang/ Langmo Oray Serbu
Thrasay Shapen	Pingkulung Oray	Mahaji Bori
Tsiligpa Shapen	Total 10	Oray Balingbi
Ashi Shaypen		Pingkulung oray
Brokpaling	Paro	Pompaling Oray
Moringmo Shaypen	Bathra Semchum	Rato Bori
Sangbaling Shaypen	Dubi Semchum	Ru Oray
Sharpa Shaypen	Luma semchum	Serbu Mingba
Tsangbulung Shapen	Pata semchum	Wangchilingpa
Total 8	Sem Kaap	Total 17
	Sem Naap	
Mongar	Sem Sep	Samtse
Brokpaling	Sem throw	Gew Bori
Dungkar Oray	Thakemi Semchum	Haray Bori
Kharshing Oray	Thebae Sem	Kalo Bori
Lokpa Oray	Total 10	Paheli Bori
Oray Changlu		Sheti Bori
Oray Serbu	Punakha	Total 5
Oray Tsalu	Semchum Kaap	
Shing Oray	Total 1	Sarpang
Total 8		Dudhey Bori
	Tsirang	Gew Bori

Trashi Yangtse	Badawari bori	Jharay Bori
Bokti Bomo	Daganay bori	Kanchi Bori
Creley	Dhulal bori	Total 4
Khalum Shaypen	Gew Bori	
Kotor Shaypay	Haray Bori	Thimphu
Phun Orsha	Jharay Bori	Loga
Ru Oray	Kali bori	Morem semchum
Shongmashing Shaypen	Kanchi Bori	Pata semchum
Total 7	Karangay shibi	Sem Naap
	Majhaji Bori	Semchum Sep
Trashigang	Pahelo bori	Trangti
Langma Oray	Total 11	Total 6
Nangkorpa Orsha		
Oray Tsalu	Wangdue	
Total 3	Ngotam	
	Total 1	

Beans	Variety/breeding line name/original	Year release	Releasing Agency
Borloto	Borloto	1990	RC-Bajo
Pusa Parvati	Pusa Parvati	1990	RC-Bajo
Kentucky Wonder	Kentucky Wonder	1990	RC-Bajo
Brothbone	Brothbone	1990	RC-Bajo
Тор Сгор	Тор Сгор	1990	RC-Bajo
Rasma	Rasma	1994	
Long John	Long John	1994	
KPS 2	Lingmethang Mung 1	2002	RC-Wengkhar
Barimung	Lingmethang Mung 2	2002	RC-Wengkhar

### National List of Notified Kinds or Varieties

#### Analysis of legume diversity

- 1. Samdrup Jongkhar, Tsirang and Pemagatshel have the record of highest beans diversity with 17, 11 and 10 landraces respectively followed by Lhuntsi and Mongar with 8 landraces each. This is followed by Trashi Yantgse, Thimphu , Samtse and Sarpang with 7, 6, 5 and 4 landraces respectively. Trashigang, Chukha has record of 3 and 2 landraces respectively. Wangdue, Paro and Punakha have the lowest record with 1 landrace each. Total of 76 landraces of beans have been recorded till date.
- 2. Choktola Oray, Gakpu oray, Gasa Sey Oray, Gew Bori, Haray Bori, Jharay Bori, Kalo bori, Kenter, Mahaji Bori, Rato Bori, Sheti Bori and Wangchilingpa are cultivated at low elevation of below 1000 masl.
- 3. Ambarma oray, Badawari bori, Bokti, Bomo, Brokchinang Oray, Brokpaling, Creley, Daganay bori, Dudhey Bori, Dhulal bori, Dungdungma oray, Gew Bori, Haray Bori, Jharay Bori, Kalo Bori, Kanchi Bori, Khalum Shaypen, Karangay shibi, Kengma Oray, Kotor Shaypay, Langma Oray, Lokpa Oray, Morem semchum, Oray Balingbi, Oray Tsalu, Oray Tsalu, Paheli Bori, Phun Orsha, Pingkulung Oray, Rato Bori, Ru Oray, Sangbaling Shaypen, Tsangbulung Shapen, Semchum Kaap, Serbu Mingba, Sheto Bori, Sharpa Shaypen, Shongmashing Shaypen and Thrasay Shapen are cultivated at mid elevation from 1000-2000 masl.
- 4. Bathra Sem, Creley, Morem semchum of Mewang, Ngotam, Oray of Yangneer and Bomdeling, Oray Tsalu of Mongar, Pata semchum of

Mewang, Sem Naap of Mewang, Semchum Sep of Mewang, Thra Shapen of Menji, Tsiligpa Shapen and Trangti are cultivated at high elevation of above 2000 mals.

## Table 8.2: Summary of traditional varieties of Genus Vigna under each Dzongkhag

Chukha	Samdrup Jongkhar	Samtse
Banmara	Gagpu	Dal
Dal	Gagpu Balingbi	Kalo Dal
Kalo Dal	Gagpu Tsalu	Total 2
Mashyam	Gakpu (Black)	
Sem Nap	Kengter	Trashigang
Total 5	Nangmay	Shakpu
	Nesa Singye	Total 1
Mongar	Saygagpu	
Gagpu	Sengye / Singye Daza	Tsirang
Goibi	Shakpu	Banmara
Nangmey	Singye Katang	Total 1
Singcri	Total 11	
Total 4		Trashi Yangtse
	Thimphu	Cray (yellow)
	Sem Hochum	Crey
	Sem Nap	Total 2
	Total 2	

# Analysis of legume diversity (Vigna)

- 1. Samdrup Jongkhar Dzongkhag exhibited highest diversity with 11 landraces followed by Chukha and Mongar with 5 and 4 landraces. Samtse, Trashi Yangtse and Thimphu have record of 2 landraces each and Tsirang and Trashigang has record of one landrace each. Total of 23 landraces of Vigna spp. has been recorded till date.
- 2. Dal of Bhalujora and Tendu, Shapay of Martshala, Mashyam of Bhalujora and Sem Nap of Bhalujora are cultivated at low elevation of below 1000 masl.
- 3. Banmara of Semjong, Mendelgang and Darla, Crey of Bomdeling, Gagpu of Orong, Gagpu Balingbi, Gagpu Tsalu, Kalo Dal, Kengter, Nesa Singye, Nangmay, Saygagpu, Sengye / Singye Daza and Singye Katang are cultivated at mid elevation between 1000-2000 masl.

AND IT'S ORIGIN

- 4. Crey of Yangtse, Shakpu of Yangnyer, Sem Hochum and Sem Nap are cultivated at high elevation above 2000 masl.
- 5. Pigeon pea: Only Samtse and Samdrup Jongkhar Dzongkhags have record of pigeon pea.

Lhuntsi	Samdrup Jongkhar	Samtse	Trashigang	Pemagatshel
Baipo/Bepa Shawling	Kaptong Leebi	Aulay bhatmas	Lebi Balingbi	Gorkha Lebi
Bumdeling Shawling	Lebi Balingbi	Bhatmas	Lebi Changlu	Tshena Lebi
Dakpa Shawling	Lebi Changlu	Kalo Badmas	Lebi Tsalu	Total 1
Khee Shawling	Lebi Tsalu	Rato Bhatmas	Lebi	
Shawling kaap	Leebi Daza	Sheto Bhatmas	Total 4	Mongar
Shawling Naap	Leebi Tomang	Total 5		Lebi
Total 6	Total 6		Thimphu	Total 1
		Tsirang	Sem kaap (W)	
		Baronili	Sem Na (B)	Trongsa
		Kalo bhatmas	Sem Na (Y)	Shawling
		Total 2	Total 3	Total 1

Table 8.3: Summary of traditional varieties of Genus Glycine

#### National list of notified kinds or varieties of Soya Bean

Soybean	Variety/breeding line name/original	Year release	Releasing Agency
One Daughter	One Daughter	1994	DSC
GC 86018-427-3	Khangma Libi-2	2002	RC-Wengkhar
AGS 258	Khangma Libi-1	1999	RC-Wengkhar

# Analysis of Glycine diversity

- 1. Lhuntsi and Samdrup Jongkhar exhibited highest diversity with 6 landraces each followed by Samtse and Trashigang and Thimphu with 5, 4 and 3 landraces respectively. Tsirang and Pemagatshel Dzongkhags have record of 2 landraces each while Pemagatshel, Mongar and Trongsa has least record of 1 landrace each. Total of 16 landraces have been recorded till date.
- 2. Aulay bhatmas and Kalo bhatmas, Lebi of Serthig, Rato Bhatmas are cultivated at low elevation of below 1000 masl.
- 3. Baronili, Baipo/Bepa Shawling, Dakpa Shawling, Kalo Bhatmass,

Gorkha Lebi, Lebi Changlu, Leebi Daza, Lebi Tsalu, Lebi of Yangneer, Shawling of Minji, Shawling Naap and Shawling kaap are cultivated at mid elevation between 1000-2000 masl.

4. Baipo/Bepa Shawling, Bumdeling Shawling, Khee Shawling, Lebi Changlu, Lebi Tsalu, Lebi of Yangneer, Sem Na, Shawling kaap and Shawling Naap are cultivated at high elevation above 2000 masl.

Dzongkhag	Variety	Total TVs
Bumthang	Namey	1
Lhuntse	Namey	1
Наа	Beysem (Black)	1
Paro	Beysem, Beysem (Black)	1
Pemagatshel	Motor	1
Wangdue	Motor	1
Samdrupjongkhar	Changma	1
Trashigang	Changma	1
Samtse	Karao	1

### Table 8.4: Summary of diversity of Genus Pisum

#### Analysis of pea diverity

Above 9 Dzongkhags have record of one variety each of Genus *Pisum*. Total of 5 landraces have been recorded till date.

A detail of legume diversity is illustrated in Annex 11

# 2.2.11 OIL SEEDS

## MUSTARD AND NIGER

#### MUSTARD AND NIGER CLASSIFICATION AND ORIGIN

#### **MUSTARD** NIGER Division Magnoliophyta Magnoliophyta Class Magnoliopsida Magnoliopsida Order Brassicales Asterales Family Brassicaceae Asteraceae Genus Brassica Brasssica campestris var. toria Guizotia (Mustard/Tori/peka) Brassica campestris var. sarson (Sarson) B. juncea (L.) Brown mustard/ G. abyssinica Linn f. Cass -Niger Mustard green/ Rayo sag

#### Classification<sup>[2]</sup>:

#### Origin:

Primary center of origin of *Brasssica campestris* is thought to be central Asia (northwest India), with secondary centers in central and western China, eastern India, Burma, and through Iran to Near East. Cultivation of *Guizotia abyssinica* is believed to have originated in the Ethiopian highlands.



*Pic.* 42. *Brasssica campestris var. toria(left) and var sarson (right)* 



Pic. 43. Guizotia abyssinica

# MUSTARD AND NIGER CULTIVATION IN BHUTAN

Mustard is cultivated by farmers all across the AEZ of Bhutan but in a very limited extent. Mustard is cultivated in spring season in higher elevation and in autumn season in lower elevation. It is predominantly grown in rotation with potatoes in higher elevation and with maize and rice in lower elevation. Niger is cultivated mostly in southern Bhutan in the dry land under rain fed condition. However, area under mustard and niger is declining due to easy availability of edible oils imported from India.

# MUSTARD AND NIGER AND ITS SOCIO-ECONOMIC IMPORTANCE

*Brassica campestris* is cultivated for its seeds for extraction of edible oil and for livestock as grains and oil cakes. Oil seeds are also one of the components of *Du-na* for religious performances. *B. juncea* is grown in a very small scale but not for extraction of oil. *Guizotia abyssinica* is grown for its edible oil and seed used for making powdered pickle. It is a minor oilseed crop when compared with mustard. Samtse, Sarpang, Samdrup Jongkhar and Tsirang top the cultivation area with 1,496, 1,493, 1,261 and 1,189 acres while Tsirang, Chukha and Paro has the highest production of 378, 315 and 295 MT respectively <sup>[6]</sup>. Bhutan imports rape/mustard oil as the domestic production meets only about 10% of the requirement.

Oil seeds are also important components of *Dru-na-gu* (nine different types of crops) for religious performances and also to light lamps. *Brassica campestris* var. *sarson* is used as *dukzay*.

# MUSTARD DIVERSITY

There are basically 3 groups of mustard in Bhutan viz. wild species of mustard, traditional landraces and improved/HYVs/modern mustard varieties.

The table 9 presents summary of traditional mustard varities.

MUSTARD AND NIGER CLASSIFICATION AND ORIGIN

Ref:

<sup>[6]:</sup> Agriculture Statistics 2006

#### Remarks:

- 1. This diversity reflected in this volume is based on the names of landraces and information on the characteristics provided by famer through inventory in the field in 26 Geogs and based on passport information of accessions in the Gene bank. The number of landraces possibly will add on with germplasm collection from other areas.
- 2. It is difficult to differentiate accurately and count on exact number of landraces under each crop as it is probable that same variety or landraces of crop is called by different names and different varieties or landraces called by same name in different villages.
- 3. Therefore, systematic molecular and morphological characterisation is crucial to unravel and ascertain actual genetic diversity in the country for each crop.

Chukha	Bumthang	Mongar
Kalo Tori	Yungar	Mem Serbu
Paheli Tori	Yungkar Nonti	Total 2
Rato Tori	Total 3	
Sorshung		Pemagatshel
Tori	Samdrupjongkhar	Memba Changlo
Tori (black)	Memba Changlu	Membu Tsalu
Total 6	Memba Serbu	Total 2
	Membu Tsalu	
Sarpang	Total 3	Samtse
Rato Tori		Sorshung
Kalo Tori	Paro	Tori
Paheli Tori	Peka	Tori (Red)
Seto Tori	Peka (R)	Tori Local
Sorshung	Total 3	Total 4
Total 5		
	Trongsa	Punakha
Zemgang	Serthi	Peka
Yungkar Maap	Yungkar	Total 1
Serthi	Total 2	
Yungkar		Trashigang

#### Table 9: Summary of diversity of mustard under each Dzongkhag

Yungkar Noenti	Wangdue	Memba Changlu
Yungkar Zhenti	Peka	Total 1
Total 5	Peka Longkhom	
	Total 2	Thimphu
Tsirang		Peka
Sorshung		Total 1
Total 1		

National list of notified kinds or varieties	; of	Mustard
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Mustard	Variety	Year release	Releasing Agency
Type-9	Туре-9	1989	RC Bajo
M-27	M-27	1989	RC Bajo
Bajo Peka 1	BSA	1994	RC Bajo
Bajo Peka 2	PT 30	1994	RC Bajo
Mustard green	Khangma Petche-1	2004	RC-Wengkhar
Mustard Green	Khangma Petche-2	2004	RC-Wengkhar

# Analysis of Mustard Diversity

- 1. Chukha Dzongkhag showed highest record of diversity with 6 landraces followed by Sarpang and Zemgang with 5 landraces each. Samtse has record of 4 landraces followed by Bumthang and Samdrup Jongkhar with 3 landraces each. Trongsa, Wangdue, Mongar and Pemagatshel have record of 2 landraces each. Punakha, Trashigang, Thimphu and Tsirang have record of only 1 landrace each. Total of 26 landraces have been recorded till date.
- 2. Memba Changlu, Membu Tsalu, Tori of Bhalujora and Tendu, Kalo Tori, Tori of Tendu, Paheli Tori, Sorshung of BaluJhora and Samtse are cultivated at lower elevation of below 1000 masl.
- 3. Memba serbu, Memba Changlo of Yurung, Gomdar and Wamrong, Membu Tsalu of Pema Thang, Membu Tsalu of Orong, Tori of Tendu, Rato Tori of Darla and Tendu, Peka of Shaba, Toewang, Kabji and Rupaisa, Serthi of Nangkor and Korphu, Sorshung of Tendu, Mendelgang, Semjong, Balujhora and Puntenchu, Yungkar of Korphu and Nangkor, Yungkar Noenti of Nangkor and Yungkar Zhenti are cultivated at mid elevation between 1000- 2000 masl.

A detail of oil seeds diversity is illustrated in Annex 12.

# OTHER MINOR OIL SEEDS

# GROUNDNUT, PERILLA AND SESAMUM CLASSIFICATION AND ORIGIN

Classification<sup>[2]</sup>

	GROUNDNUT	PERILLA	SESAMUM
Kingdom	Plantae	Plantae	Plantae
Division	Elephant	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Magnoliopsida	Magnoliopsida
Order	Fabales	Lamiales	Lamiales
Family	Fabaceae	Lamiaceae	Pedaliaceae
Genus	Arachis	Perilla L.	Sesamum
Secies:	A. hypogaea L	P. frutescens (L). Britton	S. indicum L

Origin<sup>[2]</sup>:

The peanut or Groundnut is native to South America, Mexico and Central America. Reports are that sesame was first domesticated in India and Perilla is native of Asia.

# CULTIVATION IN BHUTAN

Peanut is cultivated only in lower elevation in southern and eastern Bhutan. It is grown in a very small scale in kitchen garden by a very few farmers. Perilla is cultivated mid elevation to high elevation where as sesame is grown at lower elevation in eastern and southern Bhutan by very few farmers in a very small scale.

Ref:

<sup>[2]:</sup> Wikipedia, the free encyclopedia: http://en.wikipedia.org



Pic. 44. Ground nut (dark nuts)



Pic. 45. Ground nut (red nuts)



# SOCIO-ECONOMIC IMPORTANCE

These crops are cultivated not for oil extraction but for table purpose. Groundnut is consumed in the form of dry and roasted nuts, sesame (*til*/*Namjur*) is used for religious functions and perilla (*Nam/Silam*) is consumed by roasting and mixing with *Zaw*.

# **2.2 CROP DIVERSITY**

Only Samdrup Jongkhar, Tsirang, Chukha and Samtse have record of Niger. Ground nut is found in a very small scale at Gamung & Nangkor under Shumar Gewog under Pemagatshel Dzongkhag and at Orong and Gomdar under Samdrup Jongkhar. *Perilla* is found in southern Dzongkhag like Tsirang and *Sesamum* in Tsirang and eastern Dzongkhags.

Perilla and Sesamum are found in southern Dzongkhag like Tsirang and eastern Dzongkhag like Lhuntse, Trashigang, Trashi Yangtse, Pemagatshel and Samdrup Jongkhar.

# **2.3 COLLECTIONS IN THE GENE BANK**

# Total accessions in the gene Bank:

Royal Bhutan Gene Bank is collecting germplasm samples of all the crops since 2005. Approximately 2000 samples have been collected during the past three collection seasons of which about 1000 accessions have been processed and conserved in Gene bank as of June 2008 and the rest of the samples are being processed so as to meet Internation Gene Bank Standrads.

It should be noted that there may be lot of duplicates in the accessions as it is based on morpho-agronomic charactors.

Table below shows no of samples/accessions already processed and conserved in the Gene bank for distribution and long-term conservation.

Sl.no.	Сгор		Total samples
1	Paddy		296
2	Maize		172
3	Millets	Finger millet	58
		Foxtail millet	26
		Common millet	9
4	Barley		22
5	Buckwheat	Bitter buckwheat	41
		Sweet buckwheat	58
6	Wheat		23
7	Amaranths		12
8	Legumes	Beans	83
		Soybean	26
		Vigna (Dal)	99
		Pea	4
9	Oil seeds	Mustard	49
		Niger	4
		Perilla	16
		Sesame	1
Total accessions in the gene bank			999

# Percentage coverage of diversity in the Gene Bank accessions:

Assessment was done with the accessions that are already registered in the Gene bank in order to compare how much of what is in the field has been collected.

On an average, 41% of rice, 35% of maize, 32% of finger millet, 25% of foxtail millet, 48% of buckwheat, 30% of barley and wheat, 30% of legumes and 26% of mustard have been collected and conserved in the Gene bank. Percentage coverage of diversity in Genebank accessions is based on the names of traditional varieties of different crops. Therefore actual coverage of diversity in the field can be established only upon characterization using molecular markers. This percentage coverage indicated here may possibly increase with the above studies.

Details of the accessions being conserved in the gene bank is given in Annex 13.

# 2.4 WAY FORWARD

Bhutan has achieved a major step in conservation and management of crop genetic diversity that will contribute towards attainment food security. With the establishment of Gene bank in 2004 and implementation on-farm PGRFA conservation and utilisation programs NBC has made good progress. Yet a lot remains to be done. Some of the pertinent future actions are as below.

- a) Preparation of Volume II and subsequent revision of both volume I and II
  - For preparation of Plant Genetic Resources: Other Crops-Volume II, Number of sites per AEZ should be increased.
  - Inventory should be done along with germplasm sample collection for Volume II.

## b) Germplasm collection

• Emphasis will be given to the collection and storage of the all crop genetic diversity of the country including Crop Wild relatives (CWR).

## c) Utilization of conserved diversity

- Multiplication of endangered and threatened species and rehabilitation/taxon re-introduction will be carried out based on need assessment.
- Diversification of crop production and broadening of genetic base of crops will be given greater attention.
- Value addition interventions will be taken up for income generation and increase demand for local produce/products through better packaging and marketing strategies. NBC will work closely with other agencies of MoA for value addition interventions.
- Conserving everything would mean high cost. Therefore, DNA fingerprints of crops and crop cultivars will be developed through molecular tools and reveal the genetic identity of the accessions, classify and catalogue collections.

- d) Up-gradation of Gene bank facility
  - Establishment of IVA and IVB: The seed bank will conserve crops with orthodox seeds which tolerate extreme desiccation and freezing. But in order to conserve those crops with recalcitrant seeds which do not tolerate extreme desiccation and drying and those that can be propagated through vegetative means, IVA and IVB will be established.
  - **Field Gene bank:** Field Gene bank will be established for living collection and maintenance for fruit crops and other vegetative propagating crop plants.
  - **Back-up samples:** Currently, all collections viz. active, base and duplicates are maintained in the same building. To avoid total loss of accessions due to factors beyond control, there is a need to conserve/preserve the duplicate samples in a seperate location. This could be achieved through establishment of a permafrost Gene bank within the country after proper study.
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	Dzongkhag	Sarpang	Sarpang	Tsirang	Tsirang	Samtse	Dagana	Samtse	S. Jongkhar	P. Gatshel	Tsirang	Dumbha	Wanodue	
	Gewog	Doban	Hillay	Puntenchu	Mendelgang	Tendu	Tseza	Sipsoo	Martshala	Yurung	Puntenchu	Toomana	Rupaisa	Rupaisa
	Village	Gungring, Pangkhey, Rani, Tirkhola, Dara gaon, Beech Khola, Maugaon, Noon Pani	Hillay	Phalayday, Changey, Thulo Maylay, Sanu Maylay, Manitar, Burichu	Zomling Zor ,Riserboo B, Mendrelgang, Pematshong	Tendu Tar, Khendong,		Belbotay		Denang	Dhanseri	Wangkha, Tsachuphu	Nezioano	Samdru Gang, Ruchikha,
	Alt (m)	2	690	950-1500	1000-1550	1050	1550	646	854	622-1621	1387	1690	1550	1310-1550
	Characteristics	Good eating quality, easy shattering & threshing, tall variety, moderate yield, bold grain, early maturity	Good taste, tall variety	Tall variety, bold grains, tall variety, tolerant to draught, good yield, good milling recovery	Tall variety, good eating quality, bold grains, good yield, high straw yield, less irrigation requirement	Easy threshing, fast to cook, early maturity, medium plant height, good yield, good taste, good milling recovery	Bold grains with tall plant height		White and sticky rice, tall plt ht			Tall variety, white grains and high yielding, cylindrical/bold, fine	White orains and fall variety	White rice, tall variety, bold and big
Traditional	variety /Land race	Attay	Atay	Attay	Attay	Atay	Atay	Achami	Ardi Bara	Aring Bar	Aunadhi	A cont Dours	Agay Dawa Agay Dawa	
Local	name of crop	Dhan	Dhan	Dhan	Dhan	Dhan	Bja	Dhan	Bara	Bar	Dhan	g	Bia	i i
	S.n	<b>]</b> *						2*	3	$4^*$	5*	9		6

