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ANNUAL REPORT

2076/77 (2019/20)

Government of Nepal

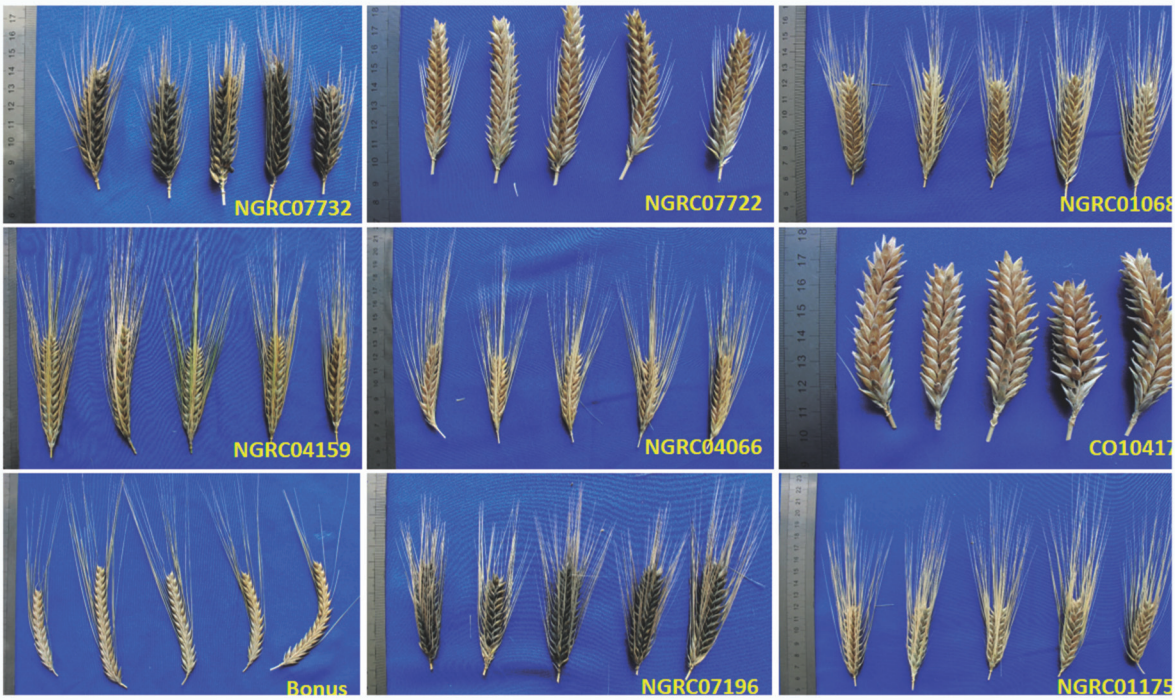
Nepal Agricultural Research Council

National Agriculture Genetic Resources Centre

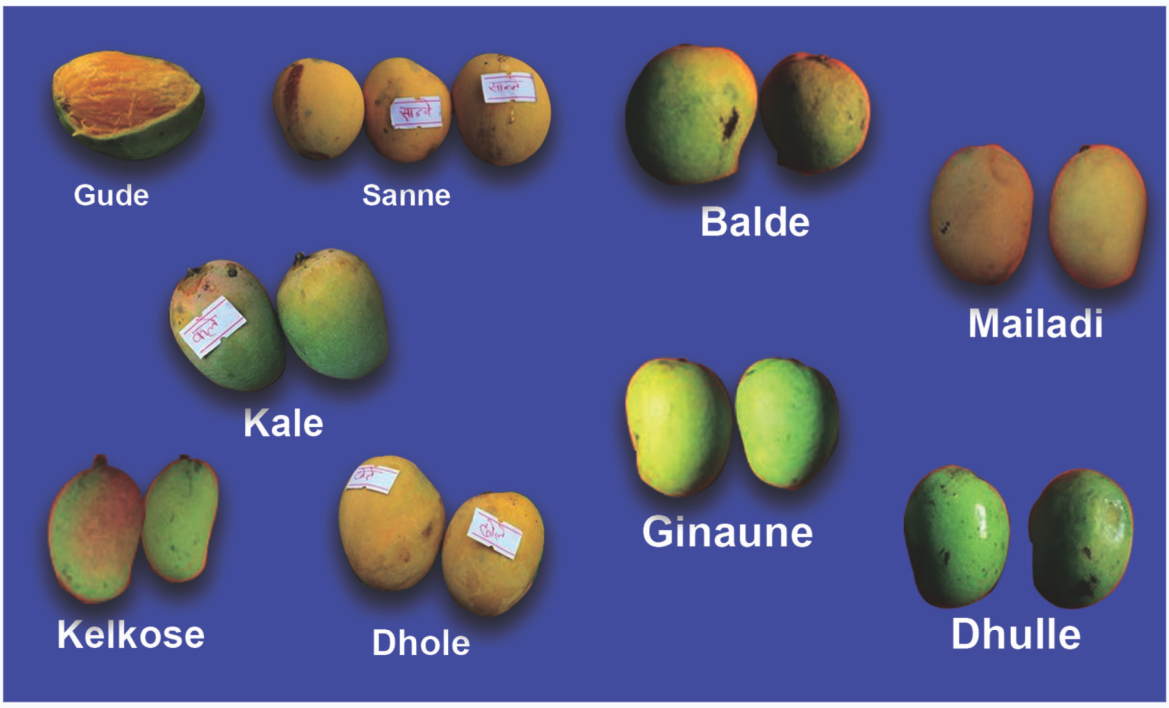
(GENEBANK)

Khumaltar, Lalitpur, Nepal

2020



Barley Diveristy at Genebank



Mango Diversity

Annual Report

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Government of Nepal
Nepal Agricultural Research Council
National Agriculture Genetic Resources Centre (NAGRC), Genebank
Khumaltar, Lalitpur, Nepal

2020

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Cover Page Photo

Background: Fingermillet Crop at Tatopani Rural Municipality, Jumla

Foreground: (From left to right: Sakini chicken, Unique popcorn landrace, Butter tree seed (Chiuri) Radish Diversity, Unique Cucumber Landrace, Indigenous fishes at local market

Bottom left: Barnyard millet at Genebank

FOREWORD

Nepal is one of the world's most biologically and culturally diverse countries. It is also one of the poorest in terms of per capita income. Conserving the genetic diversity of our crops, landraces and related wild species is essential to ensure future plant breeders can access this variation, especially in view of increased food demand by a growing population and climate change. Gene banks are repositories where biological material is collected, stored, catalogued and made available for redistribution. Agrobiodiversity loss leads to genetic erosion, the loss of genetic diversity, including the loss of individual genes, and the loss of particular combinations of genes such as those manifested in locally adopted landraces or breeds. The lack of diversity makes the population vulnerable to disease, pest or other abiotic stress. The problem of genetic vulnerability often arises with modern crop varieties, for solving such problem it needs to conserve agrobiodiversity.

This year NAGRC had two regular and four special projects, implemented by 20 staff. Four conservation strategies (ex-situ, on-farm, in-situ and breeding) have been adopted in collaboration with different research stations, department of agriculture, department livestock services, department of forests and soil conservation, provincial and local governments, universities, I/NGOs and communities.

This report covers wide areas of conservation and utilization of native agricultural genetic resources conducted in FY 2019 /20 and will be very useful for researchers, students, policy makers and farmers. NAGRC feels happy to share germplasm, knowledge and data, and therefore welcomes all.

I am very thankful to Dr. Bal Krishna Joshi, Krishna Hari Ghimire, Ajaya Karkee, Ram Prasad Mainali, Pradip Thapa and Surendra Shrestha for continuous hard work to give final shape of this annual report. I would also like to extend thanks to Mrs. Januki Giri, Mr. Lila Bahadur Jirel, Shiva Kumar Budathoki for continued support. Last but not least, the Nepal Agriculture Research Council (NARC), Bioversity International, NIAS, SDC and IFAD are highly acknowledged. Let's work together for making existing agrobiodiversity available forever to all at free of cost. I would sincerely appreciate and welcome for constructive comments and suggestion of the report.

Dr. Krishna Kumar Mishra
Chief, Nepal Genebank
Khumaltar, Lalitpur
01 October 2020

ABBREVIATIONS

ABD	Agriculture Botany Division
ABrD	Animal Breeding Division
ACR	Active Collection Room
APGR	Agricultural Plant Genetic Resources
ARS	Agriculture Research Station
BCR	Base Collection Room
BI	Bioversity International
CAT	Climate Analogue Tool
CBD	Convention on Biological Diversity
CBR	Community Biodiversity Register
CFG	Communality Field Genebank
CGIAR	Consultative Group of International Agricultural Research
CSB	Community Seed Bank
CWR	Crop Wild Relative
DNA	Deoxyribose Nucleic Acid
DoA	Department of Agriculture
ELISA	Enzyme- Linked Immunosorbent Assay
EPB	Evalutionary Plant Breeding
FAO	Food and Agriculture Organization
GEF	Global Environmental Facility
GIS	Geographic Information System
HCRP	Hill Crops Research Program

HFG	Household Level Field Genebank
HG	Household Genebank
IAAS	Institute of Agriculture and Animal Science
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
ISTA	International Seed Testing Association
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LCP	Local Crop Project
LI-BIRD	Local Initiatives for Biodiversity Research and Development
MALIM	Mangement of Aqua, Livestock, Insect and Microorganism genetic resources
M&E	Monitoring and Evaluation
MLS	Multi-Lateral System
MoALD	Ministry of Agriculture and Livestock Development
NAGRC	National Agriculture Genetic Resources Centre
NARC	Nepal Agricultural Research Council
NGLRP	National Grain Legume Research Program
NGO	Non-Governmental Organization
NGRC	Nepal Genetic Resources (Orthodox)
NGRV	Nepal Genetic Resources (Non- orthodox)
NIL	Near Isogenic Lines
NMRP	National Maize Research Program
NPC	National Project Coordinator
NPRP	National Potato Research Program

PCR	Polymerase Chain Reaction
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PIC	Polymorphic Information Content
RAPD	Random Amplified Polymorphic DNA
RARS	Regional Agriculture Research Station
RCBD	Rendomized Complete Block Design
RIL	Recombinant Inbred Lines
RNA	Ribose Nuclic Acid
SAHAS Nepal	Group of Helping Hands, Nepal
SQCC	Seed Quality Control Centre
SSR	Simple Sequence Repeat
SSTD	Seed Science and Technology Division
TOR	Terms of Reference
UNEP	United Nations Environment Facility
VDC	Village Development Committee
VFG	Village-level Field Genebank
WSV	World Seed Vault

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बीउ बैंक

- बिभिन्न ५० वटा बालीहरुको १,७२८ जातका नमुनाहरु सफा गरी उमारशक्ति परीक्षण गरिएको।

- बिभिन्न ४९ वटा बालीहरुको ५५० जातहरुको नयाँ दर्ता गरी बीउलाई मध्यमकालीन तथा दीर्घकालीन भण्डारण गरिएको साथै २५ बालीका २५० जातहरुलाई पुनरोत्पादन पश्चात् मध्यमकालीन भण्डारणमा राखिएको ।

फिल्ड जीन बैंक

- कम चिस्यानमा धेरै सुकाएर बीउ भण्डार गर्न नसकिने प्रजातिहरु (species having recalcitrant seeds) र वानस्पतिक प्रसारण हुने प्रजातिहरु (vegetatively propagated species) को संरक्षणको लागि केन्द्रको १,५०० व.मी. क्षेत्रफलमा फिल्ड जीन बैंकको स्थापना भएको ।

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- बिभिन्न २८ बालीका ३२ उत्कृष्ठ जातहरु केन्द्रको विविधता ब्लकमा प्रदर्शन तथा ब्यवस्थापन गरिएको ।

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डि. एन. ए. बैंक

- डि.एन.ए. बैंकमा ८ जातका रायो, ७७ जातका धान, ७२ जातका गहुँ, २३ जातका मकै, ४० जातका कोदो, ८३ जातका आँप, ११ जातका मुला र २५ जातका अकबरे खुर्सानीका डि.एन.ए. संरक्षण गरिएको ।

कृषकको खेतबारीमा संरक्षण (On-farm Conservation)

- बिभिन्न ९ वटा सामुदायिक बीउ बैंकहरुलाई प्राविधिक सहयोग उपलब्ध गराइएको ।
- पुरानो बंगैचाबाट उद्धार गरिएका ११ वटा आँपका जातहरुको कलमी क्षेत्रीय कृषि अनुसन्धान केन्द्र, परवानिपुरमा अनुगमन गरिएको ।

चरित्र चित्रण, मुल्यांकन तथा पूर्व बाली प्रजनन्

- बिशिष्ठ चरित्र चित्रण निर्देशिका (Standard characterization descriptors) को प्रयोग गरेर यस केन्द्रमा जम्मा १६ वालीहरुको ११२८ जातहरुको गुणात्मक तथा मात्रात्मक चरित्रहरुको बिश्लेषण तथा मुल्यांकन गरिएको ।

आंकडा व्यवस्थापन

- अल्पकालीन, मध्यमकालीन तथा दीर्घकालीन संरक्षणमा राखिएका सम्पूर्ण नयाँ संकलनहरुको आंकडा पूर्ण रुपमा ब्यवस्थित गर्ने तथा पुराना संकलनको रिक्त आंकडाहरु पुरा गर्ने काम भइरहेको । हाल सम्म ८,७४५ जातहरुको साथै यसको आंकडा जीन बैंकमा सुरक्षित रहेको छ ।

EXECUTIVE SUMMARY

Collection and Distribution

- Exploration and collection of agricultural plant genetic resources are the regular activities of genebank. A total of 1,087 samples of 79 different food crop species were collected from 19 districts during the year. The maximum diversity was collected from Ramechhap district with 594 accessions of 51 crops.

- One of the main objectives of germplasm conservation in the gene bank is the utilization of this genetic material in plant breeding and related activities. Seeds of 653 local landraces of 11 crops were distributed to different offices and breeders (NARC divisions, programs and stations, Universities, Seed companies, NGOs and Farmers) for research purpose.

Conservation

Regeneration and Multiplication

- A total 996 accessions of 25 different crops were regenerated and seed increased at NAGRC Khumatar.

Seed Bank

- Seed samples from 1,728 accessions of 50 crop species were cleaned and germination was tested.

- Seed of 550 accessions of 49 different crop species were conserved as new entries in active and base collections. A total 250 accessions of 25 crops were regenerated and kept in medium term conservation.

Field Genebank

- Field gene bank has been established in 1,500 m^2 for vegetatively propagated crops and crops with recalcitrant seeds established.

- A total of 241 accessions of 34 various recalcitrant species (12 accessions of chayote, 86 accessions of turmeric, 55 accessions of taro, 49 accessions of garlic, 2 accessions of sugarcane, 36 accessions of 29 different species of fruit crops etc.) have been collected from different places and maintained in Khumal field genebank.

- A total of 32 elite lines of 28 species were displayed and maintained at diversity block of NAGRC.

Tissue Bank

- A total of 96 accessions of potato, sweet potato and large cardamom has been maintained in Tissue Bank.

DNA Bank

- DNA of 8 accessions of leaf mustard, 25 accessions of chilli, 77 accessions of rice, 72 accessions of wheat, 40 accessions of finger millet, 23 accessions of maize, 83 accessions of mango and 11 accessions of radish were preserved in DNA bank.

On-farm Conservation

- Nine different community seed banks across the country were technically supported.

- Propagation status of rescued scion of 11 mango accessions from the old orchard monitored at Directorate of Agricultural Research, Province-2, Parwanipur.

- A total of 84 mango accessions (39 from Doti and 45 from Lamjung) were characterized using 35 morphological and 20 SSR markers.

Characterization, Evaluation and Pre-Breeding

- A total of 1128 accessions of 16 different crops were characterized and evaluated using the descriptors developed by IPGRI and other concerned international institutions.

Database Management

- Passport data of all new collections and accessions conserved in short, medium and long term storage are maintained and updated passport data of some previous collection. Till now 8,745 crops preserved at gene bank facility with its passport.

1. WORKING CONTEXT

While collecting, all kinds of agricultural genetic resources i.e. orthodox types, recalcitrant types and vegetatively propagated crop species are being collected along with passport descriptors. Some of the major problems associated during collections are:

- Many farmers are not interested to provide seed samples
- Diversity are not being captured due to very few seeds from farmers
- Collections are generally from farm store not from standing crops, due to which diversity in the collection could not be as it should be
- During collection, collectors always are facing difficulty on identifying the samples
- Difficulty on duplicates identification and possibility of collecting many duplicates

Collected germplasm are characterized and evaluated in Khumaltar and in NARC stations as necessary and the collections, which meet the Genebank standard, are assigned accession number (permanent identification number). Database of each accession is maintained and made accessible to all. Considering conservation through utilization, Genebank encourages all agriculturists to utilize landraces as much as possible. For the better management, conservation and utilization of agricultural genetic resources, all related stakeholders should be involved; therefore, Genebank has initiated to work with all stakeholders.

Requirements for getting accession number to each variety

NAGRC needs both e-copy and print copy of 1. Passport data, 2. Characterization and evaluation data, 3. Photos, 4. Enough fresh seeds (1/2 to 1 kg), if not seed (or non-orthodox crops), then field genebank information with photos and 5. Proposal submitted to seed quality control center (Sqcc).

- For non-orthodox crops, respective station should maintain variety in Field Genebank
- It takes two to three weeks to get accession number, as we need a germination report. If germination is less than 85%, NAGRC does not assign a number.
- We do not provide accession number to F_1 hybrid but provide to their parental lines

Our request

Genebank has requested all concerned stakeholders to consider following points for conservation and utilization of agricultural genetic resources (AGRs)

1. Publication of detail profile / catalog of germplasm, genotypes, varieties, breeds (all genotypes that office own) and creation of their image bank.
2. Establishment and maintenance of field genebank, crop-specific parks, aqua pond genebank and livestock / poultry farm genebank
3. Development of database of all local agricultural genetic resources available in command area of the respective office. Agricultural genetic resources include

crop genetic resources, livestock genetic resources, forage genetic resources, aquatic genetic resources, insect and micro-organism genetic resources including domesticated/cultivated, semi-domesticated and wild edible and wild relatives of cultivated and domesticated genetic resources)

4. Adoption of accessioning system of germplasm in research (availability of research findings and materials forever to all)
5. Linkage establishment with protected areas, world heritage site, Ramsar and religious sites for conservation of crop wild relatives, wild edible plants and others and community for on-farm conservation
6. Sending any local germplasm along with passport data that are available in the office to National Genebank

2. INTRODUCTION

Nepal is rich in agrobiodiversity and the national economy is based on the goods and services derived from these resources. Diverse agro-climatic environments with complex and varied farming systems, a broad mixture of ethnicity and races, varied socioeconomic settings, big differences in altitude and complex topography are the factors to create an array of micro-niches with huge agricultural diversity in the country. Three physiographic zones of Nepal, Tarai, Hill and Mountain experience a wide range of climate from tropical to temperate and arctic. The variation is mainly attributed to immense changes in elevation with the greatest range of altitude on earth, from 60 to 8848m. Prevailing of six seasons in Nepal indicate the unique climatic variation. Due to this variation across the country, diverse forms of genetic resources are being evolved and maintained.

Genetic resources are essential for sustainable development of human life. The nation holds 0.03% of earth's landmass, however, it supports 2.2% of flowering plants, 1.4% of reptiles, 2.2% of fish, 8.5% of birds, 4.2% of butterflies and 4% of mammals. Out of about 410 angiosperm families in the world, 203 (almost 50%) are found in Nepal. The Biodiversity Profiles Project (1995) ranked Nepal as having the tenth richest flowering plant diversity in Asia and 31ston a world scale.

The plant products account for the majority portion of the global food supply. Globally, over 84% of the human diet and nutrition come from plants. In Asia and the Pacific, the Near East and Africa plants provide around 90% of the average human diet. However, human beings are dangerously relying on only a few crop species. Out of the 10,000 to 12,000 known edible plant species, only 150 to 200 are used by humans and three of them alone i.e. rice, wheat and maize contribute nearly 60% of calories and proteins that humans obtain from plants.

Meeting the expected increase in food demand is not an easy task. About half of the average global production increase in cereals that were achieved under the Green Revolution was attributable to plant breeding utilizing plant genetic resources. The other half came from altered agricultural practices such as the use of fertilizers, pesticides, irrigation and expansion of cultivated areas. Since the natural resources, on which agriculture rely are finite and, in some cases, even declining, these agricultural

practices cannot be sustained over the long run. This suggests that the role of crop diversity and plant breeding will become even more important in the near future for achieving food security in a sustainable way. Indeed, over 70% of the required production, increases by 2050 will have to come from higher yield and less than 10% can be expected from an expansion in arable land.

Crop genetic resources contain the essential building blocks that are critical to food security. They are the raw materials for the genetic improvement of food crop species by plant breeders and farmers and are essential in maintaining sustainability of the global food production system. Their availability is a fundamental requirement for achieving further productivity increase and higher nutritional values through plant breeding. Crop varieties that achieve significantly higher yields and that are able to withstand new diseases and extreme weather events will have to be developed. To develop a new variety, breeders may have to screen thousands of samples in search of a particular trait. For this, it is crucial to conserve the existing crop diversity and to allow agricultural researchers, breeders and farmers access to it. Plant genetic resources that are conserved in the gene bank can be used for:

- Safe conservation for future use
- Direct use for agricultural production
- Conservation of diversity in artificial environment
- Scientific use for experimental materials
- Genetic enhancement (pre-breeding)
- Breeding materials for the sustainable development
- Materials for repatriation

Broad genetic base of traditionally inherited cultivars and livestock breeds largely contributes to Nepal being among the world's most important areas for conservation. Nepal has biodiversity values that are of significance both nationally and internationally. Initiatives in the last four decades for agricultural modernization and commercialization have led to gradual disappearance of traditional agriculture genetic resources and indigenous knowledge, skills and technologies. The nation is now experiencing the effects of ecosystem and diversity decline along with detrimental effects of climate change. Although hybrids and modern varieties have widely replaced landraces, remote northern parts of the country that are less influenced by exotics, because of harsh environments, may function as refuges for these threatened genetic resources. This necessitates the need for conservation and sustainable use of agrobiodiversity that has potential to meet the present needs and aspirations of the future generations in the changed contest. Reasons for genetic erosion are quite diverse. Many traditional crop varieties were replaced by modern improved varieties brought about the significantly higher yield that were urgently needed to feed the growing population. According to the Food and Agriculture Organization of the United Nations (FAO), more than 75 % of global crop diversity has disappeared irrevocably over the 20thcentury (1900 to 2000). One of the most important reasons for the loss

of traditional seeds, and thereby the loss of genetic diversity, is the replacement of genetically diverse farmers' varieties with modern varieties.

A large number of wild relatives of important food crops are also likely to disappear over the next decades due to climate change and changes in agricultural practices. At the same time, crops that have historically been cultivated especially well in a given region may no longer be of use and will have to be substituted by other crops. For example, in South Asia, climate change-induced temperature rise may reduce wheat and rice productivity by 30% by the year 2030. It becomes clear that crop diversity, food security and climate change are closely linked in diverse and complex ways.

Realizing the significance of conservation and sustainable use of agrobiodiversity in national development and to meet the national obligation of implementing international agreements (the Convention on Biological Diversity, 1992 and International Treaty on Plant Genetic Resources for Food and Agriculture) the Government of Nepal and Nepal Agricultural Research Council has established the National Agriculture Genetic Resources Center (Genebank) in 2010 at Khumaltar (located at 1368 m altitude and 27°40'N, 85°20'E). The establishment of the center has become a milestone in the conservation and sustainable use of agricultural genetic resources and ensuring the availability of valuable genetic resources for prosperity. There are five units under the Genebank, namely Collection and Distribution Unit, Conservation Unit, Characterization and Evaluation Unit, Biotechnology Unit, and Documentation, Publication and Training Unit.

Table 1. Total number of accessions conserved in National Genebank

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
	Cereals	**अन्न बालीहरु**			**6456**
1	Barley	*Hordeum vulgare* L.	जौ	Orthodox	895
2	Maize	*Zea mays* L.	मकै	Orthodox	703
3	Naked Barley	*Hordeum vulgare* var. *nudum* L.	उवा, करू	Orthodox	525
4	Rice, paddy	*Oryza sativa* L.	धान	Orthodox	2605
5	Wheat	*Triticum aestivum* L.	गहुँ	Orthodox	1728
	Pseudo-cereals	**नक्कली-अन्न बालीहरु**			**778**
6	Amaranth	*Amaranthus spp*. (4 species)	लट्टे, मार्से	Orthodox	355
7	Common Buck-wheat	*Fagopyrum esculentum* Moench.	मिठे फापर	Orthodox	209
8	Tartary Buckwheat	*Fagopyrum tataricum* L. Gaertn.	तिते फापर	Orthodox	214
	Millets	**कोदो बालीहरु**			**1126**
9	Barnyard Millet	*Echinochloa frumenta-cea* Link.	सामा	Orthodox	3
10	Finger Millet	*Eluesine corocana* L. Gaertn.	कोदो	Orthodox	962

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
11	Foxtail Millet	*Setaria italica* L. Beauv.	कागुनो	Orthodox	55
12	Little Millet	*Panicum sumatrense* Roth.	कुट्कि, धान कोदो	Orthodox	2
13	Pearl Millet	*Pennisetum glaucum* L.	बाजरा	Orthodox	2
14	Proso Millet	*Panicum miliaceum* L.	चीनु	Orthodox	52
15	Sorghum	*Sorghum biclor* L.	जुनेलो	Orthodox	50
	Pulses	**दलहन बालीहरु**			**2234**
16	Adjuki Bean	*Vigna angularis* Ohwi & Ohashi	मास लहरी	Orthodox	25
17	Bean, French Bean	*Phaseolus vulgaris* L.	सिमी	Orthodox	512
18	Black Gram	*Vigna mungo* L.	मास	Orthodox	70
19	Chickpea	*Cicer arietinum* L.	चना	Orthodox	321
20	Cluster Bean	*Cyamopsis tetragonaloba* Taub.	झुप्पे सिमी	Orthodox	10
21	Cowpea	*Vigna unguiculata* L.	बोडी	Orthodox	181
22	Faba (Broad) Bean	*Vicia faba* L.	बकुला	Orthodox	25
23	Field Pea	*Pisum sativum* L.	सानो केराउ, कला	Orthodox	75
24	Grass Pea	*Lathyrus sativus* L.	खेसरी	Orthodox	140
25	Green Gram, Mung Bean	*Vigna radiata* L.	मुंग, हरियो मास	Orthodox	25
26	Horse Gram	*Dolichos biflorus* Roxb.	गहत	Orthodox	75
27	Hycinth Bean	*Dolichos lablab* L.	टाटे सिमी	Orthodox	15
28	Kidney Bean	*Phaseolus vulgaris* L.	राज्मा	Orthodox	20
29	Lentil	*Lens culinaris* Medic.	मसुरो	Orthodox	350
30	Pea	*Pisum sativum* L.	केराउ	Orthodox	50
31	Pigeon Pea	*Cajanus cajan* L. Huth.	रहर	Orthodox	20
32	Rice Bean	*Vigna umbellata* Thung. *Ohwi & Ohashi*	मस्यांग, सिल्टुङ	Orthodox	106
33	Soybean	*Glycine max* L. Merr.	भटमास	Orthodox	209
34	Sword Bean	*Cannavalia ensiformis* (L.) DC.	टाटे, तरवारे सिमी	Orthodox	5
	Oilseed Crops	**तेल बालीहरु**			**297**
35	Castor	*Ricinus communis* L.	अंडिर	Orthodox	5
36	Groundnut	*Arachis hypogaea* L.	बदाम	Orthodox	15
37	Linseed	*Linum usitatissimum* L.	आलस	Orthodox	21
38	Mustard, Rapeseed	*Brassica campestris* L. var. *toria* Duth & Full	तोरी	Orthodox	145
39	Niger	*Guizotia abyssinica* L. Cross	फिलिंगे, झुसे तिल	Orthodox	15

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
40	Perilla	*Perilla frutescens* L.	सिलाम, तिल्खुरो	Orthodox	21
41	Safflower	*Carthamus tinctorius* L.	कुसुम	Orthodox	2
42	Sarson	*Brassica campestris* L. *var. sarson* Prain.	सरस्यूं	Orthodox	24
43	Sesame	*Seasamum indicum* L.	तिल	Orthodox	44
44	Sunflower	*Helianthus annuus* L.	सुर्यमुखी	Orthodox	5
	Sugar and Starch Crops	**चिनी, जरे बालीहरु**			**113**
45	Cassava	*Monihot esculenta* Crantz.	सिमल तरूल	Vegetative	2
46	Potato	*Solanum tuberosum* L.	आलु	Orthodox, Vegetative	49
47	Sugar Beet, Beet Root	*Beta vulgaris* L.	चुकन्दर	Vegetative	1
48	Sugarcane	*Saccharum officinarum* L.	उखु	Vegetative	10
49	Sweet Potato	*Ipomoea batatas* L. Lam.	सखरखण्ड	Vegetative	51
	Vegetables	**तरकारी बालीहरु**			**843**
50	Air Potato	*Dioscorea bulbifera L.*	गिठ्ठा	Vegetative	2
51	Ash Gourd	*Benincasa hispida* Thunb.	कुभिण्डो	Orthodox	2
52	Asparagus	*Asparagus officinalis* L.	कुरिलो	Orthodox	1
53	Balsam Apple	*Momordica balsamina* L.	बरेला, करेला, चुच्चे करेला	Orthodox	32
54	Bitter Gourd	*Momordica charantia* L.	तिते करेला, करेला	Orthodox	16
55	Bottle Gourd	*Lagenaria siceraria* Standl.	लौका	Orthodox	14
56	Brinjal, Egg Plant	*Solanum melongena* L.	भण्टा	Orthodox	39
57	Broad Leaf Mustard	*Brassica juncea* L.	रायो	Orthodox	53
58	Broccoli	*Brassica oleracea* L. Var. *italica* Plenck	ब्रोकाउली	Orthodox	1
59	Cabbage	*Brassica oleracea* L. Var. *capitata* L.	बन्दा	Orthodox	1
60	Calabash Tree	*Crescentia cujete* L.	पेडार, रूख लौका	Recalcitrant	1
61	Carrot	*Dacus carota* L.	गांजर	Orthodox	10
62	Cauliflower	*Brassica oleracea* L. Var. *botrytis* L.	फुलगोबी, काउली	Orthodox	1
63	Chayote	*Sechium edule* Jacq.	स्कुस, ठुलो करेला	Vegetative	49

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
64	Chinese Mallow, Cluster Mallow	*Malva verticillata*L.	लाफा साग, चिप्ले साग	Orthodox	5
65	Cucumber	*Cucumus sativus* L.	कांक्रो	Orthodox	67
66	Drumstick	*Moringa oleifera* Lam.	सजिवन	Orthodox	1
67	Edible Canna, Achira	*Canna edulis* Ker Gawl.	पुष्टकारी, फुल तरूल	Orthodox, Vegetative	2
68	Elephant Yam	*Amorphophallus campanulatus* Roxb.	ओल	Vegetative	2
69	Five Leaf Yam	*Dioscorea pentaphyla L.*	भ्याकुर	Vegetative	2
70	Garden Cress	*Lepidium sativum* L.	चमसुर	Orthodox	42
71	Garlic Pear	*Crateva religiosa* G. Forst	सिप्लीगान	Vegetative	2
72	Indian Pokeweed, Sweet Belladonna	*Phytolacca acinosa* Roxb.	जरिंगो साग	Orthodox	4
73	Indian Spinach, Malabar Spinach	*Basella alba* L.	पोइ साग	Orthodox	3
74	Knol-Khol	*Brassica oleracea* Var. *gongylodes* L.	ग्याठ गोभी	Orthodox	1
75	Lamb's Quarter	*Chenopodium album* L.	बेथे	Orthodox	6
76	Lettuce	*Brassica japonica* Thb. Sieb	जिरिको साग	Orthodox	15
77	Okra, Lady's Finger	*Abelmoschus eschulentus* L. Moench.	भिण्डी, रामतोरिया	Orthodox	128
78	Pointed Gourd	*Trichosanthes dioica* Roxb.	परवल	Orthodox	2
79	Pumpkin	*Cucurbita moschata* Duchesne.	फर्सि, कद्दु	Orthodox	90
80	Radish	*Raphaus sativus* L.	मुला, चोतो	Orthodox	69
81	Ridge Gourd	Luffa acutangula L. Roxb.	तिरई, पाटे घिरौंला	Orthodox	12
82	Roselle	*Hibiscus sabdariffa* L.	अमिली भिण्डी	Orthodox	1
83	Snake Gourd	*Trichosanthes cucumerina* L.	चिचिण्डो	Orthodox	5
84	Spinach	*Spinacia oleracea* L.	पालुंगो	Orthodox	6
85	Spine Gourd	*Momordica dioica* Roxb.	चटेल, झुसे करेला	Orthodox	1
86	Sponge Gourd	*Luffa aegyptiaca* Mill.	घिरौंला	Orthodox	32
87	Tamarillo, Tree Tomato	*Solanum betaceum* Cav.	रूख टमाटर	Orthodox	5
88	Taro	*Colocasia esculenta* L.	पिंडालु	Vegetative	51
89	Tomato	*Lycopersicon lycopersicum* L. Karsten	गोलभेडा, टमाटर	Orthodox	34
90	Turnip	*Brassica rapa* L. var. *rapa*	सलगम	Orthodox	3