# Annex 1: Details on the rice varieties (diversity)

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	ŕ	(	White and bold grains, tall variety,	1310-1680	Ruchikha, Tshamuna,	Rupaisa	
	Bja	Apa Uawa	good yield		Nezigang, Japhu		Wangdue
10	Dhan	Assam Choti	Good taste	465	Laring	Hillay	Sarpang
11*	Bara	Asu Bara	Good aroma	1650	Changjay	Yangneer	Trashigang
12	Bra	Auling Bra		2060	Sham	Menji	Lhuntse
13	Bja	Aurzom	Tall height, white grain	2150	Jigmena	Mewang	Thimphu
14	Bja	Aza Dogo	Tall variety, oval shape	1460	Yusikha	Kabji	Punakha
15	Bja	Awa Bja	· · · ·	1400	Rukha	Adang	Wangdue
16*	Bara	B.R.Attey/B. R		596	Phadey	Pema Thang	S. Jongkhar
17*	Dhan	Babu Dhan		438	Hangay Kalmatay	Sipsoo	Samtse
18*	Dhan	Babu Jasuwa		420	Kharbandi	Gumauney	Samtse
19*	5	Bangayray		356-1257		-	:
	Dhan	Dhan			Lower Saurani	Daria	Chukha
20*	Dhan	Baragoti Masino		1100	Dara Gaon	Jigmecholling	Sarpang
21	Bara	Bashmuthi	:	802	Rikhay	Orong	S. Jongkhar
22*	Dhan	Bayarni Dhan		646	Shivalay	Sipsoo	Samtse
23*	Ray	Baybupa	Good taste & milling recovery	1300	Dangdung	Langthel	Trongsa
24		Baharing		1050			
	Dhan	Dhan	High yiclding, good taste		Tendu Tar	Tendu	Samtse
25*			High yielding, good taste, medium	1050			-
	Dhan	Baiyerney	plant height		Tendu Tar	Tendu	Samtse
26		Bara		1300		1	
	Bara	Kaytsalu			Metsheshing, Redungmey	Orong	S.Jongkhar
27*			White grains, good for making Zaw,	1580~2010	Bechamang, Bamdir,		
			high yielding, good taste, early		Fangteng, Tsaling,		
	Dep	Bartshampa	maturity		Womanang	Bobdeling	T.Yangtse
28		, , , , , , , , , , , , , , , , , , ,		1640 - 1900	Khiju, Tongso, Jangsa		
	bja	batnam	boid and red grain, early maturity		Lang, Samay	I seza	Dagana

	Bara	Bedpu Bara	Early maturity, red grainsvariety		Duwang, Ngangmalang	Zobel	P.Gatshel
	Bara	Bepu Bara		1000-1200	Mandar, Redungmey	Orong	S.Jongkhar
		Bidungpa					
F	Bara	Bara		1851	Dhori	Bidung	T. Gang
	Dhan	Bihari Dhan		733	Ramitey	Phuntsholing	Chukha
	Dhan	Bhudume	Resistant to pest and disease, less viold		Mauraon	Dohan	Sarnano
	Dhan	Bhujuray Dhan		1235	Bitch Gaon	Darla	Chukha
			White grains, tall variety, good taste and quality, used for making beaten	1630		-	
	Bja	Bjaze Kaap	rice and early maturity		Rangrikha	Kabji	Punakha
	Bra	Bochola bra	Scented but low yield	1520	Lekpachu	Menji	Lhuntse
	Ëpa	Bogarma	Red grains, early maturity, good straw production	1480	Kikhar, Buli	Nangkor	Zemgang
	Dhan	Bhog Dhan		360	Hillay	Hillay	Sarpang
			White rice, bold grains, short variety,	1380-1440		Rupaisa	
_	Bja	Boktom	good taste		Woola		Wangdue
			Tall variety, goodaroma, cylindrical	1		Kabji,	
	Bja	Bonday	grains, good taste, good yield		Chephu	Toewang	Punakha
	Bia	Bondav	Tall variety, goodaroma, cylindrical grains, good taste, good vield	1380			Punakha
1			White grain, good for making zaw,	1395-1520			
	Bja	Botoli	tall variety			Toewang	Punakha
	Bja	Botoli		1460-1520	Yusikha	Kabji	Punakha
			Early maturity and attacked by bests	1380-1470			
1	Bja	Botoli	and wild animals		Damtaykha, Damtse	Kabji	Punakha
	Bra	Bra marpo	Red variety	1580	Ambrangchu	Menji	Lhuntse
	ţ	Bra			-	(	
	Bra	Hamzaywa			Ney Pema Chelin	Gangzur	Lhuntshi
	Bar	Brena Bar		1176	Pangthang	Kanglung	T. Gang

Canadania I humbohi	Korpho Trongsa	-	Yangneer Trashigang	- - - - - -	Menji Lhuntse	Korpho		;	Kabji Punakha	-	Nabgkhor Zemgang	Korpho Trongsa	Bobdeling T.Yangtse		Tendu Santse				Kabji Punakha		Puntenchu Tsirang	; ; ;	Dekiling Sarpang			BaluJhora	BaluJhora Chukha Toewang Punakha	BaluJhora Chukha Toewang Punakha Zomi Punakha	BaluJhoraChukhaToewangPunakhaZomiPunakhaNainitalSamtse	BaluJhoraChukhaToewangPunakhaZomiPunakhaNainitalSamtse	BaluJhoraChukhaToewangPunakhaZomiPunakhaNainitalSamtse	BaluJhoraChukhaToewangPunakhaZomiPunakhaNainitalSamtse	BaluJhora Chukha Toewang Punakha Zomi Punakha Nainital Samtse	BaluJhoraChukhaToewangPunakhaZomiPunakhaNainitalSamteeGamteeGamtee
	Nimshong		Shokang	Jalang, Minji, Sham,	Dragong	Nimshong		E	Tongsina	Tshaidang, Dagpai,	Kikhar	Korphu	Ngalimang		Tendu Tar, Kuchin Ta	Bithokha, Fakha,	Dukupang, Tongsina,	Rangrikha, Bithokha	Damtse		Dhanseri	: ; ;	Chockhorling			Rangay Tong	Rangay Tong Thamji	Rangay Tong Thamji Tana	Rangay Tong Thamji Tana Bitch Gaon	Rangay Tong Thamji Tana Bitch Gaon				
	1350	1950		1894-2060		1200	1990-2100			1360 - 1480		1350	I	1050		1380-2100					460-1387			222-603				1303	1303 393	1303 393 252	1303 393 356	1303 393 356	1303 393 356	1303 393 356
	Red rice, small grains, low yield.				High market value, red grains	Cood taste and grow well even in drought condition	Big and oval red grain, volume of	cooked rice increases, good yielding,	tall variety	White grains, late maturity, high	yielding, tall variety, tolerant to pest	Good taste, easy to thresh, scented		Small cylindrical white grains, good	taste, tall variety, scented		High yield, red oval grains, good	taste, adaptable to higher elevations,	good for making Zaw,															
Ruthile Bro	Budilingpa	Bomdhiling	pa bara	Bumdelingp	a	Bunalingpa Zintee		I	Bunap	Chakharpa	Epa	Chakharpa	Chalangpa	Charinangra	y		Chelep/	Chelep	Maap	Champa	Dhan	Champa Ei	Dhan	Champa Sari	Dhan		Chekhim	Chekhim Chekhim	Chekhim Chekhim Chota kati	Chekhim Chekhim Chota kati	Chekhim Chekhim Chota kati Chulthrav	Chekhim Chekhim Chota kati Chulthray	Chekhim Chekhim Chota kati Chulthray	Chekhim Chekhim Chota kati Chulthray
<b>D</b> ***	Epa		Bara		Bra	epa		i	Bja		Epa	Epa	Dep		Dhan				Bja		Dhan	ĩ	Dhan		Dhan		Bja	Bja Bja	Bja Bja Dhan	Bja Bja Dhan	Bja Bja Dhan	Bja Bja Dhan	Bja Bja Dhan	Bja Bja Dhan
45	46	47				48	49			30				51		52				53				54*			35	35	35 36*	55 56* 56*	35 36* 37*	35 36* 37*	35 36* 37*	35 36* 37*

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38	Bar	Chung Bara		1	Pasang Borang	Yangnyer	T, Gang
59		Chungki					
	Bara	Bara		1840	Bainang Rape	Ramjar	T. Yantsel
60						Phuntsho	
	Dhan	Churae		1406	Phuntsho Thang	Thang	S. Jongkhar
61*			Good taste, scented, long duration	1120-1299			
	Epa	Choti	and need more water		Riserboo B, Pematshong	Mendelgang	Tsirang
	Dhan	Choti	Good taste, fine small grains	1.300	Changey	Puntenchu	Tsirang
	Dhan	Choti	High yielding	630	Noon Pani	Hillay	Sarpang
62			Small round grains, scented, tall	900-1298	Zomling Zor,		
		Chhoti	variety, good eating quality high		Mindrelgang,		
	Bar	Masino	milling recovery,		Pernatshong,	Mendelgang	Tsirang
			White round bold grains, black	1200-1500			
		Chhoti	apicus, tall variety, scented, good		Manitar, Burichu,		
	Dhan	Masino	cating quality		Phalayday	Puntenchu	Tsirang
		Chhoti	Tall plant height	330			
	Dhan	Masino			Kuwa pani	Hillay	Sarpang
63			Small and bold grains with tall plant	1550			
	Bja	Masino	height			Tseza	Dagana
		Masino	Small white grains, hard to thresh,	٩	Beech Khola, Pangkhey,		
	Dhan		late maturity,		Bitekhola	Doban	Sarpang
64		Chubja/Ray		1700			
	Bja	kaam	Red grains			Tseza	Dagana
65				1395-1850	Čhephu, Esakha, Bjijokha,		
		Chumja/			Pangmakha, Wangkha,		
		Chumja			Lorina, Thamji,		
		Maap/	Oval red grains, good taste, tall		Tsachuphu khatey,		
	Bja	Maap Terem	variety , lodging tolerant		Bumtekha, Tami Damchu	Toewang	Punakha
66		Map		1700			
		Terem/Chu					
	Bja	mja	Bold and hig red grain		Tami Damchu	Toewang	Punakha
	Bja	Mapterem				Toewang	Punakha

Thimphu T.Yangtse T. Yantsel T.Yangtse Wangdue Thimphu Punakha Punakha Punakha Punakha Punakha Punakha T. Gang Punakha Lhuntse Lhuntse Lhuntse Khamdang Bobdeling Bobdeling Toewang Toewang Toewang Yangneer Mewang Rupaisa Menji Menji Menji Kabji Kabji Kabji Kabji Yusikha, Damtaykha, Sigye, khasadrapchu Tempakha, Yusikha, Cangtokha, Damtse, Bjijokha, Dawakha, Zamsa, Sirigang, Dragong, Minji Samdru Gang Damtaykha Mindegang Ngalimang Fangteng Demkhar Sirigang Shazam Bajokha Tsekha Damtse Sham Minji 1680-2040 1380-1820 1380-1460 1540-1690 1700 1445 1420 2160 2040 1650 16001680 20401550 ŀ F Red coloured and bold rice, medium preferred variety, high market value taste, volume increases when cooked High yielding, good eating quality, good taste, good milling recovery, Tall variety, red bold grains, good eating quality and early maturity Red and bold grains, tall variety, Good milling, have aroma, good milling recovery, early maturity, Oval red grains, good taste, tall variety, lodging tolerant, good High yield, not good taste high altitude variety good market value High yielding High yielding White variety plant height, Red variety Mapterim/C Maap/Mach Chungkharp Dawa Maap Chumia/Da Dhakpa Bra Domkharpa Dakpai Dep Map Dawa Dago Zam yangkum/ Yangkum Deletumo wa Maap Zhongja Daksaila Chunglo Chumro Chumja Dasum humja Maap Dawa Maap a Bra шn Bara Bara Dep Dep Bra Bja Bra Вга Bja Bja Bja Bja Bla Bja Bja Bja Bjä 79\* 76\* 75\* \*44 83 69 2 2 2 7 78 8 8 5 68 7 20

		Bra	:			:	
84*		Dhorae		272		Phuntsho	
	Dhan	Dhan			Phuntsho Thang	Thang	S. Jongkhar
85*	Dhan	Dollay Dhan	Hard to thresh	770	Toribari	Phuntsholing	Chukha
86	Dhan	Dudu Masee	White rice, bold grains, sickly	750	Gurung Dara	Bhalujora	Chukha
87	i	Duday	Long panicles, good taste, tall variety,	1050-1300			: : : :
	Dhan	Tulasi	good yield, small grains, scented		Tendu Tar, Khendong	Tendu	Samtse
88		Dukpa		1680			
	Bra	Zama	Red variety		Budhur	Menji	Lhuntse
68			White garins, scented, high yield,	1	Tilli/Kesa, Bara, Dugay	Shaba	Paro
	Bja	Dhumja	medium height,		Dingkha		
			Low yield, white grain, good taste,	2160			
	Bja	Dumja	scented, good for making Sip		Khasadrapchu, Sigay	Mewang	Thimphu
90	Bja	Dungchum	White grain	1480	Kalizingkha	Tseza	Dagana
91	Epa	Epa Kharti	Tall variety, medium height, easy to	1700	Nabji		
			thresh, good taste			Korpho	Trongsa
		Epa Khartila	White bold grains, good yield, good	1400			
	Epa		taste, scented		Tshaidang, Dunmang	Nahgkhor	Zemgang
92	Épa	Epa Lambu	Good taste and high yielding.	1350	Korphu	Korpho	Trongsa
93	Epa	Epa Nanjee	Red rice, black coloured husk,	I	Kamjong		
			average yieling			Nabgkhor	Zemgang
94		Epa Pagchila	Red grain, late maturity, good taste,	1400			
	Epa		high yielding		Dunmang	Nabgkhor	Zemgang
95		Epa Singye	Late maturity, tall height, good taste	1400			
	Epa	Namgay			Kamjong	Nabgkhor	Zemgang
96	Epa	Epa Zhentila	Red grains, good taste, good yield	ι	Tshedang, Kamjong	Nabgkhor	Zemgang
26	Bara	Galingpa	Good eating quality	1150-1250	Dorchang	Orong	S.Jongkhar
*86	Dhan	Gauri Dhan		360	Hillay	Hillay	Sarpang
		Gauri				Î	-
	Bara	Mashino		536	Beldangra	Pema Thang	S. Jongkhar
*66	Bja	Gherugam		2300	Chasungsa	Khamey	Gasa

Samtse	Gumannev	Kharbandi	404		lai Banela	Dhan	116*
5. Jongkhar	Pema Thang	Koila	310	Scented	Jagurtalay Masino	Dhan	115
Punakha	Shengana	Gangkha	1282		Ja Híngsam	Bja	114
S. Jongkhar	Phu			1 Jung	Í Jung		
	Langchen						113
Chukha	BaluJhora	Kothiline	594		Hola Paray	Dhan	112
Wangdue	Kazi	Kazhi	1900-1980	White grains, scented, tall variety	Hogchum	Bja	111
Lhuntsc	Menji	Lekpachu			Hang bra	Bra	
		Sham, Leshigang,	1520-2040				110*
Wangdue	Kazi	Homina	2310	High yielding, good taste	Hamjim	Bja	$109^{*}$
Samtse	Gumauney	Katharay	ŧ		Dhan	Dhan	2021
7 41 1	Luigo	Laugo			1	7	1 0.04
F	-				2	è	*401
Samtse	Denchuka		1200		Fudungev	Dhan	106
Punakha	Kabji	Tempakha, Petari,		Redgrains, tallvariety and good taste	Maap	Bja	
			1650-1960		Gyemia		
Punakha	Tœwang			Red oval grain, good taste	Maap	Bja	$105^{*}$
			1850		Gvemja	· · · · · · · · · · · · · · · · · · ·	
Punakha	Kabji	, Gagona,		rice	Gyemja	Bja	
		Tongsina, Atakha (Petari)		maturity, used for making Sip/Bitten			
				taste, Fertilizer responsive, early			
			1790-2100	Red grains, medium height, good		·····	
Punakha	Toewang	Tsachuphu khatey	1690	Tall, black husk, red grains	Gyemja	Bja	$104^{*}$
Samtse	Tendu	Khendong	1300	Tall plant height, strong stem	Gurulay	Dhan	103
Punakha	Kabji	Jawana		grains	Gunja	Bja	
			1860	Red grain, late and tall variety, oval			102
Punakha	Toewang			Tantsering, dwarf variety	Zakha	Bja	
	Kabji,		1470-1850	White and fine grains, bit bigger than	Gomchay	-	101
Zemgang	Nangkhor	Kamjong			Ray	Epa	
			1.590	High vielding and good taste	Golingpa		100

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		Dhan					
117	Bja	Jarey		1315	Wangkha	Toewang	Punakha
118		Jana		- - - - -			
	Bja	Thrachum	- - - - - - - - - - - - - - - - - - -		Kokokha	Bjena	Wangdue
119*	Dhan	Japaka Dhan		371	Chargaray	Chargaray	Samtse
	Dhan	Japaka Dhan			Buduney	Samtse	Samtse
120	Ĩ	Jasuwa			τ	ι	-
	Unan	มาลท		707	Gumauney	Sumauney	Samtse
121	Dhan	Juwa Dhan		646	Belbotay	Sipsoo	Samtse
1.22	Bja	Ja Maap	Tall height, early transplanting	1.850	Jigmena,	Mewang	Thimphu
				1890-2300	Lingkhibji, Wangchukha,	-	
	)a	Ja Maap	Tall variety, red grains, good tillering		Jagatokha, Chirlo	Kazi	Wangdue
123		Japhu		1440-2100		Rupaisa	
		Maap/	Red small bold grains, medium				
		Japhu	plant height, good taste, good		Japhu, Woola, Jala, Japhu		
	Bja	Machum	yielding		Goenpa		Wangdue
124			Tall plsnt height, long panicle,	2160			
	Bja	Jachum	susceptible to blast		Sigay	Mewang	Thimphu
125		Jala		2010		Rupaisa	
	Bja	Machum	Red rice, tall variety		Jala		Wangdue
126	Bja	Jamija		2150	Jigmena	Mewang	'l'himphu
127	Bja	Jamja maap	Tall, red and oval grain, good taste	1920	Pachakha	Toewang	Punakha
128	Bja	Jana	Drooping panicles	ŀ	Bara	Shaba	Paro
129*			Red grains, black husk, tall variety,	ł		Shaba	Paro
	Bja	Janam	good yield		Gongri, Tilli/Kesa		
	Bja	Janam	Red grains, medium plant height	1	Zamding	Rupaisa	Wangdue
130				1460-1850	Bjijokha, Tshephu,		
	i	,	Tall variety, red bold grain, early		Tsachuphu, Tsachuphu	ł	:
	Bja	Jangka	maturity and easy threshing		khatey, Thamji	Toewang	Punakha
131	Dhan	Jaya	Short tiller s, no damage by wild boar	470	Laring	Hillay	Sarpang

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132*			Small grains, good taste, high	870-1400	l f		
	Dhan	Jera Sari	yleioing, medium piant neight, good milling recovery		Jumsa, rakpang, Bokbokay , Okhor Botay,	Tendu	Samtse
	Dhan	Jera Sari	Good taste, high yield,	950	Jumsa	Tendu	Samtse
133	Bja	Jhumja	Scented		Bara	Shaba	Paro
134	Bja	Kaap Phuchum	White bold grains, tall variety with slightly scented	1780	lasakha, Samdru Gang	Rupaisa	Wangdue
135	Bja	Kachum	White rice, high yielding	2130	Komathang	Kazi	Wangdue
136	Bra	Kalifupa	High yielding, good eating quality, scented	1240-1680	Chura, Changling, Lekpachu. Budhur.	Menii	Lhuntse
137	Dhan	Kalo Chhoti	Tall plant height, scented	1280	Mindrelgang	Mendelgang	Tsirang
138		Kalo Chhoti	Tall plant height, black apicus, bold	1090-1240			
	Dhan	Masino	grains, scented		Manitar, Phalayday	Puntenchu	Tsirang
139		Kalo Chhotí	Tall plant height, black apicus,	1256			
	Dhan	Masino	scented		Mindralgang	Mendelgang	Tsirang
$140^{*}$	Dhan	Kalo Nunya		250		Kuchidiana	Samtse
	Dhan	Kalo Nuniya		750	Gurung Dara	Bhalujora	Chukha
141		Kalo	Black husk, tall plant height, big red	1500			
	Dhan	Urangay	grains, good milling recovery		Dukpa Bindu	Tendu	Samtse
142*	Bra	Kam bra	Red and white variety	1680	Budhur	Menji	Lhuntse
143	Dep	Kamdep	Early maturity, red variety	1670	Fangteng	Bobdeling	T.Yangtse
$144^{*}$		Kal Toray					
	Dhan	Dhan		393	Bitch Gaon	Nainital	Samtse
145	Dhan	Kalo Jera	Altitute in ft	1096	Manithang	Puntenchu	Tsirang
146	ļ	Kam					
	Bja	Thaygom		1020	Jaray Gang	Athang	Wangdue
147*	ł	Kamthey		1	:	-	I
	Kay	Korma		1545	Bayling	Langthei	Irongsa
148*	Dhan	Karangla		,	Reserphu A	Mendelgang	Tsirang
149*	-	Kati/kati		0007			
	Uhan	sali Dhan		1020	Daragaun	Semjong	Tsırang

150*		Khaktang/					
	Bara	Wangkharpa		1526	Shazam	Khamdang	T. Yangtse
151*	Khang	Khangpa		-		-	
	pa Dep	Dep	Scented var	1870	Phangteng	Bomdeling	T. Yangtse
152	Bja	Kawalosum	High yielding	2300	Jigmena	Mewang	Thimphu
$153^{*}$	Bar	Karangla	Red grains, good taste, good yield	1400	Reserboo A	Mendelgang	Tsirang
154*		Karma		1560	-		
	Bra	Tekpa	High yielding		Leshigang, Lekpachu	Menji	Lhuntse
		Karma		1.610-1.850			
	Dep	Tekpa	Good yield, good taste		Bamdir, Tsaling	Bobdeling	T.Yangtse
155	Bja	Kashmiray		1610-1650	Allay Gang, Chakachu	Rupaisa	Wangdue
156*		Katikey	Small grains, good taste, low yield,	365		-	
		Dhan	lodging resistant, difficult for				
	Dhan		threshing.		Hilley	Hillay	Sarpang
		Katikey		870			
	Dhan	Dhan	Small grains, good taste, low yield		Pakpay	Tendu	Samtse
157		Katusay		1500			
	Dhan	Dhan	Medium plant height, good taste		Dukpa Bindu	Tendu	Samtse
158	Bja	Kawalosum	Short variety	2135	Khasadrapchu	Mewang	Thimphu
159				1620-1720	Ngalimang, Lamda, Bechamang, Ngalimang,		
	Dep	Kem Dep	High yielding		Lamda	Bobdeling	T.Yangtse
160*		Kezang/Kez	Good taste, white grains and tall	1400.1700			
	Epa	angla Epa	plant height., early maturity		Dunmang, Buli, Kikhar	Nangkhor	Zemgang
161*	Bara	Khardungpa Bara		1805	Danelune	Bidune	T. Gang
162*					0	Phuntsho	2
	Bara	Kongkar		213	Khameythang	Thang	S. Jongkhar
163*	Bara	Kongkus		334	lampani	Langchen Phu	5. longkhar
164	Bja	Kongtse		963	Khamey	Daga	Wangdue
165	Dep	Khengpa	High yielding	1650	Fangteng	Bobdeling	T.Yangtse

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Khantana	Khantsna			1620-2100	Womanang, Ngalimang, Bochamang, Ramdir		
Dep Tsalu High yieldin	Tsalu High yieldin	High yieldin	g, early maturity		Lamda, Womanang	Bobdeling	T.Yangtse
Bar Khu Tsalu Tall height, re	Khu Tsalu Tall height, re	Tall height, re	ed colour	1200	Manitar	Puntenchu	Tsirang
Khudami/	Khudami/		-	1350			
Dhan Khudumay	Khudumay				burnchu	L'untenchu	Isirang
Khudumay/ Tall plat height, v   Phudungney needs continuous   Dhan yield	Khudumay/   Tall plat height, v Phudungney needs continuous vield	Tall plat height, v needs continuous vield	vhite small grains, irrigation, good		Маодаон	Doban	Sarpang
Dhan /Khudungay High yield, white	Khudungay /Khudunay High yield, white	High yield, white	garins	1500	Dukpa Bindu	Tendu	Samtse
Dep Kontonsala	Kontonsala			1720	Bechamang	Bobdeling	T.Yangtse
Dhan Krishna Bhog	Krishna Bhog			I	Malbassay		Chukha
Krulu Krulum Good taste m	Krulum Good taste	Good taste		1350	Korphu	Korpho	Trongsa
Bra Bra red grains	Kurtoepa High yielding, high Bra red grains	High yielding, high red grains	altitude variety,	1560-2060	Dragong, Jalang, Minji, Sham, Changling	Menji	Lhuntse
Bja Kuchum	Kuchum			2570	Drugyal Dzong		Paro
Bja Lham zim	Lham zim			1400-1800	Tokha	Toep	Thimphu
Bja Local Kaap Tall height, white g	Local Kaap Tall height, white g	Tall height, white g	grain		Tilli/Kesa	Shaba	Paro
Bra Ma Bra	Ma Bra			1680	Budhur	Menji	Lhuntse
Bia Ma Phozom Red and bold grains	Ma Phozom Red and bold grains	Red and bold grains		1590-1780	Jasakha, Parukha, Chakachu	Rupaisa	Wangdue
Red colour, tall, goo	Red colour, tall, goo	Red colour, tall, goo	od taste, bold	1470			>
Bja Maap shape	Maap shape	shape			Damtse	Kabji	Punakha
Red bold grains, goo	Red bold grains, goo	Red bold grains, goo	d yield, good	1850-2170	Homina, Kazhi, Kazhi		
Bja Maap taste	Maap taste	taste			Susa, Komathang	Kazi	Wangdue
Red bold grains, ta	Red bold grains, ta	Red bold grains, ta	ll variety, stable	1310-1550		Rupaisa	
Bja Maap yield	Maap yield	yield			Ruchikha, Nezigang		Wangdue
Bra   Mabra   Red bold grains	Mabra Red bold grains	Red bold grains		1020-1560	Budhur, Changling	Menji	Lhuntse

180*	Bja	Machum	Red grains with medium plant height, high yielding	1980	Kazhi Susa	Kazi	Wangdue
				1310-2000	Ruchikha, Woola,	Rupaisa	
			Red grains, tall variety, stable yield,		Tshamuna, Nezigang, Allay Gang, Jasakha,		
	Bja	Machum	good taste		Zamding, Palukha		Wangdue
	Dept	Machum	Good taste	1760	Bechamang	Bobdeling	T.Yangtse
181	Dhan	Malaning	Good yield, white colour rice	I	Dukpa Bindu	Tendu	Samtse
1.82	Dhan	Malingay		1570	Shetekha	Denchukha	Samtse
1.83*	Dhan	Mama Dhan		340	Hillay	Hillay	Sarpang
184*	Bara	Momo	Low yield	851	Martshala	Martshala	S. Jongkhar
185	Bja	Mamphum	Red bold and big grain	1600	Palukha	Rupaisa	Wangdue
186		Maray	Upland rice, red colour, carly	1400			
	Epa		maturity, tall height., good taste		Kamjong	Nangkhor	Zemgang
187*						Shompangkh	
	Dhan	Muray Dhan		•	Norbugang	a	Sarpang
188	Dhan	Murungay		ŀ	Bhimtar	Changmari	Samtse
$189^{*}$		Musuli					
	Dhan	Dhan		I	Kuchi Daina	Gumauney	Samtsc
	į	Musuli					(
	Dhan	Dhan		•	bhimtar	Changman	Samtse
190	Dep	Maydeep	Easy milling	1850	Bamdir	Bobdeling	T.Yangtse
191	Dhan	Moshiri	High yielding, good taste	ŀ	Maugaon	Doban	Sarpang
192*		Makhan				1	
	Dhan	Puray Dhan		770	kothiline	BaluJhora	Chukha
$193^{*}$		Malchira					
	Dhan	Dhan		400	Bhimtar	Changmari	Samtse
194	Dhan	Mawali		1440	Samkhar	Jigmecholling	Sarpang
195*	Dhan	Chetri Monsera			Testalian	(imainout)	Comteo
	Lylall	WULIDALA			I Selfeduerg	CUMMANNY	Califica

Trashigang Trashigang T. Yangtse T.Yangtse T.Yangtse Punakha Punakha T. Gang Lhuntshi Lhuntshi Dagana Chukha Chukha Samtse Samtse Samtse Paro Paro Phuntsholing Denchukha Bomdeling Bobdeling Chargaray Bobdeling Denchuka Yangneer Toewang Yangneer Phongmi Gangzur Gangzur Tsento Tseza Kabii Bechamang, Fangteng, Tshephu, Tsachuphu, Tsachuphu Khamey, Bjijokha, Wangkha , Bumtekha, Thamji Tsachuphu khatey, Sirigang, Damtse, Lower Saurinai Bumtangshing Womanang Ngalimang Chargaray Samshing Yangteng Bumtang Tektekpa Tektekpa Pangtha Toribari Chunju Tsekha Tongso Joshilo 1395-2000 1380 - 16601620-1730 2010 2380 17231200 2500 1314 2000 2020 1943 770 Bold white garians, tall variety, good good shelf life, for religious offerings Red rice, grains smaller than Batham Good for making beaten rice, white slightly scented, high market price, grains, medium height, good taste, for making zaw, late maturity High yielding and good taste Scented and good quality Good smell, upland Good taste Naning Bara Ngumlingm Pailo Bujuri Ngera bara Naam (Ray Nurlingbo Pharangay Pang bara Pashi Deb Ngingpa Onepaky Pakhay Phaodel Ngabja Ola Bra Naam) Naypa Zakha Naam Ola Ja Dhan Nabia Dhan 6 Dhan Dhan Dhan Dhan Dhan Bara Bara Bara Dep Deb Dep Bra Bra Bja Bja Bja Bja Bja 203\* 204\* 205\* 208\* 211\* 196 206\* 209 197 228 199 200 201 20 207 210

	Bara	Pang bara	Upland rice	1	Duwang	Zobel	P.Gatshel
212		Pangbara		1600			
	Bara	balingbi	Upland		Medung	Orong	S.Jongkhar
213		Pangshing	White grains, dwarf variety, high	1640-1940		;	
	Dep	Dep	yielding		Ngalimang, Lamda	Bobdeling	T.Yangtse
214	ŗ	Pho Bara		(			(
	Bara	(Red V)		1689	Langten	Kadhi	T. Cang
21.5*		Phongmipu					
	Bar	Bar		1860	Pangthang	Kanglung	T. Gang
$216^{*}$			Small bold grains, white variety, tall	600-750		Bhalujora	Chukha
	Dhan	Pyjam Dhan	variety		Gurung Dara, Ahallay		
217*	Dhan	Rambough	Bold grains, good taste	3	Tendu Tar	Tendu	Samtse
218*		Ram Tulasi					
	Dhan	Dhan		349	Kuchi Daina	Gumauney	Samtse
219*		Rangshikhar					
	Bar	pu Bara		1860	Pangthang	Kanglung	T. Gang
220*	Dhan	Rani Gaza		649	Chargaray	Chargaray	Samtse
221*		Ranjit/Ranji				Langchen	
	Dhan	ta		229	Lower Golanti	Phu	S. Jongkhar
222*	Bara	Rashu Bara	White variety		Duwang	Zobel	<b>P.Gatshel</b>
223*	Dhan	Rato	Bhota		Saurinai		Chukha
	Dhan	Rato Dhan	Need less water good taste	1490	Hariyo Muga	Hillay	Sarpang
224*		Rato Churae				Phuntsho	
	Dhan	Dhan		270	Phuntsho Thang	Thang	S. Jongkhar
225*		Robtang					
	Bara	Bara		1450	Khoyar	Gomdar	S. Jongkhar
226*		Ray Kaap/	Good taste, good yield, used for	1480-1900	Jangsa Gang, Kalizingkha,	:	+
	Bja	Ray Kaam	making zaw and bitten rice		Samay	Tseza	Dagana
227*	Bja	Ray Maap	Good taste and yield, redgrains	1900	Kazhi	Kazi	Wangdue
228	Bja	Ray Naap	Red grains, tall variety, good taste	2010	Jala	Rupaisa	Wangdue
229	Bja	Rewa	White husk, red grains, medium bold	1700	Tami Damchu	Toewang	Punakha

		Machum Zama	grains, tall variety, high altitude variety				
230*	Dhan	Ruduwa	Atitute is in ft	846	Manithang	Puntenchu	Tsirang
231	Bara	Shingkharpa Bar		2182	Wooshorong	Bartsham	T. Gang
232*	Bara	Sam Bara		I	Ngangmalang	Zobel	P.Gatshel
				1200	Redungmey, Durtshen, Modung, Morong	-	-
	Bara	Sam Bara	Upland rice		Manchang	Orong	S.Jongkhar
	Bara	Sambara	Upland rice	1400-1750		Orong	S.Jongkhar
233	Epa	Samkharpa	Good smell, late maturity.	1400	Nimshong	Korpho	Trongsa
234	Bja	Sep Bja		1380	Damtse	Kabji	Punakha
	Bja	Sep Bja	White bold grains, tall variety	1350-1440	Jala, Woola,	Rupaisa	Wangdue
235	Dep	Shang Eepa	Good taste, good yield	1540	Ngalimang	Bobdeling	T.Yangtse
236*		Sheto Dhan	White and small seeds no lodging	940			
	Dhan		problem good taste.		Muga	Hillay	Sarpang
237*			Red cover, white oval grain, tall,	1920			
	Bja	Silim Kaap	good taste		Pachakha	Toewang	Punakha
238*		Silly				Gaselo	
	Bja	Karchum		2100	Hesokha	Tshogwom	Wangdue
239*	Dep	Sonala	High yield, good taste, resistant to pest, red grains	1580-1860	Bechamang, Fangteng, Lamda	Bobdeling	T.Yangtse
240		Sonam	High yielding and low pest and	1610			
	Epa	Kelzang	diseases		Kamjong	Nabgkhor	Zemgang
241*		Sukhemey	White bold grains, high yielding,	ŀ			
	Dhan		good tastc		Maugaon	Doban	Sarpang
			Tall variety, bold grain, suitable for	1399-1450			
			dy and higher elevation, early		Tashipang, Riserboo B,		
	Dhan	Sukhimay	maturity		Samshing Gaden	Mendelgang	Tsirang
	Dhan	Sukhimey	High altitude rice	1380	Burichu	Puntenchu	Tsirang
242*	Bara	Sung Sung		1805	Khoii Dune	Uzorone	T. Gane

		T. Gang		Samtse		Tsirang	Samtse		Sarpang	-			Punakha					Punakha		Wangdue		Wangdue		Wangdue				Wangdue		учанучие
		Bidung		Tendu		Mendelgang	Tendu		Doban				Toewang					Kabji		Kazi		Kazi	Rupaisa		Rupaisa				Rupaisa	
		Danglung		Dukpa Bindu		Tashipang	Dukpa Bindu		Maugaon	Tsachuphu Khatey, Tami	Damchu, Thamji,	Bajokha, Dawakha,	Gagona	Sirigang, Tempakha, Fakha, Bithokha,	Dukupang, Zamsa,	Yusikha, Damtaykha,	Rangrikha, Gangtokha ,	Damtse, Jawana		Chirlo, Kazhi, Komathang				Samdru Gang	Ruchikha, Woola, Jala,	Tshamuna, Nezigang,	Parukha, Jasakha, Japhu	Goenpa,		
		1694	1500		1306		1500	4		1520-2000				1390-1860					1910-2170				1550		1310				1350-2100	
				Medium plant height, good taste	Good taste, red grains, shorter than	Attey	High yield, more tillering, red rice	Medium plant height, less yield, good	taste, red grains		Tall variety, white cylindrical slender	grains, used for making zaw, early	maturity, good yield		High yield, white grains, medium	height, lodging and draught tolerant,	good for making zaw, adaptable to	higher altitude, good taste,		White long grains, tall variety,		White rice, narrow and long grains		White and small rice			White rice with cylindrical shape,	good taste, good yield	Tall variety, good and soft taste,	white and smau grains,
Bara	Takulung	Bara	Tagmara	Dhan		Tagmaro	Tagmaru	Takmaru					Tan Tsering					Tan Tsering	$T_{an}$	Tshering	Tan	Tshering	Tan	Tshering			Tan	Tshering	TT.	Runanst ngt
		Bara		Dhan		Dhan	Dhan		Dhan				Bja					Bja		BJa		Bja		Bja				Bja	÷	Dja
	243*		244							245*																				

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246			Tall variety, white bold grains, erown in high altitude areas, eroof	1280-1350	Mindralaano Samshino		
	Dhan	Tapray	for making Bitten rice.		Gaden	Mendelgang	Tsirang
	Dhan	Tapray	Bold and white grains		Maugaon	Doban	Sarpang
247	Dhan	Tauli	- - - -	1.267	Relukha	Denchukha	Samtse
248*	Ray	Tenzin Bondey	- - - - - - - - -	1106	Bayling	Langthel	Trongsa
249*	Bja	Themja		2100	Dayangkha	Shaba	Paro
	Bja	Thumja	Red grain, short height, small and round seed		Bara	Shaba	Paro
250*	Dhan	Throsara Dhan		594	Kothiline	BaluJhora	Chukha
251*	Dhan	Temburay Dhan	Black husk, white grains, good taste	645-730	Noon Pani, Muga	Hillav	Sarpang
	Dhan	Timuray	Midium plant height, good taste, small grains, late variety	1050	Tendu Tat	Tendu	Samtse
252	Bja	Tolly Shakha		1494	Eusakha	Kabji	Punakha
253*	Bara	Trongsarpa Bara		2014	Yagpu Gang	Mongar	Mongar
254	Bja	Tow	White, medium height	1610	Zamsa	Kabji	Punakha
255	Вага	Tshangapa		1406	Bainang Rape	Ramjar	T. Yangtse
256	Bara	Tshewang bara		1230	Pangthang	Khar	P. Gatshel
257	Bara	Tsho Bara			Denphu	Scrthig	S. Jongkhar
258*	Bara	Tsirang Zam		930	Themnangbi	Saling	Mongar
259	Bja	Tsekhim	Tall variety, white cylindrical grains	1450	Bumtekha	Toewang	Punakha
260	Bja	Tsenam	White colour, cylindrical grain	2110	Tongsina	Kabji	Punakha
261	Bja	Tshemja (Maam)	Light yellow husk cover, medium plan height.	,	Tilli/Kesa	Shaba	Paro
262	Dhan	Tulasi dhan	Medium long panicle, big bunch type	870	Pakpay	Tendu	Samtse

Punakha	Mongar	) ) 	Samtse	T.Yangtse			Punakha	Wanedue	B		Lhuntse			S.Jongkhar	S. Jongkhar	r -	-	Zemgang	Paro	Trongsa		T. Gang	-			Punakha		:
Kabij	Ngatshang	) 	Tendu	Bobdeling			Kabji	Rupaisa			Menji			Orong		Gomdar		Nabgkhor		Langthel		Bartsham				Toewang		
Tongsina, Rangrikha, Dukupang	Omkhar		Dukpa Bindu, Katchin	Gangkhardung		Bithokha, Tongsina,	Homina, Kazhi	Palukha	Budhur, Chura,	Changling, Dragong,	Leshigang, Lekpachu	Tersheri, Dorchang,	Medung, Metsheshing,	Mandar, Manchang		Khoyar		Buli	Kharabji	Bayling		Wooshorong	-		Tshephu, Yusakha,	Chephu	Sirigang, Yusikha,	Damtse, Kazhi, Kazhi
1670-2110	1530	1300-1740			1,770-2310			1600	1200-1800			1100-1450				1000	1710		2140	1545		2182	1460				1380-2170	
Constant yield, tall variety, late maturity, red grains, good yield	Scented	Red grains, tall plant height, good	milling recovery		White oval grains, scented, good	taste, good for making beaten rice,	early maturity	White, used for religious purposes		Tall variety, good taste, high yielding,	high market value		High yielding, good milling	recovery, scented, good taste			Red grains, good yield and good	taste.				Rejected	White cylindrical grains, tall but	shorter than Nabja, good for making	zaw and bitten rice, late maturity,	hardto mill,		Good taste, white grains, high,
Uma maap	Woopkharp a /Sungsung	Wairangay	Dhan	Wang Bara		Wangda	Kaam	Wangda Kaam		Wangdi	Karma		Wangdi	Karma		Yangtsepa	Yunti Epa		Zhechum	Zindi	Zu Bara	(Red Va				Zakha		
Bia	Bara		Uhan	Dep			Bja	Bia			Bra			Bara		Bara		Epa	Bja	Ray		Bara				Bja		ł
263	264	265		266	267*				268*						269*		270		271	272	273		274*					

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				1590-2100	Parukha, Chakachu,	Rupaisa	
					Jasakha, Palukha, Japhu	I	
	Bja	Zakha	White grains, good yield, tall variety		Goenpa		Wangdue
	Bra	Zakha	Small grains, short plant height	1200	Budhur	Menji	Lhuntse
275			Short dwarf variety, cylindrical red	1660-1765			
	Bja	Zama Maap	grains, early variety, good taste		Yusakha, Pangmakha	Toewang	Punakha
276	Epa	Zangkar	Red rice and early maturity.	I	Dunmang	Nabgkhor	Zemgang
277	Bra	Zangpo Bra		2040	Sham	Menji	Lhuntse
278			Late maturity, tall variety, grains not	1			
	Bja	Zaray	so bold as Nabja, easy to thresh			Toewang	Punakha
279*	Epa	Zhenti/	Good taste and easy for threshing,	1540-1700	Nabji		
	I	Zhinti	high yielding			Korpho	Trongsa
280*	Bar	Zhung Bar	Tall, Red	1140	Manitar	Puntenchu	Tsirang
$281^{*}$			Tall height, good yield, red grains,	2160	Jigmena, Khasadrapchu,		
	Bja	Zuchum	taller than Janaam		Sigay	Mewang	Thimphu
.i+	dirates (	rarmnlaem ea	mulae in Cana Bant				

\*indicates germplasm samples in Gene Bank

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	Local	Traditional					
	name	variety	Characteristics	Alt (m)	Village	Gewog	Dzongkhag
	of crop	/Land race			)	5	
1	Ashom	Ashom	Tall variety, good taste	1250-1460	Nimshong	Korpho	Traongsa
5	-	Ashom		1			
	Ashom	Balingbi			Tongkangla Zor	Kengkhar	Mongar
		Ashom		I			
	Asnom	DalingDI			Duwang	Zodel	r.catsnel
<del>ω</del>	Ashom	Ashom Barmu	Early maturity	2400	Dakla	Kengkhar	Mongar
		Ashom	2	1200		Orong	S.Jongkhar
	Ashom	Barmu			Batshong	)	)
4	Ashom	Ashom Daza		1200	Shali	Shumar	P. Gatshel
5	Ashom	Ashom		1040	Korkhang	Chimung	P. Gatshel
		Khandha					
9	Ashom	Ashom Kaap	Early maturity	1580	Tsaling	Bomdeling	T.Gang
		Ashom		2040			
	Ashom	Karpo			Sham	Minji	Lhuntse
5		Ashom		1350-1600		Korpho	Traongsa
	Ashom	Kharti	Tall variety, good taste		Korphu		
æ		Ashom		2040			
	Ashom	Marpo	Tall variety		Sham	Minji	Lhuntse
6	Ashom	Ashom Zintí	Long cob, tall plant height.	1350	Korphu	Korpho	Traongsa
10		Baipa		1680 - 2080	Darjeeling, Shokang,	Yangneer	T.Gang
	Ashom	Ashom	Soft grains		Tektekpa		
	Ashom	Baipo	Good yield	L	Medung	Orong	S.Jongkhar
				1490-2140	Bainang, Dalifhangma,	Yangneer	T.Gang
			Good taste, sweet and soft to eat,		Darjeeling, Tektekpa,		
	Ashom	Baipo	good for quality tegma		Durung Ngambeenang		

## Annex 2. diversity of Maize

		Baipo/Bepo		1240-2040	Budhur, Chura, Dragong,		
	Ashom	Ashom	Late maturity, stable yield		Leshigang, Minji	Minji	Lhuntse
				1300-1800	Tongla, Magola,		
					Shinchongri, Zor,		
					Doktang, Bargonpa,		
		Baipo	Early maturity, high altitude variety,		Tongla Gonpa, Pinphu,		
	Ashom	Asĥom	tall variety		Shinchongri	Kengkhar	Mongar
				1150-1740	Dorchung, Pheluma,	Orong	S.Jongkhar
					Morong, Tersheri,		
		Baipo			Metsheshing, Wooling,		
	Ashom	Ashom	Bold and big grains, tall variety		Mandar, Redungmey		
				1490-2000	Changjay, Darjeeling,	Yangneer	T.Gang
					Shokang, Tektekpa,		
		Baipo	Good taste, Soft Kharang, good		Durung Ngambeenang,		
	Ashom	Ashom	quality tegma, long cobs		Demkhar, Kharthung,		
				1610-2200	Gangkhardung, Tsaling,	Bomdeling	T.Yangtse
	-	Baipo	High yielding, early maturity, soft to		Pangliho, Bechamang,	)	)
	Ashom	Ashom	eat		Tarphel		
		BaipoAshom		1520-2060	Sham, Changling,		
	Ashom	karpo			Lekpachu,	Minji	Lhuntse
	-	Baipo		1540		-	
		Ashom					
	Ashom	marpo			Sham, Changling	Minji	Lhuntse
11	Ashom	Barkong	Early maturity	860	Oloki, Shinchongri	Kengkhar	Mongar
12				1200-1750	Pheluma, Wooling,	Orong	S.Jongkhar
		Bayupu			Morong, Manchang,		
	Ashom	Ashom	Good taste		Menchiri, Redungmey		
13		Bethpa		1400			
	Ashom	Ashom			Tshalabee, Nanari, Zor	Kengkhar	Mongar
14	Ashom	Berkhala		1661	Morong	Orong	S. Jongkhar
15	Chado			1540		Nangkor	Trongsa
	mo	Chadomo	Tall height, good taste	1	Buli		
16	Ashom	Chakharpa	Late maturity and tall plant height.	1400	Nimshong	Korpho	Traongsa

17		Changron/	Early maturity high walding long	1350-1600		Kornho	Tranness
;	Ashom	Changrey pa	cobs, good taste.		Korphu		
18	Chaza	Chazam/	Tall plant height, good taste, hellow	1550-1710		Nangkor	Zemgang
	nn	C.Ngadpo	grains		Kikhar, Tali, Buli		1
19		Chepti	Good yield, lodging tolerant, soft and	1550		Puntenchu	Tsirang
	Makai	Makai	good taste		Dhanshiri		
20	Acham	Chodom Zinti	Tall stant haidht annd tacto	1600	Korahu	Korpho	Traongsa
5	Inviter	Churabhaen			mild love		
17	Ashom	скинgкнагр a/C. pali	White variety, tall variety	-	Pangthang Daza, Duwang	Zobel	P.Gatshel
52		Chema					
	Ashom	Ashom		-	Denang	Yurung	P. Gatshel
23	Ashom	Dorjilingpa		2182	Wooshorong	Bartsham	T. Gang
24		Domba	Medium sized cobs, good yield,	1400		Nangkor	Zemgang
	Domba	Sertila	yellow kernels		Kamjong, Dunmang		
25		Domba	White kernels, good yield white	1400	Tshedang, Kamjong,	Nangkor	Zemgang
	Domba	Kharti	kernels		Dunmang, Tsaiedang		
26		Dremtsepa					
	Ashom	ashom	Late maturity	1000	Shokshi	Gomdar	S. Jongkhar
27	Domba			1400-1600		Nangkor	Zemgang
		Companyo	Touly materiates madime haidht law		P.B. Dummer Tologon		
	unaza	Serpaguto/ Tsepaguto	Early maturity, medium neight, Iow yield, good tasle.		bun, Dunmang, Laleuang, Buli		
* 28	Ashom	Tecksumna		1020-2060	Sham, Changling, Budhur, Minii	Minii	Lhuntse
			Early maturity, small cobs, short	1200		Korpho	Traongsa
	Ashom	Teksumpa	plant height		Nimshong		
	Chaza		-	1500	-	Nangkor	Zemgang
	ma	Teksumpa	Small cobs, early maturity.		Ngakhar, Buli		
	Ashom	Tsígsumpa	Early variety	Ł	Zobel, Duwang	Zobel	P.Gatshel
				1650-2010	Bechamang, Barndir,	Bomdeling	T.Yangtse
	Ashom	Tsigsumpa			Fangteng, Ngalimang, Lamda, Womanang		
-		- J			Communication of the second		

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	Ashom	Tshigsumpa	Early maturity	860	Oloki	Kengkhar	Mongar
29			Big and long cobs, high yielding.	1400-1710		Korpho	Traongsa
	Ashom	Kharte	good taste, late maturity, white kernels		Nabjí, Kamjong, Dunmang, Tali		
30	-			•	Tshelingkhor, Gonpa Singma, Pangthang Daza,		-
	Ashom	Gangkhapa	Early maturity, good taste		Resnang	Zobel	P.Gatshel
31	Gayza	Gayza	Yellow seeds, 2/3 cobs/ plant		Lonikha	Doga	Paro
			Short plant height, white and small	1		Shaba	Paro
	Gayza	Gayza	grain		Dawakha		
	Gayza	Gayza	Small cobs, short plant height	Ł	Drugaydingkha	Shaba	Paro
	Gevza	Gevza	Taller than pop corn, yellow kernel, ood for making Sin	2150-2360	Sivav. limena. Somakha	Mewang	Thimphu
ŝ	201	Mato	A 12 8, 111111 101 100 9	1720	minimum (numeric) / (noro	Dogo Chalas	DATO
70		Gayza/	White seed, 2-3 cobs/plant, medium	10077		Luga, Shaba	1 41 1
		Gayza Jitsi	plant height, small seed like rat seed,		Tshongkha, Zhingkhana,		
	Gavza	so/Shechhu Gum	pop corn Shechhu Gum has 9 cobs / vlant		Gongri, Khamda, Dugay Dinokha, Somakha		
				2160		Mewang	Thimphu
	(	(	; - - - ;	2014	ċ	9	mindiana
	Geyza	Meto Gayza	Short variety, for making Sip	والمراجعة المحافة والمحافظ والمراكبة والمراجع والمحافظ والمحافظ والمحافة	Sigay	an andran an ann <del>a an a</del> ghanna mar a anna an an ann ann ann	
33	Ashom	Gonpali	Tall variety	1	Duwang	Zobel	P.Gatshel
33		Janapa				,	
	Ashom	ashom		1300	brumi	Gomdar	5. Jongkhar
35		Jangala					
	Jangala	Karpo		2113	Shongkhar	Membi	Lhuntshi
	Jangala	Jangala Serpo	Soft to eat, used for making Sip	2117	Yongra	Membi	Lhuntshí
36	Makai	Kali Makia		1050-1500	Tendu Tar, Dukpa Bindu	Tendu	Samtse
	Makai	Kalo Makai	Early maturity good taste	Ł	Khargoung	Doban	Sarpang
37	Ashom	Khalingpa		2182	Wooshorong	Bartsham	T, Gang