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
91	Water Spinach, Morning Glory	*Ipomoea aquatica* Forssk.	काङकुन साग	Orthodox	1
92	Yam	*Dioscorea alata* L.	तरूल	Vegetative	28
93	Yam Bean, Kesaur	*Pachyrhizus erosus* (L.) Urb.	केसौर	Orthodox	1
	Fruits	**फलफुल बालीहरु**			**86**
94	Apple	*Malus pumila* Miller.	स्याउ	Intermediate	2
95	Apricot	*Prunus armenicana* L.	खुर्पाने	Intermediate	1
96	Areca nut	*Areca catechu* L.	सुपारी	Intermediate	1
97	Avocado	*Persea Americana* Mill.	घिउ फल	Recalcitrant	5
98	Banana	*Musa paradisiaca* L.	केरा	Vegetative, Orthodox	5
99	Butter Tree	*Aesandra butyracea* Roxb.	चिउरी	Recalcitrant	1
100	Chestnut	*Catanopsis tribuloids* Sm.	कटुस	Recalcitrant	1
101	Citron	*Citrus medica* L.	बिमिरो	Vegetative	2
102	Custard Apple	*Annona squasmosa* L.	सिताफल, सरिफा	Orthodox	1
103	Dragon Fruit	*Hylocereus undatus* Haworth.	ड्रागन फल	Vegetative	1
104	Fig, Common Fig	*Ficus carica* L.	अंजिर	Orthodox	1
105	Grape	*Vitis vinifera* L.	अंगुर, दाख	Vegetative	1
106	Ground Apple, Yacon	*Smallanthus sonchifolius* (Poepp.) H. Rob.	भुइँ स्याउ	Vegetative	1
107	Guava	*Psidium guajava* L.	अम्बा	Orthodox	5
108	Hazel Nut	*Juglans nigra* L.	दाते ओखर	Orthodox	2
109	Emblic Myrobalan, Indian Gooseberry	*Phylanthus emblica* L.	अमला	Intermediate	1
110	Indian Plum	*Zizyphus jujube* Mill.	वयर	Orthodox	1
111	Jack Fruit	*Artocarpus heterophyllus* Lam.	कटहर	Recalcitrant	1
112	Kumquat	*Citrus japonica* Thunb.	मुन्तला	Intermediate	3
113	Lemon	*Citrus limon* L. Osbeck.	निबुवा, ज्यामिर	Intermediate	2
114	Lime	*Citrus aurantifolia* Christm.	कागती	Intermediate	3
115	Trifoliate	*Citrus trifoliata* L.	तिनपाते	Intermediate	1
116	Litchi	*Litchi chinensis* Sonn.	लिची	Recalcitrant	1
117	Mandarin Orange	*Citrus reticulate* Blanco.	सुन्तला	Intermediate	2
118	Mango	*Mangifera indica* L.	आंप	Recalcitrant	3
119	Mulberry	*Morus alba* L.	किम्बु	Orthodox	2

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
120	Nepalese Hog Plum	*Choerospondias axillaris* Roxb.	लप्सि	Recalcitrant	2
121	Olive	*Actinidia deliciosa A.Chev.*	जैतुन	Orthodox	1
122	Papaya	*Carica papaya* L.	मेंवा	Intermediate	1
123	Passion Fruit	*Passiflora edulis* Sims.	लहरे आँप	Orthodox	1
124	Peach	*Prunus persica* L. Batsch.	आरू	Intermediate	2
125	Pear	*Pyrus communis* L.	नासपाती	Intermediate	2
126	Pecan nut	*Carya illinoinensis* Wangenh.	पिकानट, ओखर	Orthodox	2
127	Pepino Melon	*Solanum muricatum* Aiton	पेपिनो मेलन	Vegetative	1
128	Persimmon	*Diospyros virginiana* L.	हलुवावेद	Recalcitrant	3
129	Pineapple	*Ananas comosus* L. Merr.	भुइकटहर	Vegetative	1
130	Plum	*Prunus domestica* L.	आलु बखडा	Intermediate	3
131	Pomegranate	*Punica granatum* L.	अनार	Recalcitrant	2
132	Pumelo	*Citrus maxima* Merr.	भोगटे, संखत्रो	Intermediate	3
133	Rough Lemon	*Citrus jambhiri* Lush.	काठे ज्यामिर	Intermediate	1
134	Strawberry	*Fragaria vesca* L.	भूइँ काफल	Orthodox, Vegetative	1
135	Sweet Orange	*Citrus sinensis* L. Osbeck.	मौसम, जुनार	Intermediate	2
136	Walnut	*Juglans regia* L.	ओखर	Orthodox	2
137	Water Melon	*Citrullus lanatus* Thunb.	तरबुजा	Orthodox	1
138	Wood Apple	*Aegle marmelos* L. Correa.	बेल	Intermediate	1
139	Chebulic Myrobalan	*Terminalia chebula* Retz.	हर्रो	Orthodox	2
140	Belliric Myrobalan	*Terminalia bellirica* (Gaertn.) Roxb.	बर्रो	Orthodox	2
	Spices	**मसला बालीहरु**			**599**
141	Black Cumin	*Nigella sativa* L.	काल जिरा	Orthodox	1
142	Thai Black Ginger	*Kaempferia parviflora* Wall.	कालो अदुवा	Vegetative	1
143	Black Pepper	*Piper nigrum* L.	मरिच	Orthodox	1
144	Cardamom	*Elettaria cardamomum* L.	सुकुमेल	Orthodox	1
145	Catmint, Catnip	*Nepeta cataria* L.	डेता	Orthodox	1
146	Chilli pepper	*Capsicum frutescens* L.	खुर्सानी	Orthodox	260
147	Coriander	*Coriandrum sativum* L.	धनिया	Orthodox	45
148	Cumin	*Cuminum cyminum* L.	जीरा	Orthodox	5
149	Fennel	*Foeniculum vulgare* L.	सौंफ	Orthodox	15

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
150	Fenugreek	*Trigonella foenum-graecum* L.	मेथी	Orthodox	10
151	Garlic	*Allium sativa* L.	लसुन	Vegetative	70
152	Ginger	*Zingiber officinale* L.	अदुवा	Vegetative	80
153	Large Cardamom	*Amomum subulatum* Roxb.	अलैचि	Orthodox	5
154	Leek	*Allium ampeloprasum* L.	छ्यापी	Vegetative	2
155	Lovage, Omum	*Levisticum officinale* Koch.	ज्वानो	Orthodox	5
156	Mountain Pepper, Litsea	*Litsea citrate* Blume.	सिल्टिमुर	Orthodox	1
157	Mint, Mentha	*Mentha spicata* L.	पुदिना	Vegetative	2
158	Vicks Plant, Peppermint	*Mentha piperita L.*	भिक्स झार	Orthodox	1
159	Basil	*Ocimum basilicum* L.	तुलसी	Orthodox	2
160	Lemon Grass	*Cymbopogon schoenanthus* L.	कागती घाँस	Vegetative	2
161	Rosemary	*Salvia rosemarinus* Spenn.	रोजमेरी	Orthodox	1
162	Onion	*Allium cepa* L.	प्याज	Orthodox	2
163	Pricky Coriander, Culantro	*EryngiumFoetidum* L.	काँडे धनिया	Orthodox	2
164	Shallot	*Allium ascalonicum* L.	छ्यापी	Vegetative	2
165	Sweet Pepper	*Capsicum annum* L. var. *annum*	भेडे खुर्सानी	Orthodox	1
166	Szechuan Button	*Acmella oleracea*(L) R.K.Jansen	मरेटी	Orthodox	1
167	Timur	*Xanthoxylum armatum* DC.	टिमुर	Orthodox	1
168	Turmeric	*Corcuma domestica* L.	बेसार, हलेदो	Vegetative	79
	Beverages and narcotics	**औद्योगिक बालीहरु**			**6**
169	Coffee	*Coffea Arabica* L.	कफी	Intermediate	2
170	Tea	*Camellia sinensis* L.	चिया	Recalcitrant	2
171	Tobacco	*Nicotiana tobacum* L.	काँचपात, सुर्ती	Orthodox	2
	Fibers	**रेसा बालीहरु**			**19**
172	Cotton	*Grossypium arboretum* L.	कपास	Orthodox	2
173	Hemp	*Cannabis sativa* L.	भाङ्ग, गाँजा	Orthodox	5
174	Jute	*Corchorus olitorius* L.	जुट	Orthodox	10
175	Sun hemp	*Crotolaria juncea* L.	सनाई	Orthodox	2
	Forages and fodders	**डाले तथा भुईं घाँसहरु**			**37**
176	Alfalfa, Lucern	*Medicago sativa* L.	लुसर्न	Orthodox	3

SN	Crop	Scientific name	नेपाली नाम	Storage behavior	Accessions, n
177	Berseem	*Trifolium alexandrinum* L.	बर्सिम	Orthodox	5
178	Cock's Foot	*Dactylis glomerata* L.	कक्स फुट	Orthodox	2
179	Fodder Fig	*Ficus semicordata* Buch.	खनायो, खन्यु	Orthodox	1
180	Mountain Ebony	*Bauhinia variegata* L.	कोइरालो	Orthodox	2
181	Napier Grass	*Pennisetum purpureum* Schumach.	नेपियर घाँस	Orthodox	1
182	Oat	*Avena sativa* L.	जै घाँस	Orthodox	9
183	Pink Ebony	*Bauhinia purpurea* L.	टाँकी	Orthodox	2
184	Red Clover	*Trifolium pretense* L.	क्लोभर	Orthodox	2
185	Rye Grass	*Lolium perenne* L.	राई घाँस	Orthodox	2
186	Setaria Grass	*Setaria viridis* L. Beauv.	कुकुर बन्सो	Orthodox	2
187	Stylo Grass	*Stylosanthis scabra* L.	स्टाइलो घाँस	Orthodox	1
188	Teosinte Grass	*Zea perennis* L.	टियोसिन्टे घाँस	Orthodox	3
189	Vetch	*Vicia sativa* L.	कुटिल कोसा	Orthodox	2
	Crop Wild Relatives	बालीका जंगली नाते दारहरू	Around 50 species		**175**
	Wild Edible Plants	जंगली खानयोग्य प्रजातिहरू	Around 50 species		**150**
	Others (Ornamental, Medicinal, etc)	अन्य	Around 50 species		**150**
	Total Species	**जम्मा संख्या**	**>330** प्रजाति		**13069**

2.1. History

Table 2. History of NAGRC, Khumaltar

Year	Milestone
1937	Start of plant exploration missions undertaken by international organizations
1940	First collection and evaluation of indigenous plants materials by the then His Majesty's Government
1972	Establishment of Vegetable Development Division with emphasis for landraces collections
1984	Establishment of Plant Genetic Resource Section in Agriculture Botany Division of NARC and actively involved in PGR exploration, collection and conservation activities
1986	Establishment of medium-term ex-situ conservation
1994	Establishment of First Community Seed Bank in Dalchowki
2003	Establishment of Community Seed Bank in Bara
2010	Establishment of National Genebank (National Agriculture Genetic Resources Center)
2012	Establishment of Field Genebank and Community Field Genebank
2013	Initiation of Tissue Bank and DNA Bank
2014	Establishment of Base Collection Room (BCR-I and BCR-II) of 100,000 accessions capacity with-18^{o}C for long-term seed conservation (50-100 years) at NAGRC
2015	Establishment of Potato Park, Sugarcane Park, Ginger and Turmeric Park
2016	Establishment of short term storage for vegetatively propagated and recalcitrant crops
2016	Establishment of aqua pond genebank

2.2. Mission

Conservation and sustainable use of agricultural genetic resources for sustained agricultural growth and livelihood.

2.3. Objectives

1. To explore, collect and conserve agricultural genetic resources for promoting sustainable use.
2. To manage and handle the agricultural genetic resources scientifically in the country according to the rules and regulations of genetic resources movement.
3. To identify the endangered, rare and unique genetic resources and give emphasis to conserve them
4. To create a single-entry point to get access to agricultural genetic resources and associated data.
5. To locate the center of diversity of all economical crop species in the country.
6. To characterize and evaluate genetic resources and avail the resources to

researchers, academicians, farmers, entrepreneurs and related stakeholders.

7. To screen genetic resources and identify markers associated with particular traits and develop elite lines through pre-breeding.
8. To manage database associated with each accession including passport, characterization, evaluation and traditional knowledge.

2.4. Conservation Strategies

Different conservation strategies have been considered so that they complement each other and help to conserve maximum diversity as much as possible. Ex-situ conservation preserves the genetic resources that have orthodox seeds in static condition. On-farm conservation, which is, also called dynamic conservation, complement the ex-situ conservation by continued cultivation of locally available crop varieties in farmers' field. In-situ conservation is useful to conserve the wild species and its relatives including wild edible plants. The Genebank has considered the following conservation strategies.

- Ex-situ conservation
  - Seed conservation as Seed Bank (Base collection and Active, or working collection for orthodox seeds)
  - In-vitro conservation (for recalcitrant seeds and vegetatively propagated crops)
    - Cryopreservation (Cryo Bank)
    - Cold storage (Tissue Bank)
  - Field Genebank and crop specific parks (for recalcitrant seeds and vegetatively propagated crops)
  - DNA bank for all kinds of APGRs
- On-farm conservation (for locally available crop genetic resources) as Household Genebank and Community Genebank (seed and field genebank)
- In-situ conservation (for wild crop species and wild relatives)

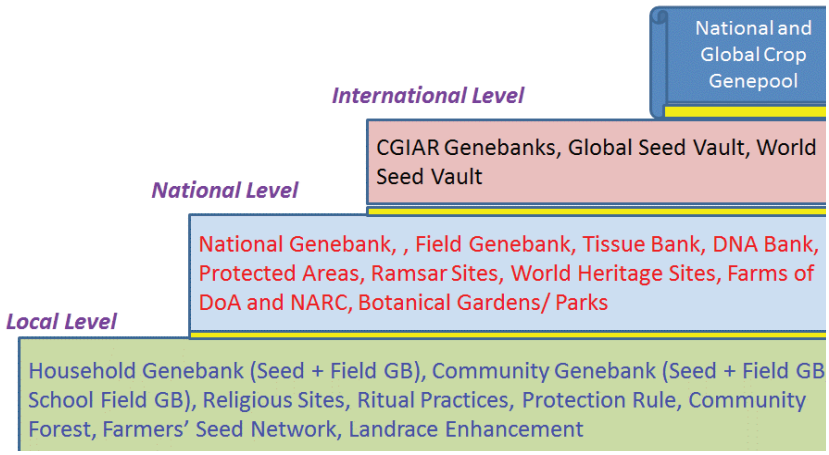


Figure 1. *Conservation ladder adopted by NAGRC for management of APGRs in Nepal*

2.5. Genetic Resources for Conservation

- Landraces
- Modern and obsolete varieties
- Breeding lines e.g. RILs, Genetic stocks, NILs, Differential lines
- Exotic genetic resources
- Wild and wild relatives of cultivated crop species
- Wild edible plants

These genetic resources are grouped as follows based on economic values

Cereals	Millets
Pulses	Sugar and Starch Crops
Oil seeds	Vegetables (leafy, root and tuber, fruit, legume)
Fruits (tropical, sub-tropical and temperate)	Spices
Fibers	Beverages
Forages (fodder tree, grass, legume)	Semi domesticated crops
CWR	

2.6. Regular Activities

Exploration and collection	Registration
Seed testing and processing	Conservation
Regeneration and multiplication	Viability monitoring
Characterization and evaluation	Genotyping
In-vitro culture	Screening and pre-breeding
Distribution and exchange of materials	Database management

2.7. Facilities Available in the Center

Long-term storage: Cold store room (called Base Collection Room, BCR) with -18°C is functional which has capacity of storing about 100,000 accessions for 50-100 years.

Medium term storage: Cold store room (called Active Collection Room, ACR) is functional which has capacity of storing about 50,000 accessions for 10-15 years.

Seed testing and processing lab: Facilities are available for seed cleaning, viability testing, germination testing, seed drying and packing, characterization and evaluation.

In-vitro culture room: Tissue culture room as well as in-vitro cold storage (Tissue Bank) facilities are available.

Molecular research lab: Facility is available for DNA works and conservation (DNA Bank).

Field genebank: A separate plot is allocated for field genebank. Field genebank

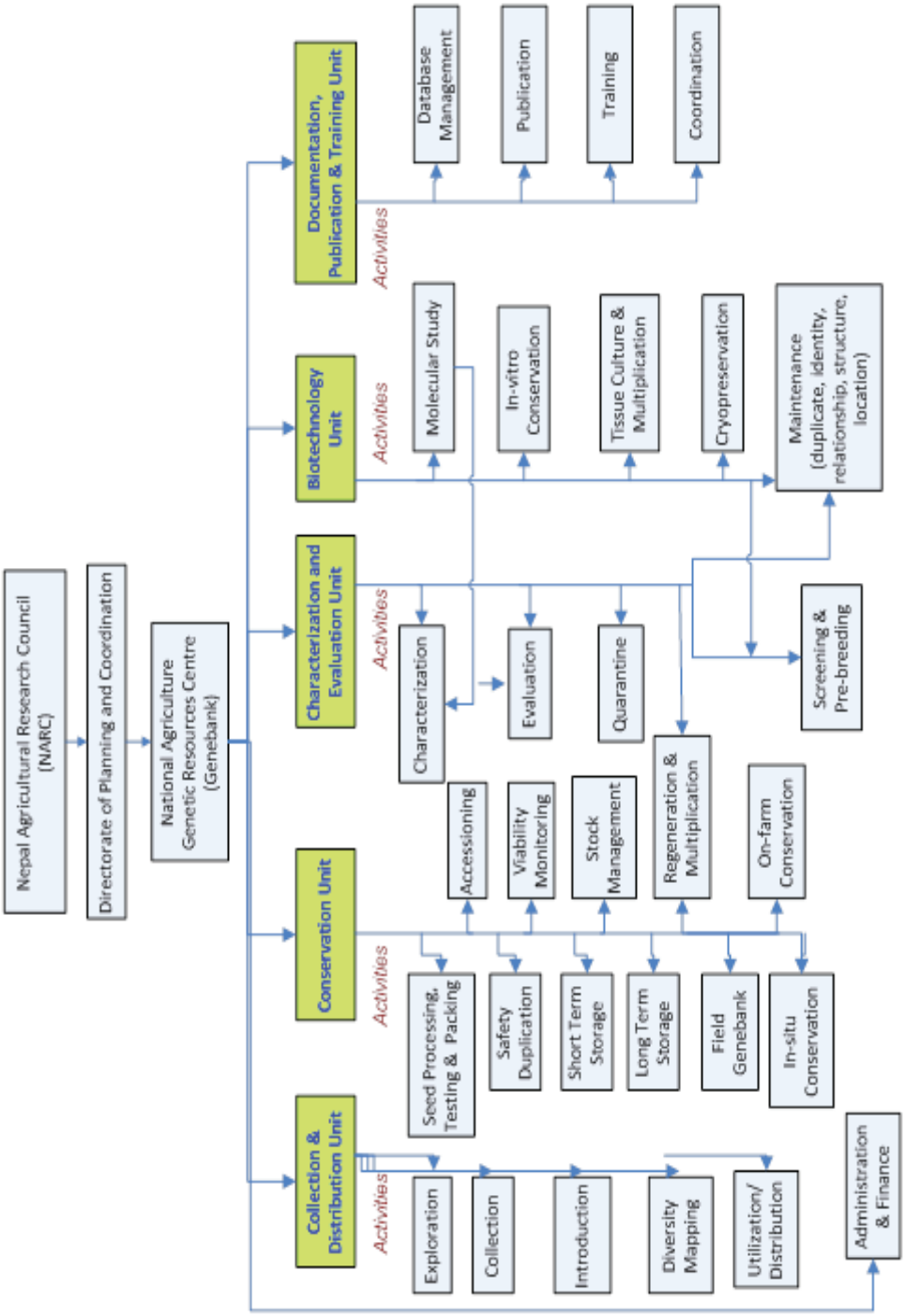
will be extended along the road and around the office buildings and premises, other NARC's stations.

Experimental plot: Field is available for diversity blocks, regeneration, multiplication, characterization and evaluation.

Database management: Documentation facilities are available for passport, management, characterization, evaluation, pre-breeding and utilization data.

Black box: Space for researchers in medium term storage has been provided following black box system.

2.8. Organization Structure and Regular Activities



3. RESEARCH HIGHLIGHTS

A. CROP AND PLANT GENETIC RESOURCES

3.1. Collection and Distribution

Major activities under this unit are exploration, collection, introduction, diversity mapping and distribution.

3.1.1. Collection

Exploration and collection of plant genetic resources are the regular activities of genebank. Exploration and collection mission was organized in close collaboration with other research stations of NARC and district agricultural development offices. This year, the multi crop germplasm were collected from 20 districts of Nepal with the following activities:

- Preparation for multi crop collection mission
- Interaction meetings with the extension workers
- Group meeting with the farmers
- Random sampling from different locations of the districts covered
- Collecting samples by farmer's interview from his/her farm house/stores/fields

A total of 1087 samples of more than 79 different food crop species were collected during the year from 19 district (Figure 2). The maximum number of accessions were collected from Ramechhap.

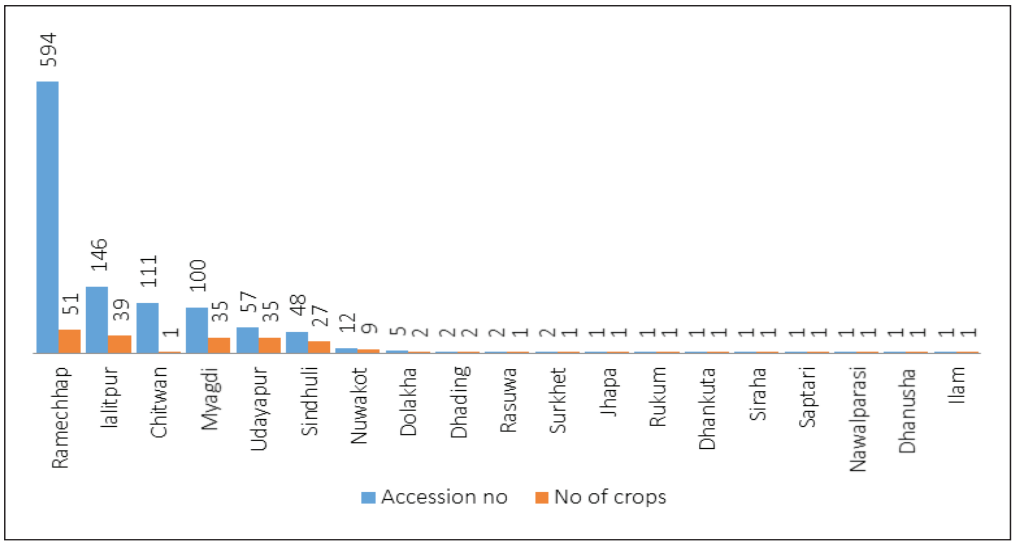


Figure 2. *Germplasm collection districts during 2076/77*

3.1.2. Distribution

One of the main objectives of germplasm conservation in the gene bank is the utilization of this genetic material in plant breeding and related activities. Seeds of the different accessions are supplied in response to the requests from the breeders and other research workers. Seeds of 653 local landraces of 11 crops were supplied in response to the requests from the researchers of 8 different institutions for research and sustainable utilization of the germplasm. Seeds are distributed only from the active collections.

Table 3. Distribution of germplasm for research/study purpose in this F/Y 2076/77

SN	Institution	Crop	Accession no
1	Grain Legume Research Program, Khajura	Blackgram	24
2	SAAN International College, Chabahil	Rice	49
3	Plant Pathology Division, Khumaltar	Chiili	20
		BLM	11
4	Seed Science Division, Khumaltar	Mustard	10
5	SEAN Seed	Akabare Khur-sani	7
6	LI-BIRD, Pokhara	Foxtail millet	2
7	Famrers	Rice	10
		Mungbean	1
8	Ph D student (3 students)	Amaranth	102
		Rice	417
	Total	**11**	**653**

Diversity kits were provided to different farmers during exploration and collection missions. It consists of pre-breeding lines (elite lines), site-specific best landraces, unique landraces, pre-release lines and released varieties.

3.1.3 Biodiversity fair assisted collaborative collection mission

Biodiversity fair is useful tool to aid exploration of local plant genetic resources. We used biodiversity fair aided collection mission in western Lalitpur in collaboration with Group of Helping Hands (SAHAS) Nepal. In-district biodiversity fairs were organized in February and December month of 2019 and these fairs were used as a tool to explore plant genetic resources found in Bagmati and Mahankal Rural Municipality of Lalitpur district. To collect these explored genetic resources, the joint field expedition, key informant survey, diversity rich farmers discussion was used as a tool. The study explored, inventoried, collected and conserved 148 accessions, highest from legumes, cereals, vegetables and root and spice crops. Few genetic resources were collected for the first time in Nepal. Few landraces, mostly from rice were identified as extinct and few are under extinction mainly due to attraction of farmers to newer

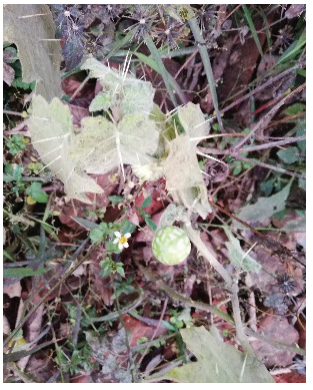
and high yielding varieties. The collected species having orthodox seeds were tested for germination ability and those that passed minimum standard were preserved in seedbank of NAGRC. NAGRC plans to characterize these accessions in the coming seasons depending upon the season of crop growing. The current expedition collected eight species for which mode of propagation is vegetative or those for which seed storage behavior falls under intermediate mode. NAGRC has been started expanding field genebank coverage using these accessions.

3.1.4. Diversity loss

Five cell analysis for plant genetic resources identified some endangered and rare landraces. Few landraces, mostly from rice were identified as extinct and few are under extinction mainly due to preference of farmers to newer and high yielding varieties. Local rice varieties with good taste and other important traits such as Lalbeti Dhan, Pokhreli Dhan, Dhulikheli Marshi, Ghouriya/Goure Dhan, Kale Dhan, Gola Dhan, Chhote/chhote Marsi/Marshe, Jarneli Dhan, Bagane Dhan, BadureDhan were extinct from studied area mainly because of low yield, lodging problems and introduction of high yield varieties, for example, Makwanpure Dhan. Few similar named local rice germplasms are being conserved in long term storage in NAGRC. However, there is no collection of rice landraces from the surveyed area. Anadi Dhan, a very special sticky rice having religious value is near to extinct from studied area.

A locally called six-month cauliflower (cauliflower curd used to mature in six months with unique taste and hardy type) is already lost from the studied area. Key informants reported that this kind of cauliflower can be grown without seed but using branch/bud directly. This might be because of a suitable altitude available in some places of surveyed VDCs. Further, many local broadleaf mustards maize, Junelo, cowpea, rice bean, pigeon pea were already extinct from the studied area, maybe old varieties were replaced by new natural crosses. Area of linseed, millet, horse gram, white adzuki bean is found to be decreasing.

The southern Lalitpur has encompassed many wild relatives of crop species including many wild relatives of brinjal (Figure 3) which might have potential to use as a genetic material in plant breeding programs however inadequate conservation coupled with lack of information system hindering their future use.



Solanum torvum Sw.

Solanum xanthocarpum

Figure 3. *Wild relatives of brinjal observed in southern Lalitpur*

3.2. Conservation

Considering the red zoning and red listing system of APGRs, NAGRC has started the translocation of endangered and rare landraces from red zone (endangered zone) to safe zone/ green zone areas. NAGRC has also initiated conservation through beautification targeting to conserve ornamental plants along with establishing living fences and hedgerow using native APGRs. Nursery has been established for agro plantation.

GIS has been used for gap analysis. Collection maps have been generated. Collection gaps as well missing species in the collection database have been reviewed for targeting collection of missing species and collection from gaps. Climate analog tool is also used to locate the analog site as well as climate-smart germplasm basically for repatriation and introduction of landraces. GIS, CAT and Google Earth are applied for better management and use of APGRs.

3.2.1. Seed Bank

Under this Unit, major activities are seed processing, testing and packing, accessioning, safety duplication, viability monitoring, short-term conservation, long-

term conservation, stock management, regeneration and multiplication, field gene bank, in-situ conservation and on-farm conservation.

Seeds of 550 accessions of 49 different crop species were conserved as new entries in active, base and duplicate collections similarly, Seed of 250 species of 25 crops were also repacked and conserved. (Figure 4).

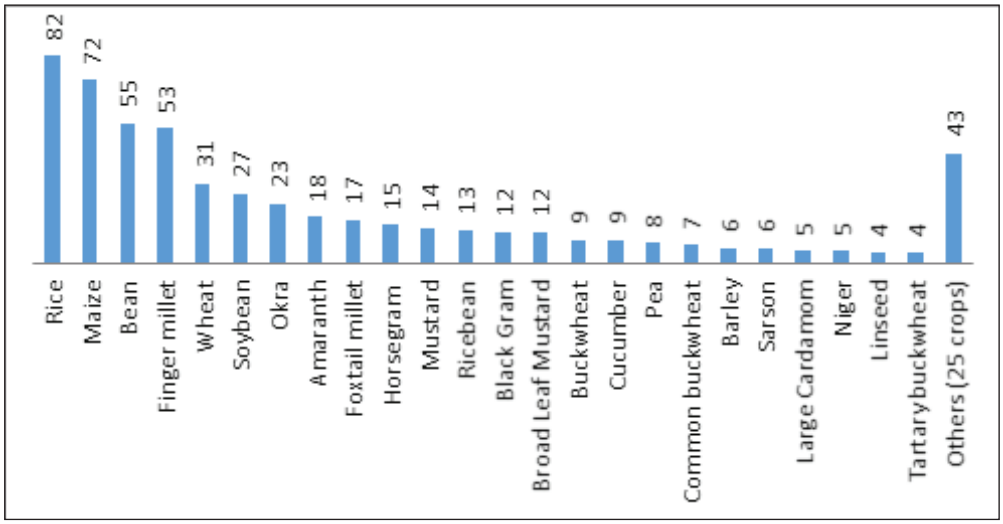


Figure 4. *Number of accessions of different crops added in medium and long-term storage during 2076/77*

3.2.2. Field Genebank

Field genebank is essential for those crops' species having recalcitrant seeds for conservation, characterization, evaluation and utilization. In addition to such types of crops, vegetatively propagated and apomictic crop species are also conserved. Instead of allocating separate field, we started using use government's farm around the road and office buildings, community farms, botanical garden, culturally protected and heritage sites. In the future, collaboration will be extended to the heritage site and culturally protected areas to establish the field genebank.

Since there is a high risk of losing accessions, it is advisable to maintain replicates of accessions in other locations, raising the cost further. Therefore, NAGRC has planned to establish Field Genebank across the country. The NAGRC has established Field Genebank at Khumaltar, called Khumal Field Genebank. Similarly, more than 10 field genebanks have been established in different NARC research stations. Some of them are crop-specific parks e.g. potato and sweet potato park, Sugarcane Park, ginger and Turmeric Park, etc. Technical support has been provided to many stakeholders to establish and maintain field genebank, community field genebank, school field genebank, village-level field genebank, aqua pond genebank, livestock farm genebank, etc.

141 accessions of two crops turmeric (86) and taro (55) were maintained in Khumal field genebank of NAGRC. Similarly, 49 accessions of garlic were maintained. Different 29 perennial plants were planted at Khumal field genebank (Prunus cerasus, Corylus avellana, Corylus avellana, Cinnamon umtamala, Eugenia jambolana, Eugenia jambolana, Taki, Tinpate, Asharephul, Lagerstroemia flosreginac, Timur, Bauhinia purpurea, Prunus cerasus, Crataeva religiosa, Madhilo, Kavro, Crataeva religiosa, Persea Americana, Citrus maxima, Psidium guajava, Eugenia jambolana and Azadirachta indica). Thirty-seven accessions of garlic and 55 accessions of taro accessions were characterized and evaluated. Details traits description are given below in section Characterization, evaluation and pre breeding of horticultural crops. Diversity of 12 accessions of chayote was assessed on-farm, and on-station using 9 morphological and 20 RAPD markers in addition to use values. Detail of this genetic study is given below under molecular marker technology.

3.2.3. On-farm Conservation

Agrobiodiversity needs to conserve at different levels i.e. farm, community, national and international to safeguard the present and future food security. Custodian farmers (agrobiodiversity rich farmers) and farming communities of diversity hot spot areas of the country need to be supported to conserve local crop varieties and indigenous knowledge.