	Ashom	Tshigsumpa	Early maturity	860	Oloki	Kengkhar	Mongar
29			Big and long cobs, high yielding.	1400-1710		Korpho	Traongsa
	Ashom	Kharte	good taste, late maturity, white kernels		Nabji, Kamjong, Dunmang, Tali		
30					Tshelingkhor, Gonpa Singma, Pangthang Daza,		
	Ashom	Gangkhapa	Early maturity, good taste		Resnang	Zobel	P.Gatshel
31	Gayza	Cayza	Yellow seeds, 2/3 cobs/ plant		Lonikha	Doga	Paro
	Gayza	Gayza	Short plant height, white and small grain	L	Dawakha	Shaba	Paro
	Gayza	Gayza	Small cobs, short plant height	Ł	Drugaydingkha	Shaba	Paro
	Geyza	Geyza	Taller than pop corn, yellow kernel, good for making Sip	2150-2360	Sigay, Jimena, Somakha	Mewang	Thimphu
32		Meto		2230	- - - - -	Doga, Shaba	Раго
	Gayza	oayza/ Gayza Jitsi so/Shechhu Gum	White seed, 2-3 cobs/ plant, medium plant height, small seed like rat seed, pop corn Shechhu Gum has 9 cobs /plant		Tshongkha, Zhingkhana, Gongri, Khamda, Dugay Dingkha, Somakha		
				2160		Mewang	Thimphu
	Geyza	Meto Gayza	Short variety, for making Sip		Sigay		
33	Ashom	Gonpali	Tall variety	1	Duwang	Zobel	P.Gatshel
34	Ashom	Janapa ashom		1300	Brumi	Gomdar	S. Jongkhar
35	Jangala	Jangala Karpo		2113	Shongkhar	Membi	Lhuntshi
	Jangala	Jangala Serpo	Soft to eat, used for making Sip	2117	Yongra	Membi	Lhuntshi
36	Makai	Kali Makia		1050-1500	Tendu Tar, Dukpa Bindu	Tendu	Samtse
	Makai	Kalo Makai	Early maturity good taste	Ł	Khargoung	Doban	Sarpang
37	Ashom	Khalingpa		2182	Wooshorong	Bartsham	T, Gang

38		Kharpa					
	Ashom	Ashom		1450	Khoyar	Gomdar	S. Jongkhar
39		Kokti					
	Ashom	Ashom		1689	Langten	Radhi	T. Gang
40		Lauripa					
	Ashom	Ashom		ı	Betseling	Lauri	S. Jongkhar
41				1	Pangthang Daza, Gonpa		
*	Ashom	Lani Sampa	Early maturity		Singma	Zobel	P.Gatshel
42	Ashom	Local		-	Ngalimang	Bomdeling	T.Gang
				2670	Dekiling, Jakar Lakhang,	Chokhor,	Bunthang
	Asham	Local	Long and large cobs with yellow seeds		Gongkhar, Goling, Tashiling		
			Average yield, tolerant to diseases,	2600-2800	Sakarmet, Famrong,	Tang	Bumthang
	Asham	Local	early maturity		Bepsur, Kunzangdrak		
	Ashom	Local	Good taste, low yield.	1350	Korphu	Korpho	Traongsa
			3-4cobs/plant, big cobs, tall plant			Shaba	Paro
	Gayza	Local	height		Drugaydingkha		
43	Domba	Local Zhenti	Tall plant height	-	Tshedang	Nangkor	Trongsa
44	Ashom	Ma Ashom		1560	Leshigang	Minji	Lhuntse
46	Makai	Makai	Medium plant height	006-009	Bihitar, Ahalay	Bhalujora	Chukha
	Makai	Makai	Tall plant height	420	Laring	Hillay	Sarpang
				1593		Mendelgang	Tsirang
	Makai	Makai	Dry land cultivation, high yield		Riserboo A		
47	Ashom	Mangdipa		1720	Bechamang, Lamda, Fanetene	Bomdeling	T.Gang
48	Ashom	Mepala		1500	Denchi	Gomdar	S. Jongkhar
49	Ashom	Monpa	White variety, Latc maturity	1	Resnang, Tshelingkhor	Zobel	P.Gatshel
50	Ashom	Murchupa		1450	khoyar	Gomdar	S. Jongkhar
51	Ashom	Narphungpa	Late maturity		Pangthang Daza	Zobel	<b>P.Gatshel</b>
52	Ashom	Ningpa		1	Bumtangshing	Gangzur	Lhuntshi

53				k	Zobel, Duwang, Banang Tshing, Gonpa Singma,		
	Ashom	Ozorongpa	High yielding		bremiung, wangatai, Ngangmalang	Zobel	P.Gatshel
54	Makai	Pachautay		1130	Katikay	Semjong	Tsirang
55	Ashom	Pakaling			Menji Woong	Serthig	S. Jongkhar
56				L	Maugaon, Torkey, Bite	Doban	Sarpang
*					Khola, Maukhola,		) -
			Yellow kernels, early maturing and		Khargoung, Pathibora,		
	Makai	Paheli	medium plant height		Tar Khar		
			Yellow kernels, hetter vield, oood	1398-2635		Mendelgang	Tsirang
	Makai	Pahali	storage life		Riserboo A, Samshingadin		
	-		Tall variety, yellow kernels, good	300-1490	Muga, Kuwa Pani, Hilley,	Hillay	Sarpang
	Makai	Paheli	vield, sweet taste.		Hariyo Muga		
				006		Bhalujora	Chukha
	Makai	Pahali	Yellow kernel, tall plant height		Bihitar		
			Yellow kernels, early maturing and	1500		Puntenchu	Tsirang
	Makai	Paheli	medium height		Changey, Dhanshiri		
				950-1500	Tendu Tar, Khendong,	Tendu	Samtse
		:	Tall plant height, yellowkernels, hard		Dukpa Bindu, Katchin,		
	Makai	Paheli	to eat, early maturity		Jumsa, Pakpay, Bokbokay		
57		Patshikap	Medium height, 2 cobs/plant, yellow			Doga	Paro
	Geyza	Geyza	seed		Khamda, Tshongkha		
58	Ashom	Pema Koepa		I	Ney PemaCheling	Gangzur	Lhuntshi
59	Asham	Perna Kota		1300	Dingor	Saling	Mongar
60		Pema		1580-1680			
	A choice	Lingpa	1 T		Amburdin Dudhu	A.5	T have too
	VPIRALI	VINITIA	now yiciu		MINUTARISCHA, DUUDUL	TITTEN	ריומווואה
	Pemali					Chokhor	Bumthang
	ngpa	Pemalingpa	Small cobs and small grains.		Jalkhar		
61	Ashom	Phophar	Popcorn		Duwang	Zobel	<b>P.Gatshel</b>

62	Asham	Raba Tsalu			Khochuphay	Yurung	P. Gatshel
63	Makai	Raja makai		1450	Reserphu A	Mendelgang	Tsirang
64				1200-1990	Budhur, Ambrangchu,		
	Ashom	Rala Ashom	Early maturity, winter maize		Dragong, Jalang	Minji	Lhuntse
	Ashom	Rala Ashom	Short variety	1400	Nanari	Kengkhar	Mongar
	Ashom	Rala Ashom	Low altitude variety		Shinchongrí	Kengkhar	Mongar
	Ashom	Rala Ashom	Winter maize	1420	Zalam Woong	Orong	S.Jongkhar
65	Asham	Romangpa		1840	Pasang Borang	Yangnyer	T, Gang
99	Asham	Rongthungp a			Reserphu A	Mendelgang	Tsirang
67	Ashom	Samchelingp a			Yongrazor	Chaskar	Mongar
68		Sanu		1250		Mendelgang	Tsirang
		Makai/Sathr					
	Makai	iya	Early maturity		Samshingadin		
*	Makai	Seti/Sheti	White kernels, tall variety, matures in 60 days, high yield, good storage life	1356-1580	Samshingadin, Tashipang, Riserboo A	Mendelgang	Tsirang
	Makai	Seti	White kernels, good taste, tall variety, high yield,	1100-1500	Thulo Maylay, Dhanshiri, Phalayday, Changey, Sano Maylay, Burichu	Puntenchu	Tsirang
	Makai	Seti Makai	Small grains, good yield, early maturity, white kernel, tall variety	600-1200	Gurung Dara, Ahalay, Bihitar, Pekashey,	Bhalujora	Chukha
				870-1500	Tendu Tar, Bokbokay .Katachin, lumsa.	Tendu	Samtse
					Pakpang, Kuchin Tar,		
	Makai	Seti Makai	Medium plant height, white kernels, good taste		Khendong, Dukpa Bindu, Pakpay, Okhor Botay		
	Makai	Seto Makai	Tall variety, good taste, small cobs	330-	Noon Pani, Laring, Kuwa Pani	Hillay	Sarpang

			Hísh vieldíne, big cobs. good taste.		Pangkhey, Gungseng, Pathibhora, Tir Khola, Mongar goung, Fedi, Beech Khola, Gungring, Khargoung, Rani, Ramitey, Torkey, Maukhola. Bite khola.	Dobarn	Sarpang
	Makai	Seti Makai	early maturity, white kernel		Maugaon		
70	Ashom	Serthigpa		k	Denphu	Serthig	S. Jongkhar
71	Gayza	Talop Gayza	Short cobs, 2-3 cobs/plant,	. 1	Dawakha, Tshongkha Gongri	Doga Shaba	Paro
72	Ashom	Tekharpo		2003	Chungkhar Mapyu	Yurung	P. Gatshel
73 *	Chakh or	Temchila			Pema Cheling	Gangzur	Lhuntshi
74	Asham	Themangp a		1713	Chokpa	Ngatshang	Mongar
75 *	Ashom	Tholongpa		1814	Phongmilem	Phongmi	T. Gang
76	Ashom	Thon Asham		1440	Thungo	Yurung	P. Gatshel
22	Asham	Thumuli		1288	Bangmari	Thangrong	Mongar
82 *	Ashom	Warong Asham		1905	Kilikhar Khashi	Mongar	Mongar
*	Ashom	Woolingpa	Short plant height, carly maturity, good yield	1300-1450	Manchang, Bcclam, Durtshen, Metsheshing	Orong	S.Jongkhar
80	Gayza	Yangzom	Short plant height, early maturity	2260	Jimena	Mewang	Thimphu
81		Zerpo		1000-1750	Pheluma, Metsheshing, Mandar, Wooling, Tersheri, Manchang,	Orong	S.Jongkhar
*	Asition in the second		Early maturely		MERCHITT' Neg at BUILES		

indicates germplasm samples in Gene Bank.

Annex 3: Diversity of Finger millet

	Local	TV/Land				(	:
	name	race	Characteristics	Alt (m)	Village	Gewog	Dzongkhag
-	Kodo	Atta Kodo		603	Lumbay	Dorokha	Samtse
5	Kodo	Barkhay Kodo		1608	Satakha	Dorokha	Samtse
3*	Kodo	Baganey/ Bangarey	High yielding, compact panicle.	365-645	Noon Pani, Laring	Hillay	Sarpang
4	Kkodo	Bhagam	Moderate yield, small panicle susceptible to pest and diseases.	320	Kuwapani	Hillay	Sarpang
2	Kodo	Chendurey		1221	Maney	Dorokha	Samtse
9	Kodo	Dolay Kodo	Compact head	870-1500	Dukpa Bindu, Jumsa, Bokbokay	Tendu	Samtse
4	Thray	Gunamo Thray	Open Head, Early Maturity	1636	Dromashong	Membi	Lhuntshi
8		Fanorav	Bio orains and easy threshing, early	1050-1500	Tendu Tar, Khendong, Katchin, Dukna Bindu		
	Kodo	Kodo	maturity, good yield, open head		Pakpay	Tendu	Samtse
0	Kodo	Fangray		900-2020	Bihitar, Pangliho	Bhalujora	Chukha
•6	Kodo	Jhamkey	Open panicles good yield, early maturity	1	Pangkhey	Doban	Sarpang
10	Kodo	Jhungay Kodo	Loose heads, red seedsand short plant height, open head	k	Tir Khola, Maukhola, Fedi	Doban	Sarpang
11*	1	Kali/Kalo	Compact head, late maturity, easy	2	Khargoung, Pathibhora, Maugaon, Noon Pani,		
	Kodo	Kodo	threshing, black seeds, good yield		Khargoung	Doban	Sarpang
	Kodo	Kali/Kalo kodo	Black seeds, cood for making ara	690-1040	Mitoa, Noon Pani	Hillav	Sarnano
0	Kodo	Kali Kodo	Small and black seeds, compact head, tall plant height, high yielding	006-009	Bihitar, Ahalay	Bhalujora	Chukha

				870-1500	Tendu Tar, Khendong,		
			Early maturity, black seeds medium		Dukpa Bindu, Pakpay,		
	Kodo	Kalo Kodo	plant height, good taste		Kuchin Tar	Tendu	Samtse
12	Kodo	Katekey	Open panicle, black seed	300-730	Hilley	Hillay	Sarpang
	Kodo	Katekay	Closed panicle	1		Doban	Sarpang
13				1580-2100	Bechamang, Bamdir,	- - - - - - -	
					Fangteng, Tsaling, Noalimano Tamda		
	Thraye	Khosomo	Early maturity , good yield		Pangliho	Bomdelong	T. Yangtse
14	Khrae	Khrae		1757	Chorten Kora	Bomdeling	T. Yangtse
15*	2	Kongpu		č		Langchen	
	Kongpu	Balingmi		334	Jampani	l'hu	S. Jongkhar
16	Kongpu	Kongpu Changlu		600	Phadey	Pema Thang	S. Jongkhar
17*	Kodo	Lurkay Kodo		1307	Lower Saurani	Darla	Chukha
18			Big head, compact finger, hard to		Gungseng, Pangkhey,		
		Mangshirey	thresh, good for brewing, reddish		Khargoung, Beech Khola,		
	Kodo	Kodo	seeds		Gungring, Ramitey	Doban	Sarpang
		Mangshirey / Mungsara		1500			
	Kodo	y č	Red seeds, coloured seeds, good taste		Dukpa Bindu	Tendu	Samtse
	Kodo	Mangshirey	Closed panicles, late maturity	351	Kuwapani	Hillay	Sarpang
19	Kodo	Mungseray Kodo Seto	Good taste	950	lumsa	Tendu	Santse
	Kodo	Mangshiray Vada		1500	Bitch Can	Downlahe	Comboo
ł	INORG	NOUD		1700	חוורדו כמסדו	L'ULUNIIA	Califica
50*	Memja	Memja	Compact head, Medium height	,	Dawakha, Tshongkha	Doga	Paro
21*	Chool I	Munchan	Closed panicle and good eating	ŀ	Bish Vhals Titholo	Dahan	0,00000
	NULU	INIULINAY	duality, uath trowit seeus		DICH NIGIA, LIENFOIA	DUDIAII	Satparig
	с Po A	we danika	Compact head, Medium plant height, late maturity, good world	900	Ribitor	Rholiniors	Chubba
	VOUU	WELLKAY	Tate manuruy, goon yiero		DIRITAL	Driatujora	CIULIN

		Murkay	Sinall black grains, compact head,	870-1120	Tendu Tar Kuchin Tar		
	Kodo	Kalo Kodo	good yield		Pakpay	Tendu	Samtse
8	Thray	Mathray		1636	Dromashong	Membi	Lhuntshi
33		Murkay				Langchen	
	Kodo	Kodo		229	Lower Golanti	Phu	S. Jongkhar
24	Thray	Ngathray	Early maturity	1580-2040	Sham, Ambrangchu	Menji	Lhuntsi
25		Paheli		940-1030			
	Kodo	Kodo	Compact head, yellow seeds		Muga	Hillay	Sarpang
26			High yielding, carly maturity, red	1671-1941	Gangkhardung, Fangteng,		
	Thray	Prangpo	seeds		Ngalimang	Bondelong	T. Yangtse
27*			Closed heads, medium yield, high	460			
	Kodo	Rato kodo	yield good taste		Laring	Hillay	Sarpang
28*			Big grains and tastes better than Kalo	950-1050			
		Seto/Sheta	kodo, medium plant height, white				
	Kodo	y Kodo	grains		Tendu Tar, Jumsa, Pakpay	Tendu	Samtse
			Tall variety, white seeds, compact	330-465			
	Kodo	Seto kodo	head		Laring, Kuwapani	Hillay	Sarpang
	Kodo	Sheto kodo	White colour, compact panicle	ľ	Maugaon	Doban	Sarpang
			White seeds, compact head, medium	950-1500	Tendu Tar, Dukpa Bindu,		
	Kodo	Sheto Kodo	plant height, good taste		Jumsa, Okhor Botay	Tendu	Samtse
29*		Sibsoo		350			
	Kodo	Bhagani	Open panicles, early maturity		Kuwapani	Hillay	Sarpang
8		Thackray	Open head, red seeds, early maturity,	600-900			
	Kodo	Kodo	medium plant height		Bihitar, Ahalay	Bhalujora	Chukha
31*	Kodo	Thangrey	Open head, dark brown small seeds		Dara gaon	Doban	Sarpang
32	Thray	Thray Local	High yielding	1650	Fangteng, Tsaling	Bomdelong	T. Yangtse
g		Yangtsepa		2041			
	Thray	Thray			Sham	Menji	Lhuntsi
34		Ngaza					
	Thray	Thray		,	Chesa	Gangzur	Lhuntshi
35	;	Pahelo			1	1	1
	Kodo	Kodo		991	Thulo Dumtoe	Dumtoc	Samtse
Kodo		Kongpu					
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Tsirang		S. Jongkhar					
Semjong		Serthig					
Daragaun		Monmola					
1130		0					
Pangdur	Sharpa	Kongpu					
Kodo		Kongpu					
36	37						

\* indicates germplasm samples in the Gene Bank.

Annex 4: Diversity of Foxtail millet

SI.	Local		Charactericity of	A 14 /)	~~~11E/X	لاستعمد	U <sub>zo</sub>
011	crop		CIIBIBULE			20000	
	Tshag	Agtshag	Nill	875	Wangchuk	Dorokha	Samtse
2	Yangra	Apchi Yangra		1000	Shokshi	Gomdar	S. Jongkhar
3*	Yangra	Bagi Yangra		1500	Denchi	Gomdar	S. Jongkhar
4	Ran	Bangala Run	Red variety	2040	Sham	Menji	Lhuntsi
ъ	Yangra	Bepu Yangra		1002-1203	Batshong, Mandar, Redungmey	Orong	S. Jongkhar
9	Ran	Cha Run	Black variety	2040	Sham	Menji	Lhuntsi
~	Yaneru	Champang Yan <i>o</i> ru		1	Barka Lanonano	Serthiø	S. Ionøkhar
8*	Yangra	Chema Yangra	Good taste	1	Zobel, Ngamalang	Zobel	P.Gatshel
	Yangra	Chema Yangra		1582	Morong	Orong	S.Jongkhar
	Yangra	Chema Yangra		1820	Darjeeling	Yangneer	T.Gang
	Yangra	Crab		1404	Manchang	Orong	S. Jongkhar
6		Dagor Tsalu/		1103-1203			
	Yanora	Dagor Yangra Tshalu			Mandar Woolino	Orono	S Ionokhar
10	Yangra	Dagor Yangra	White grains	1204	Wooling	Orong	S. Jongkhar
11		Dani shampi/		1200-1600	Tersheri, Manchang, Pheluma,		
*	Yangra	Yangra			Metsheshing, Morong	Orong	S. Jongkhar
12	Yangra	Desa Yangra		1201	Tersheri	Orong	S. Jongkhar
13		Duksumpu		1101-1204			
	Yangra	Yangra			Wooling, Mandar	Orong	S. Jongkhar
14 *							S. Jongkhar
,	Yangra	Drukjay Yangra		0/0	kakpa Dung	Martshala	
* 15	Yangra	Dujaymo Yangra		1450	Khoyar	Gomdar	S. Jongkhar

### PLANT GENETIC RESOURCES OF BHUTAN

	Thimphu	Tsirang	S. Jongkhar	Paro	S. Jongkhar	S. Jongkhar		S. Jongkhar		S. Jongkhar		T.Gang			Zemgang		S. Jongkhar	S. Jongkhar		S. Jongkhar			S. Jongkhar		T.Gang	S. Jongkhar		S. Jongkhar	S. Jongkhar
	Mewang	Mendelgang	Orong	Doga	Orong	Orong		Orong		Gomdar		Yangneer			Nangkor		Orong	Orong		Orong			Orong		Yangneer	Gomdar		Orong	Martshala
	Somakha	Penna Shong	Tersheri, Wooling	Khorlam Tag	Wooling, Batshong	Beelam	Manchang Redungmey, Tersheri,	Beelam		Denchi	Demkhar , Durung Tektekpa	Changjay, Bainang, Changjay , Dalithanzma, Darieeling			Dunmang		Batshong, Wooling, Morong	Pheluma		Tersheri, Pheluma	Tersheri, Batshong, Metsheshing	Wooling, Mandar, Manchang,	Redungmey			Khoyar		Pheluma	Martshala
2230		1050	1203	2620	1205	1302	1201-1400			1500	1660-2140			·		1201-1583		1750	1202-1600		1000-1301			1820		1450	1600		854
Tall height,	drooping head						-			Early maturity				Early maturity and tolerant.to	pests	-													Difficult to thresh
	Jili Jum	Kaguni	Khang Yangra	Khey	Khosoktang	Khotsha Yangra		Khuchanglu	Lanisampa	Yangr		Yangra	-0		Ran	Nangkorpa	Yangra	Nera Yangra	Pusoktang	Yangra		Rongshong	Yangra	Rongshung/Bus	hung.	Shorpo Yangra	Shumarpa	Yangra	Topo Yangra
	Jili Jum	Kaguni	Yangra	Khey	Yangra	Yangra		Yangra		Yangra		Yanera	0		Ran		Yangra	Yangra		Yangra	2		Yangra		Yangra	Yangra		Yangra	Yangra
16		17	18	19	20	21	33		ង		24					25		26	27		38	*				29	30		31

-	0	_						
	32	Yangra	Yangra Balingmi			Patpari	Mongar	Mongar
	33	Yangra	Yangra Changlu		1301-1403	Manchang, Beelam	Orong	S. Jongkhar
	34		Yangra	-	1600			
n		Yangra	Chenumey			Pheluma	Orong	S. Jongkhar
TAN	35	Yangra	Yangra Desa		•	Menchiri	Orong	S. Jongkhar
	36		-		1202	Batshong, Wooling, Mandar, Morong,	-	
2177		Yangra	Yangra Serbu	Early maturity		Redungmey	Orong	S. Jongkhar
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\* indicates germplasm samples in the Gene Bank.