Farmers are the key players for sustaining diversity. As a part of conservation, NARC has been supporting on-farm conservation since 2001 by involving farmers and their genetic resources in researches. This resulted in the establishment of Community Seed Bank (CSB) in Kachorwa, Bara and Simariya, Sunsari. On-farm conservation strategy has been included in different national, local documents, reports and plans.

National Genebank has implemented on-farm conservation in different areas of the country. Different approaches considered for conservation and sustainable utilization of APGR on-farm are community seed bank (CSB), community field genebank (CFG), household genebank (HG), household field genebank (HFG), village-level field genebank (VFG) and school field genebank (SFG). In addition to these, the landrace enhancement program and recognition of agrobiodiversity rich farmers have also contributed to conserving APGR. Identification of agrobiodiversity rich farmers have been initiated in collaboration with different governmental and non-governmental organizations across the country. A strong network among these farmers is supposed to establish for effectively managing APGR on-farm. Agrobiodiversity conserved by such farmers is called household genebank, which consists of seed storage (household seed bank) and household field genebank.

National Genebank (NAGRC) has technically supported many CSBSs e.g. Dalchoki CSB, Kachorwa CSB, Gadaria CSB, Rainas CSB, Simariya CSB, Chhipra CSB, Haku CSB, Ganpokhara CSB and Jugu CSB, etc. Four community field genebank have been functionalized for conserving recalcitrant seeds and vegetatively propagated crop species. NAGRC also supported to establish and maintain school field genebank by

growing local APGRs in school areas. This helps to conserve APGRs, educate the students, earn income and make environment beautiful. Genebank also encourages farmers to reintroduce the landraces from the National Genebank which is possible through analyzing the collection maps and passport database. Accessioning these APGRs and training to farmers and farming community are necessary to effectively and efficiently conserving and utilizing APGRs on-farm.

This year's major works in addition to diversity fairs, were: 1. Rescued mango germplasm from Lamjung in Parwanipur was monitored, 2. Total on-farm conservation approaches were surveyed, listed and published. 3. Good practices were published with support from special project, 4. On-farm conservation in Lamjung, Jumla, Chitwan was monitored, 5. Technical support was provided to different farmer groups, organization, 6. Mango diversity from Lamjung and Doti were assessed through SSR and agromorpho markers, 7. Interactive meeting with CDABCC for strengthening on-farm conservation was held; 8. Journal paper on on-farm conservation approaches were distributed; 9. Management and utilization of native agrobiodiversity were broadcasted through Krishi TV two times; 10. Deployment of intra varietal diversity to different farming areas using climate analog tool was documented, 10. Importance of native genetic resources was shared in social media, 11.Good practices and on-farm related papers of agrobiodiversity conservation and utilization were widely shared.

Diversity fairs were organized and diversity blocks were established in different districts in collaboration with different organizations to make crop diversity access to farmers and to ease the collections. During the collections and interaction with farmers, diversity kits were provided in different districts.

NAGRC has surveyed and strengthened household genebank in Chitwan. A farmer named has conservation mind and is agrobiodiversity rich farmer. He has established household genebank. He lives in Shreepur, Bharatpur Ward 15, Chitwan and has started conserving 106 native rice landraces and 4 improved varieties since 2008 (2065 BS). He maintains these rice collections in diversity block annually. In addition to this rice diversity, he has maintained and shared 5 chilly landraces, 7 yam landrace and few bean landraces. This year he provided rice diversity to NAGRC for long term conservation.

Chandra Prasad Adhikari, *Chitwan*

Diversity of chayote was assessed on-farm in addition to use values. Five different fruits colors have been found in chayote fruits on-farm. Almost 80% vegetable shops including foot path shops keep chayote fruits, tender shoots, and root on sale during chayote harvest season. Tuberous roots are used as an alternative to potato and are tastier than other root and tuber crops. One can harvest tender shoots, fruits and tuberous roots for more than 25 years from the same plant. About 100 kg tuberous root can be harvested from single plant at 3 years interval. It has the longest harvesting period among the vegetables within a year.

NAGRC has started to rejuvenate old mango orchards in Lamjung. Many mango orchards are very old and no one is taking care of them. Due to very old age plants, they are almost at the stage of extinction. NAGRC has started working on rejuvenating such orchards. Rainas Community in Lamjung is caring old mango orchard. To strengthen the understanding of native mango diversity, NAGRC supported and guided two master theses of IAAS, TU. Their brief works are given here.

One student has studied the mango diversity in Doti. The diversity at both morphological and genetic levels of 39 mango landraces (Table 4) of Doti district were assessed. A total of 35 IPGRI (2006) descriptors for mango were used to characterize 34 mango genotypes (33 local and 1 hybrid variety) morphologically. Genetic diversity was assessed using 20 SSR markers. The genomic DNA was extracted from young leaf samples using cetyl trimethyl ammonium bromide (CTAB) method. The results of the study showed considerable variation exist in terms of tree, leaf, fruit, stone and seed character among studied genotypes. Data on 14 quantitative traits were subjected to principal component analysis (PCA) and cluster analysis. Three major principal components were formed with Eigen value greater than one with cumulative diversity of 82.6%. PC1 explained 47.6% variations; PC2 explained 18.5% variations while PC3 explained only 16.5% variation. Results of cluster analysis grouped 34

mango genotypes into four groups with test genotype Amrapali into separate cluster. A total of twenty SSR primers were used to evaluate genetic diversity of 39 mango genotypes. Out of 20 primer pairs, 19 produced polymorphic bands and one produced monomorphic band. The PIC values ranged from 0.35 (SSR 13) to SSR 6 (0.75) with an average value of 0.53 across all genotypes. The band informativeness (IB) of the 19 SSR primers ranged from 0.402 (SSR 4) to 1.717 (SSR 10) with an average of 0.933 and the resolving power (Rp) ranged from 2.00 (SSR 9 and SSR 13) to 4.46 (SSR 5) with an average of 2.95. The 39 mango genotypes were separated into four main clusters (I II, III and IV) using UPGMA cluster analysis based on Dice similarity coefficient (Figure 5). Similarity level of 59-100% was observed among the 39 mango genotypes showing some level of genetic diversity.

Table 4. Name of mango genotypes, location along with elevation (m), latitude and longitude

SN	Landrace	Location	Elevation (m)	Latitude	Longitude
1	Masino Surkulle	Ali-Autrali, Shikhar Municipality, Doti	734	29.2465°N	80.8897°E
2	Hade	Ali-Autrali, Shikhar Municipality, Doti	709	29.2443°N	80.8926°E
3	Pothe	Ali-Autrali, Shikhar Municipality, Doti	723	29.2452°N	80.8917°E
4	Balde	Ali-Autrali, Shikhar Municipality, Doti	794	29.2481°N	80.8905°E
5	Hinge	Ali-Autrali, Shikhar Municipality, Doti	711	29.2445°N	80.8930°E
6	Kelkose	Chasi, Adharsha Gaupalika, Doti	1090	29.3098°N	80.9394°E
7	Kele	Ali-Autrali, Shikhar Municipality, Doti	779	29.2468°N	80.8903°E
8	Bhokkari	Chasi, Adharsha Gaupalika, Doti	1096	29.3108°N	80.9392°E
9	Sinure	Chasi, Adharsha Gaupalika, Doti	1095	29.3103°N	80.9388°E
10	Bannari	Chasi, Adharsha Gaupalika, Doti	1088	29.3102°N	80.9395°E
11	Kakune	Ali-Autrali, Shikhar Municipality, Doti	730	29.2468°N	80.8886°E
12	Mude	Ali-Autrali, Shikhar Municipality, Doti	794	29.2474°N	80.8895°E
13	Moto Surkulle	Ali-Autrali, Shikhar Municipality, Doti	759	29.2466°N	80.8897°E
14	Supare	Ali-Autrali, Shikhar Municipality, Doti	722	29.2455°N	80.8904°E
15	Bhadaure	Ali-Autrali, Shikhar Municipality, Doti	768	29.2471°N	80.8897°E
16	Sanne	Ali-Autrali, Shikhar Municipality, Doti	716	29.2446°N	80.8922°E

SN	Landrace	Location	Elevation (m)	Latitude	Longitude
17	Kale	Ali-Autrali, Shikhar Municipality, Doti	734	29.2466°N	80.8897°E
18	Dhulle	Ali-Autrali, Shikhar Municipality, Doti	783	29.2473°N	80.8887°E
19	Batuli	Panawata, Dipayal Silgadi Gaunpalika, Doti	1133	29.2945°N	80.9370°E
20	Lode	Khullekh, Dipayal Silgadi Gaunpalika, Doti	1024	29.2879°N	80.9455°E
21	Patale	Khullekh, Dipayal Silgadi Gaunpalika, Doti	1186	29.2919°N	80.9476°E
22	Koke	Panawata, Dipayal Silgadi Gaunpalika, Doti	1147	29.2943°N	80.9375°E
23	Rulli 1	Chasi, Adharsha Gaupalika, Doti	1118	29.3114°N	80.9403°E
24	Rulle	Ali-Autrali, Shikhar Municipality, Doti	755	29.2471°N	80.8888°E
25	Gode	Chasi, Adharsha Gaupalika, Doti	1139	29.3118°N	80.9404°E
26	Chuke	Ali-Autrali, Shikhar Municipality, Doti	700	29.2451°N	80.8940°E
27	Bele	Ali-Autrali, Shikhar Municipality, Doti	749	29.2466°N	80.8896°E
28	Ginaune	Ali-Autrali, Shikhar Municipality, Doti	734	29.2465°N	80.8897°E
29	Dhole	Ali-Autrali, Shikhar Municipality, Doti	709	29.2443°N	80.8926°E
30	Rati-Rumal	Ali-Autrali, Shikhar Municipality, Doti	723	29.2452°N	80.8917°E
31	Simte	Ali-Autrali, Shikhar Municipality, Doti	794	29.2481°N	80.8905°E
32	Gude	Khullekh, Dipayal Silgadi Gaunpalika, Doti	711	29.2445°N	80.8930°E
33	Mailadi	Khullekh, Dipayal Silgadi Gaunpalika, Doti	1090	29.3098°N	80.9394°E
34	Amrapali	Panawata, Dipayal Silgadi Gaunpalika, Doti	779	29.2468°N	80.8903°E
35	Gane	Khullekh, Dipayal Silgadi Gaunpalika, Doti	1096	29.3108°N	80.9392°E
36	Hade 1	Khullekh, Dipayal Silgadi Gaunpalika, Doti	1095	29.3103°N	80.9388°E
37	Ghutke	Chasi, Adharsha Gaupalika, Doti	1088	29.3102°N	80.9395°E
38	Chamade	Khullekh, Dipayal Silgadi Gaunpalika, Doti	730	29.2468°N	80.8886°E
39	Dashahari	Chasi, Adharsha Gaupalika, Doti	794	29.2474°N	80.8895°E

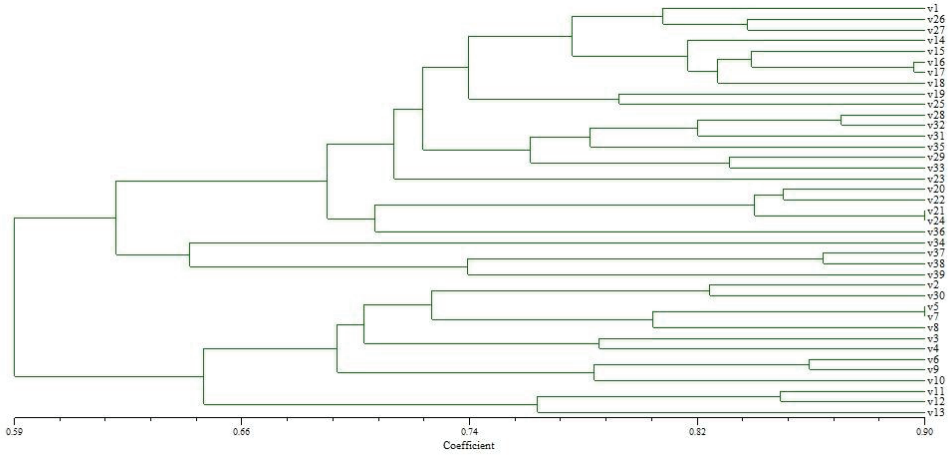


Figure 5. *UPGMA cluster analysis of 39 mango genotypes using Dice similarity coefficient based on SSR marker information. Clusters are labelled I, II, III and IV (adapted from Master thesis of Bhawani Pandey, IAAS)*

Second student has assessed the mango diversity from 4 sites of Lamjung District viz. Kusunde, Timure, Gauritar and Talentar. A total of 45 mango landraces (Table 5) were characterized using 61 traits (19 quantitative and 42 qualitative traits) based on International Plant Genetic Resources Institute (IPGRI) descriptors whereas only 16 mango genotypes were characterized along with fruit descriptors due to alternate bearing habit and harsh climatic conditions. The leaf length ranged from 15.73 cm – 26.49 cm, the leaf width ranged from 4.35cm-6.86 cm whereas leaf blade shape ranged from elliptic to ovate. The Fruit weight was significantly and positively correlated with fruit length, fruit diameter, pulp content, pulp weight, stone length, stone width stone weight, seed length, seed weight. The fruit weight ranged from 42.50 g to 302.35 g along with 67.39 % coefficient of variation. The first three principal components explained 90.3 % cumulative variance. Molecular analysis of 44 mango genotypes with 20 SSR determined the Number of alleles ranging from 2-9 per locus with an average of 5.55 alleles per locus. The observed heterozygosity differs from 0.00-0.95. Polymorphic information content (PIC) of 20 SSR marker ranged from 0.51-0.87. 44 mango genotypes are grouped into 6 clusters (Figure 6).

These sampled mango landraces in both sites are also planning to grow in IAAS, Paklihawa and Lamjung campus as mango field genebank. Farmers in both areas were also encouraged to maintain and use these diversities.

Table 5. Mango genotypes found in Lamjung District

SN	Location	Plant genotypes	SN	Location	Plant genotypes
1	Kusunde	Amile	23	Timure	Karkalay
2	Kusunde	Aahalay	24	Timure	Sindhuray 2
3	Kusunde	Supare 1	25	Timure	Thulo laharay
4	Kusunde	Bombai 1	26	Timure	Sano laharay
5	Kusunde	Lohare	27	Timure	Jagatay
6	Kusunde	Kray	28	Timure	Bombai 2
7	Kusunde	Lottaray	29	Timure	Ganaune
8	Kusunde	Kataray 1	30	Timure	Thulo kali
9	Kusunde	Maha	31	Timure	Upallo mithai
10	Kusunde	Seti 1	32	Timure	Tallo mithai
11	Kusunde	Kali	33	Timure	Seti 2
12	Kusunde	Rani	34	Timure	Suparay 2
13	Kusunde	Haledi	35	Timure	Rato taukay
14	Kusunde	Besaray	36	Timure	Kartabiday
15	Kusunde	Chilli	37	Timure	Moi Aanp
16	Kusunde	Batuli	38	Gauritar	Jhapulay
17	Kusunde	Sindhuray 1	39	Gauritar	Kharani 1
18	Kusunde	Fharsay	40	Gauritar	Mithi
19	Kusunde	Bhotelotay	41	Talentar	Kharani 2
20	Kusunde	Gaddhay	42	Talentar	Nitay
21	Timure	Kataray 2	43	Talentar	Kiray 1
22	Timure	Jureli	44	Talentar	Kiray 2
			45	Talentar	Amrapali

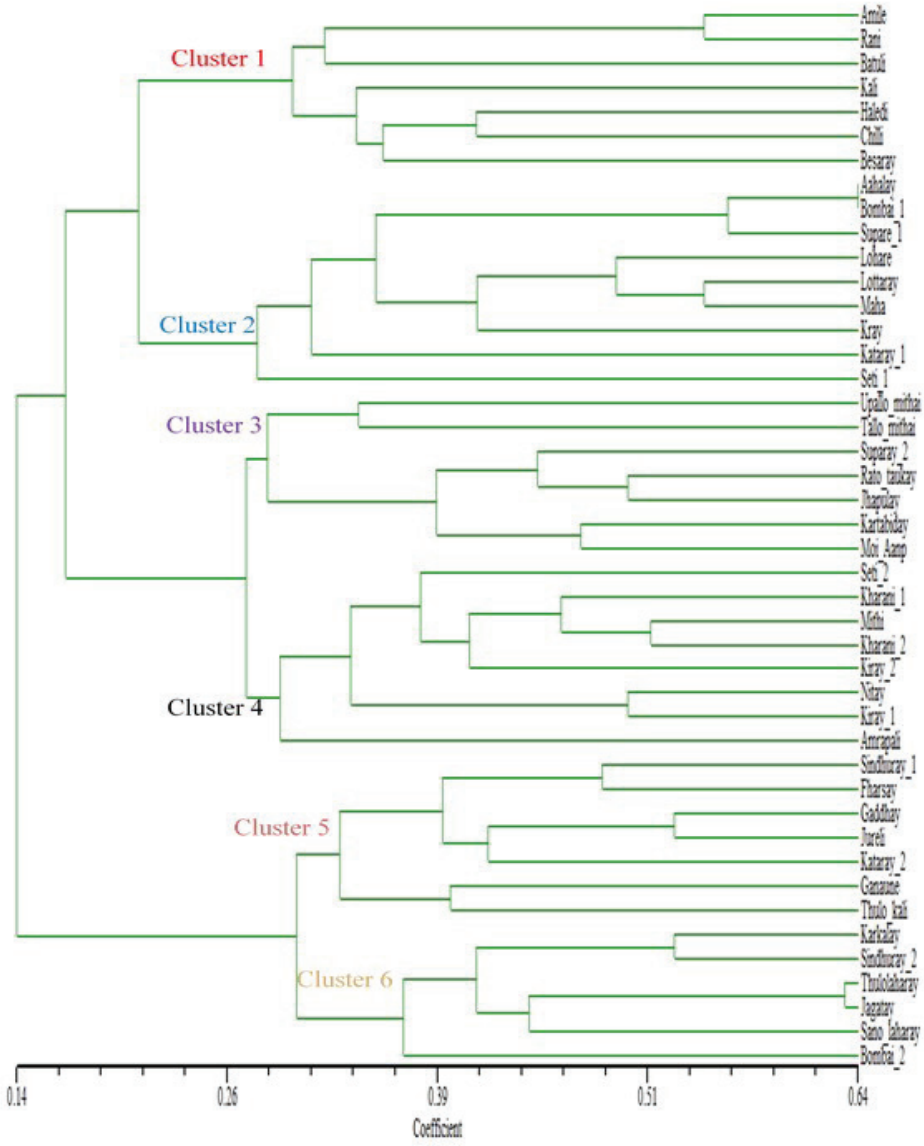


Figure 6. *Dendrogram of the 44 mango genotypes studied based on UPGMA analysis using the similarity matrix generated by the nei and Li coefficient with 11 SSR fragments (adapted from Master thesis of Aashish Pandey, IAAS).*

Two special projects, called local crop and evolutionary plant breeding projects are completely related to on-farm conservation. These projects are working in Humla, Jumla, Lamjung and Dolakha. Progres of these projects are highlighted under special project section.

3.2.4. Regeneration and Multiplication

Regeneration and seed increase of the accessions with a limited quantity of seed are the regular activities of the regeneration unit. During this year, a total of 996 accessions of 26 different crops were regenerated in (Figure 7) and multiplied at National Agricultural Genetic Resources Center, Khumaltar. Accessions were harvested after physiological maturity. Harvested seeds were threshed, dried and processed for registration and storage as Necessary.

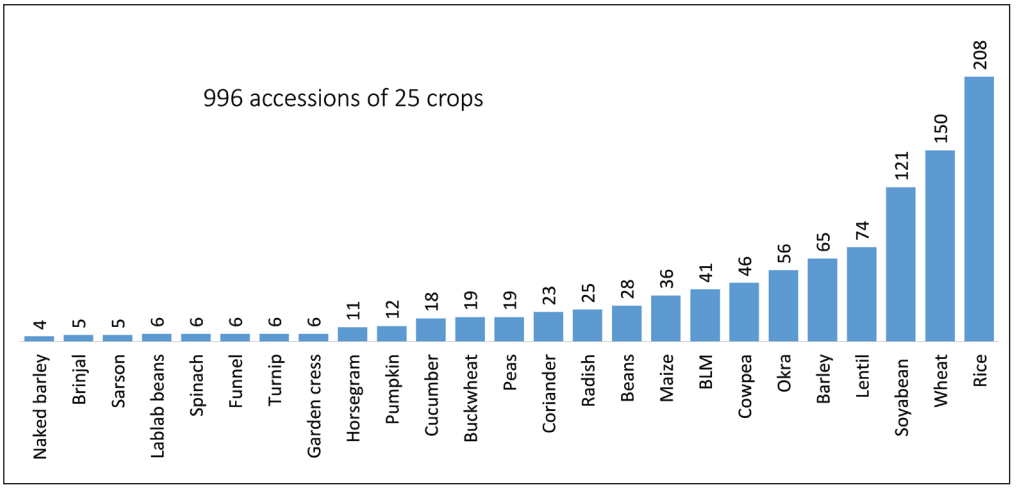


Figure 7. *Number of accessions of various crops regenerated during 2019-2020*

3.2.5. Seed Testing and Processing

Seed viability and seed health are two qualities of seed, which is monitored by periodic germination test. Seed viability is very important for the longevity of seed and seed longevity is the most important aspect, especially in gene banks. Seed laboratory plays a vital role in NAGRC which guides the majority of the consecutive activities like regeneration, conservation and utilization. The seed processing laboratory of NAGRC is accredited to ISTA and works principally on ISTA rules and SQCC Central Seed Testing Laboratory guidelines. This laboratory has been operative since the establishment of Gene Bank and is extensively focusing on seed viability testing.

A total of 1728 accessions of 50 crops were tested for germination (Table 6). 436 accessions of 40 crop species were conserved at medium and long-term storages and 133 accessions of rice were refilled on medium term conservation after regeneration.

Table 6. List of germination test

SN	CropName	No of accession tested
1	Amaranthus	160
2	Barley	25
3	Barnyard millet	1

SN	CropName	No of accession tested
4	Balsom apple	8
5	Bean	52
6	Broad leaf mustard	16
7	Broadbean	2
8	Black gram	12
9	Buckwheat	145
10	Carrot	1
11	Chickpea	1
12	Chilly	2
13	Coriander	3
14	Cowpea	9
15	Cucumber	2
16	Fingermillet	382
17	Funnel	15
18	Foxtail millet	26
19	Greengram	4
20	Garden cress	1
21	Hemp	2
22	Horsegram	21
23	Laffa saag	1
24	Lathrynus	1
25	Lambs quarter	3
26	Lentil	92
27	Linseed	7
28	Maize	95
29	Mustard (Rapeseed)	28
30	Naked barley	7
31	Niger	8
32	Oat	3
33	Okra	45
34	Pea	13
35	Pumpkins	6
36	Prosomillet	1
37	Perilla	4
38	Pigeonpea	1
39	Radish	3

SN	CropName	No of accession tested
40	Rice	351
41	Ricebean	11
42	Sorghum	8
43	Soybean	75
44	Spongegourd	4
45	Spinach	1
46	Sunflower	3
47	Swiss chard	2
48	Sesame	4
49	Sarson	3
50	Wheat	58

3.2.6. Maintenance of Diversity Block

Development and maintenance of diversity block is an important regular activity of the genebank. Different seasonal and perennial crop species diversity has been maintained in front of the genebank complex. Distinct local as well as improved varieties maintained on diversity block are: cereals/pseudocereals (rice, wheat, barley, Naked barley, maize, buckwheat, fingermillet, proso millet, foxtail millet, quinoa, sorghum, amaranths,etc), pulses (blackgram, horsegram, chickpea, lentil, soybean, ricebean,etc), seasonal vegetables (cauliflower, cabbage, broccoli, broadleaf mustard, lettuce, swisschard, eggplant, tomato, okra, peas, frenchbean, broadbean, garden cress, asparagus, summer squash, bittergourd etc.), annual and perennial root and tuber crops (radish, carrot, potato, sweet potato, taro, yam, ground apple, etc.) spices (coriander, chilly, onion, garlic, ginger, turmeric, mint, fenugreek, perilla, stevia, etc.) and sugarcane. This diversity block serves as the study blocks for different visitors (farmers, researchers, development workers, students, media persons, etc.). Diversity block represents the distinct, rare and unique variability present in a species as well as the richness of all types of species (species producing orthodox, intermediate and recalcitrant seeds as well as vegetatively propagated seasonal, annual and perennial crop species).

This year, display blocks of 32 accessions of 28 crops (Coriander, BLM, Fenugreek, Pustakari, Pineapple, Rice, Asparagus, Roselle, Niger, Cowpea, Lambs quarter, Chilly, sunflower, sorghum, water spinach, brinjal, sweet potato, strawberry, sweet flag, aromatic leaf garlic, ginger, taro, sugarcane etc. at diversity block) were established.

3.3. Characterization, Evaluation and Pre-breeding

The major activities under this unit are characterization, evaluation, quarantine, screening, pre-breeding and maintenance (duplicate, identity, relationship and structure). Evolutionary plant breeding has been started in Jumli Marsi Dhan in Khumaltar. Regeneration and multiplication activities are generally linked with characterization

and evaluation. During the year FY 2076/077, total of 1128 accessions of 16 different crop species such as wheat, rice, soyabean, lentil, barley, okra, cowpea, BLM, beans, radish, coriander, peas, buckwheat, cucumber, garden cress, fennel, spinach etc., were characterized and evaluated at NAGRC, Khumaltar (Figure 8).

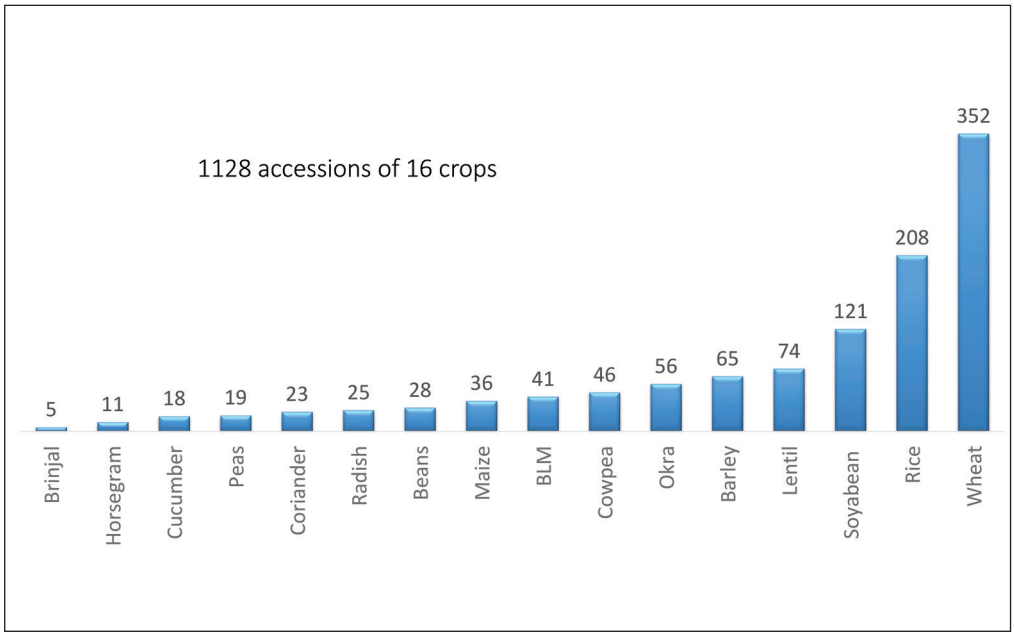


Figure 8. *Number of accessions of different crops characterized during 2076/77*

3.3.1. Characterization of agronomical crops

A. Rice

Agro-morphological characterization and diversity analysis of rice accessions in Nepal

Rice accessions collected from 22 different districts of Nepal were characterized and evaluated at National Agricultural Genetic Resources Center (NAGRC), Khumaltar during 2076/77. The characterization blocks have black loamy soil. A total of 47 Nepalese rice accessions were planted in Non-replicated rod-rows design for agro-morphological characterization. The seeding dates were 31st May and 7th June in 2018 and 2019 respectively. The standard agronomic practices were adopted for Normal crop growth. 14 qualitative and 12 quantitative characters were recorded by following the descriptor established by IRRI, Bioversity International and WARDA. Five random plants from each treatment were taken for recording data of various quantitative characters like plant height, leaf length and width, seed length and width etc. and whole plot was taken for observing qualitative characters. Averages of the data from the sampled plants were used for various statistical analysis and frequency distribution was computed for qualitative characters. Basic statistics (Maximum value, Minimum value, Standard deviation and CV %) were calculated by using Excel 2013.

Table 7. Morphological characterization of rice accessions through qualitative traits

SN	Characters	Description with code	Frequency	Frequency %
1.	Leaf blade pubescence	1-Glabrous 2-Intermediate	44 3	94 6
2.	Leaf blade color	2-Green 3-Dark green 5-Purple margin 7-Purple	42 3 1 1	90 6 2 2
3.	Basal leaf sheath color	1- Green 2- Green with purple line 4-Purple	45 1 1	96 2 2
4.	Flag leaf: Attitude	1-Erect 3- Semi-erect 5-Horizontal	40 6 1	85 13 2
5.	Ligule color	1-White 2-Purple lines 3-Purple	45 1 1	96 2 2
6.	Collar color	1-Pale green 3- Purple	45 2	96 4
7.	Auricle color	1-Pale green 2-Purple	45 2	96 4
8.	Panicle exertion	3- Moderately well exerted 5-Just exerted 7-Partly exerted 9-Enclosed	12 8 12 15	25 17 26 32
9.	Culm habit	3-Semi-erect 5-Open	46 1	98 2
10.	Panicle type	5- Intermediate 9-Open	45 2	96 4
11.	Panicle: Secondary branching	0-Absent 1-Light 2-Heavy	17 29 1	36 62 2
12.	Shattering	5-Moderate (6-25%) 7-Moderately high (26-50%) 9-High (more than 50%)	1 26 20	2 55 43
13.	Awn distribution	0-Absent 7-Long and partly awned	45 2	96 4
14.	Lemma: Coloration of Apiculus	1-White 2-Straw 3-Brown 6-Purple	3 32 11 1	6 68 24 2

Table 8. Basic statistics of quantitative characteristics

SN	Characters	Max	Min	Mean	Std.	CV %	Variance	Diversity Index(H)
1	Days to emergence	13.00	9.00	11	0.88	8.00	0.78	0.48
2	Days to heading	125.00	79.00	106.79	15.01	14.05	225.21	0.75
3	Days to maturity	174.00	123.00	156.09	18.03	11.55	325.12	0.59
4	Leaf length (cm)	48.80	16.20	35.58	7.71	21.51	59.46	0.84
5	Leaf width(cm)	1.38	0.74	1.01	0.20	19.5	0.04	0.79
6	Ligule length (cm)	2.72	1.00	1.68	0.38	22.8	0.15	0.82
7	Plant height (cm)	157.00	62.80	101.50	26.14	25.75	683.30	0.81
8	Panicle length (cm)	72.49	42.00	59.23	7.16	12.1	51.22	0.79
9	No of grains/ panicle	77.00	35.00	54.00	10.80	19.9	116.54	0.80
10	Seed length (mm)	43.73	28.00	35.11	4.37	12.45	19.11	0.82
11	Seed width (mm)	37.89	21.86	29.08	4.12	14.17	16.98	0.78
12	Test weight(gm)	36.10	14.50	23.85	5.26	22.06	27.70	0.89
13	Yield (ton/ha)	4.69	1.011	2.08	0.99	47.77	0.98	0.51

Characterization of Native aromatic rice germplasm for agro-morphological traits

Agro-morphological characterization is first stage to identify available genetic variation which is useful for designing an efficient crop improvement program. To explore diversity among Native aromatic rice landraces, twenty-three rice landraces collected from hilly regions of Nepal were characterized using standard descriptors which include twenty-five quantitative and twenty-one qualitative variables. We used Suganda-1 and Sugandha-3 locally bred promising lines as check variety. We conducted a research trial in Randomized Complete Block Design (RCBD) design with three replicates at research block of the National Agriculture Genetic Resources Centre (NAGRC), Khumaltar during 2019. To determine variation, multivariate analysis was carried out. We found enormous plant architectural and grain morphological variability among Native aromatic rice landraces. Thirty-five variables were found to be discriminatory out of 40 studied descriptors, five characters were found monomorphic. Major traits responsible for variation include days to flowering and maturity, plant height, grain yield, grains per panicle, panicle length, Number of panicles per square meter, flag leaf angle, etc. The observed qualitative and quantitative variation showed enough opportunity for future selection-based breeding or hybridization (Table 9).