SI	Local						
No	name of	TV/Land	Characteristics	Alltitude	Village	Geog	Dzongkhag
	crop	race					
1	Chera	Chera		1520	Phurangshing Gonpa	Yurung	P. Gatshel
					Denchi, Yalang, Nangkor, Maan,		
	Chera	Chera		980-1060	Gamong, Gamong, Shali	Shumar	P. Gatshel
2	Chera	Chera Tsalu		1340	Chongshing	Chongshing	P. Gatshel
	Chera	Chera Tsalu	Red variety	1450	Khoyar, Shokshi	Gomdar	S. Jongkhar
	Cher	Cher		I	Sezor, Lauri, Phajo Gonpa	Lauri	S. Jongkhar
	Chera	Chera		854	Martshala, Gorthongma, Kakpa Dung,	Martshala	S. Jongkhar
					Chenangri, Rikhay, Wooling, Pheluma,		S. Jongkhar
	Chera	Chera		773-1700	Bangtsho	Orong	
	Chera	Chera		2005	Pangthang	Yangnyer	T. Gang
Э		Chera					
	Chera	Balingbi	White variety	1000	Shokshi, Denchi	Gomdar	S. Jongkhar
4	Cham	Cham		2120	Bemjo	Tsento	Paro
	Cham	Cham		2520	Mendrel Gang	Doga	Paro
	Cham	Cham		1	Bama	Genye	Thimphu

Annex 5: Diversity of Common millet

## Annex 6. Diversity of Barley

SI.		Traditional					
ou	Local	variety	Characteristics	Alt (m)	Village	Gewog	Dzongk
	name	/Land race					hag.
	Na	Beygina	No awns, tall height and big grains	1	Gongri	Shaba	Paro
2				1360-1500		Nangkhor	Zemgan
	Bro	Bro	Presence of awns, tolerant to pest.		Buli, Dagpai		50
3*		Dukha				Mongar	Mongar
	Femong	Femong		1905			
4	Femong	Femong		I	Shinchongri, Romangla	Kengkhar	Mongar
5		Gudum	No awn, disease tolerant, awnless,	2160		Mewang	Thimph
	Na		medium height		Sigye, khasadrapchu, Jigmena		n
9	Na	Gayna	Early maturity	2580	Shellay	Rupaisa	Wandue
~			Awns on two opposite rows and no	2771-2941	Gumling, Kangrab, Shebrak,	Tang	Bumtha
			awns on the four centre rows, good		Nimalung, Khaeyar,		ng
	Nath	Janath	yielding		Tandingang, Ugyen Choling		
8		Jabu		1		Zobel	P.Gatsh
	Shophu	Shophu	Late maturity		Bananray		el
6		Jana		2280			Wangd
	Na	Chukum			Tangra	Dangchu	ue
10	Jawoo	Jaun	Lodging, tolerant to diseases	1490	Hariyo Muga	Hilley	Sarpang
	Jung	Jaun		1500	Dukpa Bindu	Tendu	Samtse
11		,		2830		Choekhor	Bumtha
	Nath	Kam Nath	Brownish and large grains		Dhur		ng
12				2630		Choekhor	Bumtha
	Nath	Kharti	Tall stem, more awns, white seeds		Jambay Lhakhang		ng
13*	Eomonic	Kar Eamon e		1135		Mastehona	Monon
	R TUININ	gitoitta.t		T±00		gitalicipgvi	IVIUIBAL
14*	Na	Na	Large spikes, medium plant height	2200-2820	Ingo, Hatam, Wangcha, Pharakha	Katsho	Haa

	Na	Na	Dark coloured grain	2581	Shellay	Rupaisa	Wandue
				2600-2940	Ugyen Choling, Dazoor, Pralang,	Tang	Bumtha
			Presence of awns, short plant heigh,		Famrong, Tendigang, Pansing,	>	ng
	Nath	Nath	large grains		Jook, Bepsur		
		- - - -	-	1650-2200	Tarphel, Fangteng, Fangteng,	Bondeling	T.
	Na	Na	Resistant to cold		Ngalimang, Pangliho, Bamdir		Yangtse
		Na	Presence of long awns, tall height,		Khamda, Zhingkhana, Bara,	Doga,	Paro
			drooping spike, high tillering		Gongri, Drugaydingkha,	Shaba	
	Na		1		Tshongkha, Dawakha, Khamda		
		Na	Presence of awn, medium height,	2135-2300	Jemina, Chaphu, Khasadrapchu,	Mewang	Thimph
			drooping spike, good vield, red		Somakha, Sigay, Khasadrapchu,	1	n
	Na		grains		Jigmena		
			Easy to dehusk, good brewing	1790		Kabji	Punakh
	Na	Na	quality		Atakha (Petari)		a
	Femong	Na	Early maturing	1980-2140	Bainang, Dalifhangma	Yangner	T.Gang
	Na	Na		2940	Katsho Goenpa	Katsho	Haa
				2250		Kazi	Wangd
	Na	Na			Goensakha		ue
	Bja	Na		2010	Jala	Rupaisa	Wandue
15				2580-2850	Ngalakhang, Nangsephel,	Choekhor	Bumtha
					Samthang, Dhur, Lusbi, Wangdi		gu
			Tall plant height with large spikes		Choling, Dekiling, Tamshing,		
			which is difficult to attack by wild		Jakar, Chamkhar, Kharsa,		
	Nath	Nath (awns)	animals, good yield and resistant to disease and pest		Goling, Tekorshong, Dojebee, Pangri, Thangbi , Dodung		
16		Nath	-	2510		Choekhor	Buntha
	Nath	(awnless)	No awns, medium plant height.		Damphel, Changwa		ng
17		Na					Wangd
	Na	Gurdum		2280	Tangra	Dangchu	ue
18		Naa		2100		Gaselo	Wangd
	Naa	Henchum			Hesokha	Tshogwom	ue -

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19	;			0		Mendelgan	-
	Na Kar	Na Kar		0111	Mendelgang	50	Tsuang
20							
	Nas	Nas		1825	Kinga Rabten	Drakteng	Trongsa
21	-		Good yield, tall height, long awn,	2780-2880	-	Choekhor	Bumtha
			easy to thrash, tolerant to pest and				gu
	Nath	Ma Nath	diseases, less attack by wild boar		Dhur, Kenchosum, Tashiling		
5				2870		Choekhor	Bumtha
	Nath	Nath Naap	Frost tolerant		Changwa, Dhur		ng
23	1		Green plant, black seed, short plant,	1		Choekhor	Bumtha
	Nath	Noenti	less awns		Jambay Lhakhang		ng
24			Good yield, absence of awn and tall	2870		Choekhor	Bumtha
	Nath	Poktola	plant height.		Dhur, Kenchosum		ng
25			Curly and less awns/hooded, high	2600-2942	Shebrak, Sakarmet, Nimalung,	Tang	Bumtha
			yielding, grains are not arranged in		Famrong, Khaeyar, Nangnang,		яц
	Nath	Prokto	rows/lines		Tandingang		
26				2770-2940	Khaeyar, Gumling, Shebrak,	Tang	Bumtha
		Pranath/Ra			Dazoor, Nimalung, Ugyen		Bu
	Nath	nath			Choling, Nangnang, Tandingang		
27							Wangd
	Nay	Sha Nay		2650	Tashi Dingkha	Dangchu	ue
28*	Shophu	Shophu/ Kar shophu		ı	Resnang, Ngangmalang, Zobel, Bananray	Zobel	P.Gatsh el
				1580-1750		Orong	Š
							Jongkha
	Shoìphu	Shophu			Morong, Pheluma		r
29			Awnless , tall, early maturity, ,low	1400		Nangkhor	Zemgan
	Bro	Tongola	yield		Dunmang		ы С
30*	Thongle					Mendelgan	
	Y	Thonglay		1450	Reserphu B	ыс	Tsirang
31							S.
	5	Zhung			Dhain Conno	;	Jongkha "
	remong	remong			rado Gonpa	PAULI	ľ

32*     Femung     Zu Femung     P.       * Indicates germplasm samples in the Gene Bank.     1500     Khochiphai     Dungmin     Ratshel		-		
32*     Femung     Zu Femung     Dungmin       * Indicates germplasm samples in the Gene Bank.	P. Gatshel			
32*     Eemung     Zu Femung     Khochiphai       * Indicates germplasm samples in the Gene Bank.     1500     Khochiphai	Dungmin	: : : : : :		
32*     Femung     Zu Femung     1500       * Indicates germplasm samples in the Gene Bank.	Khochiphai			
<ul> <li>32* Femung Zu Femung</li> <li>* Indicates germplasm samples in the Gene Bank.</li> </ul>	1500			
32* Femung Zu Femung * Indicates germplasm sa		mples in the Gene Bank.		
32* Femung * Indicates ge	Zu Femung	rmplasm sai		
32* * In	Femung	dicates gei		
	32*	* In		

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## Annex 7: Diversity of Wheat

Sl. no	Local name	TV/Land race	Characteristics	Alt (m)	Village	Gewog	Dzo.
1	Ka	Bjoma	Tall plant height, good taste, reddish and bold grains, good yield, les awn	1905-2170	Kazhi, Komathang	Kazhi	Wangdue
			Tall plant height, seeds	1980-2440	Kazhi Susa, Lumche, Lumche, Channa Tahanal kana, Chaning		
		Bjhoma/ Ka	maturity, good yield, short		Cuegua Isuangkuana, Cuegua, Ruphakha, Goensakha, Bel, Jele		
	Ka	Bjoma	awns, easy to thresh,		Goenpa, Jele	Kazhi	Wangdue
		Bjaka		2160-2340			
	ł	Maap/Local			:		-
	Ka	Maap			Jimena	Mewang	I himphu
7	Ka	Bjhoka	Whitish seeds	2200-2440	Bel, Rephakha	Kazhi	Wangdue
	Ka	Bjokam		1	Dugay Dingkha	Shaba	Paro
	Ka	Bjaka kaap		2160-2340	Jimena	Mewang	Thimphu
3	Ka	Bjonam		1	Bara, Gongri, Zhingkhana	Shaba	Paro
4				2200-2940	Ingo, Hatam, Bali, Wangcha, Katsho		
			High yielding, late		Goenpa, Mome choko, Lukha,		
	Ka	Boe Ka	maturity		Pharakha	Kazhi	Wangdue
5*	Bong	Bong		1490-1800	Darjeeling, Durung Ngambeenang	Yangneer	T.Gang
9	Dho	Dho		1020-1680	Budhur	Minji	Lhuntse
			Tall plant height, more	2200-2800			
			straw for cattle, long and				
	Ka	Dube Ka	narrow grains		Ingo, Lukha, Wangcha	Katsho	Haa
7*	Gawn	Gaun	Tall plant height	870	Pakpay	Tendu	Samtse
			Medium plant height, big	006-009			
	Gawn	Gaun	grains		Bihitar, Ahalay	Bhalujora	Chukha
8			Awnless, small grains,	1540-1700			
	Goo	Goo	good taste		Buli	Nangkor	Zemgang

					Bumthang		Bumthang	Thimphu	Paro	Haa	Haa	Wangdue	Thimphu		Thimphu	Wangdue			Paro	T.Yangtse				Bumthang			Samtse
					Choekhor		Tang	Mewang	Doga	Katsho	Katsho	Sephu	Mewang		Mewang	Rupaisa			Doga	Bomdeling				Choekhor			Tendu
	Ngalakhang, Pangri, Dawathang, Kharsa, Ugyen Choling, Nangnang,	Tashiling, Tandingang, Dhur,	Zhajithang, Nangsephel ,Tendigang,	Dodung, Khaeyar, Kunzangdrak,	Kangrab, Dazoor, Pansing, Sakarmet	Famrong, Ugyen Choling, Nimalung,	Pralang,	Sigay, Jimena	Tshongkha	Hatam, Bali, Mome choko, Pharakha	Ingo	Busa	Jimena	Chaphu, Khasadrapchu, Jimena,	Sigay	Japhu		, Tshongkha, Lomikha, Dawakha,	Khamda	Ngalimang, Pangliho	Chamkhar, Tamshing, Jakar,	Gongkhar, Kharsa, Goling, Thangbi,	Damphel, Samthang, Chamkhar,	Changwa			Dukpa Bindu
2700-2940						2600-2820		2160-2300		2100-2820	2200	2750	2260	2135-2350		1680	1			1780	2510-2720				1500		
Optimum height, easy for harvest and thrashing,	short awns, grains arranged in rows/lines,	droops at maturity, small	grains, high yielding,	tolerant to insects, presence	of awns on two sides	Presence of short awns,	reddish grain		Good yield, no awn	· · · ·	Tall variety	nill					Long awn, tall height small grain, late maturity Small	grains, tall height, good	taste		Tall plant height, awns	present, medium sized	grains, good taste and high	yielding	Small and blackish seed,	tall plant height, high	yielding, late maturity
					G00		Goo	Gudam	Gudum	Jabah Ka	Jangwab Ka	Ka Doma	Ka kaap		Ka Maap	Ka Maap			Ka/Jho	Ka				Ka			Kalo Gawn
					Goo		80	Ka	Ka	Ka	Ka	Ka	Ka		Ka	Ka			Ka	Ka				Ka			Gawn
								*6		10	11	12	13	14			15*								16		

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Kar         Presence of awns high         1400-1600         Taaling Buli, Durmang, Ngakhar         Nangkor         Zemgang           Kar         Taul and strong plants,         2100-2770         Tsaing Buli, Durmang, Ngakhar         Nangkor         Zemgang           Ka         Khotoeb Ka         maturity         2100-2770         Tsaing Buli, Durmang, Ngakhar         Nangkor         Zemgang           Goo         Khotoeb Ka         maturity         2100-2770         Ingo, Hatam, Bali, Mome choko,         Katsho         Haa           Goo         Komal         yielding         2830         Dhur         Choekhor         Bumthang           Goo         Krachain         Hairy panicles, Jess attack         2830         Dhur         Choekhor         Bumthang           Goo         Kradum         by wild animals         2700-2940         Katsho Gooenpa, Mome choko,         Katsho         Haa           Ka         Ka)         taste, santack         2830         Dhur         Choekhor         Bumthang           Goo         Kradum         by wild animals         2700-2940         Katsho Goonpe, Katho         Bumthang           Ka         Ka)         taste, santack         2830         Dhur         Choekhor         Bumthang           Ka	~	Kar	Kar	High yielding.	1400	Nimshong	Korphu	Trongsa
KarKar Tonglayield tolerant to pest and diseasesTaing, Buli, Dummang, NgakharNangkorZemgangKaKhoteeb KamaturityTall and strong plants , long panicles, early100-2770freque, Hatam, Bali, Mome choko, PhatakhaKatshoHaaGooKomalyielding2100-2770freque, Hatam, Bali, Mome choko, PhatakhaKatshoHaaGooKomalyielding2830DhurChoekhorBumthangGooKrachainheight and grains with awn2880DhurChoekhorBumthangGooKrachainhyielding2830DhurChoekhorBumthangGooKrachainbyield animals2830DhurChoekhorBumthangGooKradumby wild animals2700-2940Katsho Geenpa, Mome choko,KatshoHaaKaKa)taste.small grain, awn less2700-2940Katsho Geenpa, Mome choko,KatshoHaaKaKa)taste.small grain, awn less2700-2940Katsho Geenpa, Mome choko,KatshoHaaKaKa)taste.small grain, awn less2700-2940Katsho Geenpa, Mome choko,KatshoHaaKaKa)taste.small grain, awn less2700-2940KatshoBumthangKatshoHaaKaKa)taste.small grain, awn less2700-2940KatshoBumthangKatshoKatshoHaaKaKa)taste.small grain, awn less2700-2940KatshoHaaKatshoKatshoKats				Presence of awns high	1400-1600			
KarKar Tongladiseases.Tail and strong lants , org panicles, earlyTail and strong pants , ingo, Hatam, Bali, Mome choko,NangkorZemgangKaKhotoeb KamaturityIngo, Hatam, Bali, Mome choko, ingo, Hatam, Bali, Mome choko,KatshoHaaGooKomalyieldi, tall plant2830DhurChoekhorBumthangGooKomalyieldi, tall plant2880DhurChoekhorBumthangGooKrachainhoight and grains with awn2880DhurChoekhorBumthangGooKrachainhoight and grains with awn2830DhurChoekhorBumthangGooKradumWid animals2830DhurChoekhorBumthangKaKa)Hairy panicles, less attack2830DhurChoekhorBumthangKaKashBhirDhurChoekhorBumthangMome choko,KatshoKaKaKashDhurDhurChoekhorBumthangKaKaYueka200-2940Katsho Geenpa, Mome choko,KatshoHaaKaKaWhitish colour seed, Tall1300-1500Pharakha, Jali, HatamKatshoHaaKaYuekaMome seed, Tall1300-1500Dukpa Bindu, KatshinShabaParoKaYuekaMome chokuShabaShabaParoKarhoKarhoKaYuekaMome seed, Tall1300-1500Mome chokuKarhoHaaKaYuekaMome seed,				yield tolerant to pest and				
KaTall and strong plants, lorg panicles, early browe panicles, early browe panicles, early browe panicles, early browe panicles, early browe panicles, High2100-2770 PharakhaIndex, Mome choko, KatshoFatshoHaaGooKomalNo hairy panicles, High2830DhurChoekhorBumthangGooKomalGoo kradumGoo kradum2880DhurChoekhorBumthangGooKrachainheight and grains with awn by wild animals2880DhurChoekhorBumthangGooKrachainheight and grains with awn by wild animals2880DhurChoekhorBumthangGooKrachainheight and grains with awn by wild animals2880DhurChoekhorBumthangLocal (HabiHairy panicles, less attack2830DhurChoekhorBumthangKaKashKasho Goenpa, Mome choko,KatshoKatshoHaaKaKa)Sheto GawnBunthangSheto RadumShabaKaYuekaPharakha, Bali, HatamShabaPharakhaKaYuekaPharakha, Baliu, KathinTall Pharakha, Baliu, KathinShabaKaYuekaPharakha, Baliu, KathinShabaPharakeKaYuekaPharakha, Baliu, KathinShabaPharakeKaYuekaPharakha, Baliu, KathinShabaPharakeKaYuekaPharakha, Baliu, KathinShabaPharakeKaYuekaPharakha, Baliu, KathinShabaPharak		Kar	Kar Tongla	diseases.		Tsaing, Buli, Dunmang, Ngakhar	Nangkor	Zemgang
KaKhotoeb KaIong panicles, earlyIngo, Hatam, Bali, Mome choko,KatshoHaaGooKomalNo hairy panicles, High2830DhurChoekhorBumthangGooKomalyielding2880DhurChoekhorBumthangGooKrachainHairy panicles, Iss attack2830DhurChoekhorBumthangGooKradumHairy panicles, less attack2830DhurChoekhorBumthangGooKradumDhurZoo-2940Katsho Goenpa, Mome choko,KatshoChoekhorBumthangKaKa)Nhitish colour sed, Tall1300-1500Pharakha, Bali, HatamChoekhorHaaKaKaWhitish colour seed, Tall1300-1500Pharakha, Bali, HatamFanduSamtseKaYuekaProvinish seed colour2Dukpa Bindu, KatchinTenduSamtseKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmaPight yield, short awn and-FenchosuKarchosuKarchosuKarchosuKarYunangmaProvenish seed colour-FenchosuFanduShabaParoKarYunangmaProvenish bort-FenchosuFanduFanduParoKarYunangmaFandu-FanduParoKarYunangmaFandu-FanduParoKarYueka <td< td=""><td></td><td></td><td></td><td>Tall and strong plants ,</td><td>2100-2770</td><td></td><td></td><td></td></td<>				Tall and strong plants ,	2100-2770			
KaKhotoeb KamaturitymaturityGooKomalNo hairy panicles, High2830DhurKatshooHaaGooKomalyielding2830DhurChoekhorBumthangCooKrachainheight and grains with awn2880DhurChoekhorBumthangCooKradumheight and grains with awn2830DhurChoekhorBumthangCooKradumhywild animals2830DhurChoekhorBumthangCooKradumPy wild animals2700-2940Katsho Goenpa, Mome choko,HaaKaXa)Whitish colour seed, Tall1300-1500Pharakha, Bali, HatamKatshoHaaKaKa)Whitish colour seed, Tall1300-1500Pharakha, Bali, HatamKatshoHaaKaKaYuekaPharakha, Bali, HatamKatshoHaaKaKaYuekaPharakha, Sali, HatamKatshoHaaKaYuekaPharakha, Sali, HatamKatshoHaaKaYuekaPharakha, Sali, HatamKatshoHaaKaYuekaPharakha, Sali, HatamKatshoHaaKaYuekaPharakha, Sali, HatamKatshoHaaKaYuekaPharakha, Sali, KathinFenduSantseKaYuekaMueka-Tilli/Kesa, ZhingkhanaFaroKaYuekaManage by wild boarFenduParoKaYuekaMaage by wild boarFendu </td <td></td> <td></td> <td></td> <td>long panicles, early</td> <td></td> <td>Ingo, Hatam, Bali, Mome choko,</td> <td></td> <td></td>				long panicles, early		Ingo, Hatam, Bali, Mome choko,		
GooKomalNo hairy panicles, High2830DhurChoekhorBumthangGooKrachainyielding2880DhurChoekhorBumthangGooKrachainheight and grains with awn2880DhurChoekhorBumthangGooKrachainheight and grains with awn2880DhurChoekhorBumthangLoodKradumby wild animals2830DhurChoekhorBumthangKaKa)Local (Habi)Tall plant height, good2700-2940Katsho Goenpa, Mome choko,KatshoHaaKaKa)taste, small grain, awn less2700-2940Ratsho Goenpa, Mome choko,KatshoHaaKa)Local (Habi)Tall plant height, good2700-2940Ratsho Goenpa, Mome choko,KatshoHaaKa)Ka)Whitish colour seed, Tall1300-1500Pharakha, Bali, HatamKatshoArshoArshoKanWhitish colour seed, Tall1300-1500Pharakha, Bali, HatamTenduSamtseKanYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangma-Fendus-TenduBumthangParoKarYunangmaTilli/Kesa, ZhingkhanaShabaParo		Ka	Khotoeb Ka	maturity		Pharakha	Katsho	Haa
GooKomalyieldingDhurChoekhorBumthangGooKrachainGood yield, tall plant2880DhurChoekhorBumthangGooKrachainheight and grains with awn2880DhurChoekhorBumthangGooKradumby wild animals2830DhurChoekhorBumthangGooKradumby wild animals2830DhurChoekhorBumthangKaLocal (HabiTall plant height, good2700-2940Katsho Goenpa, Mome choko,ChoekhorBumthangKaKa)taste, small grain, awn less2700-2940Katsho Goenpa, Mome choko,HaaKaKa)taste, small grain, awn less1300-1500Pharakha, Bali, HatamKatshoHaaKaYuekaWhitish colour seed, Tall1300-1500Dukpa Bindu, KatchinTenduSamtseKaYuekaYuekaYuekaTenduShabaParoKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmaTenduShabaParoKenchosumChoekhorBumthang				No hairy panicles, High	2830			
GooKrachainGood yield, tall plant2880DhurChockhorBumthangGooKrachainheight and grains with awn2830DhurChockhorBumthangGooKradumby wild animals2830DhurChockhorBumthangGooKradumby wild animals2830DhurChockhorBumthangKaLocal (HabiTall plant height, good2700-2940Katsho Goenpa, Mome choko,KatshoHaaKaValtish colour seed, Tall1300-1500Pharakha, Bali, HatamKatshoHaaKaValtish colour seed, Tall1300-1500Dukpa Bindu, KathinTenduSamtseKaVuekablant height, good taste,Dukpa Bindu, KathinTenduSamtseKaYuekaMone chour-Tilli/Kesa, ZhingkhanaManParoKarYunangma-Tilli/Kesa, ZhingkhanaShabaParoKarYunangma-More damage by wild boarKenchosumKenchosumKarYunangmaKarYunangmaKarYunangmaKarYunangmaKarYunangmaKarYunangmaKarYunangma </td <td></td> <td>G00</td> <td>Komal</td> <td>vielding</td> <td></td> <td>Dhur</td> <td>Choekhor</td> <td>Bumthang</td>		G00	Komal	vielding		Dhur	Choekhor	Bumthang
GooKrachainheight and grains with awnDhurChockhorBumthangGooKradumHairy panicles, Jess attack2830DhurChockhorBumthangGooKradumby wild animals2830DhurChockhorBumthangLocal (HabiTall plant height, good2700-2940Katsho Goenpa, Mome choko,KatshoHaaKaKa)taste, small grain, awn less2700-2940Katsho Goenpa, Mome choko,HaaKaKa)whitish colour seed, Tall1300-1500Pharakha, Bali, HatamKatshoHaaKaYuekablant height, good taste,2700-2940Katsho KathinTenduSamteaKaYuekablant height, good taste,Dukpa Bindu, KathinTenduSamteaKaYuekathrownish seed colour-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmathree damage by wild boarKenchosumChoekhorBumthangKarYunangmathree damage by wild boarIlli/KesuMuthhangKarYunangmathree damage by wild boarIlli/Kesu-KarYunangmathree damage by wild boarKarthree damage by wild boarKarthree damage by wild boarKarthree damage by wild boar<				Good yield, tall plant	2880			
GooHairy panicles, less attack by wild animals2830DhurLocal (Habi by wild animalsHairy panicles, less attack Bumthang2830KaLocal (Habi Local (Habi Ka)Tall plant height, good taste, small grain, awn less2700-2940Katsho Goenpa, Mome choko, Pharakha, Bali, HatamKatshoHaaKaWhitish colour seed, Tall plant height, good taste, Kas1300-1500Pharakha, Bali, HatamKatshoHaaKaWhitish colour seed, Tall plant height, good taste, Kas1300-1500Dukpa Bindu, KatchinTenduSamseKaYuekaPueka-Tilli/Kesa, ZhingkhanaShabaParoKarWinangma-Tilli/Kesa, ZhingkhanaShabaParoKarYunangma-Tilli/Kesa, ZhingkhanaChoekhorBumthang		80 90	Krachain	height and grains with awn		Dhur	Chockhor	Bumthang
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KaLocal (HabiTall plant height, good2700-2940Katsho Goenpa, Mome choko,HaaKaKa)taste, small grain, awn less2700-2940Pharakha, Bali, HatamKatshoKaWhitish colour seed, Tali1300-1500Pharakha, Bali, HatamKatshoCawnSheto Gawnbrownish seed colourDukpa Bindu, KatchinTenduKaYuekaed colour-Tilli/Kesa, ZhingkhanaPanaKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaPanoKarYunangmamore damage by wild boar.+KenchosumChoekhorBunthang		G00	Kradum	by wild animals		Dhur	Choekhor	Bumthang
KaKa)taste, small grain, awn lessPharakha, Bali, HatamKatshoHaaKaWhitish colour seed, Tali1300-1500Dukpa Bindu, KatchinTenduSamtseGawnSheto Gawnbrownish seed colour-Dukpa Bindu, KatchinTenduSamtseKaYuekaPownish seed colour-Tilli/Kesa, ZhingkhanaShabaParoKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmamore damage by wild boarKenchosumChoekhorBunthang			Local (Habi	Tall plant height, good	2700-2940	Katsho Goenpa, Mome choko,		
MethodowWeight colour seed, Tall1300-15001300-15001300-15001300-1500CawnSheto Cawnbrant height, good taste,Dukpa Bindu, KatchinTenduSamtseKaYuekaPrownish seed colour-Tilli/Kesa, ZhingkhanaShabaParoKarYuekaHigh yield, short awn and-Tilli/Kesa, ZhingkhanaShabaParoKarYunangmamore damage by wild boarKenchosumChoekhorBunthang		Ka	Ka)	taste, small grain, awn less		Pharakha , Bali, Hatam	Katsho	Haa
Cawnplant height, good taste, brownish seed colourDukpa Bindu, KatchinTenduKaYueka-Tilli/Kesa, ZhingkhanaShabaKarYueka-Tilli/Kesa, ZhingkhanaParoKarYunangma-KenchosumChoekhorBunthang				Whitish colour seed, Tall	1300-1500			
Gawn     Sheto Gawn     brownish seed colour     Dukpa Bindu, Katchin     Tendu     Samtse       Ka     Yueka     -     Tilli/Kesa, Zhingkhana     Shaba     Paro       Ka     Yueka     -     Tilli/Kesa, Zhingkhana     Shaba     Paro       Kar     Yueka     -     Tilli/Kesa, Zhingkhana     Shaba     Paro       Kar     Yunangma     more damage by wild boar.     -     Kenchosum     Choekhor     Bumthang				plant height, good taste,				
<ul> <li>Ka Yueka Yueka - Tilli/Kesa, Zhingkhana Shaba Paro</li> <li>High yield, short awn and - Yenchosum Yunangma more damage by wild boar.</li> </ul>		Gawn	Sheto Gawn	brownish seed colour		Dukpa Bindu, Katchin	Tendu	Samtse
Kar         Yunangma         High yield, short awn and more damage by wild boar.         -         Kenchosum         Choekhor         Bumthang	*	Ka	Yueka		•	Tilli/Kesa, Zhingkhana	Shaba	Paro
Kar Yunangma more damage by wild boar. Kenchosum Choekhor Bumthang				High yield, short awn and	۲			
		Kar	Yunangma	more damage by wild boar.		Kenchosum	Choekhor	Bumthang