Table 9. Major qualitative traits associated with different local aromatic rice accession, 2076/77

SN	GENOTYPE	Leaf length (cm)	Leaf width (cm)	Flag leaf length	Flag leaf width	Flag leaf angle	Ligule length	Culm length	Culm diame-ter
1	NGRC o 1698	36.3	1.72	31.6	1.16	27.8°	1.24	91.48	3.704
2	NGRC o 1708	45.4	1.8	31.8	0.78	16.8°	1.36	101.61	4.976
3	NGRC o 1815	49	2.24	28.6	0.48	24.8°	1.2	110.11	4.674
4	NGRC o 1825	44.8	1.14	30.8	1.08	48.4°	1.8	105.15	5.428
5	NGRC o 1867	36.6	1.3	25.8	0.56	44.8°	1.44	96.85	4.894
6	NGRC o 2030	36.4	0.78	24.2	0.34	32.4°	1.86	84.4	4.606
7	NGRC o 1911	35.2	1.86	21.4	0.4	22.8°	2.18	70.81	3.31
8	NGRC o 1945	36.4	0.78	26.4	0.4	45.4°	1.46	82.45	3.32
9	NGRC o 2049	44.2	0.9	24.78	0.64	39.6°	2.48	113.59	7.776
10	Hansaraj	41.4	0.88	21.2	0.64	34.4°	1.48	109.78	5.544
11	NGRC o 2094	33.2	0.8	27.6	0.62	29.4°	1.22	88.44	5.574
12	NGRC o 2847	38	0.84	25.4	0.6	52°	1.78	105.84	4.746
13	NGRC o 2852	42	0.88	30.1	0.28	20.2°	1	101.55	2.706
14	NGRC o 3052	48.4	1.64	28.8	0.83	36.2°	2	102.77	6.142
15	NGRC o 3078	50.6	1.32	28.6	0.56	33.4°	2.12	117.14	5.568
16	NGRC o 2821	59.6	0.9	33.2	0.44	33.6°	2.92	105.4	5.586
18	NGRC o 3210	47.4	1.26	30.4	0.48	29.4°	1.29	88.6	6.752
19	NGRC o 4999	39	0.74	28.1	0.52	24.4°	2.4	85.8	6.286
20	NGRC o 3249	46.6	1.58	27.8	0.66	18.4°	1.62	91.93	4.684
21	NGRC o 3211	36.4	1.44	34.4	0.48	26.2°	1.66	84.55	5.73
22	NGRC o 2919	34.8	1.3	35.2	0.6	24.4°	1.44	89.3	6.008
23	08 FAN 10	32.2	1.18	24.8	0.82	28.2°	1.58	85.03	4.652
24	Sugandha-1	31.8	1.08	27.2	0.7	37.4°	1.16	97.89	6.05
25	DIAMOND	31.2	1.2	24	0.54	31.4°	1.26	58.4	7.116
26	Sugandha-3	36.2	1.42	29	0.92	33.2°	2.2	85.48	7.29
27	REX	33.4	1.28	31	0.68	28.6°	1.42	71.83	5.398

Evaluation of rice landraces for blast diseases resistance

Rice blast, caused by *Pyricularia grisea*, is one of the major diseases that cause severe yield losses of rice in Nepal. The rapid genetic evolution of the blast fungus often breaks the resistance of rice generally governed by major gene. Therefore, for the development of resistant genotypes, continuous efforts are required for exploring more resistant genotypes to manage the diseases. To identify the blast resistant genotypes, present on Nepalese rice landraces, two hundred accessions of National genebank, collected from different parts of Nepal, were tested on greenhouse under artificially inoculated condition. Sabitri and Sankharika/Masuli were used as

resistant and susceptible check respectively during experiment. Blast infected leaf of rice collected from the Plant Pathology Division, Khumaltar and kept under moist condition for one Night. Conidia of blast fungus collected on distilled water by gently washing the infected leaf and sprayed over the rice seedlings evenly. Blast disease incidence was evaluated in two weeks after inoculation. The incidence of blast disease in blast Nursery was scored from 0 (no lesions) to 9 (necrosis of all leaves and sheaths) following Standard Evaluation System (SES, IRRI, 2002). Accessions were assigned to the resistance group with blast diseases scoring 0-3 (0-1: highly resistant; 2-3: resistant), moderate resistance group with blast diseases scoring 4-6 and susceptible with blast diseases scoring 7-9.

More than fifty percent of tested rice accessions showed resistant reaction to the blast diseases pathogen (Table 10 and 11). These resistant genotypes Need to verify further and identify resistant genes by molecular techniques and utilization in National breeding program in future.

Table 10. Proportion of rice accessions showing different reaction to blast pathogen during 2019

SN	Reaction (blast scoring)	No of accessions	Proportion (%)
1	Highly resistant (0-1)	105	52.5
2	Resistant (2-3)	69	34.5
3	Moderately resistant (4-5)	15	7.5
4	Susceptible (6-9)	11	5.5

Table 11. Rice accessions showing different types of reactions to blast at greenhouse under artificially inoculated condition at Khumaltar, during 2019

Highly resistant	Resistant	Moderately resistant	Susceptible
NGRC01657,NGRC01661,NGRC01662,NGRC01672,NGRC01709,NGRC01711,NGRC01781,NGRC01782,NGRC06643,NGRC07191,NGRC01825,NGRC01881,NGRC06642,NGRC01883,NGRC06635,NGRC06636,NGRC01872,NGRC01874,NGRC01877,NGRC01900,NGRC01901,NGRC01903,NGRC06632,NGRC01905, NGRC01919, NGRC01921, NGRC01922,NGRC01923,NGRC01924,NGRC01926,NGRC01927,NGRC01928,NGRC01929,NGRC01931,NGRC01932,NGRC01934,NGRC01936,NGRC01937,NGRC01938,NGRC01942,NGRC01943,NGRC01946,NGRC01947,NGRC01949,NGRC01953,NGRC01956,NGRC01957,NGRC01958,NGRC01960,NGRC03218,NGRC03245,NGRC03246,NGRC01976,NGRC01977,NGRC02054,NGRC01978,NGRC02084,NGRC02087,NGRC02089,NGRC03217,NGRC02093,NGRC02095,NGRC02099,NGRC02106,NGRC02108,NGRC02114,NGRC02115,NGRC02116,NGRC02117,NGRC02121,NGRC02123,NGRC02129,NGRC03181,NGRC02132,NGRC02133,NGRC02135,NGRC02139,NGRC02140,NGRC02141,NGRC02820,NGRC02858,NGRC02864,NGRC02881,NGRC02944,NGRC02945,NGRC02946,NGRC02903,NGRC02920,NGRC02933,NGRC02935,NGRC02936,NGRC02937,NGRC02955,NGRC02989,NGRC03012,NGRC03025,NGRC03028,NGRC03029,NGRC03861,NGRC03035,NGRC03036,NGRC03037,NGRC03043,NGRC03049,NGRC03050	NGRC01715,NGRC01797,NGRC01820,NGRC01821,NGRC01842,NGRC01843,NGRC06637,NGRC06638,NGRC01879,NGRC06634,NGRC01873,NGRC01876,NGRC01878,NGRC01902,NGRC01915,NGRC01916,NGRC06633,NGRC01918,NGRC01920,NGRC01930,NGRC01935,NGRC01939,NGRC01945,NGRC01960,NGRC05726,NGRC06631,NGRC01955,NGRC03249,NGRC01961,NGRC01965,NGRC02079,NGRC02080,NGRC02081,NGRC02086,NGRC02091,NGRC02092,NGRC02094,NGRC02097,NGRC02102,NGRC02104,NGRC02107,NGRC02109,NGRC02111,NGRC02119,NGRC02120,NGRC02122,NGRC02124,NGRC02125,NGRC02126,NGRC02127,NGRC02137,NGRC03166,NGRC02826,NGRC02918,NGRC02919,NGRC02932,NGRC02934,NGRC02947,NGRC02948,NGRC02986,NGRC03081,NGRC02990,NGRC02991,NGRC07304,NGRC03027,NGRC03032,NGRC04933,NGRC04934,NGRC03289	NGRC01888,NGRC01875,NGRC01899,NGRC01925,NGRC01948,NGRC02083,NGRC02112,NGRC02134,NGRC02819,NGRC02988,NGRC03042,NGRC03044,NGRC03045,NGRC03298,NGRC07305	NGRC01940,NGRC01954,NGRC02013,NGRC02098,NGRC02105,NGRC02113,NGRC02852,NGRC03026,NGRC03030,NGRC03047,NGRC04940

B. Barley

Characterization and evaluation of barley accessions

A total of 65 accessions of barley accessions were characterized and evaluated at Khumaltar for 7 qualitative and 15 quantitative characters. The experiments were conducted in a randomized complete block design (RCBD) with two replications at NAGRC Khumaltar, Lalitpur. Sowing was done on 19thNovember 2019. Each entry was sown continuously in eight rows of 2 m length with distance of 25 cm between rows. The field was fertilized with Organic manure at the rate of 6 t/ha during land preparation and NPK at the rate of 100:50:0 kg/ha supplied from DAP and Urea during sowing time as a basal application. Irrigation was done at critical stage of irrigation i.e. tillering, bolding and flowering stage. Five plants were randomly selected in each plot and tagged in an advance for data recording. Both qualitative and quantitative data were recorded following IPGRI descriptors (IPGRI 1994). Thousand kernel weight and grain yield/plot were recorded after sun-drying in gram but grain yield later extrapolated to kilogram (kg) per hectare. Percent yellow rust diseases severity was recorded before crop maturity with modified Cobb's scale (Peterson et al. 1948) and reaction based on Roelfs et al (1992). Coefficient of infection (CI) was calculated by multiplying of diseases severity (DS) and constant values of infection type (IF). The constant values for infection types were used based on: R: 0.1, MR: 0.25, M: 0.5, MS: 0.75 and S:1. Statistical analysis of data for quantitative characters and average coefficient of infection (ACI) carried out by MSTAT-c software version 1.3. Analysis of variance (ANOVA) was performed using General Linear Model and comparison of genotypes was made based on Duncan's multiple range tests at 5% level of significance.

Maximum frequency of qualitative characters on spike density, lamma awan/hood, lemma awn barbs, glume colour, awn colour, growth habit andNumber of rows on spike were found lax type (36), Awned type (46), Rough type (50), Brown type (45), Brown type (39), Erect type (43) and four rowed type (42) (Table 12). Out of 65 barley accession, 12 accessions were not shown any yellow rust diseases sign and symptoms (Table12). Accessions NGRC04104, NGRC05985, NGRC07575, NGRC07729, C07196 were found early maturing type; C07863, NGRC05985 and NGRC04059 were found shortest plant height; NGRC01162 and C010253 were found longest spike length;NGRC00810, C07468 and C010365 were found higher number of spike per m2; NGRC01181, C010551 and C07468 were found higher Number of seed per spike; C07141 and C07468 were found higher 1000 seed weight, and C010551, C010365 and NGRC04225 were found high yielding among the tested genotypes (Table 13). Accessions NGRC00967, NGRC01152, NGRC03884, NGRC04059, NGRC04066, NGRC04104, NGRC04188, NGRC04189, NGRC05985, NGRC07575, NGRC07729 and C010253 were found lowest and C010510 and C07430 were found highest Average Coefficient of Infection (ACI) value for yellow rust diseases among the tested genotypes (Table 13)

Table 12. Five qualitative characteristics of 65 barley landraces with yellow rust reaction

Accession No	Spike Density	Lemma awn \hood	Awn color	Number of rows on spikes	Host reaction (Yellow rust)
NGRC00810	Lax	Awned	Brown	4	S-MS
NGRC00811	Lax	Awned	Brown	4	S-MS
NGRC00853	Lax	Awned	Brown	6	S
NGRC00904	Lax	Awned	Brown	4	S-MS
NGRC00922	Lax	Awned	Brown	4	S-MS
NGRC00967	Lax	Awned	Black	4	-
NGRC00969	Dense	Awnleted	Amber/white	6	S
NGRC01051	Intermediate	Awnleted	Amber/white	4	S-MS
NGRC01068	Intermediate	Awnleted	Amber/white	6	S
NGRC01152	Intermediate	Awned	Brown	6	-
NGRC01160	Lax	Awned	Brown	4	S
NGRC01162	Lax	Awned	Amber/white	4	S
NGRC01168	Lax	Awned	Brown	4	S
NGRC01175	Intermediate	Awned	Amber/white	6	S-MS
NGRC01180	Intermediate	Awnleted	Brown	6	S
NGRC01181	Dense	Awnleted	Brown	6	S-MS
NGRC02431	Lax	Awned	Brown	4	S-MS
NGRC03884	Intermediate	Awned	Amber/white	4	-
NGRC03902	Lax	Awned	Brown	4	S
NGRC04059	Lax	Awned	Amber/white	4	-
NGRC04066	Lax	Awned	Amber/white	4	-
NGRC04104	Lax	Awned	Amber/white	4	-
NGRC04126	Intermediate	Awned	Brown	4	R-MR
NGRC04128	Lax	Awnleted	Brown	4	R-MR
NGRC04130	Lax	Awned	Amber/white	4	S-MS
NGRC04150	Lax	Awned	Amber/white	4	MR-MS
NGRC04153	Lax	Awned	Amber/white	4	S-MS
NGRC04159	Lax	Awned	Brown	4	S
NGRC04164	Lax	Awned	Brown	4	S
NGRC04175	Intermediate	Awned	Brown	4	S
NGRC04183	Lax	Awned	Amber/white	4	S
NGRC04186	Lax	Awned	Amber/white	4	MS-MR

Accession No	Spike Density	Lemma awn \hood	Awn color	Number of rows on spikes	Host reaction (Yellow rust)
NGRC04188	Lax	Awned	Amber/white	4	-
NGRC04189	Intermediate	Awned	Brown	6	-
NGRC04191	Intermediate	Awned	Amber/white	4	MR-MS
NGRC04206	Intermediate	Awned	Brown	4	S
NGRC04212	Lax	Awned	Brown	4	S-MS
NGRC04219	Intermediate	Awned	Brown	4	S
NGRC04225	Lax	Awned	Brown	4	S
NGRC04230	Lax	Awned	Brown	4	S-MS
NGRC04234	Lax	Awned	Brown	4	S
NGRC05985	Intermediate	Awned	Brown	6	-
NGRC05992	Lax	Awned	Brown	6	S
NGRC06001	Lax	Awned	Brown	4	S
NGRC07575	Intermediate	Awnless	Brown	4	-
NGRC07576	Intermediate	Awnless	Brown	6	S-MS
NGRC07722	Intermediate	Awnless	-	4	S
NGRC07729	Intermediate	Awned	Amber/white	4	-
NGRC07732	Intermediate	Awnleted	Amber/white	6	S-MS
NGRC08132	Lax	Awnless	-	4	S
C010417	Intermediate	Awnless	-	6	S
C07207	Intermediate	Awned	Brown	6	S
C07430	Intermediate	Awnleted	Amber/white	6	S
C07196	Intermediate	Awnleted	Brown	6	S
C010253	Lax	Awned	Brown	4	-
C07863	Lax	Awned	Brown	4	S
C07141	Intermediate	Awnleted	Amber/white	6	S
C07468	Lax	Awned	Brown	6	S
C010172	Intermediate	Awnleted	Brown	6	S
C010365	Lax	Awned	Amber/white	4	S
C010169	Lax	Awned	Brown	4	S
C010531	Dense	Awnleted	Brown	6	S-MS
C010510	Dense	Awnleted	Brown	6	S
C010551	Dense	Awnleted	Brown	6	S
Bonus	Lax	Awned	Amber/white	2	S

Table 13. Mean value of 11 quantitative characters of 65 barley landraces

Treat-ment	Days to flower-ing	Days to ma-turity	Flag leaf length (cm)	Plant height (cm)	Spike length (cm)	Spike /m2	ACI (Yellow rust)	Awn length (cm)	Seed per spike	Seed length (mm)	Yield (t/ ha)
NGRC00810	109^{f-m}	161^{a}	12.10^{f-n}	144.0^{a-j}	16.3^{c-f}	535^{ab}	14.0^{f-j}	8.95^{a-h}	58.$^{a-k}$	10.08^{b-d}	2.81^{a-i}
NGRC00811	116^{a-h}	160^{ab}	13.73^{b-f}	151.1^{a-d}	16.9^{c}	341^{e-o}	14.5^{f-j}	7.45^{b-j}	52^{e-l}	9.61^{d-l}	2.32^{d-j}
NGRC00853	117^{a-f}	153^{a-g}	14.15^{b-d}	136.3^{c-o}	11.5^{wx}	355^{e-o}	22.5^{d-j}	5.65^{j-m}	57^{b-l}	9.04^{i-q}	2.73^{a-j}
NGRC00904	112^{d-m}	158^{a-d}	11.89^{g-o}	152.3^{ab}	15.0^{f-o}	216^{p}	19.0^{e-j}	0.75^{r}	50^{g-l}	9.26^{e-p}	2.55^{b-j}
NGRC00922	105^{j-m}	159^{a-c}	11.36^{j-q}	137.0^{b-o}	12.0^{u-w}	278^{i-p}	7.0^{h-j}	6.50^{g-l}	58^{a-k}	9.55^{d-n}	2.04^{ij}
NGRC00967	108^{g-m}	152^{b-h}	9.61^{s-z}	135.7^{b-o}	26.4^{b}	340^{e-o}	0.0^{j}	6.80^{e-k}	64^{a-g}	9.95^{k-q}	2.46^{b-j}
NGRC00969	108^{g-m}	148^{f-j}	12.55^{d-l}	133.3^{f-o}	9.5$^{yz[}$	265^{k-p}	15.0^{f-j}	3.25^{n-p}	58^{a-k}	9.17^{f-p}	2.46^{b-j}
NGRC01051	109^{f-m}	147^{f-j}	11.29^{j-r}	141.9^{a-m}	9.8$^{yz[}$	300^{h-p}	24.0^{d-j}	4.30^{m-p}	56^{c-l}	9.73^{d-j}	2.52^{b-j}
NGRC01068	110^{e-m}	148^{f-j}	11.82^{j-o}	145.7^{a-i}	11.6^{vwx}	338^{e-o}	45.0^{a-d}	3.60^{n-p}	60^{a-j}	9.24^{e-p}	1.99^{j}
NGRC01152	105^{j-m}	158^{a-e}	10.62^{n-u}	141.4^{a-n}	15.3^{e-n}	341^{e-o}	0.0^{j}	7.50^{b-i}	64^{a-g}	9.32^{d-p}	2.95^{a-g}
NGRC01160	109^{f-m}	152^{b-h}	11.49^{j-p}	147.5^{a-g}	16.4^{c-e}	334^{f-o}	45.0^{a-d}	9.00^{a-c}	60^{a-j}	9.41^{q}	1.97^{j}
NGRC01162	111^{d-m}	158^{a-e}	14.77^{b}	153.5^{a}	28.0^{a}	243^{op}	50.0^{a-c}	8.15^{a-h}	61^{a-i}	9.79^{d-i}	2.18^{g-j}
NGRC01168	106^{i-m}	158^{a-e}	13.06^{c-i}	149.7^{a-e}	16.8^{cd}	290^{h-p}	15.0^{f-j}	7.60^{a-h}	58^{a-k}	10.55^{bc}	3.07^{a-e}
NGRC01175	107^{h-m}	149^{f-j}	9.97^{p-x}	139.2^{a-o}	14.7^{i-p}	380^{d-k}	4.5^{ij}	8.20^{a-h}	57^{c-l}	9.25^{e-p}	2.71^{a-j}
NGRC01180	118^{a-e}	158^{a-e}	9.61^{s-z}	148.2^{a-f}	10.1^{yz}	263^{l-p}	55.0^{ab}	2.49^{pq}	66^{a-f}	8.82^{m-q}	2.63^{a-j}
NGRC01181	115^{a-i}	156^{a-f}	7.86^{l}	142.4^{a-l}	8.3$^{\l}$	305^{h-p}	38.5^{b-f}	1.41^{qr}	73^{a}	9.00^{j-q}	2.76^{a-j}
NGRC02431	118^{a-e}	158^{a-d}	11.86^{h-o}	135.8^{z-o}	12.7^{t-w}	469^{a-d}	5.1^{h-j}	5.55^{k-m}	61^{a-i}	8.91^{l-q}	2.88^{a-h}
NGRC03884	103^{lm}	146^{g-j}	10.04^{p-w}	135.4^{d-o}	15.6^{c-l}	365^{d-n}	0.0^{j}	8.30^{a-g}	59^{a-k}	9.09^{h-q}	2.70^{a-j}
NGRC03902	106^{i-m}	152^{c-i}	12.25^{e-n}	124.4^{o-q}	14.2^{m-r}	290^{h-p}	20.0^{e-j}	7.75^{a-h}	56^{c-l}	9.61^{d-l}	3.03^{a-f}
NGRC04059	110^{e-m}	158^{a-d}	11.61^{i-p}	113.0^{pq}	14.0^{n-s}	335^{f-o}	0.0^{j}	5.65^{j-m}	57^{b-k}	8.64^{pq}	2.63^{a-j}
NGRC04066	107^{h-m}	147^{f-j}	9.22$^{u-[}$	136.2^{c-o}	14.3^{l-r}	278^{i-p}	0.0^{j}	8.95^{a-h}	48^{i-l}	8.79^{n-q}	2.16^{g-j}
NGRC04104	104^{k-m}	143^{ij}	8.29$^{y-[}$	132.4^{f-o}	15.0^{f-o}	348^{e-o}	0.0^{j}	6.52^{g-l}	54^{d-l}	9.52^{d-n}	2.24^{g-j}
NGRC04126	110^{e-m}	160^{ab}	9.62^{s-z}	137.7^{a-o}	16.0^{c-i}	292^{h-p}	1.3^{j}	6.90^{d-k}	60^{a-j}	9.58^{d-m}	2.35^{c-j}
NGRC04128	115^{a-i}	161^{a}	9.63^{s-z}	132.8^{f-o}	12.1^{u-w}	263^{l-p}	0.6^{j}	4.80^{l-n}	63^{a-h}	9.35^{d-p}	2.28^{e-j}
NGRC04130	109^{f-m}	161^{a}	11.91^{g-o}	137.7^{b-o}	15.7^{c-k}	306^{h-p}	22.5^{d-j}	8.40^{a-g}	64^{a-g}	9.24^{e-p}	2.23^{g-j}
NGRC04150	107^{h-m}	151^{d-i}	9.78^{q-y}	136.7^{b-o}	14.8^{h-p}	311^{g-p}	5.0^{h-j}	8.40^{a-g}	46^{j-l}	9.19^{f-p}	2.41^{b-j}
NGRC04153	108^{g-m}	160^{ab}	10.97^{k-l}	145.0^{a-i}	16.6^{c-e}	338^{e-o}	7.0^{h-j}	8.35^{a-g}	55^{d-l}	9.89^{c-f}	2.06^{ij}
NGRC04159	112^{c-l}	160^{ab}	10.90^{l-t}	143.2^{a-l}	16.2^{c-g}	307^{h-p}	50.0^{a-c}	8.65^{a-e}	58^{a-k}	9.68^{d-k}	1.99^{j}
NGRC04164	117^{a-g}	161^{a}	20.85^{a}	140.1^{a-o}	16.1^{c-h}	272^{j-p}	19.5^{e-j}	7.15^{c-k}	62^{a-i}	9.64^{d-l}	2.22^{g-j}
NGRC04175	105^{j-m}	145^{h-j}	8.13z$^{[}$	131.3^{h-o}	14.8^{h-p}	350^{e-o}	5.0^{h-j}	8.40^{a-g}	49^{h-l}	9.34^{d-p}	2.53^{b-j}
NGRC04183	105^{j-m}	146^{g-j}	13.53^{b-g}	134.1^{e-o}	15.7^{c-k}	423^{c-g}	20.0^{e-j}	7.75^{a-h}	60^{a-j}	9.80^{d-i}	2.33^{d-j}
NGRC04186	104^{k-m}	149^{f-j}	8.46$^{w-[}$	128.9^{j-o}	14.8^{h-p}	368^{d-m}	2.5^{j}	8.15^{a-h}	55^{d-l}	9.26^{e-p}	2.53^{b-j}
NGRC04188	105^{j-m}	148^{f-j}	8.13$^{z-[}$	128.4^{j-o}	14.9^{g-p}	282^{i-p}	0.0^{j}	8.45^{a-f}	51^{g-l}	9.52^{d-n}	2.15^{h-j}
NGRC04189	106^{i-m}	152^{b-h}	8.83$^{v-[}$	127.9^{k-o}	13.9^{o-t}	253^{n-p}	0.0^{j}	8.70^{a-e}	48^{i-l}	9.10^{g-q}	2.37^{c-j}
NGRC04191	106^{i-m}	149^{f-j}	8.93$^{v-[}$	127.8^{l-o}	13.6^{p-t}	376^{d-l}	5.0^{h-j}	7.90^{a-h}	56^{d-l}	9.53^{d-n}	2.46^{b-j}
NGRC04206	106^{i-m}	148^{f-j}	10.00^{p-x}	137.4^{b-o}	14.9^{g-p}	320^{f-p}	11.25^{g-j}	9.30^{ab}	55^{d-l}	9.59^{d-l}	2.52^{b-j}
NGRC04212	117^{a-g}	159^{a-c}	9.82^{q-y}	143.7^{a-k}	15.7^{c-k}	352^{e-o}	28.0^{c-i}	9.40^{a}	51^{f-l}	9.24^{e-p}	2.51^{b-j}
NGRC04219	104^{k-m}	145^{h-j}	9.35$^{x-[}$	136.1^{d-o}	14.8^{h-p}	343^{e-o}	10.0^{g-j}	8.63^{a-e}	53^{e-l}	9.00^{j-q}	2.59^{b-j}
NGRC04225	105^{j-m}	147^{f-j}	12.65^{e-j}	134.1^{e-o}	14.6^{j-q}	319^{f-p}	50.0^{a-c}	8.60^{a-e}	50^{g-l}	9.86^{d-g}	3.14^{a-c}
NGRC04230	122^{ab}	159^{a-c}	9.34$^{t-[}$	147.3^{a-g}	15.9^{c-j}	301^{h-p}	29.0^{c-i}	8.75^{a-d}	48^{i-l}	9.30^{e-p}	2.45^{b-j}
NGRC04234	104^{k-m}	145^{h-j}	10.35^{o-v}	135.5^{d-o}	14.4^{k-q}	355^{e-o}	10.0^{g-j}	8.15^{a-h}	48^{i-l}	9.40^{d-p}	2.67^{a-j}
NGRC05985	105^{j-m}	144^{ij}	8.05$^{z-[}$	111.5^{q}	12.0^{u-w}	323^{f-p}	0.0^{j}	6.60^{f-l}	56^{c-l}	8.69^{o-q}	2.87^{a-h}
NGRC05992	105^{j-m}	160^{a}	12.11^{f-n}	146.4^{a-i}	15.6^{c-l}	313^{g-p}	10.0^{g-j}	7.45^{b-j}	48^{i-l}	9.14^{f-q}	2.155^{g-j}
NGRC06001	110^{e-m}	150^{e-i}	9.66^{r-z}	138.4^{a-o}	14.6^{j-qz}	449^{b-e}	50.0^{a-c}	7.95^{a-h}	42^{l}	9.14^{f-q}	2.30^{d-j}
NGRC07575	103^{m}	143^{ij}	10.97^{p-x}	140.5^{a-o}	13.1^{r-u}	311^{g-p}	0.0^{j}	0.00^{r}	59^{a-k}	10.59^{b}	2.29^{d-j}
NGRC07576	108^{g-m}	147^{f-j}	12.54^{b-g}	148.1^{a-f}	12.8^{s-v}	383^{d-j}	24.5^{d-j}	0.00^{r}	61^{a-i}	9.21^{f-p}	3.05^{a-e}

Treatment	Days to flowering	Days to maturity	Flag leaf length (cm)	Plant height (cm)	Spike length (cm)	Spike /m2	ACI (Yellow rust)	Awn length (cm)	Seed per spike	Seed length (mm)	Yield (t/ha)
NGRC07722	114^{b-j}	147^{f-j}	12.50^{e-m}	137.3^{b-o}	7.8$^{]^}$	295^{h-p}	30.0^{c-h}	0.00^{r}	66^{a-e}	9.35^{d-p}	2.42^{b-j}
NGRC07729	103^{lm}	143^{ij}	7.89^{l}	142.1^{a-m}	15.7^{c-k}	360^{d-n}	0.0^{j}	7.95a-h	59^{a-k}	9.54^{d-n}	2.39^{c-j}
NGRC07732	123^{a}	158^{a-d}	10.84^{m-u}	145.7^{a-i}	10.1^{yz}	366^{d-n}	11.5^{g-j}	2.50^{pq}	54^{d-l}	16.86^{a}	2.44^{b-j}
NGRC08132	111^{d-m}	147^{f-j}	10.92^{l-t}	145.1^{a-i}	7.5$^{^}$	296^{h-p}	15.0^{f-j}	0.00^{r}	65^{a-g}	9.82^{d-h}	2.19^{g-j}
C010417	111^{d-m}	148^{f-j}	10.11^{p-w}	142.7^{a-l}	5.5^{-}	280^{i-p}	32.5^{b-g}	0.00^{r}	69^{a-d}	8.64^{pq}	2.64^{a-j}
C07207	112^{c-l}	150^{d-i}	14.36^{bc}	152.0^{a-c}	11.9^{u-w}	339^{e-o}	43.0^{a-e}	4.35^{m-o}	60^{1-j}	9.70^{d-k}	2.50^{b-j}
C07430	107^{h-m}	147^{f-j}	12.39^{e-m}	134.9^{e-o}	9.6$^{yz[}$	320^{f-p}	65.0^{a}	3.30^{n-p}	66^{a-f}	9.66^{d-l}	2.70^{a-j}
C07196	117^{a-f}	141^{j}	12.97^{g-o}	136.6^{b-o}	10.6^{xy}	270^{i-p}	30.0^{c-h}	4.00^{m-p}	57^{b-k}	9.51^{d-n}	2.24^{f-j}
C010253	108^{g-m}	145^{h-j}	13.11^{c-i}	130.8^{i-o}	28.2^{a}	390^{c-i}	0.0^{j}	7.75^{a-h}	61^{a-i}	9.41^{d-o}	2.83^{a-i}
C07863	121^{a-c}	160^{d-i}	11.17^{j-s}	112.0^{q}	16.5^{c-e}	58^{q}	50.0^{a-c}	5.70^{j-m}	57^{b-k}	9.04^{i-q}	0.40^{k}
C07141	103^{m}	145^{h-j}	12.09^{f-n}	137.1^{b-o}	9.2$^{zl\}$	328^{f-p}	45.0^{a-d}	4.15^{m-p}	69^{a-d}	9.76^{d-j}	2.69^{a-j}
C07468	111^{e-m}	154^{a-g}	12.60^{d-k}	135.6^{d-o}	15.4^{e-m}	539^{ab}	12.5^{g-j}	6.35^{h-l}	71^{a-c}	10.0^{b-e}	3.08^{a-d}
C010172	111^{d-m}	154^{a-g}	13.51^{b-h}	137.5^{b-o}	10.7^{xy}	306^{h-p}	45.0^{a-d}	3.40^{n-p}	63^{a-i}	9.86^{d-g}	2.94^{a-h}
C010365	103^{lm}	160^{d-i}	12.65^{d-j}	126.0^{n-p}	13.$^{q-t}$	559^{a}	5.0^{h-j}	5.42^{k-m}	57^{b-k}	9.11^{g-q}	3.19^{ab}
C010169	110^{e-m}	160^{a-c}	12.27^{e-n}	133.5^{f-o}	15.5^{d-m}	254^{m-p}	12.5^{g-j}	6.90^{d-k}	45^{kl}	9.31^{e-p}	2.65^{a-j}
C010531	113^{c-k}	154^{a-g}	13.82^{b-e}	139.0^{a-o}	9.7$^{yz[}$	404^{c-h}	5.7^{h-j}	2.95^{o-q}	67^{a-e}	9.23^{f-p}	2.56^{b-j}
C010510	119^{a-d}	154^{a-g}	13.82^{b-e}	132.0^{g-o}	10.2^{yz}	78^{q}	65.0^{a}	2.90^{o-q}	67^{a-e}	9.66^{d-l}	0.83^{k}
C010551	109^{f-m}	148^{f-j}	14.37^{bc}	147.1^{a-h}	8.8$^{[\}$	430^{c-f}	6.3^{h-j}	3.40^{n-p}	72^{ab}	9.71^{d-k}	3.39^{a}
Bonus	118^{a-e}	157^{a-e}	6.26$^{\}$	126.4^{m-p}	16.0^{c-i}	495^{a-c}	15.0^{f-j}	6.60^{f-l}	25^{m}	8.82^{m-q}	2.82^{a-i}
GM	110	152	11.2	137.6	14.0	329	19.14	6.0	57.5	9.5	2.48
LSD	7.2	6.78	1.4	12.7	1.1	91.7	20.36	1.5	11.9	0.6	0.64
P value	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	.000
CV	3.3	2.2	6.1	4.6	3.9	14.0	34.5	12.7	10.4	3.2	12.8

3.3.2. Characterization of Horticultural crops

A. Taro

Morphological characterization of taro (*Colocasia esculenta*) accessions through qualitative traits

Fifty-five taro accessions collected from different districts of Nepal were characterized and evaluated at National Agricultural Genetic Resources Center (NAGRC), Khumaltar at 2019. These accessions were planted in Non-replicated rod-rows design for agro morphological characterization. The seeding date was 6th April 2019. Plot size for this experiment was 1.7 m x 2m and maintained the distance of 30 cm and 50 cm between the plant and row respectively. Different characters were recorded by following the descriptor established by Bioversity International. Five random plants from each treatment were taken for recording data of various quantitative characters like plant height, position of leaf lamina, leaf blade margin, vein pattern, petiole color, leaf waxiness etc. were taken for observing qualitative characters. Frequency distribution was computed for qualitative characters.

Table 14. Morphological characterization of taro accessions through qualitative traits

SN	Characters	Description with code	Frequency	Frequency %
1.	Plant height	1-Dwarf (less than 50cm)	24	44
		2-Medium (50-100 cm)	31	56
		3. Tall (Greater than 100 cm)	0	0
2.	No of solons	0-None	12	22
		1-1-5	41	75
		2-6-10	2	3
		3-11-20	0	0
		4- Greater than 20	0	0
3.	Positions of leaf lamina	1-Drooping	0	0
		2- Horizontal	0	0
		3-Cup shaped	0	0
		4- Erect-apex up	0	0
		5- Erect- apex down	55	100
		99- Erect	0	0
4.	Leaf blade margin	1-Entire	1	2
		2- Undulate	29	53
		3- Sinuate	24	43
5.	Vein pattern	1-V pattern	0	0
		2- I pattern	0	0
		3- Y pattern	55	100
7.	Petiole color	1-Pale green	0	0
		2-Yellow	0	0
		3- Orange	0	0
		4- Green	9	16
		5- Purple	46	84
8.	Leaf waxiness	0-Absent	0	0
		1- Present	55	100

B. Garlic

Agro-morphological characterization of garlic *(Allium sativum)* accessions

Thirty-seven accessions collected from different districts of Nepal were characterized and evaluated at National Agricultural Genetic Resources Center (NAGRC), Khumaltar at 2019. These accessions were planted in Non-replicated rod-rows design for

agro morphological characterization. The seeding date was 6thNov 2019. There was maintained the distance of 20 cm and 15 cm between the plant and row respectively. Different characters were recorded by following the descriptor. Five random plants from each treatment were taken for recording data of various quantitative characters like Days to emergence, Plant height, Clove length, Clove width, no of cloves/bulb, Clove width and Longitudinal diameter of bulb and whole plot was taken for observing qualitative characters. Frequency distribution was computed for qualitative characters.

Table 15. Basic statistics of quantitative characteristics

SN	Characters	Mean ± S.E	Std.	Var.	CV %	Min.	Max.
1	Days to emergence	9±0.32	1.95	3.79	20.82	7	18
2	PH after 30 days (cm)	15.86±0.62	3.82	14.57	24.06	8.82	27
3	PH after 120 days (cm)	35.55±1.50	9.11	83.04	25.64	22.40	60.80
4	Clove length (cm)	3.68±0.10	0.62	0.39	16.89	2.5	4.9
5	Clove width(mm)	10.43±0.33	2.01	4.04	19.27	6.3	14.1
6	No of cloves/bulb	19±1.27	7.71	59.45	39.90	5	39
7	Clove weight (gm)	18.32±2.47	15.03	225.77	82.01	2.33	70.94
8	Diameter of bulb (mm)	31.92±1.18	7.19	51.72	22.53	18.79	53.51

Table 16. Morphological characterization of garlic accessions through qualitative traits

SN	Characters	Description with code	Frequency	Frequency %
1.	External cloves	0- Absent	18	49
		9- Present	19	51
2.	Plant vigor	2-Very weak	3	8
		3- Weak	8	22
		4- Slightly weak	5	14
		5- Intermediate	11	30
		6- Slightly vigorous	4	10
		7-Vigorous	3	8
		8- Very vigorous	1	3
		9- Extremely vigorous	2	5
3.	Leaf color	2-Very light	3	8
		3- Light	4	10
		4- Slightly light	15	41
		5- Intermediate	15	41
4.	Anthocyanin color-ation at the base of pseudostem	2-Very Weak	2	5
		3- Weak	7	19
		4- Slightly Weak	13	36
		5- Intermediate	12	32
		6- Slightly strong	3	8

SN	Characters	Description with code	Frequency	Frequency %
5.	Bulb skin color	1- White	26	70
		2- Light pink	1	3
		4- Light brown	10	27
6.	Thickness ofNeck	1- Extremely thin	3	8
		2-Very thin	2	5
		3- Thin	5	14
		4- Slightly thin	8	21
		5- Intermediate	5	14
		6- Slightly thick	5	14
		7-Thick	5	14
		8-Very Thick	4	10
7.	Bulb shape of base	1- Recessed	1	3
		2- Flat	29	78
		3- Round	7	19
8.	Compactness of cloves	3-Loose	4	11
		5-Intermediate	10	27
		7-Compact	20	54
		9- Very compact	3	8
9.	Bulb skin thickness	2- Very thin	1	3
		3- Thin	14	37
		4- Slightly thin	8	22
		5- Intermediate	8	22
		6- Slightly thick	6	16
10.	Peeling	1- Extremely easy	2	5
		2- Very easy	5	14
		3-Easy	7	19
		4- Slightly easy	9	24
		5-Intermediate	4	11
		6- Slightly hard	3	8
		7-Hard	7	19
11.	Cracking of bulb skin	2-Very frequent	3	8
		3-Frequent	10	27
		4- Slightly frequent	9	24
		5-Intermediate	11	30
		6- Slightly rare	4	11
12.	Clove skin color	1-White	24	65
		2-Light pink	13	35
13.	Intensity of clove skin color	3- Weak	3	9
		4- Slightly weak	2	5
		5-Intermediate	2	5
		6-Slightly strong	2	5
		7-Strong	14	38
		8- Very strong	14	38

SN	Characters	Description with code	Frequency	Frequency %
14.	Anthocyanin stripes on clove skin	0-Absent	12	32
		9-Present	25	68
15.	Clove shape	3- Slim round	18	49
		5- Flat	3	8
		7- Thick round	16	43
15.	Easiness of dividing bulb into cloves	2- Very easy	1	3
		3-Easy	4	11
		4- Slightly easy	4	11
		5-Intermediate	12	32
		6- Slightly hard	6	16
		7-Hard	7	19
		8- Very hard	2	5
		9-Extremely hard	1	3

C. Mustard

Regeneration and characterization

Mustard (*Brassica juncea* [L.] Czern & Coss) has been widely used as green leafy vegetables and for extracting cooking oil in Nepal. The country has few dozens of mustard accessions in its government owned National genebank. Despite huge number of accessions, the information on characteristics of these genetic accessions is limited reflecting limited studies on it. Study on characterization of native mustard germplasm is imperative to identify unique landraces for breeding program and future efficient mustard collection and conservation.

Agro-morphological characterization of 23 accessions that has collected and conserved either at short or at medium term facility at NAGRC, NARC were used in the mustard characterization trial. The seedlings were raised inside the plastic tunnel on 3 October 2019. A 3-4 leaf stage seedlings were transplanted in plastic tunnel on 3 November 2019 condition provided that each accession received 16 plants. Second replication was transplanted at open field condition however they did not grow well therefore data was collected only from replication that had grown at plastic tunnel. Agro-morphological characterization was made using different morphological traits that cover traits observed at seedling to harvesting stage following descriptors made by International Board for Plant Genetic Resources and Descriptors for Brassica and Raphanus. The descriptor encompasses both quantitative and qualitative traits representing variables.

We found enormous plant architectural variability among native mustard landraces. Twenty-five variables were found to be discriminatory out of 30 studied descriptors, five characters were found monomorphic. Major traits responsible for variation include days to flowering and maturity, plant height, branch number etc. The observed qualitative and quantitative variation showed enough opportunity for future selection-based breeding or hybridization. The major quantitative variation observed in the present study is depicted in Table 17.

Table 17. Major qualitative traits associated with different mustard accession, 2076/77

SN	Acc #	DOF	PH (cm)	LL (cm)	LW (cm)	PL (cm)	FSL (cm)	SL (cm)	SW (mm)	BL (cm)	NSS
1	CO 3389	77	176.6	32	16.1	3.1	1.34	3.04	3.86	0.84	15.4
2	C0 4846	106	186	56.4	20.4	8.9	1.24	3.18	3.93	0.96	17.8
3	C0 4847	136	224.6	57.2	24.3	7.16	1.24	2.92	2.454	0.92	15.8
4	C0 4850	80	179.6	64	23	7.3	1	9.94	3.646	0.92	15.4
5	C0 7356	138	214.4	32.4	15.8	2.2	1.44	3.18	2.51	0.7	18.4
6	C0 7357	95	186.2	40	22.1	4.8	1.22	2.64	3.434	0.92	16.6
7	C0 7442	129	170.8	59	28	6.1	1.14	3.16	3.442	1.2	19.2
8	C0 7904	74	148.4	42.6	18.4	5.1	1.02	3.1	3.332	0.6	13.6
9	C0 7906	74	153	32.3	17.2	2.34	0.84	3.38	4.094	0.76	19.8
10	C0 7907	80	173.8	31	15.5	2.9	0.7	3.16	3.718	0.88	18.2
11	C0 10021	101	184.2	54.2	22.2	5.9	1.26	3.4	3.722	0.98	19.8
12	C0 10174	147	198.6	45	22.8	3.06	0.98	4.04	3.574	0.84	18
16	NGRC0 8383	147	183.6	50.4	28.6	5	1.42	3.2	2.72	0.8	18.6
17	NAGRC0 8384	128	188.8	54.2	26.9	3.6	1.4	2.52	2.944	0.76	10.6
18	NGRC0 3858	97	204.6	66.4	34	4.2	1.26	2.88	3.13	1.16	13.6
19	NGRC0 3859	153	223	75.8	37.6	4.2	1.18	2.54	3.66	0.8	13
20	NGRC0 6628	153	227.6	71.4	40.2	4.6	1.2	2.96	3.66	0.82	14.4
21	NGRC0 6629	116	203.6	60	28.8	10	0.96	2.96	3.06	0.9	13.4
22	NGRC0 8381		159.8	43.6	23	6	1.36	3	3.13	0.72	18.4
23	NGRC0 8380	111	201.2	54.2	28	5	1.44	2.54	4.00	0.64	15.4

We found different unique mustard accession. Red Leafed Rayo, Kande Rayo, Dunde rayo and Gujmuje Rayo are few of them (Figure 9). The red leafed rayo seems interesting accession for developing good quality and unique mustard variety however total leaf harvest from this type is minimal. Total leaf number from dunde rayo, gujmuje rayo and other mixed type rayo was found to be the highest making them interesting line for higher yield.

Red leafed Rayo Kande Rayo Gujumuje Rayo

Figure 9. *Unique Rayo characterized in the present study.*

D. Radish

Regeneration and characterization

Radish, *Raphanus sativus* L. is economically important Brassicaceae root crop grown worldwide including Nepal. This is one of the important salad crops. Considering wide ecogeographic diversity of the country, wide range of radish genotypes is expected to found in Nepal however information is limited. For this crop, the adequacy of genebank holding is also Not determined. Under this scenario, collection and characterization is important for better conservation expedition and utilization.

An on-farm radish characterization trial was conducted at research field of NAGRC, NARC. Local mustard seeds of 25 accessions collected from NAGRC, NARC, each representing different treatments, were laid out in randomized complete block design with three replicates. Field was chosen where brassicaceae crops were not grown during previous season. The plot size was 6 square meters (3-m x 2-m). Compost was applied at 10 Mt/ha before 15 days of final land preparation. Chemical fertilizer was applied manually at 30:30:30NPK kg/ha during final land preparation. To meet vernalization requirement, the radish seeds were sown at open field conditions on 4 October 2019. The seeds were sown in a continuous row, and row to row distance was 25 cm. After a month of emergence, the plant to plant distance was maintained at 10 cm. The other agronomic practices were adopted according to general cultivation procedures. For characterization purpose, agro-morphological characterization was made using different morphological traits that cover traits observed at seedling to harvesting stage following descriptors made by International Board for Plant Genetic

Resources and Descriptors for Brassica and Raphanus. The descriptor encompasses both quantitative and qualitative traits representing variables.

We found enormous plant architectural variability among native radish landraces. Most of the variables observed in the present study were found to be discriminatory. Major traits responsible for variation include days to flowering and maturity, plant height, siliqua length, siliqua breadth etc. The observed qualitative and quantitative variation showed enough opportunity for future selection-based breeding or hybridization. The major quantitative variation observed in the present study is depicted in (Table 18).

Table 18. Major qualitative traits associated with different radish accession, 2076/77

SN	Acc #	DOF (1st)	DOF (50%)	PH (cm)	N.of .L	DbL	MOD	LL (cm)	LW (cm)	PL (cm)	SL (cm)	SW (mm)	LB (cm)	NSSi
1	NGRC0 4702	96	158	152.2	11.8	2.5	201	39.52	13.8	3.26	3.02	7.48	2.1	4.8
2	NGRC0 4685	77	121	129	11.4	1.86	189	32.6	9.6	2.8	4.1	9.118	3.42	6
3	NGRC0 4692	81	124	152.4	7	2.24	194	27.6	9.1	2.54	3.72	9.248	1.98	6.6
4	NGRC0 4694	101	131	166	9.4	2.54	201	39.5	12.9	3.04	4.44	9.146	1.26	4.8
5	NGRC0 4695	111	158	278.2	7.2	2.5	206	28.04	10.54	2.8	4.08	6.366	1.18	5.4
6	NGRC0 4696	121	161	145	9.8	2.08	208	29.14	9.6	1.34	5.94	8.458	1.8	5.8
7	NGRC0 4698	107	143	147.4	8	2.48	206	33.4	10.7	3.1	5.88	9.366	2	6.8
8	NGRC0 6505	157	163	111.25	6.8	2.46	204	20	6.3	1.6	4.8	5.84	2.1	6
9	NGRC0 7330	158	163	107.6	5.6	2.28	199	16.9	6.2	1.84	3.36	7.1	1.04	4.6
10	C0 5722	149	163	131.6	11	1.8	204	27.32	10.5	1.78	6.04	7.014	2.62	5.2
11	C0 7148	107	136	125.6	11.2	2.42	201	43.5	17.2	3.5	6.24	9.142	2.08	5.8
12	C0 7380	117	163	115.8	7.4	2.36	199	27.3	9.3	2	6.02	5.528	2.28	5.2
13	C0 10186	118	158	68	8.6	1.8	-	18.42	6.7	1.08	5.36	4.624	2.22	7.6
14	C0 2172	84	136	157.8	12.4	2.4	204	50.6	15.3	3	6.66	9.392	3.38	6.8
15	C0 1062	107	134	149.8	6.2	3.3	204	29.6	9.4	3.1	6.12	8.29	2.4	5
16	Acc # 1065	111	146	136.2	7.6	2.16	208	32.7	11.3	2.48	5.12	9.402	2.3	4
17	Acc # 1455	66	128	130.6	6.8	2.9	199	32.2	11.6	2.5	6.04	9.68	2.2	8.2
18	Acc # 1860	86	129	143	7.4	2.18	199	35.44	10.9	3.5	7.54	8.668	3.34	7
19	Acc # 1972	80	131	146.2	3	2.6	197	21.2	7.4	2.1	6.32	8.902	3.26	5.4
20	Acc # 6216	121	144	153.8	9.8	1.9	208	32.1	10.2	1.92	6.5	8.8	2.3	6.8
21	Acc # 6261	102	146	130	6	2.4	197	20.3	6.6	0.92	6.2	8.656	2.56	4.8
22	Acc # 7481	63	117	159.6	4.8	3.6	197	29.5	7.3	4.1	6.24	11.526	1.96	6.6
23	Acc # 9682	107	146	149.8	8.2	3.52	204	41.7	9.3	6	5.84	7.314	1.7	5.4
24	Acc # 8065	94	136	148.4	4.2	3.42	197	31.4	11.6	2.3	5.42	7.94	1.94	6.6
25	Acc # 6258	105	136	141	3.8	3.1	199	21.3	7.8	1.86	5.14	7.006	1.84	6.6

Few radish landraces were unique in terms of root properties which is the most interesting trait for breeder (Figure 10) One of the local types, dominantly known as chodo radish was found one of the unique accessions. This radish is believed to be radish with medicinal properties and widely grown in Karnali and far-western region for culinary purpose.

Figure 10. *Few unique radish landraces regenerated in the present study.*

3.4. Biotechnology

Biotechnological tools can contribute significantly for the management and sustainable utilization of APGRs. In addition, advances in biotechnology are occurring at a rapid pace and provide novel opportunities for more effective and efficient management of APGRs. Biotechnology applications must be integrated with ongoing conventional conservation activities. Advances in biotechnology (conservation biotechnology) have generated new opportunities for APGRs conservation and utilization. Techniques like in-vitro culture and cryopreservation have made it easy to collect and conserve genetic resources, especially of species that are difficult to conserve as seeds. Tissue culture methods are now widely applied for the elimination of systemic diseases such as viruses for safe exchange of germplasm. While technologies like enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) have provided tools that are more sensitive and pathogen-specific for seed health testing. Molecular markers are increasingly used for screening germplasm to study genetic diversity, identify redundancies in the collections, test accession stability and integrity, and resolve taxonomic relationships. The technology is also accelerating the utilization of APGRs.

In the past, conservation efforts have been mainly focused on orthodox seeds e.g. rice, maize, wheat, soybean, mustard, chili, etc. and conservation methods are well established for such crops. There are also a number of other important crops that are sterile or produce recalcitrant seeds or do not easily produce seeds, or seed is highly heterozygous and clonal propagation is preferred to conserve. Examples are banana, sweet potato, citrus, mango, sugarcane, cassava, yam, potato and taro, etc. These species are usually conserved in Field Genebanks. Although Field Genebank provides easy access to material for use, they are at the risk of destruction by natural calamities, pests and diseases. Safety duplicates of the living collections are therefore, needed to establish using alternate strategies of conservation and biotechnology has contributed significantly by providing complementary in-vitro conservation options through tissue culture techniques.

DNA markers, on the other hand, are very effective to manage all kinds of APGRs including orthodox, non-orthodox seed crops and vegetatively propagated crops. The utilization of conserved materials is also being accelerated through the advances made in biotechnology. NAGRC has utilized in-vitro tissue culture and molecular marker technologies to conserve and utilize APGRs.

The major activities of the Biotechnology Unit are molecular characterization and evaluation, in-vitro conservation, tissue culture and multiplication, screening and pre-breeding, and maintenance (duplicate identity, relationships, structure, and location). This unit has two laboratories (Molecular Research Lab and Tissue Culture Lab) to support the APGRs conservation and utilization. Current activities under these two labs are depicted in the flow diagram (Figure 11).

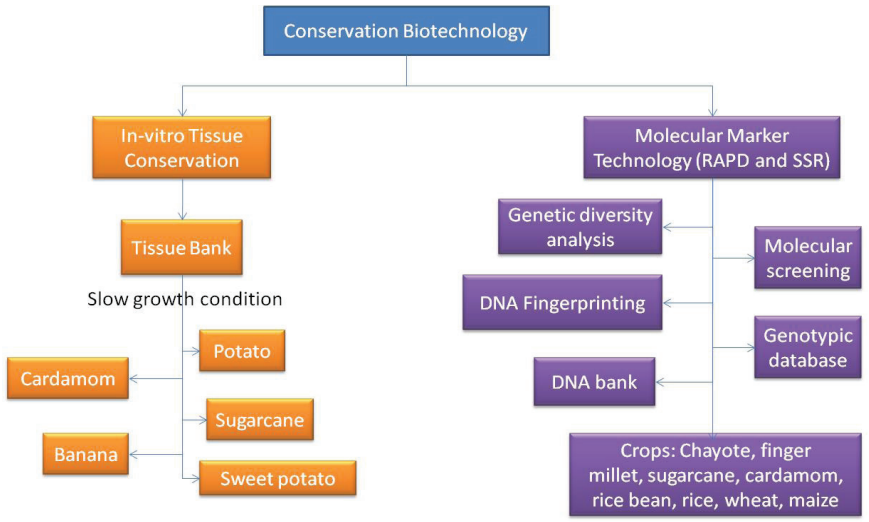


Figure 11. *Flow diagram of current activities in Biotechnology Lab.*

3.4.1. Molecular Research Lab

This lab is established especially for genotyping the accessions preserved under the Genebank. The followings are the major activities to be carried out under this lab.

- Genotyping/ Fingerprinting/ Characterization
- Evaluation/ Screening
- Gene Tagging/ Genetic Structure
- Diversity/ Relationship Study
- Duplication/ Identification Study
- Maintenance of DNA bank

Molecular markers technology: Molecular marker technology has been applied for generating DNA finger printings, analyzing genetic diversity, characterizing germplasm, establishing DNA bank. Genotypic database are being linked with other data e.g. phenotypic data, passport data and use data. These activities have also been carried out in collaboration with different breeding institutes and universities.

DNA fingerprinting: DNA profiles of 22 accessions of rice using 6 SSR markers, 40 collections of finger millet using 9 RAPD and 5 SSR markers, 23 maize accessions using 5 SSR markers, 12 chayote collections using 20 RAPD markers and 83 mango landraces using 20 SSR markers have been developed and maintained electronically.

Screening for a particular trait: Under the pre-breeding program, NAGRC has focused on screening the collections using linked DNA markers with economic traits e.g. drought tolerance in rice and maize, submergence tolerance in rice, blast resistance in rice, quality protein in maize, rust resistance in wheat. This year, SSR markers were used to screen mango, finger millet and rice germplasm.

DNA Bank: DNA Bank, as a part of the Genebank, is a repository of DNA, usually for research. The DNA Bank is conserving the different kinds of DNA extracted from the genetic resources in tubes at -40^{o}C. DNA conserved in DNA Bank is used for studies and research at molecular levels. After genotyping, the remaining DNA is quantified and conserved at Deep Fridge. DNA Bank was started in 2013 by conserving the DNA of 11 accessions of chayote.

DNA of 25 accessions of Akabare chilly, 8 samples of rayo, 77 samples of rice, 40 collections of finger millet, 23 maize accessions, 83 landraces of mango and 11 sample of radish have been preserved in DNA bank. Additional DNA from 59 accessions of rice and 72 accessions of wheat were conserved for further work at DNA bank.

Genotypic database: After the genotypic study, all kinds of genotypic data are being maintained. Currently, NAGRC has genotypic database of chayote, wheat, maize, finger millet, barley, bitter buckwheat, cardamom and sugarcane. Data format for DNA bank (storage and distribution) was revised and database of DNA bank was updated. Gel scoring method have been developed and shared.

Genetic diversity assessment: Chayote: Diversity of 12 chayote was assessed on-farm, and on-station using 9 morphological and 20 RAPD markers in addition to use values (Table 19). Journal paper is prepared and its abstract is given here. Seto Ishkush (chayote with white fruit) formed a separate cluster, indicating unique accession. The highest genetic diversity was found between Hariyo Ishkush and Golkaade Ishkush. The total number of amplified DNA bands varied from 2 (OPC-20) to 10 (OPC-11) with an average of 5.7 bands per primer. The size of bands generated ranged from 100 bp to 3000 bp. A total of 85 amplified bands were found and all bands were polymorphism. The polymorphism information content (PIC) ranged from 0.22 to 0.46. Three major clusters were formed based on RAPD information (Figure 12). Among the five conservation methods, field genebank was found effective in Nepal.

Table 19. Passport detail of landraces of Chayote used in this study

SN	Accession	Local Name	Collection Site	Latitude	Longitude
1.	BKJ-12-01CY	Golkaade Ishkush	Kaskal Kuwa, Harisiddhi-8, Lalitpur	27° 37.983’	85° 21.046’
2.	BKJ-12-02CY	Seto Ishkush	Kaskal Kuwa, Harisiddhi-8, Lalitpur	27° 37.983’	85° 21.046’
3.	BN-12-01CY	Golkaade Seto Ishkush	Guptesor-6, Ramechhap	27° 35'40.25”	86° 12'21.18”
4.	SKM-12-01CY	Kaalo Ishkush-1	Dhapakhel, Lalitpur	27° 38'35”	85° 19'84”
5.	UK-12-10CY	Hariyo Ishkush-1	Dangalpu, Bhimeshwor-6, Dolakha	27° 38'	86° 4'
6.	UK-12-21CY	Kaade Ishkush-1	Biruwa, Bhimeshwor-6, Dolakha	27° 37'	86° 4'
7.	UK-12-33CY	Hariyo Ishkush	Saridanda, Jethol-8, Sindhupalchok	27° 41'	85° 54'
8.	UK-12-39CY	Seto Thulo Ishkush	Saridanda, Jethol-8, Sindhupalchok	27° 41’	85° 54'
9.	UK-12-40CY	Seto Saano Ishkush	Saridanda, Jethol-8, Sindhupalchok	27° 41'	85° 54'
10.	UK-12-48CY	Ishkush	Fetaalitol, Thulopakhar-2, Sindhupalchok	27° 42'	85° 52'
11.	UK-12-68CY	Kaalo Ishkush	Saatkilo, Thumpakhar-3, Sindhupalchok	27° 14'	85° 50'
12.	UK-12-81CY	Kaade Ishkush	Swanra, Pangretar-7, Sindhupalchok	27° 44'	85° 49'

Adapted from Joshi et al 2020

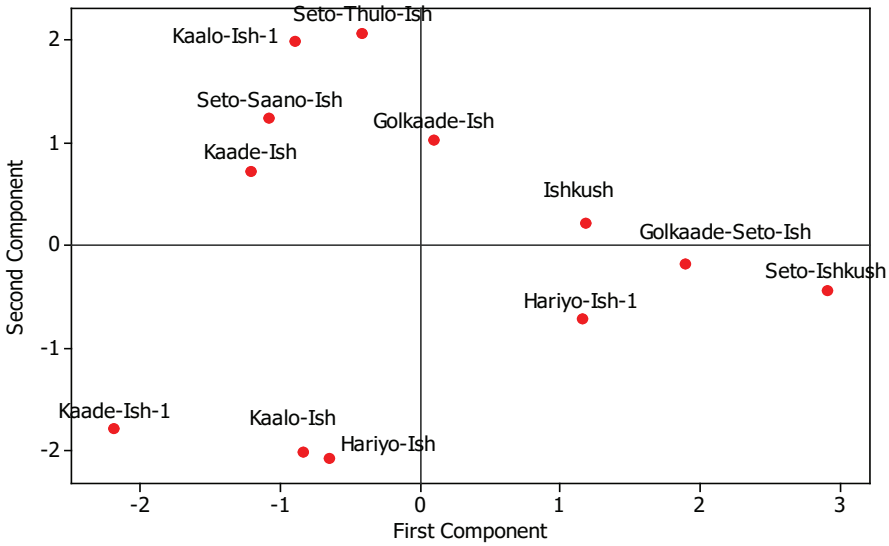


Figure 12. *Plot of 12 accessions of chayote based on the first and second principal components. Ish means Ishkush (adapted from Joshi et al 2020)*

Maize: Five SSR markers were used to develop the DNA finger prints and to assess the diversity of 23Nepalese maize landraces (Table 20). A paper has been published in SAARC JA vol 18 and its abstract and some figures are given here. Five locus-based DNA finger prints have distinguished majority of the landraces (Figure 13). The average number of alleles was 2 per locus. Umc1333 marker had shown the highest gene diversity, heterozygosity and polymorphism information content (PIC). At landrace level, the highest gene diversity, heterozygosity and PIC values were found in Seto Local and Seti Makai-3. 23 maize landraces formed four clusters and these clusters were related with seed color. Name of landraces also reflected genetic similarity. Genetically similar landraces can be pooled for conservation and creating dynamic diversity rich population. Distantly related landraces (Bhirkaule, Local Seto Makai, Seto Makai-1, Makai Makai-1761) can be used in breeding program (Figure 14). Detection of low genetic diversity might be due to bottleneck effects during the collection of these landraces from farmers. Therefore, collection strategy needs to be revised for capturing maximum diversity.

Table 20. Details of maize landraces used in this study

SN	Landrace	Accession	Collection site
1	Sano Panhelimakai	C2605	Thosey 6, Tapu, Ramechhap
2	Makai-1761	NPGR-01761	NK
3	Mangre	11035	Amargadi-2, Dadeldhura
4	Thulochura	11044	Radimadi, Dailekh
5	Seto Local	11054	Dhalea, Pyuthan
6	Makai	11066	Rimal-7, Kaski
7	Seto Makai-1	C0691	Likhu-4 Likhu, Dolpa
8	Ratomakai	NPGR-01706	Bortan, Bajura
9	Pahenlo makai-1	C5109	Dalchoki-3, Goth Bhanjyang, Lalitpur
10	Mailisathiyamakai	C5051	Ratamate-1, Raigaun,Nuwakot
11	Amrikane Makai	C4937	Kaule-6,Nuwakot
12	Bhirkaule	C5046	Dhaibung-6 Dhaibung, Rasuwa
13	Sathiyamakai	C5050	Ratamate-1, Raigaun,Nuwakot
14	Local Seti Makai	C5169	Gupteshwor-8, Bhojpur
15	Dharim Choti Paheli	C5170	Ranibash-4, Bhojpur
16	Paheli Makai-2	C5172	Champe-5, Bhojpur
17	Paheli Makai-3	C5174	Pancha-2, Bhojpur
18	Sadiya Makai	C5175	Pyauli-4, Bhojpur
19	Purano Local	C5176	Gupteshwor-1, Bhojpur
20	Seti Makai-2	C5177	Mulpani-8, Bhojpur
21	Paheli Makai-4	C5178	Mulpani-7, Bhojpur
22	Paheli Makai-5	C5179	Bokhim-5, Bhojpur
23	Seti Makai-3	C5180	Bokhim-7, Bhojpur

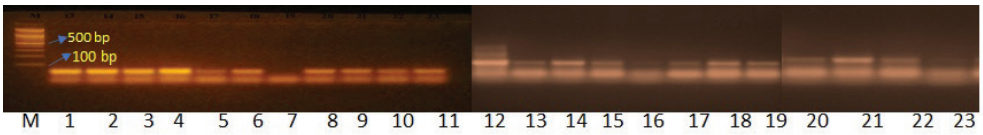


Figure 13. *SSR profile of 23 maize landraces with Bnlg1194 SSR marker in agarose gel. M, 100 bp marker; Lane number is indicated by the number which corresponds with landraces listed in Table 20 (Adapted from Joshi et al 2020, SAARC JA, vol 18).*

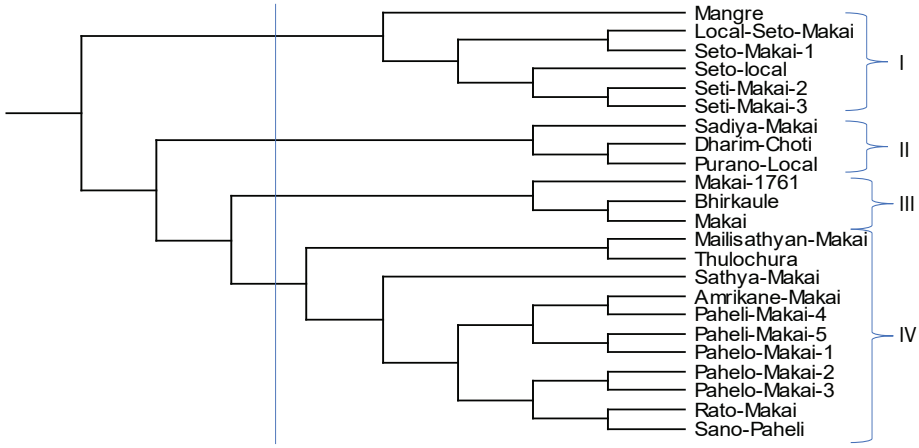


Figure 14. *Clustering of 23 maize landraces based on 5 SSR markers using UPGMA method (Adapted from Joshi et al 2020, SAARC JA, vol 18).*

Finger millet: Genetic diversity was assessed in forty landraces of finger millet using 9 RAPD and 5 SSR markers (Table 21). A journal paper has been published in Nepal J. Biotech, Vol 8 and its abstract and some figures are given here. These landraces were collected from Kaski and Dhading districts. None of single primers of these RAPD and SSR could separate all 40 landraces. The average number of bands were 6.33 and 7.8 per RAPD and SSR primers respectively (Figure 15). Mean polymorphism information content was of 0.314 for RAPD and 0.37 for SSR. Primer OPA-4 produced the highest number of bands and the lowest numbers of bands were produced by OPA-16. Among the SSR primers, SSR-06 produced the highest number of polymorphic bands and UGEP-53 produces the lowest bands. RAPD based dendrogram has generated four clusters and SSR based dendrogram has generated two clusters. In both dendrogram and principal component analyses, Purbeli landrace was found unique locating separately in the cluster and scatter plot (Figure 16). Nei's genetic distance produced by RAPD and SSR primers was similar that is 0.327 by RAPD and 0.296 by SSR markers. Genetic distance produced by SSR markers was higher than distance produced by RAPD marker. These landraces were from two districts and therefore have shown intermediate diversity. These molecular marker-based findings should be more useful if we could link with agromorphological traits. Inclusion of large number of landraces collected from different areas are needed to get higher level diversity in addition to associate genetic diversity with geographical sites. Groupings of these landraces could be useful for selecting landraces in breeding program as well as planning conservation program.