UCIIC D'AIIK. unucates germpiasm samples in the

SI.	Local	Traditional					
no	name of	variety	Characteristics	Alt (m)	Village	Gewog	Dzo.
	crop	/Land race					
<del>``</del> *	Brema	Brema		1800	Bargonpa, Shinchongri, Romangla	Kengkhar	Mongar
	F	F		,	Zobel, Banang Tshing Pangthang Daza,		
	Breino	Bremo			Bananray	Zobel	P.Gatshel
				1000-1750	Morong, Durtshen, Mandar, Tersheri,		
	Bremo	Bremo			Pheluma, Wooling, Beelam	Orong	S. Jongkhar
		Bremo		1650-1720			
	Bremo	Local			Bechamang, Fangteng	Bomdeling	T.Yangtse
5	t	Chakharpa		1		Ē	F
	Charay	/>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				lang	Bumthang
3	ţ	Ę	Tolerant to	2780	Khaeyar, Kunzangdrak, Dazoor, Pralang,	E	t
	Charay	Charay	disease		Famrong,	lang	Bumthang
				2600-2830	Sakarmet, Nimalung, Nangnang, Dazoor, Shebrak, Kunzangdrak, Gumling, Kangrab,		
					Pansing, Bepsur, Ugyen Choling, Pangri,		
			Good yield		Jambay Lhakhang, Chamkhar, Jalkhar		
			and good taste,		Tekorshong, Dhur, Wangdi Choling,		
			tolerant to		Tashiling, Dodung, Zhajithang, Dekiling,		
	Charai	Charay	disease		Jakar, Kharsa, Goling, Nasepel	Choekhor	Bumthang
	Charay	Charay	Average yield	1400	Kamjong, Dunmang, Tsaidang, Buli	Nangkor	Zemgang
ъ			High yield,	1			
			bitter taste, late				
			maturity, less				
		Charay Ser	damage by				
	Charay	nguel	wild boar		Kenchosum, Changwa	Choekhor	Bumthang
9			Sweet taste,	ı			
			white flour,				
		Charay	red stem, red				
	Charay	Zing	flower		Kenchosum	Choekhor	Bumthang

Annex 8: Diversity of Sweet buckwheat

			_				
			Sweet taste,	ŀ			
		Charay	early maturity,				
	Charay	Zungna	low yield		Changwa	Choekhor	Bumthang
8			Good keeping	2100-2940	Wangcha, Katsho Goenpa, Mome choko,		
	Garay	Garay	quality		Pharakha, Hatam, Ingo, Lukha	Katsho	Haa
	Garay	Garay		1690-2580	Jasakha, Shellay	Rupaisa	Wangdue
			Red stem,	1			
			white flower,				
			medium				
			height, brown				
		_	seed, more		Khamda, Zhingkhana, Tshongkha, Lomikha,		
	Garey	Garay	branching		Dawakha, Khamda	Doga	Paro
			Bigger seed	ı			
			compared to				
		_	bitter				
			buckwheat,				
	Gayray	Garey	early maturity		Tilli/Kesa, Bara, Zhingkhana,	Shaba	Paro
			Sweet taste,	2360			
			red flowering,				
			triangle				
	Gayray	Gayray	shaped seeds		Jimina, Khasadrapchu	Mewang	Thimphu
	Gayray	Gayray		2250	Jele	Kazhi	Wangdue
6	Gunchu	Gunchung		1960-2070			
	ng	/Bremo			Tektekpa, Shokang, Changjay	Yangneer	T.Gang
10	Jara	Jara		1680-2040	Sham, Budhur	Minji	Lhuntse
1]*			Red stem,	300-940			
		Methey	purple flower,				
	Phapar	Phapar	high yield		Hilley, Muga, Larey, Noon Pani	Hilley	Sarpang
	Methey	Methey	Medium plant	600-			
	Phapar	Phapar	height		Pekasay, Bihitar, Ahalay	Bhalujora	Chukha
			Sweet taste,	870-1500			
	Methey	Methey	big seeds, red		Tendu Tar, Jumsa, Khendong, Dukpa Bindu,		
	Phapar	Phapar	stem,		Katchin, Bokbokay, Pakpay, Kuchin Tar	Tendu	Samtse

		Sweet taste, -			
		red straw,			
		resistant to			
		pestand	Beech Khola, Pangkhey, Bitekhola,		
	Methey	disease, good	Maukhola, Gungseng, Khargoung, Mongar		
Phaper	Phaper	for making	goung, Pathivora, Maogaon, Ramitey	Doban	Sarpang
* Indicator of		anlos in the Cone Douls			

Indicates germplasm samples in the Gene Bank.

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SI.	Local	Traditiona					
no	name of crop	l variety /Land race	Characteristics	Alt (m)	Village	Gewog	Dzo.
<del>]</del> *	Bjo	Bjo	Resistant to pests	2100-2820	Wangcha, Katsho Goenpa, Mome choko, Pharakha, Hatam	Katsho	Haa
		,	Greenish stem, white flower,	1	Tshongkha, Lomikha, Dawakha,		
	Bjo	Bjo	bitter in taste, late maturity		Tshongkha, Khamda, Tshongkha	Doga	Paro
	Bjo	Bjo	Bitter taste, white flowers	2360	Jimina	Mewang	Thimphu
	Jow	Bjo			Bara, Tilli/Kesa, Zhingkhana	Shaba	Paro
	Bjo	Bjo Kagam	Less bitter taste, good yield, pyramid shaped seeds	1	Khamda	Doga	Paro
	Bjo	Bjo Naap	Bitter taste, oval shaped seeds	I	Khamda	Doga	Paro
2*				2550-2850	Changwa, Chamkhar, Norgang, Jakhar, Tekorshong, Dhur,		
					Nangsephel, Kharsa, Zhajithang,		
			Tall nlant heicht hitter taste		Samtnang, Jambay Lnaknang, Dhur, Tashilino, Doduno, Lushi		
			and high yielding, tolerant to		Nasepel, Goling, Wangdicholing,	Choekho	
	Bradhma	Bradhma	disease and pest		Thangbi ,Damphel	r	Bumthang
				2750-2940	Kunzangdrak, Kangrab,		
					Tandingang, Nangnang, Shebrak,		
			Bitter taste, small seeds, high		Gumling, Nimalung, Pralang,		
			yielding, early maturity, no pest		Ugyen Choling, Bepsur, Khaeyar,		
	Bradhma	Bradhma	and diseases		Jook, Famrong	Tang	Bumthang
			White flower, bitter taste, high	1360-1600	Ngakhar, Buli, Kikhar, Dagpai,		
			yielding, good storage life,		Tsaiedang, Dunmang, Kamjong,	Nangkho	
	Bradhma	Bradhma	medium yield, medium height.		Ngakhar	r	Zemgang
3*				1580-2060	Budhur, Sham, Ambrangchu,		
	Braw	Braw	Supplementary food		Jalang	Minji	Lhuntsi

	Khalu	Braw		1880-2140	Changjay, Dalifhangma, Tektekpa, Shokang, Bainang	Yangneer	T.Gang
4				2870		Choekao	
	Bradhma	Guentho	Good taste, Winter crop		Dhur	ĩ	Bumthang
	Bradhma	Guentho	Grains short with clear edges	2941	Tendigang	Tang	Bumthang
5		Haapa	High yielding compared to	2820			
	Bradhma	Bradhma	local, tolerant to disease		Dazoor, Pansing, Sakarmet	Tang	Bumthang
6	Bradhma	Jhar Korpa	Grains with no clear edge	2940	Tendigang	Tang	Bumthang
2		Khala					
	Khala	Changlu			Resinang	Shumar	P. Gatshel
*8				1600-2160	Kharthung, Bainang, Bainang,		
	Khala	Khala			Tektekpa, Kharthung	Yangneer	T.Gang
		Khalu/Kha		1660-1920	Changjay, Bananray , Darjeeling,		- - - - -
	Khalu	la			Demkhar , Kharthung, Darjeeling	Yangneer	T.Gang
				1850-2200	Pangliho, Tarphel, Fangteng,	Bomdelin	
	Bremo	Khala			Ngalimang,	ы	T.Gang
	Khala	Khala/		F	Zobel	Zobel	P.Gatshel
		Kurtoep		1800		Kengkha	
	Khala	braala			Bargonpa, Romangla,	, i	Mongar
94		Cheneya					
	Phaper	Phapar			Ghondeygoung	Bara	Samtse
$10^*$	Teto	Tethey		465-1040			
	Phapaer	Phapar	White colour and bitter taste		Laring, Muga	Hilley	Sarpang
				F	Fedi, Mongargoung, Bari gari,		
					Dobhan, Torkey, Maukhola,		
		Tethey	Tall plant height, high yielding,		Gungring, Khargoung, Tirkhola,		
	Phapar	Phapar	easy to thresh, good for health		Dara gaon, Pathibhora,	Doban	Sarpang
				950-1500	Kuchin Tar, Jumsa, Khendong,		
	Titay	Tethey			Dukpa Bindu, Katchin, Pakpay,		
	Phaper	Phapar	Bitter taste, smali grains		Kuchin Tar	Tendu	Samtse
* ind	licates germ	plasm sampl	es in the Gene Bank.				

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Dzo.	Paro	S. Jongkhar	Tsirang	S. Jongkhar	S. Jongkhar	T. Yangtse	T. Gang	S. Jongkhar	S. Jongkhar	P. Gatshel	P. Gatshel	P. Gatshel	P. Gatshel	P. Gatshel	Lhuntshi	P. Gatshel		Wangdue	P. Gatshel	T. Yangtse	T. Gang	S. Jongkhar	Lhuntshi	Lhuntshi
Gewog	Doga	Serthig	Semjong	Serthig	Lauri	Bomdeling, Yangtse	Uzorong	Gomdar	Orong	Yurung	Chongshing	Shumar	Dungmin	Khar	Gangzur	Chimung		Dangchu	Zobel	Khamdang	Yangneer	Orong	Membi	Menji
Village	Mendrel Gang	Barka Langnang	Nilpokhari	Menji Woong, Monmola	Woongthi	Yangteng, Bayling	Khoji Dung, Benshingmo	Sawang	Wooling	Khangma, Bumpawoung, Denang	Chongshing, Mandi	Yalang, Denchi	Upper Dungmin	Khar Moonadung, Tsebar Shinangri	Chesa	Korkhang		Chuba Woo	Resinang	Shazam	Pangthang	Morong	Phagi Dung	Tadongchen
Variety name	Allay	Banzar Mo	Latay	Las Mo	Mo	Moo	Lhasamo	Lhasamo	Lhasomo	Lhasamo	Lhasamo	Lhasamo	Lhasomo	Lhasomo	Lhasomo	Lhasamo Balingbi		Mao/Zhimtshi	Mo Balingbin	Moo Balingbin	Mo Tsalu	Moo Tsalu	Moo Marpo	Muth Ngapo
Crop name	Allay	Мо	Latay	Las Mo	Mo	Moo	Мо	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Lhasamo	Mao/Zhimts	hi	Mo	Moo	Мо	Moo	Moo	Muth
Sl. no	1	2	3	4	5		9	7								×	6		10		11		12	13

Lhuntshi		S. Jongkhar	Wangdue	Punakha	Thimphu	
Gangzur	Martshala, Orong,	Serthig	Phobjikha	Toewang	Chang	
Bumtangshing		Kakpa Dung, Wooling, Serthig	Hal	Thamji	Begana	
Shar Muth	-	Sharang Mo	Zhimtshi Kaap	Zimtshi Kaap	Zimtsi	
Muth		Mo	Zhimtsi	Zimsi	Zimtsi	
14	15		16		17	

# Annex 11. Diversity of Legumes

### Annex 11.1. Phaseolus spp.

		accene of F.					
SI.	Local name						
no	of crop	TV/Land race	Characteristics	Alt (m)	Village	Gewog	Dzo.
1	Shaypen	Ashi Shaypen	Good yield	1990	Jalang	Menji	Lhuntsi
2*	Oray	Abi Lhazom		1430	Khominang	Yurung	P. Gatshel
3	Oray	Abi Lhazom Oray		1	Khochuphay	Yurung	P. Gatshel
4	Oray	Ambarma oray	Dwarf variety	1450	Khoyar	Gomdar	S. Jongkhar
ß	Semchum	Bathra Sem	Determinate, red striped pod cover	1	Tilli/Kesa	Shaba	Paro
			Red and white striped seeds,	I			
	Semchum	Batha Sem	determinate and heavy fruiting		Dawakha	Paro	Doga
9	Semchum	Batha Semchum	Climbing type, white and black striped seed, flat fruit,	I			
				2150	Tshongkha , Khamda,		
					Tshongkha, Lomikha,		
					Zhingkhana, Gongri ,		
	Semchum	Bathra Sem	Climbing type, white and black striped seed, flat fruit,		Dugay , Dingkha, Tilli/Kesa , Dawakha	Doga	Paro
7*	Bori	Badawari bori		1760	Nil Pokhari	Semjong	Tsirang
×						Bomdelin	
	Bokti Bomo	Bokti Bomo		1943	Yangteng	g	T. Yangtse
9*		Brokche/					
		Brokchinang					
	Oray	Oray		1020	Khothakpa, Maan	Shumar	P. Gatshel
10	Semchum	Brocaling	Climbing, string less	ı	Tshongkha	Paro	Doga

[] <b>*</b>	Shavpen	Brokpaline		1200-1894	Budhur, Dragong, Jalang, Lekpachu, Chura	Menii	Lhuntsi
				1300-1400	Doktang, Tongla Gonpa Magola, Zor, Shinchongri	·····	
	Oray	Brokpaling	Climbing variety		Romangla	Kengkhar	Mongar
12	Oray	Bumthang Oray	Climber		Resnang	Zobel	P. Gatshel
13	Oray	Choktola Oray	Dwarf variety	1000	Shokshi	Gomdar	S. Jongkhar
	Oray	Choktola Oray		806	Rikhay	Orong	S. Jongkhar
14				1650-2020	Ngalimang Lamda	- - 1	
	Shaypen	Creley	Good yield		Fangtiho Tarphel Bechamang Fangteng	Bomdelin 8	T. Yangtse
15*	Bori	Daganay bori		1130	Katikay, Bararay	Semjong	Tsirang
16*	Bori	Dudhey Bori		1520	Samkhar	Jigmecholl ing	Sarpang
17*				0 H H	Zamlingzor, Samshing	Mendelga	 1
	Bori	Dhulal bori		770-1450	Gaden, Reserphu A	ng	Tsirang
	Bori	Dhulal Bori		1130-1760	Nilpokhari, Bararay, Katikay,	Semjong	Tsirang
						Puntench	
	Bori	Dulal Bori		4634	Burichu	n	Tsirang
18	Semchum	Dubi Semchum	Climber, stringy, long pod	ŧ	Zhingkhana	Shaba	Paro
19	Oray	Dungkar Oray	Climbing variety	L	Tongla Gonpa	Kengkhar	Mongar
20*	Orati	Dungdungma	Durant variaty	1450	Khovar Danchi	Comdar	S Ionothar
21	Orav	Gaknu orav	(Timber	1000	Shokehi	Gomdar	S longkhar
22	Orav	Gasa Sev Orav		622	Rishor	Orong	S. Iongkhar
23*	×	Gew Bori				Jigmecholl	
	Bori			1500	Samkhar	ìng	Sarpang
	Bori	Gew Bori		1414	Mithun	Dorokha	Saintse
	Bori	Gew Boti		1250	Samshing Gaden, Zamlingzor, Reserphu A	Mendelga ng	Tsirang

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		Gew Bori		Nil Pokhari, Kokray,		,
	Bori		810-1760	Bararay ,Katikay	Semjong	Tsirang
	Bori	Gew Bori	166	Thulo Dumtoe	Dumtoe	Samtse
		Gew Bori			Denchukh	
	Bori		465	Bongaylay	a	Samtse
	Bori	Gew Bori	1608	Satakha	Dorokha	Samtse
24	Bori	Haray Bori	869	Kakpadung	Martshala	S. Jongkhar
	Bori	Haray Bori	166	Thulo Dumtoe	Dumtoe	Samtse
	Bori	Harav Bori	4634	Burichn	Puntench	Tsirane
	Bori	Haray Bori	1130	Katikay	Semjong	Tsirang
	Bori	Haray Bori	1440	Tabji Kulung Da	Darla	Chukha
	Bori	Haray Bori	907-1414	Timburay, Mithun B	Dorokha	Samtse
	Bori	Harey Bori	1230	Katikay	Semjong	Tsirang
25	Bori	Jharay Bori	0///	Zamlingzor	Mendelga ng	Tsirang
					Jigmecholl	
	Bori	Jharay Bori	1520	Samkhar	ing	Sarpang
26	Bori	Kali bori	1130	Katikay	Semjong	Tsirang
		······································	0		Mendelga	F
	inoq.	Nalo Ucit V-1- D	004	Zauuugzoi Mid D	л <u>Б</u>	1 SILGUE
	1701	NALU DUIT	1144	WILLIAGE D,	DUIUNIA	Califica
27*	Bori	Kanchi Bori	1450	Reserphu A, Samshing Gaden	Mendelga ng	Tsirang
		Kanchi Bori		Nilpokhari, Bararay,		
	Bori		1760	Katikay	Semjong	Tsirang
		Kanchi Bori			Jigmecholl	
	Bori		1500	Samkhar	ing	Sarpang
58	Oray	Khachi Oray	ŀ	Zobel, Resnang	Zobel	P. Gatshel
53	Shaypen	Khalum Shaypen	1580	Tsaling	Bomdelin	T. Yangtse

PLANT GENETIC RESOURCES OF BHUTAN

						50	
30*	Отау	Kharshing Oray	Determinate type	-	Shinchongri	Kengkhar	Mongar
	Oray	Kharshing Oray	Determinate type		Zobel, Resnang	Zobel	P. Gatshel
31	Shibi	Karangay shibi		1230-1760	Katikay, Nilpokhari	Semjong	Tsirang
32	Oray	Kengma Oray	Determinate fype	1450	Khoyar	Gomdar	S. Jongkhar
33	Oray	Kenter		875	Kakpa Dung	Martshala	S. Jongkhar
34	Shapay	Kotor Shaypay		1480	Bagpa	Tongshan g	T. Yangtse
35*	Oray	Langma Oray		1840	Pasang Borang	Yangnyer	T. Gang
36*	Oray	Langnang/ Langmo Oray Serbu		1000-1300	Shokshi, Brumi	Gomdar	S. Jongkhar
37*	Oray	Lokpa Oray		1379-1694	Nyami, Chortong	Ngatshan g	Mongar
38	Semchum	Ĺoga	Yellow flower, brownish type seed		Lomekha	Mewang	Thimphu
39	Semchum	Luma semchum	Green and long fruits	,	Dugay Dingkha	Shaba	Paro
40	Bori	Mahaji Bori		222	Khameythang	Phuntsho Thang	S. Jongkhar
	Bori	Majhaji Bori		770	Zamlingzor	Mendelga ng	Tsirang
*[¥	Sem Chum	Morem semchum	Determinate variety, yellow seed, stringy when matured	2360	Jemína	Mewang	Thímphu
	Shapen	Moringmo Shaypen	Determinate variety	1200-1990	Budhur, Jalang ,Leshigang, Lekpachu	Menji	Lhuntsi
42*	Orsha	Nangkorpa Orsha			Pangthang	Radhi	T. Gang
43	Semchum	Ngotam	Climbing variety	2750	Busa	Sephu	Wangdue

PLANT GENETIC RESOURCES OF BHUTAN

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44×	Oray	Oray	· · · · · · · · · · · · · · · · · · ·	1400	Nanari	Kengkhar	Mongar
	Oray	Oray		900	Suzung	Orong	S. Jongkhar
		- - - - - - -	Good taste and early	1580-2140	Changjay, Bainang ,Dalifhangma, Darjeeling,		
	Oray	Oray	maturing		Demkhar, Durung	Yangneer	T. Gang
				1540-2010	Bechamang,		
	Shavnen	Orav	Good taste		Gangkhardung, Tsaling, Noalimano Womanano	Bomdelin °	T Yanotse
45*	Orav	Orav Balingbi	Dwarf variety	1000-1500	Shokshi, Denchi	6 Gomdar	S. Ionekhar
46	Oray	Oray Changlu		1400	Tsalabee, Magola	Kengkhar	Mongar
	Отау	Oray Changlu	Good taste	1	Zobel, Resnang	Zobel	P. Gatshel
47*	Oray	Oray Serbu		I	Zor	Kengkhar	Mongar
	Oray	Oray Serbu	Climber	1	Resnang	Zobel	P. Gatshel
48*	Oray	Oray Tsalu		1200	Shali	Shumar	P. Gatshel
	Oray	Oray Tsalu		1500	Benshingmo	Uzorong	T. Gang
	Oray	Oray Tsalu		2014	Yagpu Gang	Mongar	Mongar
	Oray	Oray Tshalo		1006	Nyami	Ngatshan g	Mongar
49	Bori	Paheli Bori		1221-1414	Mihtun, Maney	Dorokha	Samtse
	Bori	Paheli Bori		846-1393	Mayona, Kaduri	Denchukh a	Santse
	Bori	Pahelo bori		950-1400	Zamlingzor, Reserphu A	Mendelga ng	Tsirang
	Bori	Pahelo bori		1230	Mendelgang	Mendelga ng	Tsirang
	Bori	Pahelo bori		1130-1760	Nil Pokhari, Katikay	Semjong	Tsirang
50	Semchum	Pata Sem	Big seeds, climbing variety	E	Lomikha, Tshongkha, Dawakha	Doga	Paro