Table 21. Landraces of finger millet collected from different regions for this study

SN	Landrace	Site and district
1	Setothulo	Kaski
2	Kalo ghudo-2	Pumdibhumdi-6, Kaski
3	Bachuwa-1	Kaski
4	Thulo kalo-1	Kaski
5	Mangsire-2(k)	Kaski
6	Chimte	Dhading
7	Thulo kalo-2	Kaski
8	Kholse	Kaski
9	Setosano	Kaski
10	Kalo ghudo-3	Kaskikot-5, Kaski
11	Setojhyapa	Kaskikot-2, Kaski
12	Tori pane	Kaskikot-2, Kaski
13	Seto	Kaskikot-2, Kaski
14	Mangsire-1	Dhikur pokhara-2, Kaski
15	Kalo ghude-1	Dhikur Pokhara-2, Kaski
16	Mangsire-1	Chimkeswori-3, Kaski
17	Katike-2	Chimkeswori-2, Kaski
18	Kaile	Chimkeswori-3, Kaski
19	Khukur kane-2	Chapkot-6, Kaski
20	Dalle	Chapkot-9, Kaski
21	Khukur kane-1	Chapkot-9, Kaski
22	Chamare	Dhading
23	Champate	Dhading
24	Setokodo	Dhading
25	Mangsire-2(d)	Dhading
26	Katike-1	Dhading
27	Jhyape seto-1	Kaski
28	Pumdeli	Kaski
29	Dalle kodo-1	Kaski
30	Purbeli	Kaski
31	Seto usro-2	Kaski
32	Kalo ghude-1	Kaski
33	Dhudekodo	Kaski
34	Usrokodo	Kaski
35	Dalle kodo-2	Kaski
36	Gairegaule	Kaski
37	Kalo ghude-2	Kaski
38	Mangsire	Kaski
39	Raikare	Kaski
40	Setobhachuwa	Kaski

k, from Kaski; d, from Dhading. Adaptd from Joshi et al 2020,Nepal J Biotech Vol 8.

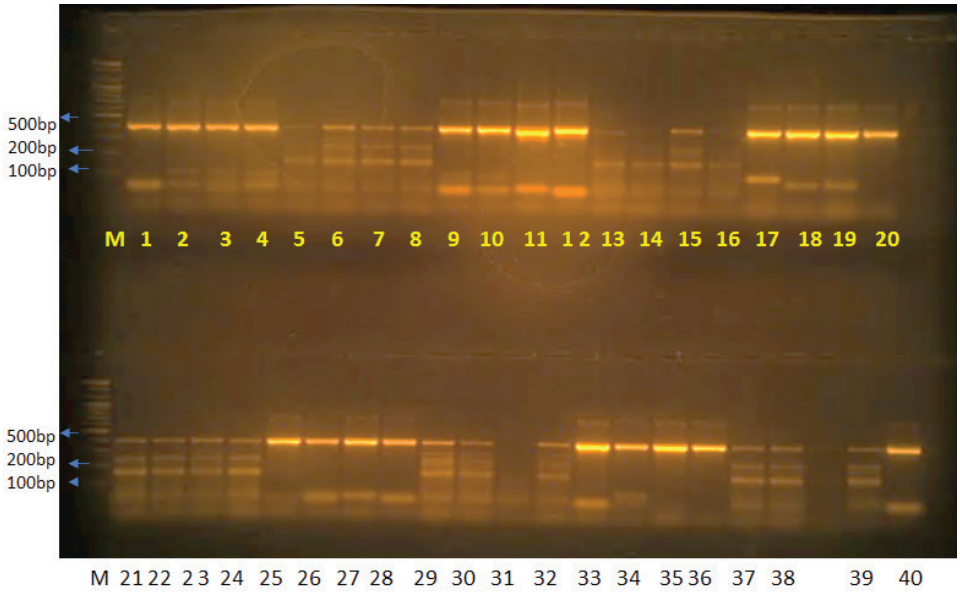


Figure 15. *SSR profiles 40 finger millet landraces amplified by UGEP-10 primer. M, 100 bp ladder and lane number represent the sequence Number of Table 21, Adapted from Joshi et al 2020, Nepal J Biotech Vol 8.*

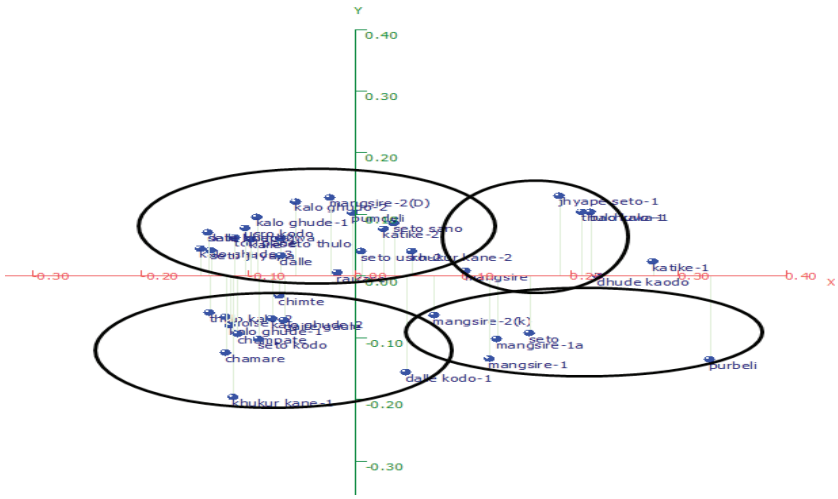


Figure 16. *Scatter plot of 40 finger millet landraces based on 9 RAPD markers. Adapted from Joshi et al 2020, Nepal J Biotech Vol 8.*

Mango: 39 landraces of mango from Doti and 44 landraces from Lamjung were studied using 20 SSR markers. Their description is given under on-farm conservation section.

3.4.2. Tissue Culture Lab

Tissue culture lab is set for in-vitro conservation of those crop species other than orthodox seeds. Two main activities under this lab are i. In-vitro tissue conservation

and ii. Multiplication and distribution. The cold storeroom is available for storing in-vitro grown plantlets.

Orthodox seeds can easily be dried and stored at low temperatures for many years. Recalcitrant seeds and vegetatively propagated crops need alternatives for long term conservation. In-vitro tissue conservation has been considered widely. This technique is very effective for conserving those crop species, which either produce recalcitrant seeds or does not produce any seeds. Plantlets can be kept in test tubes on nutrient medium for indefinite periods of time by transferring at regular intervals. It requires little space for preservation of a large number of crop landraces. Plantlets are maintained in an environment free of pests or pathogens and can easily be kept free from viruses, insect parasites, fungi or bacteria. Because of such advantages, in-vitro tissue culture has been initiated in NAGRC with the following objectives: Development of Tissue Bank and Cryobank, Conservation of plantlets of vegetatively propagated crop species and species with recalcitrant seeds, through in-vitro (shoot tip) culture in cold storage (medium-term conservation), Cryopreservation of vegetatively propagated crop species and species with recalcitrant seeds through shoot tip culture (Long term conservation) and Multiplication and distribution of in-vitro cultured plantlets.

Subculture of 96 sample of potato, large cardamom and sweet potato have been maintained in test tube in Tissue bank. Sand rooting is adopted for growing in-vitro plantlets. Many local collections of potato and sweet potato are being maintained in NPRP's Tissue bank and have been used and distributed as needed.

3.5. Documentation, Publication and Training

The activities of Documentation, Publication and Training Unit are database management, publication, training and coordination. A large number of information is acquired and generated under genetic resources conservation programs. Therefore, development of an efficient documentation system is essential to facilitate optimal conservation, easy access and efficient utilization of agricultural genetic resources. Such a system should be able to store and supply accurate, reliable and up-to-date information. NAGRC operates a computerized documentation and database management system using MS Excel program. The database of all the germplasm including phenotype, genotype, images and, seed and plant herbarium is properly documented manually and also using MS Excel program each year. The information is generally disseminated through annual reports, technical papers and visitors to the Genebank.

Passport data of all new collections and accessions conserved in short, medium and long-term storage are maintained and updated passport data of some previous collection. Passport data of 8745 accessions were updated. Data management for Seed Bank, Tissue Bank, Field Genebank and DNA bank has been updated. The image bank of some accessions is also updated. Format for stock database are revised. Characterization data of some crops has been developed in Excel linking with passport data. Passport format was provided to many stakeholders.

Identification of the germplasm is very important in the Genebank. Standard labeling of each germplasm has been set and it will ease for handling germplasm. Collection number is used during processing in the Genebank i.e. before getting accession number and then accession number after assigning this number to each collection. Prefix NGRC is used for orthodox crop collections (Seed Bank) and NGRV for non-orthodox collections (Field Genebank and Tissue Bank) in accession number. During handling in the Genebank activities, collection district, crop name and local name are also used.

Scientists from Genebank facilitated many trainings organized by different governmental and non-governmental organizations. Some of them are Data recording, Statistical analysis, PGR and resilient seed system, Forage biodiversity conservation etc. List of publications, presentations, participation in workshop and training and genebank works in media are given in Annexes.

Training-Workshop on Agrobiodiversity Management for Agricultural Stakeholder at Karnali Province

To disseminate good practices of agrobiodiversity management, to update agrobiodiversity conservation approaches practiced at Karnali province and to orient on agro-biodiversity program planning and implementation strategies, one day training workshop on Agrobiodiversity Management for Agricultural Stakeholder at Karnali Province was carried at Directorate of Agricultural Development, Birendranagar, Surkhet on Falgun 29, 2076 Surkhet, Karnali province. The training encompassed 40 participants including staffs of ADO of Dailekh, Paschim Rukum, Jajarkot, Kalikot, Salyan; Staffs ago-biodiversity related stakeholders from Surkhet (government line); I/NGOs; NARC (Surkhet, Dailekh, and Salyan), etc. Dr. Krishna Kumar Mishra, Mr. Krishna Hari Ghimire, Mr. Chitra B. Rokaya and Mr. Ram P Mainali had participated the training as a resource person. Each resource person presented one presentation following detail discussion. The major content of the presentation and discussion includes i. Agro-biodiversity status (global and national) and conservation approaches ii. Strategies for agro-biodiversity conservation and utilization, diversity deployment and awareness tools iii. Collection methods, local variety crop inventory and categorization of APGR, red zoning, red listing (five cell analysis), GI etc. iii. Agrobiodiversity conservation initiatives at Karnali Province (including status of community seed bank and their management, role of agrobiodiversity on making organic Karnali, future outlook etc.). The training was expected to enhance the capacity of provincial stakeholders on agrobiodiversity conservation and utilization. The discussion became very fruitful to explore the future possible tools for agrobiodiversity conservation. The chief guest, Secretary, MoLMAC, Karnali province became happy to collaborate for conserving and utilizing local genetic resources in better way.

3.6 SPECIAL PROJECTS

Special Project 1. Integrating traditional crop genetic diversity into technology: using a biodiversity portfolio approach to buffer against unpredictable environmental change in the Nepal himalayas (local crop project)

NAGRC in collaboration with HCRP, ARS Jumla, LIBIRD and Bioversity International, implemented a UNEP GEF project "Integrating Traditional Crop Genetic Diversity into Technology: Using a Biodiversity Portfolio Approach to Buffer against Unpredictable Environmental Change in the Nepal Himalayas (GEF On-farm Project)" since 2014 to conserve and use globally important diversity of traditional crops for increased productivity, ecosystem resilience and ecosystem services. The project carried out research and development of eight traditional mountain crops which include: amaranth, buckwheat, beans, naked barley, foxtail millet, proso millet, finger millet and cold tolerant rice. These crops have high intraspecific diversity and important for local food and nutrition security of smallholder farmers in Nepal mountains. Since these crops are climate resilient and nutrient dense, they are being promoted by the project as climate smart Himalayan Superfoods. Major achievements made by the project are follows:

Community Seed Bank Establishment and Strengthening

Project has established, operationalized and strengthened four community seed banks in four project sites and conserved and promoted globally important rare and valuable traditional mountain crop varieties including other local crops for the future benefits of the national and global community. These CSBs have conserved 232 unique and endangered local farmers varieties of 56 different crops with major focus on the local varieties of traditional mountain crops. A total of 500 local crop genetic resources are safely stored as duplicate in National Genebank for future use in breeding and adaptation to changing climate.

Diversity Deployment and Participatory Variety Selection

Project has sourced, deployed and evaluated 300 crop varieties of 8 target mountain crops in the farmers' fields in the four mountain agro-ecosystems by mobilizing farmers' groups and cooperatives. From these a total of 65 locally adapted superior farmers' preferred varieties of 8 target crops are identified, selected and promoted through participatory variety selection (PVS). Among them 7 locally adapted superior varieties of five traditional crops (amaranth, bean, finger millet, foxtail millet and proso millet) are being further selected, improved and they are officially submitted for national listing and official registration for enhanced benefit sharing among mountain communities. One of the amaranth varieties namely "Ramechhap Hariyo Latte" has been officially listed and registered as the first amaranth variety in Nepal in December 2018.

Seed Multiplication, Distribution and Scaling up

The project strengthened the seed multiplication and distribution system of traditional mountain crops by mobilizing and building the capacity of the custodian, farmers' groups and community seed banks. A total of about 20 MT of seeds of about 60 varieties of 8 target crops are produced in the last four years in the project sites which are accessed and used by about 20,000 households in the project districts and beyond in the different mountain locations of Nepal.

Design, Development and Piloting of Processing Machines for Minor Millets:

Project has designed, developed and piloted processing equipment mainly electric thresher for proso millet (Chino Kutak) to reduce acute drudgery of women and improve efficiency in the processing. In addition, project also piloted and upscaled finger millet thresher (pearler) to over 500 households in the project sites for improving efficiency, reducing cost by four times and improving welfare of women farmers in processing of millet. This intervention has been instrumental in cultivation, conservation and promoting the traditional millet crops by reducing significant women drudgery in the remote rural mountain households.

Piloting and Mainstreaming Community Biodiversity Management Practices:

Project has developed and piloted several good practices and diversity rich solutions for mainstreaming conservation and use of agro-biodiversity in agriculture development and environmental conservation. These include community biodiversity management practices such as community seed banks, community biodiversity management (CBM) funds, farmers' diversity field schools, participatory seed exchange, participatory value chain development, Diversity fairs etc. for development for enhancing local level access and benefit sharing. These good practices and approaches are being upscaled and integrated in local and national agricultural development programs and projects of the partner organizations and stakeholders in the country.

Value Chain Development and Marketing

Project has developed framework for value addition, value chain development and marketing for the promotion of traditional crop varieties and their products by mobilizing and facilitating farming communities, local entrepreneurs, homestay groups and community seed banks. In Humla a tripartite model agreement with local CBOs and entrepreneurs has been made for the value addition, processing and marketing of local nutritious healthy diversity-based products and modern food recipes (cakes, bread, biscuits and other bakery products) from the traditional crops. Project facilitated local community seed bank for opening of a fair price gift shop (Kosheli) in Jumla and facilitated formation of women homestay groups in Lamjung to stimulate production, promote and market consumption of traditional healthy organic food products. Nutrition analysis, food recipe formulation and support in value addition, product diversification and marketing are being done linking with national and regional food fairs and organic markets.

Capacity Building and Gender Inclusion:

The local capacity building of farming communities, custodians and stakeholders are key part of the project. In the last 5 years project has organized 35 national level capacity building activities comprising trainings, visits, workshops and consultation meetings and 85 local level capacity building activities covering project site meetings, diversity field schools, cross site visits and orientation meetings. Project has addressed adequately gender issues in the management and promotion of local crop biodiversity with 57% of women in the leadership and decision-making positions in Community Seed Bank (CSB) Management Committee and 62% of the women participants in the regular Diversity Field School classes. In addition, project supported building capacity of a dozen researchers of national partners in conservation of agro-biodiversity. A total of 20 thousand households received benefits in the project sites and beyond through good quality seeds, germplasm and information on conservation and promotion of traditional mountain crops.

Publication and Dissemination of Knowledge Products:

Project has made significant contribution in documenting, publication and wide sharing of output of the project activities, focusing on cultivation techniques of traditional crops and varieties to awareness materials, good practices and research results. In the last five years, it has been able to develop and publish about 75 publications in different forms such as books (6), booklets (6), Journal papers (10), flyers (22), posters (16) News blogs (8) and brochures (6. Project has developed and operationalized its own project Website (**www.himalayancrops.org**) for local and global sharing. Furthermore, project also disseminated outputs of the project activities to stakeholders and policy makers through several news media (national TVs, FM Radio) including a project developed two important Videos (**https://m.youtube.com/ watch?Feature =youtu.be&v=918hsD4w-Zs**) and (**http://himalayancrops .org/project-info/**).

Special Project 2. Use of genetic diversity and evolutionary plant breeding for enhanced farmer resilience to climate change, sustainable crop productivity and nutrition under rainfed conditions (EPB Project)

After the implementation of the project the following progress has been made:

- A protocol was developed to carry out the project task.
- Project staff from NARC, LIBIRD and Bioversity International have regularly met for improving technical understanding on EPB and implementing project activities effectively.
- Genebank team has identified analog sites of Jumla and Lamjung trial site for selecting germplasm. Genebank materials (rice and bean) were provided based on the analog sites to these two sites.
- Establishment of Trial, site visit and monitoring: A team were visited with the

purpose of to conduct Inception Meeting of Evolutionary Plant Breeding Project at Jumla site and the trial sets of rice and bean have been composed and transplanted.

- Similarly, Rice transplanting was done according to the farmers practice in Lamjung site. Blast diseases scoring were done. Blast diseases symptoms seen in all treatments at nursery and there is not significant different between the treatment.
- An inception Meeting of the Project was conducted in Jumla

Working team formation

Working technical team has been formed in NARC. Breeders and plant pathologist from National Genebank and ARS, Jumla are involved in the team. Relevant experts will invite from other institutes if necessary.

Protocol preparation

Detail protocol for both sites has been developed in collaboration with LIBRID and Bioversity International. NARC organized three-time meetings to finalize the protocols inviting key project staff. Detail has been shared by LIBIRD.

Training on EPB

The national training workshop on EPB was organized from 4-6 Feb 2019 in Hotel Himalayas, Kupandole, Lalitpur. The participants were plant breeders, agronomists, plant pathologists, development professionals, representatives from national research and development organizations of Nepal. There were 8 participants from NARC. The objectives were to understand theoretical concepts and develop practical skills and methods on Evolutionary Plant Breeding (EPB) including Participatory Plant Breeding (PPB) approaches, to gain knowledge and skills on Experimental Design and Statistical Analysis of EPB populations using R-Stat Package and to design and finalize field trials on EPB populations and selection methods in rice and beans. Training was facilitated by Prof (Dr.) Salvatore Ceccarelli; Consultant Bioversity International and former Senior Plant Breeder, ICARDA; and Dr. Stefania Grando, Consultant, Bioversity International.

Dr. Bal Krishna Joshi from NARC participated in "Policy-Market Capacity Building Workshop" held from 30 April- 4 May in Amman, Jordan along with others from LIBRD and Bioversity International Nepal. The program was organized with the objective of orienting and capacitating the EPB project implementing partner countries, and to start up and implementing the component 3 and 4. The resource person was Travis William Reynolds (PhD), Isabel Lopez and Devendra Gauchan from Bioversity International.

Learning material and concept paper

Concept paper on EPB has been drafted targeting researchers to help on understanding EPB. EPB status along with rationale in Nepal is also documented. This paper has been submitted to Journal. Its abstract is given below (Box 1).

Understanding and planning meeting

Project staff from NARC, LIBIRD and Bioversity International have regularly met for improving technical understanding on EPB and implementing project activities effectively. Such meetings have enhanced the understanding of project staff.

Germplasm identification and collection

Genebank team has identified analog sites of Jumla and Lamjung trial site for selecting germplasm. Genebank materials (rice and bean) were provided based on the analog sites to these two sites. For details of these materials, please refer LIBRID report.

Trial establishment and site visit and monitoring

Jumla

Team were visited Jumla from 17-28 March 2019 with the purpose of to conduct Inception Meeting of Evolutionary Plant Breeding Project at Tatopani Rural Municipality-4, Hanku, Jumla; to compose trial sets of rice and bean, select land and soaked rice seeds for the experimentation of EPB Project at Tatopani-4, Aireni, Jumla. Team has done inception Meeting of Evolutionary Plant Breeding Project was conducted at Tatopani Rural Municipality-4, Hanku, Jumla on 10th Chaitra, 2075. Trial sets of rice and bean were composed, land selected and rice seeds were soaked on 11th Chaitra, 2075 for the experimentation of EPB Project at Tatopani-4, Aireni, Jumla.

On 10th Chaitra, 2075, we organized an "Inception Meeting of Evolutionary Plant Breeding Project" at Tatopani Rural Municipality-4, Jumla. There were 78 participants from different groups of CSB, Rural Municipality, ARS Vijayanagar, project partners (Genebank and LIBIRD). During the meeting, we have highlighted the achievements of LCP, and shared the concept and activities of EPB projects. Dr. Santosh Shrestha from LIBIRD and Dipendra Ayer from LIBIRD highlighted the programs/activities of Nepal Seed System Project and objectives of EPB Project. Dr. Sri Prasad Vista-ARS Chief, Mr. Dhiraj Jaisi-Chair, Tatopani RM-4 highlighted the importance of local crops and local seed for the food security of the district. The meeting was chaired by Mrs. Shanti Shobha KC and MC of the meeting was Mr. Dhan Krishna Pandey, Chairman of Dhauligadh CSB, Tatopani-4, Jumla.

Trial sets of rice and bean were composed for different entries as per the protocols. Experimental field was selected and rice seeds were soaked on 11th Chaitra, 2075 for the experimentation of EPB Project at Tatopani-4, Aireni, Jumla with the help of Santosh Shrestha, Pragati Paneru, Dipendra Ayer, Sundar Raut, Kavita Jaisi and Lalita Magar.

Second time, breeders visited Jumla from 17-22 June 2019 to transplant rice

experiment of EPB Project at Tatopani-4, Aireni, Jumla and to prepare EP trial sets of beans and select experimental site at Tatopani-4, Gautambada, Jumla.

Rice experiment of EPB Project was transplanted at Tatopani-4, Aireni, Jumla.

Team observed rice experiment site at Aireni. Collaborating farmer was requested to apply irrigation and plough the field with sufficient FYM application. Also visited rice nursery and asked motivator to uproot seedlings separately with proper labeling of all the entries.

Final land preparation (puddling and land leveling) was done and field layout was done (Figure 17). Each plot was of 20 m^2 (4 m X 5 m) size. After layout, seedlings of each entry were transplanted as per the farmers' practice i.e. single seedlings per hill with about 10 cm spacing between plants.

After planting two replications, selection plot (mixture of landraces, breeding lines and improved varieties) was transplanted. Adjacent to the selection plot, diversity block of 37 genotypes (landraces from local area as well as from genebank i.e. collected from other analogous areas, advanced breeding lines and improved varieties)

was transplanted for display as well as seed increase for next year. Each genotype was planted with 2 rows of 5 m length. Proper labeling of plots was done. Motivator Ms. Kabita Jaisi was guided for the proper time of irrigation and other observations.

Trial sets of beans were composed for different entries as per the protocols. Field was selected for the experimentation of EPB Project at Tatopani-4, Gautambada, Jumla with the help of Pragati Paneru, Sundar Rawat, Lalita Ale Magar and Kabita Jaisi Parajuli.

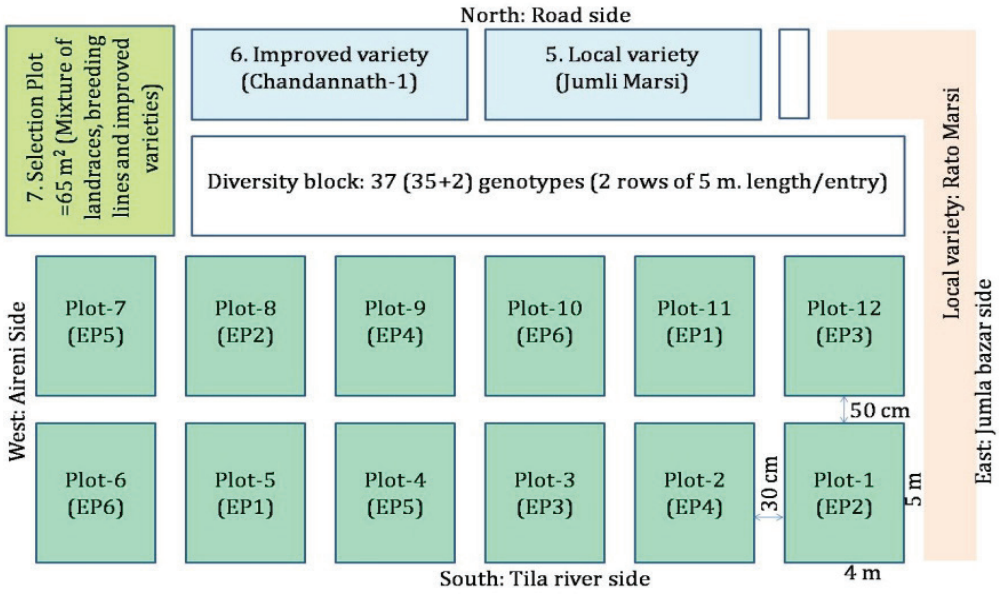


Figure 17. *Field layout of rice EPB trial at Jumla*

For bean trial establishment, plant breeder, Ms. Pratikshy Shrestha from ARS, Jumla was participated. She is young breeder and have attended training on EPB.

Lamjung

Plant pathologist from National Genebank participated Lamjung site during transplanting rice at 27 June 2019. The purpose of this visit was to make field layout and transplantation EPB rice trail and monitoring of project activities conducted in Ghanapokhara site. Team prepared lay out and transplanted EPB materials in the field. General observation of the rice seedlings and scoring of blast diseases were also conduced.

Field layout consists 12 plots for 2 replications of 20 m^2 plot (4m*5m) for EPB trail and one separate selection plots of 40 m^2 plot was made and treatments (Table 22) were allocated as (Figure 18) in the main field. Transplanting is done according to the farmers practice i.e. plant population (RR*PP) on 28th June 2019.

Table 22. Rice mixture components and treatments used on EPB Lamjung.

Trt	Mixture	Components
1	Local landraces	Mixture of local landraces of the sites
2	Local landraces 1	Mixture of local landraces of similar agroecological domains across Nepal
3	Improved varieties	Mixture of improved varieties of similar agroecological domains across Nepal
4	Landraces + Improved varieties + Breeding lines	Mixture of local landraces, improved varieties, and breeding lines of similar agroecological domains across Nepal
5	Local Landrace	Single popular local landrace as a check
6	Improved Variety	Single popular improved released variety as a check
Sel Plot	Landraces + Improved varieties + Breeding lines	Separate bigger plot of the mixture for selection by men and women farmers as well as researchers. Three sub EPs will be developed for Next year's trial: RSEP1 (selected by men farmers), RSEP2 (selected by women farmers), and RSEP3 (selected by researchers).

Figure 18. *EPB rice transplanting on the main field at Lamjung, Ghanapokhara*

Blast diseases scoring were done on 0-9 scoring scale (Table 23). Blast diseases symptoms seen in all treatments at Nursery and there is not significant different between the treatment. Lowest diseases symptoms were found on treatment 3 and 6 with blast diseases scoring 2 and in all other treatment, more disease symptoms were found i.e. diseases scoring of 2. Blast diseases may be due to local pathogen that is more aggressive to these varieties and may be the varieties used in mixture have adult plant resistant. So, regular monitoring and scoring of the blast diseases is necessary to draw the conclusions. Rice seedlings on nursery was found that treatment 2 had the highest blast scoring i.e. 4 scale. Higher intensity of rice blast disease symptoms was observed in the nursery. Therefore, regular monitoring and scoring of the diseases is necessary in future.

Table 23. Rice blast scoring on EPB trail at nursery on 2076/03/13

Treatment	Blast scoring
1: Mixtures of local landraces of the sites	2
2: Mixture of local landraces of similar agroecological domains across Nepal	2
3: Mixtures of improved varieties of similar agroecological domains across Nepal	1
4: Mixtures of local landraces, improved varieties, and breeding lines of similar agroecological domains across Nepal	2
5: Single popular local landraces as a check (Gaure)	2
6: Single Popular Improved released variety as a check (Khumal 4)	1
7: Separate bigger plot of the mixture (treatment 4)	2

Table 24. A disease scoring was done on 0-9 scoring scale given by Manandhar et al, 2016 as follows

Scale	Lesion type and affected leaf area
0	No lesions observed
1	Small brown speckes of pin-point size or larger brown specks without sporulating center
2	Small roundish to slightly elongated, Necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin.
3	Lesions type is the same as in scale 2, but a significant number of lesions on the upper leaves
4	Typical susceptible blast lesions, 3 mm or longer, infecting less than 4% o of the leaf area
5	Typical blast lesions infection 4-10 % of the leaf area
6	Typical blast lesions infection 11-25 % of the leaf area
7	Typical blast lesions infection 26-25% % of the leaf area
8	Typical blast lesions infection 51-75 % of the leaf area and, any leaves are dead.
9	More than 75% leaf area affected

Knowledge sharing and management

Project has made joint monitoring team to project sites and annual review and planning meeting involving researchers and senior management team of the NARC and LI-BIRD and Bioversity International Nepal office for sharing the progress and highlighting the concept of EPB project activities.

A review paper on concept and rationale of evolutionary plant breeding in Nepal was prepared submitted to academic journal of Institute of Agriculture and Animal Science (IAAS), TU for publication. A Nepali language flyer on 'Evolutionary Plant Breeding' was published in Nepal which includes basic concepts of evolutionary plant breeding and overall objectives of the EPB project (Publications are currently online at www.libird.org). These publications can also be used as farmers' friendly training materials on EPB. A knowledge product regarding EPB concepts, methodology and population management was drafted and is under review before publication during the next reporting period. These publications are the combined efforts of NAGRC, NARC and LIBIRD with necessary technical support from Bioversity International. EPB progress and results of the trial will also be documented in the form of research articles in near future. EPB methodology field guide will be synthesized during next reporting periods in consultation with experts from NAGRC, NARC, LI-BIRD and Bioversity International collaboratively.

Scaling up and sustainability

The project has made foundation for scaling up and sustainability of the project by supporting and strengthening community seed bank initiatives and linking research and development activities of NARC and Department of Agriculture respectively. The

EPB project activities are directly linked with research and conservation activities of National Genebank which will provide sustainability of the work. Work is also on-going with University Education through promoting the value of EPB in the context of Nepal. At the local level, an important component of the sustainability of the project is proper selection of the project sites and the communities' interest in the project agenda. The identified project sites such as Jumla and Lamjung have comparative advantages of having a rich diversity of rice and bean, as well as associated biodiversity, and availability of support systems such as community interest, potential markets and other livelihood options. The project has been designed with the farmer at the center and of the importance of adopting working practices that are fully participatory and that reflect farmers' needs and concerns in diversity management so that diversity rich practices developed are appropriate. The cornerstone for long-term sustainability of project objectives is that all participants and stakeholders are fully engaged, and that partnerships and institutional linkages are solid and transparent. The national project coordinators involved in the project have the experience of working together in earlier projects on the conservation funded by Bioversity. The project has strengthened collaboration among national partners, in particular in sharing information and resources.

In Nepal, the project builds on formal linkages already established from past projects between community-based organizations, agricultural extension agencies and national research and policy agencies. For instance, it has built linkage with GEF UNEP project and SDC Seed System Project being of NARC, LI-BIRD and Department of Agriculture being implemented through Bioversity International. These linkages are used to scale up locally-implemented initiatives, which enhances the availability of quality of seeds and other planting materials.

Gender focus

Project has made special focus for the involvement of women farmers in the evaluation of field trials in the project sites. Besides this, priority has been given for women farmers for the site level training and orientation prorams, meetings and cross site visits. For instance, in the September 2019, 3 women farmers from Lamjung sites were facilitated and supported for a week-long field visits in Jumla project site for learning and sharing of their experiences. Similarly, about half of the participants during field days and evaluation of field trials were women in Jumla and Lamjung in September and October 2019 respectively.

Environment and climate focus

The project activities are environmentally sound as the field research activities are focused on local crop diversity of rice and bean with organic production using local climate resilient crop varieties and management practices. The farmers' indigenous crop management practices that are environment friendly are being adopted and being promoted.

Nutrition

Improving nutrition of the farm households and consumers is a special focus of the project. Bean crop is highly nutritious in terms of higher protein and micronutrient. The traditional varieties of rice focused in the EPB project such as Jumli rice is considered nutritious in terms of higher protein and antioxidants. Local landraces of rice from Lamjung also considered nutritious and highly preferred by local communities and consumers because of their nutrition value in addition to taste and grown under fully organic conditions.

Youth

Youth farmers are encouraged to participate in the project activities in both Jumla and Lamjung project sites. Most of the farmers (> 60%) participating in the project activities (orientation, training, meetings) are younger group of farmers from 16-40 % age groups.

Cross Site Visit to Jumla

A cross site exchange visit program was organized in Jumla project site on 23-28 September 2019. A team of farmers from Lamjung EPB site, LI-BIRD staffs and expert team from Bioversity and NAGRC were participated the program. An interaction meeting was organized for discussing EPB principles, project introduction and objectives of the joint monitoring visits including farmers, experts' team and stakeholders. The team comprises 30 persons (15 male and 15 female) have visited to Rice EPB trial in Ayereni-5 and Bean EPB trial in Gautambada-4, Jumla. Farmers from Ghanpokhara Community Seed Bank, Lamjung also visited and evaluated the rice and bean EPB trial in Jumla along with Jumla farmers. A small meeting was organized for discussing EPB principles, project introduction and objectives of the joint monitoring visits including farmers, experts' team and stakeholders. After quick interaction meeting, team along with farmers and stakeholders made visit to Rice EPB trial in Ayereni-5 and Bean EPB trial in Gautambada-4, Jumla. Farmers from Ghanpokhara Community Seed Bank, Lamjung also visited and evaluated the rice and bean EPB trial in Jumla along with Jumla farmers. Diversity blocks maintained for rice and bean in each trial sites were also observed by the experts and it was much easier to characterize germplasm source used in the EPB trial in Nepal. It was found that EPB trials are maintained in good condition and experts team suggested to continue the trial as it is going on. It was also discussed and planned that same entries plus selected three additional EPs of both crops, rice and bean, will be added in next year's trial. On the next day, staff and OJT orientation meeting was also done in EPB site office in Jumla for handling EPB trials and overall activities of EPB project Feedback were collected and documented. EPB consultants and plant breeders monitored field, provided feedback to run the trial as such. Field data observation and further steps were also discussed among the team member for the success of EPB project and improving rice and bean population. Further planning and suggestions from the experts' team were discussed in the meeting.

Cross site visit to Lamjung

Similarly, a team of EPB project comprising of Dr. Bal K Joshi, Ajaya Karki and Surendra Shrestha(NAGRC), Mr. Dipendra K. Ayer and Dr. Santosh Shrestha (LI-BIRD) and Devendra Gauchan (Bioversity International) visited EPB project site in Lamjung from 17-18 October 2019 with the objective of to monitor, evaluate and supervise EPB activities, to select rice population, to discuss with farmers, to guide technical staff and to plan for further works. The team with local men and women farmers visits to the EPB field trials and observed and evaluated best performing field treatments. Based on field observation and interaction with farmers, some of the populations were identified as best among the treatments. The populations of local landraces mixture was observed better during the assessment. Farmers from Jumla (one male and one female) participated in farmers' field days and field evaluation in Lamjung site with the field staff. This gave opportunity for farmers to learn and exchange of knowledge and experiences of field activities of Jumla and Lamjung sites. The team provided technical guidance and information to the site staff to record the data well during harvesting and further interact with local farming communities and stakeholder further for their feed backs. The plant pathologist of the team from NAGRC (NARC), Mr. Ajaya Karki also stayed longer for disease scoring and also technical supporting for rice EP population data collections during harvesting.

Participatory evolutionary plant breeding (PEPB) has been successfully implemented in both Jumla and Lamjung districts in rice and bean. Local and regional diversity on these crops were grown providing opportunity to farmers and breeders to see the diversity options as well as to select the desired ones. Farmers in both sites had reacted positively and regular interaction among the relevant stakeholders had increase the horizon of EPB. We focused not only grain yield but also on other biotic factors and quality. It is also very important to focus on all factors for better managing them in sustainable way of grain yield. This is new concept and need to develop awareness materials as well as awareness program. One set of these EP is better to evaluated in Khumaltar so that regular monitoring can be done along with estimation of each year genetic gain. This is also helpful to mainstream the practice as well as for influencing the policy makers. This trial should also be better to link with education system. Training on both breeding and statistics might accelerate the program. There are some issues of difficulty to manage intra level diversity at population and this challenge need to tackle with generating some evidence-based knowledge.

Special Project 3. Improving seed system for smallholder farmer and food security

Consultation workshop on farmer's variety registration and commercialization

Consultation workshop on farmer's variety registration and commercialization" on 30 December 2019 in National Genebank, Khumaltar, Lalitpur. This workshop was the important platform for both farmers and policy makers to share their experience as well as give a way forward for registration and commercialization of farmer's variety.

The main agendas of workshop were:

- Discussion about registration process of local landraces, their commercialization and source seed production and variety maintenance
- Discussion about Farmer's right, Plant Variety protection (PVP) and Access Benefit Sharing (ABS) mechanism
- Experience sharing by farmers (Farmers from CSB) about the problems faced during registration of farmers variety
- Sensitize planners, R&D processionals and farmers about the need of farmers' variety registration and commercialization

Outcome/recommendation which were concluded from this workshop are as follows.

- The participants fully agreed the need of relaxed provisions of farmers' variety registration and their commercialization for the conservation and sustainable use of agrobiodiversity for the benefits of both farming community and country.
- All the participants were informed about the relaxed ANNEX D provision for the registration of local crop. During workshop we found that even some of the VRRSC members were not well familiar with ANNEX D provision for registration. They were sensitized about relax provision on registration of local landraces.
- Participants agreed to adopt existing simple short format as given in the Annex D as compulsory for the farmers' variety registration. Some elaborate format related to specific disease and pest scoring information including soil and other elaborate information can be provided if possible.
- From this workshop all the participants realized that there will be two types of registration one type of variety will be listed for only conservation and commercialized for local community (limited domain) as per Annex D and another type of variety will be registered as well as will be commercialized for larger domain as per Annex B provision for e.g. Kacharawa-4 variety of rice. Likewise, this variety which have high productivity as well as high market demand, should be tested in multiple domains before registration
- All the participants suggested on source seed production of local variety can be done in related community (From where the variety is registered) with the technical help of National Gene bank or related commodity program of the NARC will maintain the source seed production

- During discussion all the participants in the workshop realize on the inclusion of National Gene Bank in Variety Release and Registration Sub Committee which can facilitate on the registration of local variety
- Representatives from SQCC, DOA and MOALD suggest that listing of all the local landraces should be done before registration that can be done by National gene bank
- Mr. Madan Thapa (Chief of SQCC) suggest on we should go for truthful labeling for the seeds produced by farmers after registration and these seeds are categorized as improved seed.

Study of gender roles in bean production system in Jumla district

Bean (Phaseolus vulgaris L.) is one of the most important annual legume crops which has great nutritional and economic value. Bean is indigenous crop to Jumla as well as Karnali province as a whole which is gaining popularity by the name Jumli simi/ Rajma. Being nutrient dense and an excellent source of dietary fiber, Jumli bean can be promoted as a healthy crop which can potentially reduce the risk of developing a chronic disease (Wu et al. 2004). Jumli bean is highly diversified with color, size and shape. There is the practice of mixing different varieties of bean before sowing which is practiced from the ancient period and has been passed from generation to generations. There are different roles and responsibilities of gender in diversity management and decision making in bean production system.

The questionnaire and survey methodology was developed by the project team and was refined using the inputs from various experts within the project team of NAGRC, Bioversity International and LI-BIRD as well as with the involvement of gender specialist and pre-testing was done at Dhading district. Household survey was done in seventy-five households of four wards (Gutambada, Aireni, Dhaulapani & Raka) by using random sampling method from 8-13th September 2019.Household survey was supplemented by two focus group discussion at Gautambada and Raka respectively. Data compilation and entry was and analysis was done by using Microsoft excel 2013.

- There was higher percentage of female farmers (54%) involved in whole bean production system than male farmers (46%) in the study area.
- Women farmers were more decision maker than men in bean production system. The result showed that 79 %, 95%, 84%, 92% and 49% women decide for seed sowing, weeding, fertilizer application, harvesting and marketing of bean respectively.

There is higher involvement of women farmers in bean production as well as decision regarding different cultural practices in bean production system. Female farmers are more important for conserving local agro-diversity and maintaining local seed system than male farmers in Jumla district.

Special Project 4. Characterization of Akabare chilli

A total of 30 chilli accessions collected from five districts of eastern Nepal (Table 25) were characterized at the field of National Agriculture Genetic Resource Centre (NAGRC),Nepal Agricultural Research Council (NARC) Khumaltar during April 2019 to January 2020.Seed were sown in nurseries on April 1, 2019 and seedlings of 6–7 leaves were transplanted (40 days after sowing) using 60 cm row to row and 20 cm plant to plant distance. FYM at 10 t/ha and N: P_2O_5:K_2O at 90:60:60 kg/ha were applied before transplanting. Intercultural operations i.e. irrigation, weeding etc. was done as required. Morphological data of 27 qualitative and 21 quantitative traits were recorded using the standard descriptors for characterization (IPGRI, AVRDC and Catie, 1995). Descriptive statistics and frequency distribution were employed to estimate and analyze the diversity via MS Excel.

Days to fruiting, average width of fruit, average weight per fruits, number of fruits per plant and fruit bearing period etc. are the most important yield attributing characters that contributes production and marketing value of Akabare chilli. Days to fruiting of CO-11064 and CO-11070; fruit width of CO-11045 and CO-11046; fruit weight of CO-11045 and CO-11062; Number of fruits per plant of CO-11047 and CO-11044 and fruit bearing period of CO-11058 and CO-11046, were found higher as compared to other tested genotypes (Table 25). Descriptive statistics for quantitative traits and frequency distribution of each qualitative traits are presented in (Table 26) and (Table 27), respectively and detailed qualitative traits were presented in (Table 28).

Table 25. Collection site details of Akabare chilli accessions

SN	Collection No	Local Name	Collection Site	Latitude	Longi-tude	Altitude (m)
1	CO-11044	Akabare Khursani	Ilam, Pashupatinagar	26.936	88.078	1478
2	CO-11045	Akabare Khursani	Solukhumbu, Panchan	27.410	86.690	1400
3	CO-11046	Akabare Khursani	Panchthar, Chilingdin	27.334	86.515	1872
4	CO-11047	Akabare Khursani	Okhaldhunga, Barnalu	27.334	86.515	1910
5	CO-11048	Akabare Khursani	Panchthar, Rabi	26.926	87.679	1695
6	CO-11049	Akabare Khursani	Panchthar, Rabi	26.936	87.694	1692
7	CO-11050	Akabare Khursani	Khotang, Batase	27.076	86.726	1600
8	CO-11051	Akabare Khursani	Panchthar, Rabi	26.936	87.694	1692
9	CO-11052	Akabare Khursani	Panchthar, Rabi	26.936	87.687	1692
10	CO-11053	Akabare Khursani	Khotang, Diktel	27.257	86.765	1880
11	CO-11054	Akabare Khursani	Panchthar, Pauwasar-nath	27.065	87.804	1865
12	CO-11055	Akabare Khursani	Khotang, Buipa	27.237	86.714	1400
13	CO-11056	AkabareKhursani	Khotang, Buipa	27.215	86.724	1600
14	CO-11057	AkabareKhursani	Khotang, Buipa	27.217	86.730	1400

SN	Collection No	Local Name	Collection Site	Latitude	Longitude	Altitude (m)
15	CO-11058	AkabareKhursani	Khotang, Buipa	27.217	86.730	1400
16	CO-11059	AkabareKhursani	Panchthar, Rabi	26.936	87.693	1692
17	CO-11060	AkabareKhursani	Ilam, Samalbung	26.875	88.143	1705
18	CO-11061	AkabareKhursani	Khotang, Buipa	27.209	86.722	1450
19	CO-11062	AkabareKhursani	Panchthar, Rabi	26.921	87.682	1645
20	CO-11063	AkabareKhursani	Panchthar, Rabi	26.921	87.682	1650
21	CO-11064	AkabareKhursani	Panchthar, Pauwasarnath	27.063	87.807	2405
22	CO-11065	AkabareKhursani	Panchthar, Sarandanda	26.982	87.668	1793
23	CO-11066	AkabareKhursani	Khotang, Buipa	27.238	86.714	1450
24	CO-11067	AkabareKhursani	Khotang, Rajapani	27.237	86.694	1080
25	CO-11068	AkabareKhursani	Khotang, Buipa	27.215	86.724	1600
26	CO-11069	AkabareKhursani	Ilam, Barbote	26.959	87.919	1440
27	CO-11070	AkabareKhursani	Solukhumbu, Salyan	27.410	86.660	1540
28	CO-11071	AkabareKhursani	Panchthar, Rabi	26.936	87.694	1692
29	CO-11072	AkabareKhursani	Panchthar, Rabi	26.922	86.667	1700
30	CO-11073	AkabareKhursani	Ilam, Barbote	26.959	87.919	1440

Table 26. Descriptive statistics for quantitative traits of Akabare accessions

ACC NO	Plant height (cm)	Stem length (cm)	Stem diameter (cm)	Mature leaf length (cm)	Mature leaf width (cm)	Days to flowering	Number of flowr (per axil)	Days to fruiting	Fruit-bearing period (d)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit pedicel length (cm)	Number of locules	Seed diameter (mm)	1000-seed weight (g)	no of fruit/ plant
CO-11044	149.8	25.4	1.7	14.5	10.3	98	3	104	179	1.9	1.8	2.8	3.1	2	4.8	6.6	141
CO-11045	126.4	3.4	2.0	8.7	5.1	88	2	93	164	2.5	2.2	5.4	2.5	2	3.5	5.1	59
CO-11046	136.3	13.0	1.8	6.0	3.3	93	2	98	187	2.3	2.2	2.1	3.0	3	4.6	6.2	126
CO-11047	147.1	9.5	2.3	9.4	6.2	99	2	104	178	2.4	2.1	3.7	3.2	3	4.5	5.3	150
CO-11048	119.1	15.0	1.8	16.2	9.9	100	1	109	105	1.9	1.9	2.8	2.3	3	4.8	6.1	24
CO-11049	112.3	4.3	2.5	7.1	3.4	91	1	95	155	2.0	2.1	3.3	3.2	2	3.6	4.0	88
CO-11050	123.0	4.6	2.0	15.8	9.4	95	2	100	111	1.7	1.7	2.0	2.2	2	4.3	7.4	87
CO-11051	143.3	8.0	1.8	13.3	8.1	100	2	117	173	2.1	1.7	1.8	2.1	3	4.2	6.1	82
CO-11052	160.3	8.4	1.9	14.9	8.2	105	2	118	165	2.1	0.8	2.6	2.4	3	4.4	5.3	54
CO-11053	140.1	12.7	1.9	10.8	6.6	100	2	108	174	1.8	1.8	2.8	2.7	3	4.4	6.6	79
CO-11054	164.0	23.5	1.9	13.5	7.9	102	2	113	157	1.7	0.8	1.3	2.4	1	4.2	3.2	37
CO-11055	156.1	25.5	1.8	12.5	8.5	111	2	122	165	1.9	0.8	2.4	2.7	3	4.6	6.8	90
CO-11056	142.8	22.0	2.1	12.6	7.6	101	2	108	177	2.1	1.6	2.7	2.8	3	4.3	6.7	90
CO-11057	133.3	5.2	1.9	8.4	5.0	98	2	101	169	2.0	1.8	2.9	2.6	2	4.0	5.0	51
CO-11058	91.2	6.2	1.9	14.8	7.5	96	2	99	183	1.6	1.7	2.4	2.1	3	4.1	4.3	38
CO-11059	110.0	6.7	2.1	16.0	9.4	103	2	115	167	2.9	0.6	1.9	3.5	3	4.9	4.8	53
CO-11060	85.6	4.8	1.6	12.8	8.9	104	2	117	165	1.5	0.9	0.8	2.1	1	4.4	3.9	29
CO-11061	94.8	7.3	1.8	13.1	7.2	97	2	101	136	1.6	1.6	1.8	2.4	3	4.7	4.8	47
CO-11062	179.6	35.4	2.0	17.5	10.5	104	2	118	165	2.6	1.2	6.1	3.4	2	4.6	7.1	108
CO-11063	137.2	8.5	2.1	15.1	10.1	106	3	117	165	1.8	0.8	2.0	2.4	3	3.6	5.7	69

ACC NO	Plant height (cm)	Stem length (cm)	Stem diameter (cm)	Mature leaf length (cm)	Mature leaf width (cm)	Days to flowering	Number of flowr (per axil)	Days to fruiting	Fruit-bearing period (d)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit pedicel length (cm)	Number of locules	Seed diameter (mm)	1000-seed weight (g)	no of fruit/ plant
CO-11064	50.0	3.1	1.2	10.0	4.7	83	2	87	172	2.1	1.8	3.9	2.1	2	4.2	4.4	29
CO-11065	93.9	13.5	1.4	9.5	4.4	93	2	102	167	1.7	1.7	2.9	2.4	2	4.1	6.0	55
CO-11066	118.6	33.6	1.6	16.4	9.1	99	2	119	182	2.2	1.9	2.5	3.1	3	4.0	5.6	103
CO-11067	124.2	11.7	2.0	16.0	9.6	102	2	106	180	2.3	0.8	2.6	2.5	3	4.6	5.4	29
CO-11068	143.4	22.0	1.8	14.3	9.3	103	2	118	165	2.0	1.7	2.6	2.5	3	4.4	7.1	97
CO-11069	120.0	6.4	1.7	8.8	5.2	98	2	105	182	1.9	1.9	2.7	3.0	2	3.3	2.0	120
CO-11070	111.3	4.2	2.0	10.5	5.0	95	1	91	183	2.7	1.5	2.8	2.8	2	3.6	3.3	117
CO-11071	119.3	22.9	1.8	16.4	9.8	98	2	102	181	2.1	1.7	2.4	2.2	2	4.5	6.4	56
CO-11072	141.7	23.1	2.1	18.5	10.7	100	2	112	171	2.1	1.0	2.4	2.4	3	4.3	6.1	61
CO-11073	156.9	18.5	2.2	17.2	10.2	99	2	103	179	2.2	2.0	2.7	2.9	3	4.9	6.4	119
Minimum	***50.0***	***3.1***	***1.2***	***6.0***	***3.3***	***83***	***1***	***87***	***105***	***1.5***	***0.6***	***0.8***	***2.1***	***1***	***3.3***	***2.0***	***24***
Maximum	***179.6***	***35.4***	***2.5***	***18.5***	***10.7***	***111***	***3***	***122***	***187***	***2.9***	***2.2***	***6.1***	***3.5***	***3***	***4.9***	***7.4***	***150***
Mean	***127.7***	***13.6***	***1.9***	***13.0***	***7.7***	***99***	***1.9***	***107***	***167***	***2.1***	***1.5***	***2.7***	***2.6***	***2***	***4.3***	***5.4***	***76***
SD	***27.15***	***9.31***	***0.25***	***3.37***	***2.28***	***5.46***	***0.39***	***8.87***	***19.1***	***0.33***	***0.49***	***1.03***	***0.40***	***0.43***	***0.43***	***1.30***	***35.9***

Table 27. Descriptor states, their frequency and proportion of phenotypic classes for 26 qualitative traits

SN	Characters	Observed phenotypic class	Frequency	Proportion, %
1	Stem shape	Cylindrical	9	30.0
		Angled	19	63.3
2	Stem pubescence	Sparse	27	90.0
		Intermediate	3	10.0
3	Plant growth habit	Prostrate	6	20.0
		Intermediate	14	46.7
		Erect	10	33.3
4	Branching habit	Sparse	4	13.3
		Intermediate	18	60.0
		Dense	8	26.7
5	Tillering	Sparse	8	26.7
		Intermediate	18	60.0
		Dense	4	13.3
6	Leaf density	Sparse	6	20.0
		Intermediate	19	63.3
		Dense	5	16.7
7	Leaf colour	Light green	8	26.7
		Green	8	26.7
		Dark green	14	46.6
8	Leaf shape	Deltoid	20	66.6
		Ovate	5	16.7
		Lanceolate	5	16.7
9	Flower position	Pendant	2	6.7
		Intermediate	20	66.6
		Erect	8	26.7
10	Corolla colour	White	11	36.7
		Light yellow	19	63.3
11	Corolla spot colour	White	30	100.0
12	Corolla shape	Rotate	30	100.0
13	Anther colour	White	23	76.7
		Purple	6	20.0
		Green	1	3.3
14	Filament colour	White	1	3.3
		Green	8	26.7
		Blue	9	30.0
		Purple	12	40.0

SN	Characters	Observed phenotypic class	Frequency	Proportion, %
15	Stigma exertion	Inserted	4	13.3
		Same level	1	3.3
		Exerted	25	83.3
16	Calyx margin	Entire	1	3.3
		Intermeidate	26	86.7
		Dentate	3	10.0
17	Fruit colour at mature stage	Orange	2	6.6
		Light red	12	40.0
		Red	11	36.7
		Dark red	5	16.7
18	Fruit shape	Almost round	7	23.3
		Triangular	14	46.7
		Campanulate	2	6.7
		Blocky	7	23.3
19	Fruit shape at pedicel attachment	Truncate	17	56.7
		Cordate	10	33.3
		Lobate	3	10.0
20	Neck at base of fruit	Absent	29	96.6
		Present	1	3.3
21	Fruit shape at blossom end	Pointed	2	6.7
		Blunt	13	43.3
		Shunken	15	50.0
22	Fruit blossom end appendage	Absent	29	96.6
		Present	1	3.3
23	Fruit surface	Smooth	9	30.0
		Semi-wrinkled	14	46.7
		Wrinkled	7	23.3
24	Seed colour	Straw	17	56.7
		Brown	2	6.6
		Other	11	36.7
25	Seed surface	Smooth	14	46.7
		Wrinkled	16	53.3
26	Seed size	Intermediate	19	63.3
		Large	11	36.7

Table 28. Qualitative traits of 30 Akabare accessions

ACCESSIONNO	Stem pubes-cence	Branching habit	Leaf density	Leaf colour	Flower position	Fruit colour at matur. stage	Fruit shape	Fruit shape at blos end	Fruit surface	Seed surface	Seed size
CO-11044	Sparse	Intermediate	Sparse	Dark green	Intermediate	red	Triangular	Blunt	Wrinkled	Smooth	Intermediate
CO-11045	Intermediate	Dense	Dense	Dark green	Erect	Orange	Almost round	Shunken	Smooth	Wrinkled	Intermediate
CO-11046	Sparse	Intermediate	Intermediate	Dark green	Intermediate	red	Campanulate	Blunt	Wrinkled	Smooth	Intermediate
CO-11047	Sparse	Intermediate	Intermediate	Green	Intermediate	Light red	Triangular	Blunt	Semiwrinkled	Wrinkled	Large
CO-11048	Sparse	Intermediate	Intermediate	Green	Erect	Light red	Blocky	Shunken	Wrinkled	Smooth	Large
CO-11049	Sparse	Dense	Dense	Dark green	Intermediate	Dark red	Blocky	Shunken	Smooth	Wrinkled	Intermediate
CO-11050	Sparse	Intermediate	Intermediate	Dark green	Intermediate	Light red	Blocky	Blunt	Semiwrinkled	Smooth	Intermediate
CO-11051	Sparse	Sparse	Sparse	Light green	Intermediate	red	Blocky	Pointed	Wrinkled	Smooth	Large
CO-11052	Sparse	Sparse	Sparse	Light green	Intermediate	red	Triangular	Shunken	Semiwrinkled	Smooth	Large
CO-11053	Sparse	Sparse	Intermediate	Light green	Intermediate	red	Almost round	Shunken	Semiwrinkled	Wrinkled	Intermediate
CO-11054	Sparse	Sparse	Sparse	Dark green	Intermediate	Orange	Triangular	Blunt	Semiwrinkled	Wrinkled	Intermediate
CO-11055	Sparse	Intermediate	Intermediate	Light green	Intermediate	Light red	Triangular	Shunken	Semiwrinkled	Smooth	Large
CO-11056	Sparse	Intermediate	Intermediate	Green	Intermediate	Dark red	Triangular	Blunt	Semiwrinkled	Smooth	Large
CO-11057	Sparse	Dense	Dense	Light green	Erect	Dark red	Almost round	Blunt	Smooth	Smooth	Intermediate
CO-11058	Sparse	Dense	Intermediate	Light green	Intermediate	Light red	Almost round	Blunt	Semiwrinkled	Wrinkled	Intermediate
CO-11059	Sparse	Intermediate	Intermediate	Dark green	Intermediate	Light red	Triangular	Pointed	Semiwrinkled	Wrinkled	Intermediate
CO-11060	Sparse	Intermediate	Intermediate	Green	Intermediate	Light red	Campanulate	Blunt	Wrinkled	Wrinkled	Intermediate
CO-11061	Sparse	Intermediate	Intermediate	Green	Intermediate	red	Almost round	Shunken	Semiwrinkled	Smooth	Intermediate
CO-11062	Sparse	Intermediate	Intermediate	Dark green	Intermediate	Light red	Triangular	Shunken	Semiwrinkled	Smooth	Large
CO-11063	Sparse	Intermediate	Intermediate	Dark green	Erect	red	Triangular	Shunken	Smooth	Wrinkled	Intermediate
CO-11064	Sparse	Dense	Sparse	Dark green	Pendant	red	Triangular	Blunt	Smooth	Wrinkled	Intermediate
CO-11065	Sparse	Dense	Sparse	Green	Erect	red	Almost round	Shunken	Smooth	Wrinkled	Large
CO-11066	Sparse	Intermediate	Intermediate	Light green	Intermediate	Light red	Blocky	Blunt	Smooth	Wrinkled	Large
CO-11067	Sparse	Intermediate	Intermediate	Dark green	Intermediate	Dark red	Triangular	Blunt	Wrinkled	Wrinkled	Large
CO-11068	Sparse	Intermediate	Intermediate	Green	Intermediate	Light red	Triangular	Blunt	Semiwrinkled	Wrinkled	Large
CO-11069	Sparse	Dense	Dense	Green	Erect	red	Almost round	Shunken	Smooth	Smooth	Intermediate
CO-11070	Sparse	Dense	Dense	Dark green	Erect	Dark red	Triangular	Shunken	Smooth	Wrinkled	Intermediate
CO-11071	Intermediate	Intermediate	Intermediate	Dark green	Pendant	Light red	Blocky	Shunken	Wrinkled	Smooth	Intermediate
CO-11072	Intermediate	Intermediate	Intermediate	Light green	Intermediate	Light red	Triangular	Shunken	Semiwrinkled	Smooth	Intermediate
CO-11073	Sparse	Intermediate	Intermediate	Dark green	Erect	red	Blocky	Shunken	Semiwrinkled	Wrinkled	Intermediate

3.7. Management of aqua, livestock, insect and microorganism genetic resources (MALIM)

Major works were 1. Passport format for aquatic animal genetic resources drafted; 2. Data of aquatic, livestock, micro and insect genetic resources updated, 3. Rampur Livestock farm genebank and Aquatic pond genebank in Begnas monitored and discussed for further improvement, 4. Detail agrobiodiversity and conservation status documents shared among the relevant stakeholders, and 5. Discussion held on livestock farm genebank establishment along with passport for aquatic animal and livestock genetic resources.

Status paper on 'Agrobiodiversity and its Conservation in Nepal' was prepared and published in the Journal of Nepal Agricultural Research Council (https://narc.gov.np/narc-journal/). Its abstract is: Agrobiodiversity and its conservation status were studied through literature review, field survey, key informant survey and focus group discussion. Results of field implementation of some good practices and action research were also documented. Among 24,300 total species in the country, 28% are agricultural genetic resources (AGRs), termed as agrobiodiversity. Agrobiodiversity has six components (crops, forages, livestock, aquatic, insects and microorganisms) and four sub-components (domesticated, semi-domesticated, wild relatives and wild edible) in Nepal. Agrobiodiversity on each component exists at agroecosystem, species, variety/breed/biotype/race/strain, genotype and allele levels, within an altitude range from 60 to 5,000 m. There are 12 agroecosystems supporting 1026 species under crop component, 510 under forage, 35under livestock, 250 under the aquatic animal, 17 under aquatic plant, 3,500 under insect and 800 under microorganism. An estimated loss of agrobiodiversity is 40%, however, farmers have reported up to 100% loss of AGRs in some areas for a particular species. Conservation of agrobiodiversity has been initiated since 1986. Four strategies namely ex-situ, on-farm, in-situ and breeding have been adopted for conservation and sustainable utilization of AGRs. Eighty good practices including process, methods and actions for managing agrobiodiversity have been in practice and these practices come under five conservation components (sensitization, method and approach, accelerator, value and enabling environment) (Figure 19, Box 1). Within the country, 18,765 accessions of AGRs have been conserved in different kinds of banks. A total of 24,683 accessions of Nepalese crops, forages and microbes have been conserved in different international and foreign Genebanks. Some collections are conserved as safety duplication and safety backup in different CGIARs' banks and World Seed Vault, Korea. Two global databases (GENESYS and EURISCO) have maintained 19,200 Nepalese accessions. Geographical Information System, Climate Analog Tool and biotechnological tools have been applied for better managing AGRs. Many stakeholders Need to further concentrate on the conservation and utilization of AGRs. Global marketing of some native AGRs is necessary for sustaining agriculture and attracting young generations as well as conserving them through use.

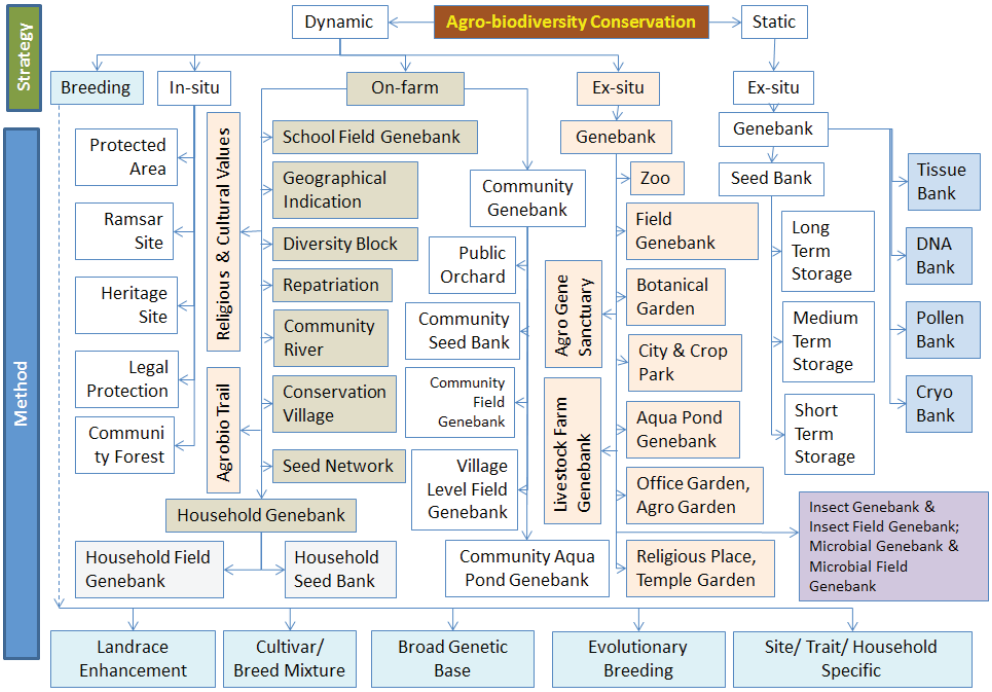


Figure 19. *Agrobiodiversity conservation four strategies and 44 methods and approaches (Adapted from Joshi et al 2020, Journal of NARC, Vol 6).*

Box 1. Additional process, methods, action and good practices used for conservation and sustainable utilization of AGRs

1. Accessioning and naming system
2. Agro-plantation
3. Agrobiodiversity rich farmers
4. Incentive and award
5. Black box and safety duplication and backup
6. Pre breeding & domestication
7. GIS + CAT
8. Restocking
9. Image bank
10. Seed and crop herbaria and agro museum
11. Red zoning and red listing
12. Germplasm rescue
13. Agro haat bazaar
14. Site specific staple crop
15. Diversity fair/ seed fair
16. Food fair & Himalayan super foods (PQTHN)
17. Local food shop
18. Diversity kit
19. Diversity rich solution
20. Enhancing ecological services
21. Global and national gene pools
15. Each household as shop
16. Participatory seed exchange
17. Product diversification
18. Value addition
19. Multi- stakeholder and disciplinary approaches
20. Agrobio education
21. Landraces catalog, ownership documentation, CBR and registration
22. Local media for community sensitization
23. On-farm agrobiodiversity measurement
24. Diversity field school
25. Simplifying the traditional tech
26. Home stay and market linkage
27. Agrobio poetry and folk song
28. Sharingshop, writeshop and virtual workshop
29. Traveling seminar

Adapted from Joshi et al 2020, Journal of NARC, Vol 6

4. TECHNOLOGY TRANSFER AND SERVICES

- 653 accessions of 11 different crops were distributed to different researchers, students and farmers.
- Free consultation services were provided to more than 349 clients (NGOs, community seed banks, farmers, researchers, students and internet users).
- Provided accession number to 10 accessions which were requested by different organization for release and registration
- Provided resource person in different trainings (statistics, plant breeding, post plant breeding, research methodology, seed science, on-farm conservation, GIS and CAT, etc.)
- Molecular lab facility and technical support to IAAS students, Fishery Research Division, Biotechnology Division, Commercial Crops Research Division, NAST and Animal Breeding Division
- Descriptors for different crops were provided to researchers.