	Semchum	Pata semchum	Climber, flat and long fruit, string less,	1	Gongri, Tilli/Kesa, Dugay Dingkha	Shaba	Paro
	Sem Chum	Pata semchum	Bunching fruit, string less, big pod, climber, flat beans,	2360	Jemina, Chaphu, Somakha	Mewang	Thimphu
51*	Oray	Patang Oray	Good taste	1	Zobel, Resnang	Zobel	P. Gatshel
52	Orsha	Phun Orsha		1728	Shangdang	Ramjar	T. Yangtse
53*					Khoyar, Shokshi, Denchi,		
	Oray	Pingkulung oray		1450	Shokshi	Gomdar	S. Jongkhar
	Oray	Pingkulung Oray		1120	Chimung Barkong	Chimung	P. Gatshel
54	Oray	Pompaling Oray	Dwarf variety	1450	Khoyar, Denchi	Gomdar	S. Jongkhar
55	Bori	Rato Bori		1235	Bitch Gaon	Darla	Chukha
	Bori	Rato Bori		334	Jampaní	Langchen Phu	S. Jongkhar
56*	Oray	Ru Oray	Dwarf variety	1450	Khoyar	Gomdar	S. Jongkhar
	Отау	Ru Oray			Zor	Jamkhar	T. Yangtse
57*	Shapen	Sangbaling Shaypen		1560	Leshigang	Menji	Lhuntsi
58	Shapen	Tsangbulung		1990	falang	Menji	Lhuntsí
59	Semchum	Sem Kaap	White seeds and determinate variety		Dawakha	Doga	Paro
60	Semchum	Sem Naap	Black seeds and determinate variety	1	Dawakha	Doga	Paro
	Semchum	Sem Naap	Black seeds, determinate variety, slightly yellow colour, animal feed	ı	Tilli/Kesa	Shaba	Paro
	Semchum	Sem Naap	Climbing, high fiber content, medium variety plant, yellow flower, black seed	2230	Somakha, Lomekha	Mewang	Thimphu

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.10	Semchum	Sem Sep	Only seeds consumed, yellow seed, determinate variety	1	Khamda, Tshongkha, Lomikha, Dawakha	Doga	Paro
	Semchum	Semchum Sep	Determinate, green pod, yellow seed	2280	Lomekha, Jemina	Mewang	Thimphu
62	Semchum	Sem throw	Soft when young, hard after mature, climber		Khamda	Doga	Paro
63	Semchum	Semchum	Determinate, stringless, heavy fruiting	2135	Khasadrapchu	Mewang	Thimphu
64	Semchum	Semchum Kaap	Climber, white seeded fiberless	1380	Damtsi	Kabji	Punakha
65	Semchum	Semchum Kaap	Determiniate type		Khamda Tshongkha Khamda Tshongkha	Doga	Paro
66	Oray	Serbu Mingba	Dwarf variety	1000-1300	Shokshi, Brumi	Gomdar	S. Jongkhar
67	Rott	Choti Rori		846	K adher	Denchukh	Comfeo
	Bori	Sheto Bori		1221	Maney	u Dorokha	Samtse
68	Shapen	Sharpa Shaypen		1560	Leshigang	Menji	Lhuntsi
69	Oray	Shing Oray			Shinchongri	Kengkhar	Mongar
70	Shapen	Shongmashing Shaypen		1860	Bechantang, Bamdir	Bomdelin g	T. Yangtse
Ц	Shapen	Thra Shapen		2087	Tadongchen	Menji	Lhuntshi
	Shapen	Thrasay Shapen	Bold big White seeds, climbing type	1636	Dromashong	Membi	Lhuntshi
72	Shapen	Tsiligpa Shapen		2113	Shongkhar	Membi	Lhuntshi
73	Semchum	Thakemi Semchum	Fibreless, climber, long and bunchy fruit		Zhingkhana	Shaba	Paro

Paro	Thimphu	S. Jongkhar
Shaba	Mewang	Gomdar
Zhingkhana	Somakha	Shokshi
•	2230	1000
Climber, stringy, long pod	Black seed, climber	Climber
Thebae Sem	Trangti	Wangchilingpa
Semchum	Semchum	Oray
74	75	76

\* Indicates germplasm samples in the Gene Bank

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### PLANT GENETIC RESOURCES OF BHUTAN

		,					
14	Singye	Nesa Singye		1450	Khoyar	Gomdar	
	Ngesa Singi	Nesa Singye		1090	Wooling, Chongti	Orong	
15*	Nangmay	Nangmay		1200	Tersheri	Orong	1 1
	Nangmey	Nangmey		-	Shinchongri	Kengkhar	
$16^{*}$	Shakpu	Shakpu		2005	Pangthang	Yangnyer	
					Sezor, Tshothang, Betseling,		
	Shakpu	Shakpu		1	vurguanna, raupa Nadang	Lauri	
			-		Debtshang, Denphu, Serthig,	-	
	Shakpu	Shakpu			Monmola, Barka Langnang, Menji Woong, Menji, Woong	Serthig	
17	Shepay	Shapay		851	Martshala	Martshala	•
18	Gagpu	Saygagpu		1400	Durtshen	Orong	
19	Sem	Sem Hochum	Yellow seeds	2150	Jigmena	Mewang	
8			More yield, good	2150			
	Sem nap	Sem Nap	taste		Jigmena	Mewang	
			Round short pod,	750			
	Dhal	Sem Nap	black covered pod, vellow seeds		Gurung Dara, Bihitar	Bhaluiora	
					X		
21	Singcri	Singcri		1	Shinchongri, Zor	Kengkhar	
22*				1000-1750	Pheluma, Tersheri,		
					Batshong, Wooling, Mandar,		
		Sengye / Singye			Mandar, Redungmey,		
	Sengay	Daza			Manchang, Beelam	Orong	
33	Singye	Singye Katang		1400	Beelam, Manchang	Orong	
-							

Indiactes germplasm samples in Gene Bank

Annex 11.3 : Macrotylemma

Sl.no	Local name of crop	TV/Land race	Characteristics	Altitude	Village	Geog	Dzongkhag
1	Gahat	Gahat		1130	Katikay	Semjong	Tsirang
	Gahat	Gahat		4634	Burichu	Puntenchu	Tsirang
	Gahat	Gahat		1230	Katikay	Semjong	Tsirang
	Gahat	Gahat		3982	Dara Gaong	Dorokha	Samtse

An	nex 11.4: 1	Pisum					
SI.	Local	Traditional					
no	name of	variety/Land	Characteristics	Alt (m)	Village	Gewog	Dzo.
	crop	race					
$1^*$							
	Beysem	Beysem	Big pod, tall plant height, good market, 4-5 seeds/pod	2281	Bara, Zhingkhana, Drugaydingkha, Tilli/Kesa	Shaba	Paro
2*			Pink flower, good taste, black	1	Khamda, Lomikha,		
	Beysem	Beysem (Black)	seed, big pod, tall height		Tshongkha	Doga	Paro
	Bevsem	Beysem (Black)	Small and blackish seeds	2200- 2820	Ingo Hatam Mome choko	Katsho	Наа
3				1300-	0 - 1 - 0 0 0		
	Changma	Changma	Good market value	1580	Morong, Metsheshing	Orong	S. Jongkhar
	Changmu	Changma	Early maturing	2140	Bainang	Yangneer	T.Gang
3	Kayrao	Karao	Small seeds	1520	Gabji B	Denchukha	Samtse
				1200-	Upper Dungmin, Woong		
	Motor	Motor		1450	Borang	Dungmin	P. Gatshel
4	Motor	Motor		705	Jutshakha	Daga	Wangdue
വ				2780-	Dhur, Kenchosum, Jakar,		
			Dark green and tall plant height,	2830	Jakar Lakhang, Tashiling		
			white seeds, Big pods, Good taste		Ugyen Choling, Changwa,		
	Namey	Namey	frost susceptible		Tsangtsangma, Dawathang	Choekhor	Bmthang
	Namey	Namey		I		Tang	Bumthang
		Namey		1.560-			
	Namin			1894	Changling, Dragong	Minji	Lhuntse

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ics Alt (m)		603	1340	1560-2061		od 950-1300	2061	1540	1499	1520	1700	1340	770	1	1	1541-2060	1000-1400	g 1990
istics Alt (m		603	1340	1560-206	lg,	good 950-1300	7 2061	1540	1499	1520	1700	1340	770	1	1	7 1541-200	1000-140	sing 1990
Characteristi					High yielding, white variety	Yellow type, goo market value	White variety	5							Tall varity	Black variety		Used for making
		nas			a H wł	Ye	5 M	wling	nass	nas	las	las	nas	eebi	bi Ta	/ling Bl	gbi	U.
		nas			a			wlin	nass	nas	าลร	las	nas	eebi	bi	rling	gbi	

### Annex 11.5. Glycine

S. Jongkhar	S. Jongkhar	S. Jongkhar	S. Jongkhar	G Ionobhar			T. Gang		S. Jongkhar	Mongar			T. Gang	Samtse	Thimphu		Thimphu		Trongsa	>	Lhuntsi	Lhuntsi	Samtse
Orong	Lauri	Serthig	Orong	Orono	0		Yangneer		Serthig	Kengkhar			Yangneer	Tendu	Mewang		Mewang		Korphu	-	Minji	Minji	Tendu
Durtshen, Manchang	Betseling, Dungmanma	Denphu, Monmola, Menji Woong	Morong	Pheluma, Mandar, Manchang	<b>O</b> INTERNET	Darjeeling, Changjay,	Dalifhangma, Durung, Demkhar	Denphu, Barka	Langnang	Oloki	Tsaling, Shokang,	Tektekpa, Kherey,	Dalifhangm	Jumsa	Jigmena, Sigay		Sigay		Nabii	Budhur, Sham, Chura,	Leshigang	Budhur, Sham, Dragong	Jumsa
1400	1	I	1661	1100-1750	1680-2000				I	860	1500-2070			950	2150-2360		2161		1700	1681-2040		1680-2041	950
					Good nutritive	value,	supplementary food as porridge							Small and reddish seeds	Yellow flowering,	reu grains, nairy	Bigger pod, white grain	Black grains, hairy, yellow flowering	Small seed vellowish colour				Big and whitish colour seeds,
Lebi Changlu	Leebi Daza	Leebi Daza	Leebi Daza	I abi Tealn			Lebi Tsalu		Leebi Tomang	Lebî			Lebi	Rato Bhatmas	Sem Na (Y)		Sem kaap (W)	Sem Na (B)	Shawling	þ	Shawling kaap	Shawling Naap	Sheto Bhatmas
Lebi	Leebi	Leebi	Leebi	I ahi			Lebi		Leebi	Lebi			Lebi	Bhatmas	Sem Na		Sem Na	Sem Na	Shawling	Shawling	)	Shawling	Bhatmas
	$13^{*}$			14				15		16				17	18		19*	20	21			22	23

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24	Lebi	Tshena Lebi		I	Pangthang Daza,	Zobel	P. Gatshel
					Resnang		
* In	diactes germi	plasm samples in	genebank				

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### Annex 11.6 Cajanus

1DalRahari DalCumauneySamtse2ChangmaShing ChangmaS. Jongkhar	Sl. no	Local name of crop	Traditional variety /Land race	Characteristics	Alt (m)	Village	Geog	Dzongkhags
2 Changma Shing Changma S. Jongkhar S. Jongkhar	1	Dal	Rahari Dal				Gumauney	Samtse
	2	Changma	Shing Changma				Gomdar	S. Jongkhar

SI.	Local name of	Traditional varietv /Land	Characteristics	Alt (m)	Village	Gewog	Dz0.
	crop	race			0	þ	
1*	Memba	Mem Serbu		-	Tashi Pogtor	Chaskar	Mongar
	Memba	Memba serbu		1500	Denchi	Gomdar	S. Jongkhar
		Memba					
	Memba	Serbu		I	Debtshang	Serthig	S. Jongkhar
2		Memba			Khangma Chayma,		
	Memba	Changlo		1458	Barnadang	Yurung	P. Gatshel
		Memba					
	Memba	Changlu		1300-1500	Dechi, Brumi	Gomdar	S. Jongkhar
		Memba					
	Memba	Changlu		1978	Nambethpuwoong	Wamrong	T. Gang
		Memba					
	Memba	Changlu		I	Betseling, Dungmanma	Lauri	S. Jongkhar
		Memba					
	Memba	Changlu		600	Phadey	Pema Thang	S. Jongkhar
3*	Membu	Membu Tsalu		773-1370	Gonmenang, Chenangri	Orong	S. Jongkhar
	Membu	Membu Tsalu		980	Maan	Shumar	P. Gatshel
4			Yellow seeds, tall plant height,	006-009			
	Tori	Tori	good market value		Bihitar, Ahalay, Pekashey	Bhalujora	Chukha
വ			Red colour seeds, high oil	870-1050	Bokbokay, Tendu Tar,		
	Tori	Tori	content		Jumsa	Tendu	Samtse
9	Tori	Rato Tori		470	Laring, Hilley	Hilley	Sarpang
	Tori	Rato Tori		1307	Lower Saurani	Darla	Chukha
			Medium plant height, Red	1050			
	Tori	Tori (Red)	seeds		Tendu Tar	Tendu	Samtse
7*	Tori	Tori (black)	Black seeds low market value	901	Bihitar	Bhalmora	Chukha

# Annex 12. Diversity of Oil seeds Annex 12.1 Mustard

			Short variety, black seeds, low	601-901			
	Tori	Kalo Tori	oil content		Bihitar, Ahalay	Bhalujora	Chukha
	Tori	Kalo Tori	Small seed and pods.	,	Pathibora, Beech Khola,		
					Tir Khola, Ramitey,		
					Torkey, Bitekhola,		
					Maukhola, Rani,		
					Khargoung, Mongar		
					goung, Fedi, Gungring , Pathibora		
	Tori	Kalo Tori	Susceptible to pest and diseases. Dark brown seed.	465	Laring	Hilley	Sarpang
				950-1500	Jumsa, Khendong,		
			Black seeds high oil content,		Katchin, Okhor Botay,		
	Tori	Tori Local	medium height		Dukpa Bindu	Tendu	Samtse
ðo			Reddish black seeds, medium	2340			
	Peka	Peka	height		Jimena, Sigay	Mewang	Thimphu
*6			Black seeds, medium plant	2250-2170	Goensa Gangto,		
	Peka	Peka	height, good yield		Komathang	Kazhi	Wangdue
10		Peka					
	Peka	Longkhom		2400	Chuba Woo	Dangchu	Wangdue
11			Tali variety, yellow seeds, high	006-009			
	Tori	Paheli Tori	market value		Ahalay, Bihitar	Bhalujora	Chukha
	Tori	Paheli Tori	Yellow grains, oil content is	1	Tir Khola	Doban	Sarpang
			high, bigger seeds and late maturity				
12			Red seed, short height, high		Tshongkha, Khamda		
	Peka	Peka (R)	yielding		,Dawakha	Doga	Paro
13			Yellow flower, good oil content,	,	Lomikha, Dawakha,		
	Peka	Peka	black seeds		Khamda	Doga	Paro
			Medium height, reddish black	2350	Jimena, Sigye,		
	Peka	Peka	seeds, early maturing		khasadrapchu, Lomekha	Mewang	Thimphu
14			Medium plant height, good	F	Gongri, Drugaydingkha		
	Peka	Peka	yield and good oil content		Tilli/Kesa,	Shaba	Paro
15	Pcka	Peka	Small grain medium height more yield	1765	Yusakha, Pangmakha	Toewang	Punakha
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16	Peka	Peka	Taller than improve variety, dark red seeds	1520-2050	Yusikha, Chegma Lumche	Kabji	Punakha
	Peka	Peka		1680	Japhu	Rupaisa	Wangdue
18	Yungkar	Serthi	Yellow coloured seeds, late variety, high yielding, high oil content	1451-1700	Kamjong, Tali, Tsaidang, Ngakhar, Kikhar	Nangkor	Zemgang
19	Yungkar	Serthi	YeJlow colour, low yield, unsusceptible to pest and diseases.	1700	Nabji	Korphu	Trongsa
20	Tori	Seto Tori	White seeds good yield production.	350-940	Noon Pani ,Laring, Kuwa Pani, Muga, Muga, Noon Pani	Hilley	Sarpang
	Tori	Seto Tori	Big pods, high oil content, white seeds, late maturity, high oil content	1	Bitekhola, Maugaon, Bitekhola, Pangkhey, Pathibora, Tar Khar, Pathibora	Doban	Sarpang
22*	Tori	Sorshung	Yeilow seed colour	1301	Khendong	Tendu	Samtse
	Tori	Sorshung		1250	Reserphu A, Samshing Gaden ,Pema Shong	Mendelgang	Tsirang
	Tori	Sorshung		1340	Bararay, Katikay, Nilpokhari, Daragaun	Semjong	Tsirang
	Tori	Sorshung		1221	Maney	Dorokha	Samtse
	Tori	Sorshung		1520	Samkhar	Jigmechollin g	Sarpang
	Tori	Sorshung		603	Rangay Tong	Balujhora	Chukha
	Tori	Sorshung		761	Allhay	Phuntsholin g	Chukha
	Tori	Sorshung		1578	Dhanseri	Puntenchu	Tsirang
	Tori	Sorshung		363	Buduney	Samtse	Samtse

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Bumthang	Trongsa	Zemgang	Zemgang	Bumthang	Zemgang	Zemgang
Tang	Korphu	Nangkor	Nangkor	Tang	Nangkor	Nangkor
Dazoor, Ugyen Choling, Sakarmet, Nimalung, Pralang, Khaeyar, Nangnang, Shebrak, Dhur	Nimshong	Dunmang, Tali, Kikhar, Buli	Tali	Tashiling	Tshedang	Kikhar, Tsaidang
2750-2820	1250	1550-1710	1701	2780	ì	1450
Tolerant to pest and disease, low yielding, small and blackish seeds, short plant height	Black colour and early maturity.	Early maturity, bit small in size, black seeds, high oil content.	Błack colour seeds, łow yield, low oił content, early maturity	Small seeds, short plant height	Tail plant height, high oil content.	Red colour seeds, low oil content, early maturity
Yungar	Yungkar	Yungkar	Yungkar Noenti	Yungkar Nonti	Yungkar Maap	Yungkar Zhenti
Yungar	Yungkar	Yungkar	Yungkar	Yungkar	Yungkar	Yungkar
23			24*		25	26

	101 12.21	A CIDICA UNITAL	ğaı				
SI No	Local name of crop	TV/Farmers' Varietv	Characteristics	Altitude	Village	Geog	Dzongkhag
1*	Philingay	Philingay	1	921-1450	Khoyar, Brumi, Shokshi,	Gomdar	S. Jongkhar
	Philingay	Philingay	1	880	Kakpadung, Gorthongma	Martshala	S. Jongkhar
	Philingay	Philingay			Bararay, Nilpokhari, Dara Gaun,		
			ı	1130-1760	Katikay	Semjong	Tsirang
	Philingay	Philingay	1	1244	Upper Saurani	Darla	Chukha
	Philingay	Philingay	1	770	Toribari	Phuntsholing	Chuka
	Philingay	Philingay	-	I	Thulo Dumtoe	Dumtoe	Samtse

# Annex 12.2. Diversity of Niger

# Annex 12.3 : Diversity of Groundnut

	Village Geog Dzongkhag	Chongshing P. Gatshel	Mongar Mongar	Mongar Mongar	
		,	1	ı	
	Altitude	1	1	1	
	Characteristics	1	1	1	۰ د
`	TV/Farmers' Variety	Badam	Badam Balingmi	Badam Tsalu	-
	Local name of crop	Badam	Badam	Badam Tsalu	
	SI No	1	2	3	1

\* Indicates germplasm samples in Gene Bank.

# Annex 13: Germplasm accessions in the PGRFA Gene Bank as on June 2008

Annex 13.1. Rice

Sl No	Local name of crop	TV/Farmers' Variety	Place of collection (Gewog)	Place of collection (Dzo)
1	Dhan	Achami Dhan	Sipsoo	Samtse
2	Dhan	Aring Bar	Yurung, Shumar, Orong	P. Gatshel
3	Bar	Asu Bar	Kanglung, Uzorong	T. Gang
	Bra	Asu Bra	Kurtoe	Lhuntshi
4	Dhar	A 11	Mendelgang, Puntenchu,	Toiner
5	Dhan	Attay	Semjong,	Tsirang
6	Dhan	Aunadhi Dhan	Puntenchu	Isirang
0	Bara	B.K.Attey	Pema Thang	S. Jongkhar
7	Dhan	BK	Phuntsho Thang	S. Jongkhar
0	Dhan	Babu Dhan	Sipsoo	Samtse
8	Dhan	Babu Jasuwa	Gumauney	Samtse
9	Bara	Baipa Bara	Bidung	T. Gang
10	Bara	Baipo Bara	Jamkhar, Khamdang, Tongshang	T. Yangtse
10	Dhan	Bakhra Kotay	Nainital	Samtse
11	Dhan	Bangayra Dhan	Darla	Chukha
	Dhan	Bangayray	Samtse	Samtse
12	Bar	Bar	Shumar	P. Gatshel
13	Bara	Bara	Ngatshang	Mongar
	Bara	Bara	Martshala	S. Jongkhar
14	Bara	Bara Changlu	Bidung	T. Gang
	Bara	Bara Changlu	Ramjar	T. Yangtse
15	Bara	Bara Tsalo	Ngatshang, Chaskar	Mongar
16	Dhan	Baragoti Masino	Jigmecholling	Sarpang
17	Dep	Bartshampa Dep	Bomdeling	T. Yangtse
18	Dhan	Bayarni Dhan	Sipsoo	Samtse
19	Ray	Baybokpa	Langthel	Trongsa
20	Ray	Baybupa	Langthel	Trongsa
21	Bara	Bidungpa Bara	Bidung	T. Gang
22	Dhan	Bihari Dhan	Phuntsholing	Chukha
	Dhan	Bihari Dhan	Samtse	Samtse
23	Bara	Bonday	Saling	Mongar
	Ray	Bondey	Langthel	Trongsa
	Bja	Bondey	Tewang	Punakha
	Bara	Bondey	Phongmi	T. Gang
	Ray	Bondey	Drakteng	Trongsa
24	Bra	Bra	Gangzur	Lhuntshi

	1			
25	Bara	Brayna Bara	Dramitse	Mongar
	Bar	Brena Bar	Kanglung	T. Gang
26	Dhan	Bujuray Dhan	Darla	Chukha
27	Bra	Bunalingpa Bra	Gangzur	Lhuntshi
28	Bra	Butshula Bra	Gangzur	Lhuntshi
29	Dhan	Champa Dhan	Dekiling	Sarpang
30	Dhan	Champa Dhan	Puntenchu	Tsirang
	Dhan	Champasar	Phuntsho Thang	S. Jongkhar
	Dhan	Champasari	Phuntsholing, Balujhora	Chukha
		Champasari		_
	Dhan	Dhan	Chengmari	Samtse
31	Dhan	Chetri Monsara	Gumauney	Samtse
32	Dhan	Chota Kati	Nainital	Samtse
33	Dhan	Choti Dhan	Semjong, Puntenchu	Tsirang
34	Dhan	Chulthay Dhan	Samtse	Santse
35	Bara	Chung Bara	Yangner	T. Gang
36	Bara	Chungki Bara	Ramjar	T. Yangtse
37	Bja	Dago Zam	Тоер	Thimphu
38	Bara	Dakpa Bara	Khamdang	T. Yangtse
	Bra	Dakpa Zamo	Membi	Lhuntshi
39	Bara	Daksaila	Khamdang	T. Yangtse
40	Bja	Dasum	Gaselo Tshogwom	Wangdue
41	Dhan	Dhorae Dhan	Phuntsho Thang	S. Jongkhar
42	Dhan	Doley	Phuntsholing	Chukha
	Dhan	Dolly Katikay	Biru	Samtse
43	Вја	Dumja	Shaba	Paro
	Вја	Dumja	Mewang, Chang	Thimphu
		Dumja /Tall		
	Bja	variety	Luni, Shaba	Paro
44	Dhan	Gauri Mashino	Pema Thang	S. Jongkhar
	Dhan	Gawria Dhan	Mendelgang	Tsirang
	Dhan	Gawria / Gira	Shampanakha Dakiling	Carmana
45	Bia	Chorugan	Vhamay	Gaso
46	Bio	Gilerugani	Khamay	Gasa
	Bia	Gyenja	Gaselo Tehogwom	Wangdua
47	Dhan	Hajjam	Phuntsho Thang	S longkhar
48	Bro	Hangahra	Mapii	L huntshi
49	Dhan	Harin Tal	Cumannay	Samtoa
50	Ria	Насач	Lango	Paro
51		Lupa	Lango	C Longellage
52	Dham	I jung		S. JOINGKINAL
53	Ria	Jan Dangla	Maurana Chang Canva	Thimphu
	Bio	Janam (Mak	Chaba Tapata	
	Dja	Janam/ Nak	Snapa, Isento	raro
	ыa	j Janam/Nam	Lango	Paro

54	Dhan	Japaka Dhan	Samtse, Chargari	Samtse
55	Dhan	Jasuwa Dhan	Gumauney	Samtse
56	Dhan	Jera Sari Dhan	Chengmari, Tendu Shompangkha	Samtse
57	Dhan	Juwa Dhan	Sipsoo	Samtse
58	Dhan	Kalo Dhan	Darla	Chukha
59	Dhan	Kalo Nunia	Gumauney, Sipsoo, Chargari	Samtse
60	Dhan	Kalo Timburay	DoroKha	Samtse
		Kalo Timburey		
(1	Dhan	Dhan	Jigmecholling	Sarpang
61	Dhan	Kaltoray Dhan	Nainital	Samtse
62	Bra	Kam Bra	Gangzur	Lhuntshi
63	Ray	Kamthey Korma	Langthel	Trongsa
64	Dhan	Karangla	Mendelgang	Tsirang
65	Bra	Karma Tekpa	Yangtse, Bomdeling	T. Yangtse
	Bra	Karma Tekpa	Menji	Lhuntshi
66	Dhan	Kati Dhan	Semjong	Tsirang
67	Dhan	Kati Sali Dhan	Gumauney	Samtse
68	Dhan	Katikay Dhan	Hillay, Dekiling	Sarpang
69		Khaktang/Wang	7/7 1	<b>T N</b> .
70	Bara	Kharpa Bara	Knamdang Martabala Langahan Phu	1. Yangtse
/0	Bara	Khamti	Phuntsho Thang, Orong	S. Jongkhar
71	Khang		Thanksho Thang, orong	o, jonginiar
	pa Dep	Khangpa Dep	Bomdeling	T. Yangtse
72	-	Khardungpa		
70	Bara	Bara	Bidung	T. Gang
73	no			
	Tsalu	Khoptang Tsalu	Bomdeling	T. Yangtse
74	Bara	Kongkhar	Phunsho Thang	S. Jongkhar
75	Bara	Kongkus	Langchen Phu	S. Jongkhar
76	Bja	Kuchum	Lango, Shaba, Tsento, Luni	Paro
77	Bja	Lham Zim	Тоер	Thimphu
78	Mabra	Mabra	Tongshang	T. Yangtse
79	Bja	Machum	Тоер	Thimphu
80	Dhan	Makhan Puray	Balujhora, Phuntsholing	Chukha
81	Dhan	Malchira Dhan	Chengmari	Samtse
82	Dhan	Mama Dhan	Hillay	Sarpang
83	Dhan	Mashino Dhan	Mendelgang	Tsirang
			Langchenphu, Pema Thang,	
	Dhan	Mashino Dhan	Martshala	S. Jongkhar
84	Dhan	Masino Dhan	Jigmecholling	Sarpang
85	Bara	Momo	Martshala	S. Jongkhar
86	Dhan	Monsar Dhan	Hillay	Sarpang
1				
L	Dhan	Monsara Dhan	Samtse	Samtse

88	Dhan	Muray Dhan	Shompangkha	Sarpang
89	Dhan	Musuli Dhan	Changmari, Gumauney	Samtse
		Sheto Musuli		
00	Dhan	Dhan	Gumauney	S. Jongkhar
90	Bra	Naepay Вга	Menji	Lhuntshi
91	Bara	Naning Bara	Phongmi	T. Gang
92	Dhan	Nepali Dhan	Gumauney	Samtse
93	Bra	Ola Bra	Gangzur	Lhuntshi
94	Bja	Olaja	Tsento	Paro
95	Dhan	One Paki	Samtse	Samtse
96	Dhan	Pahelo Attay	DoroKha	Sarpang
97	Dhan	Pahelo Masino	DoroKha	Samtse
98	Dhan	Pakhay Dhan	Samtse	Samtse
	Dhan	Pakhay Dhan	Phuntsholing	Chukha
99	Bar	Pang Bar	Uzorong, Kanglung	T. Gang
	Bar	Pang Bar	Yurung	P. Gatshel
	Bara	Pang Bara	Serthig, Lauri,	S. Jongkhar
100	Dhan	Phaodel Dhan	Chargmari	Samtse
101	Bara	Phongmipu	Kanglung	T. Gang
102	Rav	Punakhapa	Drakteng	Trongsa
103	Dhan	Pviam Dhan	Baluihora	Chukha
104	Dhan	Ram Bough	Chargari	Samtse
	Dhan	Ram Bough	Darla	Chukha
105	Dhan	Ram Tulasi Dhan	Gumauney	Samtse
106	Dimit	Rangshikharpa	Summing	ounitise
	Bar	Bar	Kanglung	T. Gang
107	Dhan	Rani Gaza	Chargari	Samtse
108	Dhan	Ranjita	Phuntsho Thang	S. Jongkhar
109	Bara	Rashu Bara	Lauri	S. Jongkhar
	Bara	Rashu Bara	Radhi	T. Gang
110		Rato Churae		
	Dhan	Dhan	Phuntsho Thang	S. Jongkhar
111	Ray	Ray Kar	Langthel	Trongsa
	Ray	Ray Kar	Drakteng	Trongsa
112	Ray	Ray Mar	Langthel, Drakteng	Trongsa
	Bara	Robtang Bara	Gomdar	S. Jongkhar
113	Dhan	Ruduwa	Puntenchu	Tsirang
114	Bara	Sam Bara	Gomdar	S. Jongkhar
115	Dhan	Sanu Attay	Semjong, Puntenchu	Tsirang
116		Sheto		
		Botay/Paro		
14.7	Dhan	Attay	Daria	Chukha
117	Dhan	Sheto Kalani	Shompangkha	Sarpang
118	Dhan	Sheto Masino	DoroKha	Samtse
119	Barr	Shingkharpa	Partsham	TCana
1	Dara	Dara	Dartsham	1. Gang

		-		
120	Bja	Silly Karchum	Orong	S. Jongkhar
	Bja	Silly Karchum	Gaselo Tshogwom	Wangdue
121	Bara	Sonala (Red var)	Bomdeling	T. Yangtse
122	Bara	Sorbang Bara	Radhi	T. Gang
123	Dhan	Sukhimi Dhan	Semjong	Tsirang
	Dhan	Sukhimi Dhan	Mendelgang	Tsirang
124		Sung Sung (Red		
	Bara	Var)	Tongshang	T. Yang <b>t</b> se
125	Bara	Sung Sung Bara	Radhi, Uzorong	T. Gang
	Bara	Sung Sung Bara	Chaskar	Mongar
126	Bara	Takulung Bara	Bidung	T. Gang
127	Bja	Tandin Tshering	Тоер	Thimphu
	Bja	Tandin Tshering	Thedtsho	Wangdue
138	Ray	Tenzin Bondey	Langthel	Trongsa
	Ray	Tenzinla Bondey	Drakteng	Trongsa
139	Bja	Thayray	Luni	Paro
140	Bja	Themja	Shaba	Paro
141	Dhan	Thosara	Balujhora	Chukha
142	Dhan	Timburay Dhan	Semjong	Tsirang
143	Bja	Тоер Маар	Gaselo Tshogwom	Wangdue
144	Bara	Trongsarpa Bara	Mongar	Mongar
145	Bara	Tshering Zam	Serthig	S. Jongkhar
146	Bara	Tsho Bara	Serthig	S. Jongkhar
147	Bara	Tsirang Zam	Saling	Mongar
148	Bara	Wangda Karma	Radhi, Phongmi	T. Gang
	Bara	Wangdi Karma	Toetsho	T. Yangtse
	Bara	Wangdi Karmo	Gomdar	S. Jongkhar
ŀ	Bara	Wangdi Karmo	Thangrong	Mongar
149		Wangmo Kharpa		-
	Bara	Bara	Khamdang	T. Yangtse
150	Bara	Yangtsepa Bara	Gomdar	S. Jongkhar
151	Bja	Zakha	Тоер	Thimphu
	Bja	Zakha	Nyisho	Wangdue
152	Bara	Zhung Bara	Gomdar	S. Jongkhar
	Bara	Zhung Bara	Radhi	T. Gang
	Bara	Zhung Bara	Khamdang	T. Yangtse
153	Ray	Zindi	Langthel	Trongsa
154	Bja	Zuchum	Mewang, Chang	Thimphu

(Gewog)	collection(Dzo)	
Semjong, Mendelgang	Tsirang	
Shompangkha, Dekiling,	C	
Jigmecholling, Hillay	Sarpang	
Chengmari, Samtse	Samtse	
Phuntsholing, Darla	Chukha	
Khamdang	T. Yangtse	
Membi	Lhuntshi	
Drakteng	Trongsa	
Ngatshang	Mongar	
Phongmi	T. Gang	
Gangzur	Lhuntshi	
Kanglung	T. Gang	
Yurung	P. Gatshel	
Uzorong	T. Gang	
Mongar	Mongar	
Shumar	P. Gatshel	
Yurung	P. Gatshel	

S. Jongkhar

S. Jongkhar

Place of

collection(Dzo)

**Place of collection** 

Yurung

Langthel

Lauri, Martshala

### Annex 13.2. Maize

**TV/Farmers' Variety** 

Sheti Makai

Sheti Makai

Sheti Makai

Sheti Makai

Teksumpa

Ashom

Trimchila

Sinpo Ashom

Themnangpa

Teksumpa Ashom

Tholongpa Ashom

Tshigsampa Ashom

Tshigsumpa Asham

Tshigsumpa Ashom

Woolingpa Ashom

Woolingpa Ashom

Yangtsepa Asham

Zhung Ashom

Warong ashom

Local

crop

Makai

Makai

Makai

Makai

Ashom

Chana

Ashom

Ashom

Ashom

Chakhor

Ashom

Asham

Ashom

Ashom

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name of

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### Annex 13.3. Finger millet

SI No	Local name of crop	TV/Farmers' Variety	Place of collection (Gewog)	Place of collection(Dzo)
1	Kodo	Jamkay/ Jumkay	Mendelgang	Tsirang
2	Kodo	Kalo Kodo	Jigmecholling, Hillay	Sarpang
	Kodo	Kalo Kodo	Changmari	Samtse
3	Kodo	Katikay Kodo	Puntenchu	Tsirang
4	Kodo	Kodo Bagani	Hillay	Sarpang
5	Kongpu	Kongpu	Gomdar, Serthig	S. Jongkhar
	Kongpu	Kongpu	Radhi, Bidung	T. Gang
	Kungpo	Kungpo	Drakteng	Trongsa
6	Kodo	Lurkay Kodo	Darla	Chukha
7	Memja	Memja	Khamey	Gasa
8	Kodo	Murdkay Kodo	Darla	Chukha
9	Kodo	Rato Kodo	Mendelgang	Tsirang
	Kodo	Rato Kodo	Gumauney	Samtse
10	Kodo	Sheto Kodo	Jigmecholling	Sarpang
	Kodo	Sheto Kodo	Semjong	Tsirang
11	Kodo	Thangray Kodo	Balujhora	Chukha

### Annex 13.4. Foxtail millet

Sl No	Local name of crop	TV/Farmers' Variety	Place of collection (Gewog)	Place of collection (Dzo)
1	Yangra	Bagi Yangra	Gomdar	S. Jongkhar
2	Yangra	Busung Yangra	Serthig	S. Jongkhar
3	Yangra	Chema Yangra	Shumar, Yurung	P. Gatshel
4	Yangra	Dani Shampin Yangra	Yurung	P. Gatshel
5	Yangra	Dujaymo Yangra	Gomdar	S. Jongkhar
6	Yangra	Rongshong Yangra	Yurung	P. Gatshel
7	Yangra	Yangra	Yangner	T. Gang
	Yangra	Yangra	Serthig	S. Jongkhar
	Yangra	Yangra	Shumar	P. Gatshel
8	Yangra	Yangra Tsalu	Yurung	P. Gatshel

### Annex 13.5. Bitter buckwheat

Sl No	Local name of crop	TV/Farmers' Variety	Place of collection (Gewog)	Place of collection (Dzo)
1	Вјо	Вјо	Genye, Mewang	Thimphu
	Вјо	Вјо	Tsento	Paro
2	Bradma	Bradma	Drakteng	Trongsa
3	Braw	Braw	Saling	Mongar
4	Khala	Khala	Serthig, Lauri, Gomdar	S. Jongkhar
	Khala	Khala	Yangner, Phongmi	T. Gang
	Khala	Khala	Yurung, Shumar	P. Gatshel
	Khala	Khala	Dramitse, Ngatshang	Mongar
5	Bra	Kurtoepa Bra	Menji	Lhuntshi
6	Fapar	Titey Fapar	Semjong	Tsirang
	Fapar	Titey Fapar	Puntenchu	Tsirang

### Annex 13.6. Sweet buckwheat

Sl No	Local name of crop	TV/Farmers' Variety	Place of collection (Gewog)	Place of collection (Dzo)
1	Bremo	Bremo	Shumar, Yurung, Zobel	P. Gatshel
2	Gayray	Gayray	Khamey	Gasa
	Gayray	Gayray	Doga	Paro
3	Guntshung	Guntshung	Lauri, Serthig	S. Jongkhar
	Guntshung	Guntshung	Mongar, Dramitse, Ngatshang, Thangrong, Chaskar	Mongar
4	Fapar	Metehy Fapar	Chargari, Samtse	Samtse
	Fapar	Methey Fapar	Mendelgang, Semjong	Tsirang
	Fapar	Methey Fapar	Darla	Chukha
	Fapar	Mithey Fapar	Jigmecholling	Sarpang

Sl	Local name	TV/Farmers'	Place of collection	Place of collection
No	_of crop	_Variety	_(Gewog)	_(Dzo)
1		Dukha		
	Femong	Femong	Mongar	Mongar
2	Femong	Femong	Yurung	P. Gatshel
	Femung	Femung	Gomdar	S. Jongkhar
3	Kar Femong	Kar Femong	Ngatshang	Mongar
	Femung	Kar Femung	Bidung	T. Gang
	Femung	Kar Femung	Ngatshang	Mongar
4	Na	Na	Genye, Mewang	Thimphu
	Na	Na	Naja	Paro
	Na	Na	Khamey	Gasa
6	Nas	Nas	Drakteng	Trongsa
7	Shofu	Shofu	Sershong	S. Jongkhar
8	Thongley	Thongley	Mendelgang	Tsirang
9	Femong	Zu Femong	Gomdar	S. Jongkhar

### Annex 13.7. Barley

### Annex 13.8. Wheat

Sl No	Local name _of crop	TV/Farmers' _Variety	Place of collection _(Gewog)	Place of collection (Dzo)
1	Bong	Bong	Serthig	S. Jongkhar
2	Gaung	Gaung	Balujhora	Chukha
3	Ka	Ка	Genye, Mewang	Thimphu
4	Ka	Ка	Naja, Doga	Paro
	Ка	Ка	Khamey	Gasa
5	Ka	Ka Gudum	Chang	Thimphu
6	Вјо	Yue Jo	Khamey	Gasa
7	Ka	Yue Ka	Tsento	Paro

### Annex 13.9. Sorghum

Sl.no	Landraces	Geog	Dzongkhag
1	Khu bar	Orong	S. Jongkhar
2	khubar local	Orong	S. Jongkhar
3	Local Khubara	Orong	S. Jongkhar

### Annex 13. 10. Legumes

### 13.10.1 Beans

Sl. no	Landraces	Geog	Dzongkhag	
1	Oray	Abi Lhazom	Yurung	P. Gatshel
2	Oray	Ambarma Oray	Gomdar	S. Jongkhar
3	Bori	Badawari	Semjong	Tsirang
4	Oray	Brokche Oray	Shumar	P. Gatshel
5	Oray	Brokcheling Oray	Uzorong	T. Gang
	Oray	Brokcheling Oray	Shumar	P. Gatshel
6	Oray	Brokchinang	Uzorong	T. Gang
7	Oray	Brokpaling Oray	Mongar, Ngatshang, Thangrong	Mongar
	Oray	Brokpaling Oray	Bartsham	T. Gang
	Oray	Brokpaling Oray	Shumar	P. Gatshel
	Shapen	Brokpaling Shapen	Membi	Lhuntshi
8	Bori	Daganay Bori	Semjong	Tsirang
9	Bori	Dhulal Bori	Mendelgang	Tsirang
10	Bori	Dudey Bori	Semjong	Tsirang
11	Oray	Dungdungma Oray	Gomdar	S. Jongkhar
12	Bori	Geo Bori	Jigmecholling	Sarpang
13	Oray	Job Oray	Dramitse	Mongar
	Oray	Jog Oray Changlu	Gomdar	S. Jongkhar
	Oray	Jok Oray	Bidung	T. Gang
14	Bori	Kanchi Bori	Semjong	Tsirang
15	Oray	Kharshing Oray	Gomdar	S. Jongkhar
	Oray	Kharshing Oray	Shumar	P. Gatshel
16	Oray	Langmo Oray Serbu	Gomdar	S. Jongkhar
15	Oray	Lokpa Oray	Ngatshang, Chaskar	Mongar
16	Shapen	Moranmo Shaypen	Gangzur	Lhuntshi
	Oray	Morenmo Oray	Dramitse	Mongar
17	Orsha	Nangkorpa Orsha	Radhi	T. Gang
18	Oray	Oray	Shumar	P. Gatshel
	Oray	Oray	Wamrong	T. Gang
19	Oray	Oray Balingbi	Gomdar	S. Jongkhar
20	Oray	Oray Mingba	Gomdar	S. Jongkhar
21	Oray	Oray Serbu	Gomdar	S. Jongkhar
	Oray	Oray Serbu	Shumar	P. Gatshel
	Oray	Oray Serbu	Ngatshang	Mongar
22	Oray	Oray Tsalu	Shumar	P. Gatshel
	Oray	Oray Tsalu	Ngatshang, Mongar	Mongar
	Oray	Oray Tsalu	Uzorong	T. Gang
23	Oray	Patang Oray	Shumar	P. Gatshel

	Oray	Patang Oray	Thangrong	Mongar
24	Oray	Pingkulung Oray	Gomdar	S. Jongkhar
25	Oray	Pompaling Oray	Gomdar	S. Jongkhar
26	Oray	Ru Oray	Jamkhar	T. Yangtse
27	Semchum	Semchum Sep	Doga	Paro
28	Shaypen	Shaypen	Gangzur	Lhuntshi

### 13.10.2 Pea

Sl.no	Local Name	Landrace	Geog	Dzongkhag
1	Boesem	Boesem	Naja	Paro

### 13.10.3 Vigna

Sl No.	Local Name	Landrace	Geog	Dzongkhag
1	Goibee	Goibee	Yurung	P. Gatshel
2	Dhal	Kalo Dhal	Mendelgang	Tsirang
3	Nangmai	Nangmai	Shumar	P. Gatshel
	Nangmay	Nangmay	Thangrong	Mongar
4	Shagpu	Shagpu	Serthig	S. Jongkhar
5	Shagpu	Shagpu Tsalu	Serthig	S. Jongkhar
6	Shengjee	Shengjee	Ngatshang	Mongar
	Singye	Singye	Shumar	P. Gatshel
	Shengji	Shengji	Wamrong	T. Gang
	Shenji	Shenji	Lauri, Serthig, Orong	S. Jongkhar
7	Dhal	Pahelo Dhal	Gumauney	Samtse
	Dhal	Pahelo Dhal	Phuntsholing	Chukha

### 13.10.4 Soybean

Sl	Local			
No	Name	Landrace	Geog	Dzongkhag
1	Leebi	Leebi	Bidung	T. Gang
	Leebi	Leebi	Yurung	P. Gatshel
	Leebi	Leebi	Dramitse	Mongar
2		Leebi		
	Leebi	Balingmi	Lauri	S. Jongkhar
3	Leebi	Leebi Changlu	Lauri	S. Jongkhar
4	Leebi	Leebi Daza	Lauri, Serthig	S. Jongkhar
5	Sem Kaap	Sem Kaap	Khamey	Gasa

### Annex 13.11. Oil seeds

### 13.11.1 Mustard

Sl No	Local Name	Landrace	Geog	Dzongkhag
1	Memba	Changlu	Gomdar	S. Jongkhar
2			Puntenchu, Semjong,	
	Tori	Kalo Tori	Mendelgang	Tsirang
	Tori	Kalo Tori	Darla	Chukha
	Tori	Kalo Tori	Jigmecholling	Sarpang
3	Memba	Mem Serbu	Chaskar	Mongar
	Memba	Memba Serbu	Gomdar, Serthig, Lauri	S. Jongkhar
	Membu	Membu Serbu	Kanglung	T. Gang
	Membu	Membu serbu	Zobel	P. Gatshel
4	Memba	Memba	Dramitse	Mongar
	Memba	Memba	Lauri	S. Jongkhar
5	Membu	Membu Tsalu	Shumar	P. Gatshel
6	Peyka	Peyka	Mewang	Thimphu
7			Mendelgang, Semjong,	
	Tori	Sorshung	Puntenchu	Tsirang
	Tori	Sorshung Tori	Samtse	Samtse
8	Yukar	Yukar Nontila	Drakteng	Trongsa

### 13.11.2 Niger

Sl.No	Local Name	Landrace	Geog	Dzongkhag
1	Feeling	Feelingay	Gomdar	S. Jongkhar
	Feelingay	Feelingay	Semjong	Tsirang
	Feelingay	Feelingay	Darla	Chukha
	Feelingay	Feelingay	Semjong	Tsirang
2	Namjur	Namjur	Serthig	S. Jongkhar

Total of 999 accessions of above traditional varieties of crops have been processed and being conserved in the GeneBank. About 1000 samples are under process of cleaning, viability testing, drying, seed moisture content testing, seed quantity determination, packaging and documentation for the registration into the Gene Bank.

### Annex 11: Schedule of Inventory of PGRFA

Geog/Represe ntative sites	Schedule	RNRRC	Staff responsible
Chokor & Tang	3/05/02 to 16-06/02	RC-Bjakar	Karma Dema, Chogyal Dendup, Tashi Tshering, Wangda, Pema Yuden, Luda Wangdi, Chimi Lhamo, Dorji, Rabgay, Karma Chophel, Jigme Dorji, Tshering Dendup
Katso & Bji	3/4/03	RC-Yusipang	Dolo Dukpa, Cheki Wangmo, Tshering
Mewang	8/5/02 to 7/6/02	RC-Yusipang	Kinley, Hema, Mumta Chetri
Doga & Shaba	28/5/02 to 9/6/02	RC-Yusipang	Karma Wangchuk, P.L Giri, D.B Rana, Mumta Chetri, Lekjay, Hema
Drakten & Korpho	17/4/03 to 21/4/03	RC-Bjakar	Lekjay, Dorji, Gallay, C Dorji.
Kabjisa <i>,</i> Teowang	16/5/02 to 28/5/02	RC- Bajo	Deo Kumar, Aita, Neelam Pradhan, Karma, Jambay
Rupaisa, Kazi	6/3/03 to 31/3/03	RC- Bajo	Sonam, Karma, Neelam Pradhan, Zangmo, Minjur
Yangneer	19/5/03 to 23/5/03	RC Khangma (Wengkhar)	Dendup Wangchuk, Tshewang Dorji, L N Sharma, N B Adhikari, Tshewang, Tshering.
Kengkhar	10/5/04 to 12/5/03	RC Khangma (Wengkhar)	Rinzin Choney, P B Biswa, N B Adhikari, Phuntsho, Tenzin Phuntsho
Bomdeling	14/8/02 to 15/8/02	RC Khangma (Wengkhar)	Tshewang Dorji, Pushpalal Khatiwara, Karma Wangdi, N B Adhikari
Zobel	22/5/03 to 23/5/03	RC Khangma (Wengkhar)	Lhatshola, T B Katwal, L N Sharma, Rinchen Dorji
Nangkhor	12/5/03 to 18/5/03	RC-Bjakar	Lekjay, Dorji, Dophu
Puntenchu, Mendalgang	10/4/02 to 18/4/02	RC Bajo	Doley, Neelam, Karma, Rinzin Chuni, Durba,
Tseza	15/5/03 to 21/5/03	RC-Bajo	Kinley Namgay, Neelam Prodhan, Karma
Balujora	9/4/03 to 16/4/03	RC Yusipang	PL Giri, DB Rana
Dovan	1/1/03 to 5/1/03	RC-Bjakar	C Dorji, Dorji, Sarita Rai, Choeda, Wangda Dukpa,
Tendu	15/5/03 to 20/5/03	RC-Yusipang	P L Giri, D B Rana
Hilley	6/7/02 to 10/7/02	RC-Bjakar	Pema Wangchuk, Sarita Rai, Wangda Dukpa, Choeda
Orong Menzi	8/4/03 to 13/4/03	RC-Khangma (Wengkhar)	Phuntsho, N B Adhikari

## Annex 12. Dzongkhag Agricultutural officers and AEOs involved in collection of additional information.

The following staff were involved in gathering additional information from the sites in 2007.

Dzongkhag	Geog	Staff involed in collecting additional information
Tsirang	Mendeygang, Puntenchu	Mr. Sonam (DAO)
Samchi	Tendu	Ms. Sherub Chezom (AEO)
Trongsa	Korphu	Ngawang Chogyal (DAO)
Dagana	Tseza	Jigmi Dorji(DAO)
Sarpang	Hillay	Sangay Wangdi (AEO)
Zhemgang	Nangkor	Sonam Wangdue AEO)
S/Jongkhar	Orong	G.S.Rai (DAO)
Wangdue	Kazhi, Rupaisa	Suraj Gurung, Dorji Gyeltshen, Kinley Dukpa (AEOs)
Thimphu	Mewang	Kinley Om (AEO)
Chukha	Balujhora/Sampheling	Dechen Wangmo (AEO)
T. Gang	Yangneer	Tshering (AEO)
Lhuntshi	Menji	Karma Wangchuk (AWO)
Punakha	Kabji, Toewang	Suraj Khawas, D.K.Sharma (AEO)
На	Katsho	Kinley Dukpa (AEO)