5. BUDGET AND EXPENDITURE

- A sum of NRs 34844000 was annual budget of FY 2076/077 and NRs. 23939087 was received from NARC. Among which NRs 23939087 was expended during the period and NRs 10904913 is balanced (Annex 6.1).

6. KEY PROBLEMS

- Diversity are not being captured due to very few seeds from farmers
- Collections are generally from farm store not from standing crops
- Difficulty on identifying the samples and duplicates and possibility of collecting many duplicates
- Difficulty to regenerate and multiply cross-pollinated crop species
- Poor utilization of indigenous AGRs in breeding and research
- Difficulty on marking sampling sites and sampling method
- Insect pest and disease problems in seeds
- Seed setting problem during regeneration and non-viability of old collections
- No system of accessioning germplasm before doing research
- Lack of systematic governance mechanism of AGRs in the country
- Lack of screen house and glass house facilities
- Limited technical manpower and financial support
- Many pathological problems including problems in soil
- Regeneration fields are not well drained
- Need strong collaboration with organization located across the country
- Need to expand on-farm and in-situ conservation activities across the country

7. WAY FORWARD

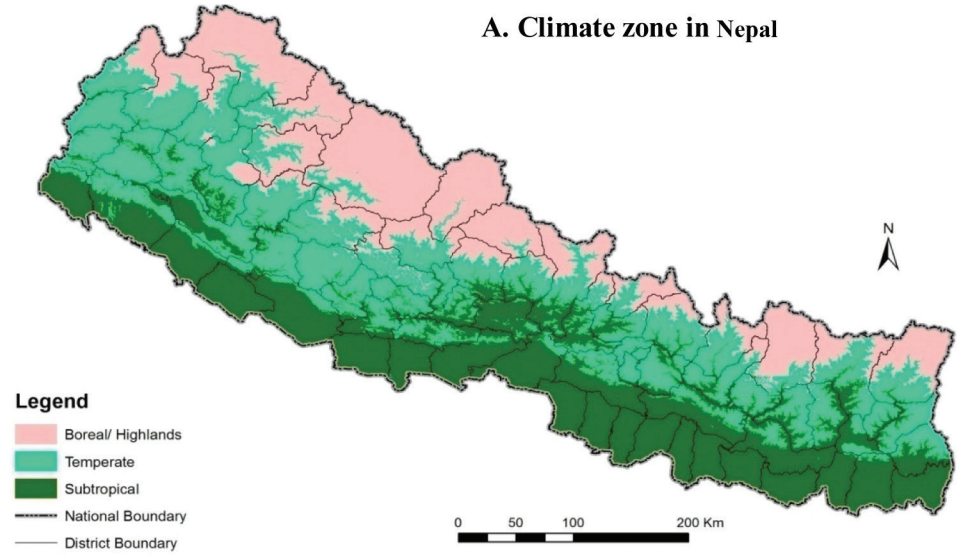
- Development of guidelines for APGR flows and collections
- Participation in ITPGRFA-MLS and make access to accessions available under MLS to researchers, breeders and farmers
- Construction of screen house and glass house
- Establishment of sub field genebank in all NARC stations, farms of DoA and offices of District Agriculture Development Offices, aqua pond genebank and animal farm genebank
- Need to initiate cryopreservation (Cryo Bank)
- Need to further strengthen the conservation of microorganism, insects, animal and aqua genetic resources
- Establishment of accessioning system and research advances based on accession
- Strengthen utilization and on-farm conservation
- Rescue collections from red zone areas and repatriation of germplasm
- Coordination for regeneration, collection and multiplication
- Coordination for in-situ conservation: There are many wild species and wild relatives of cultivated species and wild edible plants distributed across the country. These are the reservoir for different important genes and evolution

continuously takes places interacting with nature. These sites, where, important wild and wild relatives of crop species and wild edible plants exist, and are conserved or protected, are called in-situ conservation area. Economical means of in-situ conservation is coordination with National Parks, religiously and culturally protected sites, heritage sites and community. It is Necessary to locate species that Needs to be conserved on-site and develop strategies to protect their habitat collaborating with relevant stakeholders.

Covid 19 effects

Due to Covid 19 effects, one regional training could not be organized. Field works e.g. collections, monitoring, field genebank assessment in other research stations, implementation of on-farm conservation related activities, regeneration and characterization in other stations, interaction meeting with different stakeholders are greatly hampered. Harvesting of winder crops and planting of summer crops in National Genebank also affected. Agro gene sanctuary in Khumaltar could be maintained. Training on plant breeding, statistics and farmers levels could not be organized. On-farm related special projects, (LCP and EPB) were greatly affected and many activities in the field were not implemented.

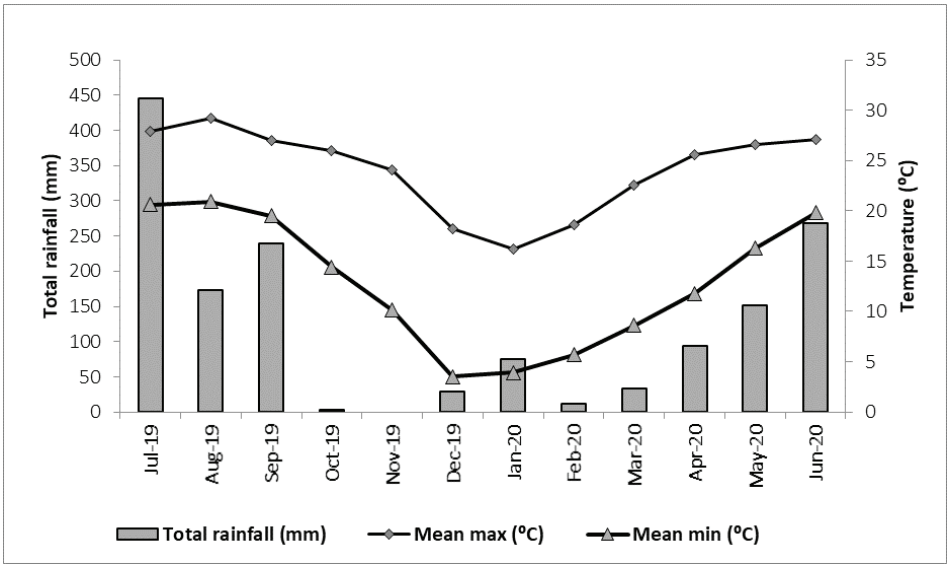
Annex 1.1. Map of the command areas



B. NARC Stations

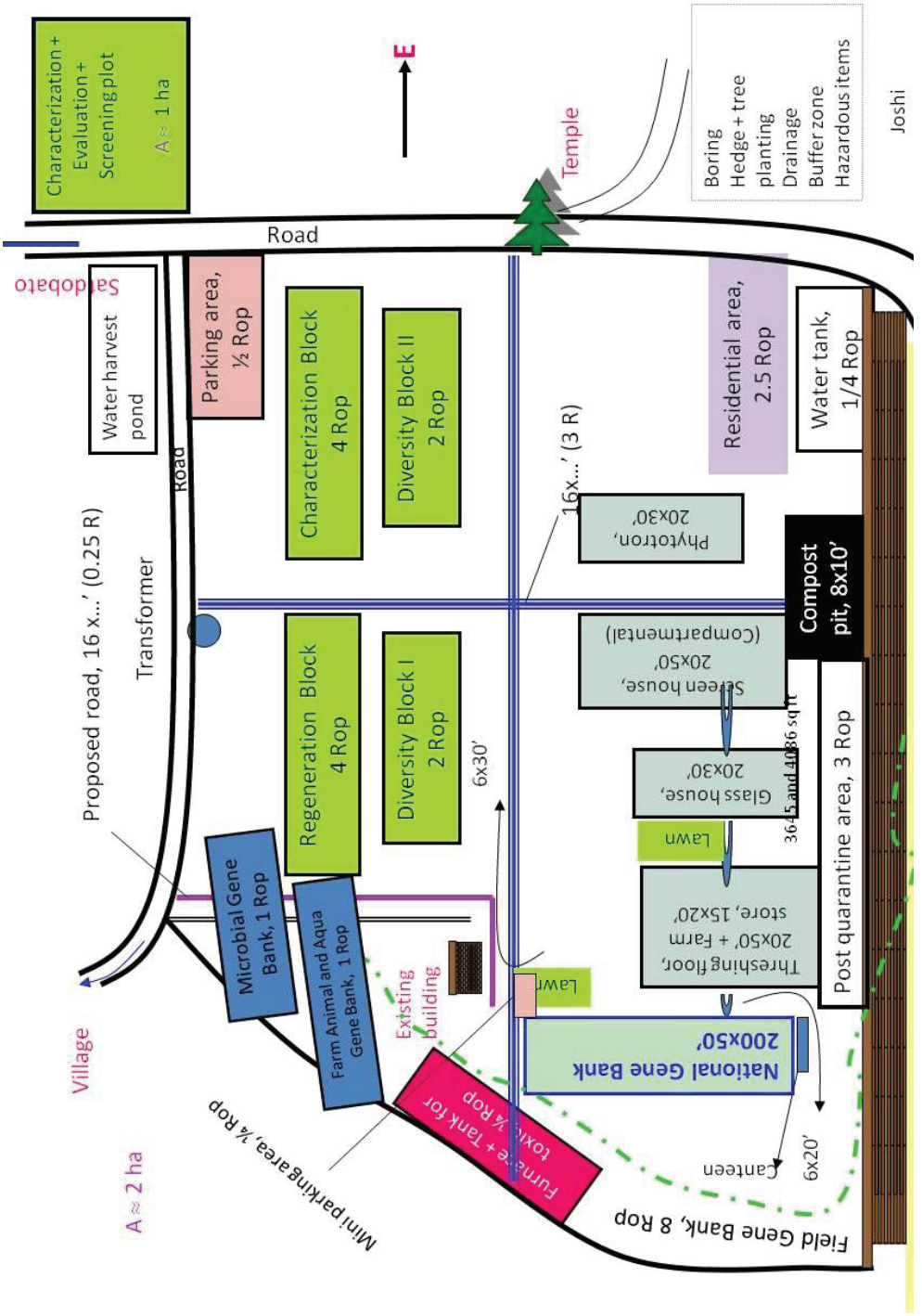
Command areas of NAGRC include all eco-zones (A) and NARC Stations (B).

Annex 1.2 Monthly agro-meteorological data of Khumaltar



During this Fiscal Year, NAGRC, Khumaltar received 1525 mm annual rainfall in 147 rainy days with annual average of maximum and minimum temperature 25.9°C and 12.93°C, respectively.

Annex 2.1. Map of the Genebank Complex, Khumaltar



Annex 2.2 List of laboratory facilities

SN	Name of laboratory	Major instruments	Manpower in laboratory	Testing facilities
1.	In-vitro Culture Lab	Laminar Hood, In-vitro Culture Room, Autoclave, Shaker, pH meter, Distilled water plant	Dr Bal K Joshi	For tissue culture and in-vitro conservation
2.	Molecular Research Lab	PCR machine, Tissue lyzer, Centrifuge, Deep fridge, Gel doc, Electrophoresis unit, Water bath, autoclave, Pipettes, Vortex, Nano-based Spectrophotometer, ice-maker, Distillation unit, deep freezer	Dr Bal K Joshi Krishna H Ghimire and Ajaya Karkee	For DNA works (diversity assessment, identification, screening and genes tagging and mapping)
3.	Seed Testing and Processing Lab	Seed germinator, pH meter, Aspirator, Seed grader, Conical divider, Soil divider, Seed counter, magnifying glass, Gamet seed divider, Digital moisture meter, Oven, Grinding mill, Digital balance, Microscope, Purity board, Compound microscope, BOD Incubator	Pradeep Thapa and Sanjay Karki	For seed cleaning, testing and characterization
4.	Seed drying and packing Lab	Drying room. Digital weighing machine, Dehumidifier, Moisture meter, Seed dryer, Hygrometer	Krishna H Ghimire and Shiva K Budhathoki	For drying and packaging for storage
5.	Medium- and Long-Term Storage	Cooler, dehumidifier, rack, Hygrometer,	Krishna H Ghimire and Shiva K Budathoki	For conserving orthodox seeds to active and base collection
6.	Short Term Storage	Rack	Dr Bal K Joshi	For one season storing of planting materials

Annex 2.3. Human resource in 2076/77 (2019/20)

SN	Name	Position	Qualification	Specialization/ working area
1.	Dr Krishna K. Mishra	Senior Scientist (S-5)	Ph D	Plant Breeding
2.	Dr. Bal K. Joshi	Senior Scientist (S-3)	Ph D	Genetics and Plant Breeding
3.	Mr. Krishna H. Ghimire	Senior Scientist (S-3)	M Sc	Plant Breeding and PGR
4.	Ms. Deepa Singh Shrestha (Study Leave)	Senior Scientist (S-3)	M Sc	Plant Breeding
5.	Mr. Homan Regmi (Study leave)	Scientist (S-1)	M Sc	Entomology
6.	Mr. Ajaya Karkee	Scientist (S-1)	M Sc	Plant Pathology
7.	Mr. Ram P Mainali	Technical Officer (T-6)	M Sc	Entomology/ Plant Breeding
8.	Mr. Pradip Thapa	Technical Officer (T-6)	M Sc	Plant Breeding
9.	Mr. Shiva K. Budhathoki	Technical Officer (T-6)	I Sc Ag	Plant Breeding
10.	Ms. Januki Giri	Account Officer (A-6)	M.Com	Financial Admin
11.	Mr. Lila Bahadur Jirel	Admin. Officer (A-6)	M.Com	Administration

SN	Name	Position	Qualification	Specialization/ working area
12.	Mr. Santosh Sharma (Study leave)	JT (T-5)	ISC Ag	
13.	Mr. Kabir Alam Ansari	Electrician (T-5)	Eng. Diploma	
14.	Mr. Sanjay Karki	JTA (T-4)	SLC	
15.	Mr. Dipak Manandhar	Light Driver		
16.	Mr. Sunil K. Mandal	Tech. Assistant	SLC	
17.	Ms. Babita K. Chaudhari	Tech. Assistant	SLC	
18.	Ms. Nisha Maharjan	Tech. Assistant	SLC	
19.	Ms. Indira Adhikari	Tech. Assistant	SLC	
20.	Ms. Rita Thapaliya	Tech. Assistant	JTA	
21.	Mr. Shyam B. Blon	Adm. Assistant	Literate	
22.	Mr. Surendra K. Shrestha*	Database Officer	MBA	Business admin
23.	Dr. Devendra Gauchan*	Project Manager	PhD	Economics
24.	Mr. Safal Kathiwada*	Project Assistant	MBA	Business admin

** Project Staff*

Annex 3 Summary progress of NARC research projects and activities in 2076/77 (2019/20)

Project code number	Name of project/ activity	Activity leader	End year	Budget allocate	Major progress achievements
33267001	Management of Agricultural Plant Genetic Resources (MAPGR) in Nepal	KK Mishra	On-going	5804	
Activity 1	Exploration, collection and distribution of multi-crop germplasm	KK Mishra	2077	800	Collected 1087 accessions of 79 crops from 19 district.
Activity 2	Seed cleaning and testing	P Thapa	2077	100	1728 accessions of 50 crops tested for germination
Activity 3	Seed processing and conservation of germplasm in medium- and long-term storages	KH Ghimire	2077	300	Seed of 550 accessions of 45 cultivated crops species dried, labeled, packed and conserved in medium & long term storage
Activity 4	Regeneration, multiplication and characterization of agronomical crops	KH Ghimire	2076	500	A total of 923 accessions of 11 crops regenerated and characterized morphologically
Activity 5	Regeneration, multiplication and characterization of horticultural crops	RP Mainali	2077	400	A total of 275 accessions of 14 crops regenerated and characterized

Project code number	Name of project/ activity	Activity leader	End year	Budget allocate	Major progress achievements
Activity 6	Development and management of Field Genebank for vegetatively propagated and recalcitrant seed crops	BK Joshi	2076	420	A total of 241 accessions of 34 various recalcitrant species have been collected and maintained in Khumal field genebank
Activity 7	Promotion of on-farm conservation of agricultural biodiversity	BK Joshi	2077	342	➢ Rescued mango germplasm from Lamjung in Parwanipur monitored, ➢ Total on farm conservation approaches surveyed, listed and published ➢ Good practices published with support from special project, ➢ On-farm conservation in Lamjung, Jumla, Chitwan monitored, ➢ Technical support provided to different farmer groups, organization, ➢ Mango diversity from Lamjung and other different parts of the country assessed through SSR and agromorpho markers, etc.; ➢ Interactive meeting with CDABCC for strengthening on-farm conservation held three times; ➢ Journal paper on on-farm conservation approaches distributed; ➢ Management and utilization of native agrobiodiversity broadcasted through Krishi TV two times; ➢ Deployment of intra varietal diversity to different farming areas using climate analog tool documented ➢ Importance of native genetic resources shared in social media; ➢ Good practices of agrobiodiversity conservation and utilization shared; ➢ 20 research papers on different aspects of on-farm agrobiodiversity finalized.
Activity 8	In-vitro conservation of vegetatively propagated and recalcitrant seed crops	BK Joshi	2077	300	Potato, sweet potato, banana and large cardamom plantlet sub cultured.

Project code number	Name of project/ activity	Activity leader	End year	Budget allocate	Major progress achievements
Activity 9	Use of molecular markers for management of agricultural biodiversity	BK Joshi	2077	1500	• Extraction of DNA from 59 accessions of rice and 72 accessions of wheat and conserved for further work at DNA bank. PCR and gel electrophoresis of 2 rice variety with 19 SSR Marker and 42 rice variety with 19 rice blast resistant primers. • DNA finger print of 12 accessions of chayote, 80 landraces of rice, 23 landraces of maize and 64 landraces of wheat developed • Genetic diversity and relatedness among 12 accessions of chayote, 80 landraces of rice, 23 landraces of maize and 64 landraces of wheat measured and studied • Data format for DNA bank (storage and distribution) revised and database of DNA bank updated • Gel scoring method developed and shared • Electronic data of DNA based research findings updated (rice, chayote, wheat and maize) • DNA finger print of 40 finger millet landraces developed • Three scientific papers on genetic diversity and relatedness among 12 accessions of chayote, 23 landraces of maize,40 landraces of finger millet prepared and submitted to different journals • Electronic data of DNA based research findings updated (finger millet)
Activity 10	Evaluation and pre-breeding of agronomical crops	KH Ghimire, A Karkee	2077	350	220 rice landraces were evaluated.
Activity 11	Evaluation and pre-breeding of horticultural crops	D Singh	2077	350	28 bean landraces were evaluated.
Activity 12	Documentation and database management	BK Joshi, A Karkee	2077	200	Passport data up to 8745 accessions updated and regeneration, characterization, stock management data maintained.
Activity 13	Maintenance of display blocks	A Karkee	2077	200	Display blocks of 28 crop species maintained
FMP	Farm Management Project of NAGRC		On-going	810	
Activity 1	Research and Office Support		2077	1285	Office and farm security, sanitation, cleaning and beautification of NAGRC complex done regularly.

Project code number	Name of project/ activity	Activity leader	End year	Budget allocate	Major progress achievements
Activity 2	Annual Report publication		2077	100	Annual report (FY 2075/76) published
Activity 3	Training on Field genebank establishment and Management		2077	300	Due to Covid 19 Lockdown, This activity remained.
Activity 4	Training workshop on Agrobiodiversity management for agricultural stakeholder at state-6		2077	200	Organize one day orientation workshop on " Agricultural biodiversity management workshop for the stakeholders of Karnali pradesh" at Surkhet.
Activity 4	Organize genebank/ Agrobiodiversity day on the occasion of 9th NAGRC establishment day (Asoj 21)		2077	100	Due to Deshain vacation on 21 Asoj, genebank day did not organized.

Annex 4.1. Training/workshop/seminar organized in FY 2076/77 (2019/20)

SN	Name of Training/ Workshop/ Seminar	Duration	Target group	Location
1.	Training on Quality Seed Production Processing and Management	5 Sep 2019	Farmers/ Community Seed Bank	Lamjung
2.	Orientation Program on Agrobiodiversity Management for Stakeholders from Karnali Province	12 Mar 2020	Scientist, Extension worker, NGOs, Farmers, Entrepreneurs	Surkhet
3.	Consultation Workshop on Farmer's Variety Registration and Commercialization	30 December 2019	Extension worker, NGOs, Farmers	NAGRC, Khumaltar
4.	Final Output Sharing Workshop of UNEP/GEF Local Crops Project	12 February 2020	Scientist, GO, NGOs, Farmers, Entrepreneurs	Lalitpur

Participants of the Quality Seed Production, Processing and Management Training conducted at Marsyangdi-2, Lamjung on 5th September, 2019.

Participants of the Consultation Workshop on Farmer's Variety Registration and Commercialization conducted at NAGRC, Khumaltar on 30th December, 2019.

Participants of the Final Output Sharing Workshop of UNEP/GEF Local Crops Project conducted at Lalitpur on 12th February, 2020.

Participants of the Orientation Workshop on Agrobiodiversity Management conducted at ADD, Surkhet on 30th March, 2020

Annex 4.2 Publications in FY 2077/78 (2019/20) (by NAGRC)

SN	Name of publications	Type	Language	Authors	No. of copies
1.	Annual Report 2075/76 (2018/19)	Book	English	BK Joshi, KH Ghimire, A Karkee, RP Mainali, P Thapa and S Shrestha	200

Annex 4.3 Information disseminated through media in FY 2076/77 (2019/20)

SN	Information disseminated/ Media coverage	Type	Name/ type of media	Date/ time
1.	About native genetic resources, buckwheat	Interview: Joshi, BK	Krishi TV	Two times in 2020
2.	About local agrobiodiversity	interview: Joshi, BK	ABC TV	2020
3.	About endangered wild rice in Biratngar	News	Local News paper	2019
4.	About Genebank and Local Crops	Interview: KH Ghimire	Krishi Bahas- ABC TV	Two Times 2019
5.	About Fingermillet	Interview: KH Ghimire	Hellow Kisan- Krishi TV	Three Times 2020
6.	About Anadi Rice	Interview: KH Ghimire	Hellow Kisan- Krishi TV	Two Times 2020
7.	About Genebank and Local Crop Diversity	Documentary	NTV Plus	2019
8.	About Local Crop promotion	News	Krishi TV	2020

Annex 4.4 Visitors to NAGRC in FY 2076/77 (2019/20)

SN	Category	Number	Districts	Area of major interest
1.	Farmers	35	Myagdi, Lamjung, Dolakha, Taplejung	Genebank and local seed
2.	Teachers and students	230	Kathmandu, Lalitpur, Bhaktapur, Kavre	Agrobiodiversity
3.	Extension officials	13	Kathmandu, Lalitpur, Bhaktapur	Seed bank and genebank
4.	NGO Officials/Journalist	15	Various organizations	Agro-biodiversity conservation and Genebank
5.	International delegates	25	Italy, Uganda, Ethiopia, China, Japan, India	Agro-biodiversity, Genebank
6.	Political Leaders	21	Ministers, Parliament Members, Party Leaders	Agro-biodiversity, Genebank, Local Seeds/ Crops

Annex 5.1 Training/workshop/seminar attended by staff in FY 2076/77 (2019/20)

SN	Name of Staff	Position	Name of Training / seminar/ workshop	Duration, d	Place/ country	Organizer
1.	Mr. KH Ghimire	S-3	Global Meeting for Mainstreaming and Upscaling the ICRAF-IFAD-Bioversity project results	5	Uganda	NARO
2.	Dr. KK Mishra	S-4	Genebank Management of Asian Region and AGM	6	Vietnam	Crop-Trust
3.	Dr. KK Mishra	S-4	Mid-term evaluation of RARS	5	Japan	IAEA
4.	Mr. A Karkee	S-1	2019 Goal Data-IT Workshop	3	Vietnam	Crop-Trust
5.	Mr. RP Mainali	T-6	2019 Seminar on Hybrid Maize and Rice	25	China	
6.	Mr. P Thapa	6	Strategies of Rural Vitalization and Integrated Agricultural Practices	8	China	
7.	Dr. BK Joshi	S-3	Consultative Workshop on Promotion of Climate-Smart Practices and Varieties for Intensive Rice-based Systems in Nepal	1	Kathmandu Nepal	
8.	Dr. BK Joshi	S-3	SAARC Regional Consultative Meeting. Seeds without Borders in South Asia	3	Kathmandu Nepal	SAARC and IRRI
9.	Dr. BK Joshi	S-3	Preliminary Mid-term Review of Nepal's Seed Vision 2013-2025 & Validation Workshop on Hybrid Seed Production Guidelines	2	Kathmandu Nepal	CIMMYT, SQCC, NARC, SEAN

Annex 5.2 Paper publication, presentation in FY 2076/77 (2019/20) by staff

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
Published papers			
1.	फापर	जोशी, बालकृष्ण	स्थानीय/रैथाने बाली खेति प्रबिधि, उत्पादन विविधिकरण तालिम स्रोत पुस्तिका । बाली विकास तथा कृषि जैविक विविधता संरक्षण केन्द्र, हरिहरिभावन; पेज: २७-५७
2.	जातिय मिश्रित खेती प्रबिधि	जोशी, बालकृष्ण र कृष्ण हरि घिमिरे	१३औ बाह्य अनुसन्धान कार्यशाला गोष्ठीको प्रोसिड्डीङ र नवीनतम कृषि प्रविधि (ध्रुब भट्टराई र अन्य, सम्पादक) । बाह्य अनुसन्धान महाशाखा, खुमलटार; पेज: ७३-८८ ।
3.	सामुदायिक बिउ बैंक र सामुदायिक फिल्ड जिन बैंक : स्थापना, संचालन प्रकृय र फाईदा	जोशी, बालकृष्ण	१३औ बाह्य अनुसन्धान कार्यशाला गोष्ठीको प्रोसिड्डीङ र नवीनतम कृषि प्रविधि (ध्रुब भट्टराई र अन्य, सम्पादक) । बाह्य अनुसन्धान महाशाखा, खुमलटार; पेज: २९-३३ ।२०७६
4.	उत्परिवर्तनशील बाली प्रजनन् परियोजना	जोशी, बालकृष्ण, दिपेन्द्र कुमार ऐर, कृष्ण हरि घिमिरे र देवेन्द्र गौचन	जानकारी– पत्र १: १–४। ली–बर्ड, राष्ट्रीय जीन बैंक र बायाभर्सिट इन्टरनेशनल, नेपाल ।२०७६
5.	उत्परिवर्तनशील बाली प्रजनन्: के हो, किन र कसरि गरिन्छ	जोशी, बालकृष्ण, दिपेन्द्र कुमार ऐर, कृष्ण हरि घिमिरे र देवेन्द्र गौचन	जानकारी– पत्र २: १–८ । ली–बर्ड, राष्ट्रीय जीन बैंक र बायाभर्सिट इन्टरनेशनल, नेपाल ।
6.	कोदोको बीउ संरक्षण	जोशी, बालकृष्ण र कृष्ण हरि घिमिरे	राष्ट्रीय कृषि आनुवंशिक स्रोत केन्द्र । नेपाल जिनबैंक पत्र, अंक १७ ललितपुर ।
7.	Integrated Approach of National Seed Systems for Assuring Improved Seeds to the Smallholder Farmers in Nepal	Joshi BK, R Humagain, LK Dhakal and D Gauchan	Strengthening Seed Systems- Promoting Community Based Seed Systems for Biodiversity Conservation and Food & Nutrition Security in South Asia (RB Shrestha, ME Penunia and M Asim, eds). SAARC Agriculture Center, Bangladesh; Asian Farmers' Association, the Philippines; and Pakistan Agricultural Research Council, Pakistan; pp. 181-194
8.	Integrated Approach of National Seed Systems for Assuring Improved Seeds to the Smallholder Farmers in Nepal	Joshi BK, R Humagain, LK Dhakal and D Gauchan	Strengthening Seed Systems- Promoting Community Based Seed Systems for Biodiversity Conservation and Food & Nutrition Security in South Asia (RB Shrestha, ME Penunia and M Asim, eds). SAARC Agriculture Center, Bangladesh; Asian Farmers' Association, the Philippines; and Pakistan Agricultural Research Council, Pakistan; pp.181-194
9.	Hybrid rice seed production manual. NARC, Kathmandu, Nepal	Sah SN and BK Joshi	

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10.	Cultivar mixture for minimizing risk in farming and conserving agrobiodiversity	Joshi BK, SP Vista, SB Gurung, KH Ghimire, R Gurung, S Pant, S Gautam and PB Paneru	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp.14-25
11.	Performance of bushy bean genotypes under sole and mixed cultivation in mountain environment	Vista SP, NH Ghimire, PM Mahat and BK Joshi	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 26-29
12.	Performance of trailing type bean genotypes under sole and mixed cultivation in mountain environment	Vista SP, NH Ghimire, PM Mahat and BK Joshi	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 30-33
13.	Finger millet germplasm evaluation for blast disease resistance and agronomical traits in Dolakha, Nepal	Gurung SB, BK Joshi and RC Prasad	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 48-54
14.	Jumli maarsee rice evolved in Jumla, Nepal: Nature's choices for high mountains with nutrition dense landrace	Joshi BK, P Ojha, D Gauchan and P Chaudhary	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 71-74
15.	Advancement, simplification and piloting of electrical proso millet de-husker (Chino Kutak) for the mountain farmers	Bhandari GR, D Gauchan, B Bhandari, BK Joshi and S Panta	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 75-81

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
16.	Nutritionally unique native crop landraces from mountain Nepal for geographical indication right	Joshi BK, P Ojha, D Gauchan, KH Ghimire, B Bhandari and HB KC	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 87-99
17.	Tradition of mixing bean landraces: Diversity rich solution for secured quality harvest and conservation in mountain agriculture	Joshi BK, RC Prasad, R Gurung, S Gautam, A Subedi, AR Adhikari, A Karkee and D Gauchan	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 116-124
18.	Factors influencing cultivation and promotion of traditional crops in the mountains: A case of Jumla district, Nepal	Thapa Magar DB, D Gauchan and BK Joshi	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 125-137
19.	On-farm diversity and consumption choices of traditional crops in the mountains of Nepal	Gauchan D, BK Joshi, S Sthapit and DI Jarvis	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp 148-154
20.	Organic farming and marketing of traditional crops in Nepal mountains: Gaps, issues and opportunities for improvement	Gauchan D, E Palikhey, S Sthapit, BK Joshi, HK Manandhar and DI Jarvis	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp.163-173
21.	Value chain development and mainstreaming of traditional crops for nutrition sensitive agriculture in Nepal	Gauchan D, BK Joshi, B Bhandari, KH Ghimire, S Pant, R Gurung, N Pudasaini, PB Paneru, KK Mishra and DI Jarvis	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 174-182

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
22.	Deploying intra specific diversity of traditional crop in mountain agroecosystems through the use of climate analogue tool	Ghimire KH, BK Joshi and D Gauchan	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and D Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 100-107
23.	Diversifying the sourcing deploying methods to enhance the crop diversity	Ghimire KH, BK Joshi, R Gurung, N Pudasaini, D Gauchan, S Sthapit and D Jarvis	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 40-47
24.	On-farm Agrobiodiversity Measurement and Conservation	Joshi BK, KH Ghimire, R Gurung, N Pudasaini, S Pant, P Paneru, D Gauchan, KK Mishra and D Jarvis	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 15-24
25.	Red Zoning and Red Listing	Joshi BK, KH Ghimire, B Bhandari, D Gauchan, R Gurung and N Pudasaini	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 25-30
26.	Diversity Rich Solution	Joshi BK, D Gauchan, B Bhandari and D Jarvis	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 31-34
27.	Geographical Indication	Joshi BK and D Gauchan	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 35-39
28.	Germplasm Rescue and Repatriation	Joshi BK, KH Ghimire, R Gurung and D Gauchan	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 48-52
29.	Cultivar Mixture	Joshi BK, SB Gurung, SP Vista, PB Paneru, R Gurung and S Pant	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 65-70

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
30.	Participatory Preference Ranking for Crop Landrace Selection	Ayer DK, BK Joshi and KH Ghimire	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 71-75
31.	Study of gender roles in production system in Jumla District	Thapa P, R Tamang, D Gauchan and N Pudasaini	Poster
32.	Simplifying the Traditional Processing System of Minor Millets	Bhandari GR, BK Joshi, D Gauchan, B Bhandari and S Panta	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 82-87
33.	Diversity Fair	Pudasaini N, R Gurung, B Bhandari, P Shrestha and BK Joshi	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 88-94
34.	Multiple Strategies and Partnerships in Promoting Traditional Mountain Crops	Bhandari B, D Gauchan and BK Joshi	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 108-113
35.	Nutrition Dense Native Crops and Food Recipes	Ojha P, R Karki, A Mishra, U Subedi and BK Joshi	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 114-121
36.	Conserving Traditional Knowledge of Local Plant Genetic Resources through Farmers Varieties Catalogue	Gurung R, N Pudasaini, D Gauchan, BK Joshi, B Bhandari and S Shrestha	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 122-131
37.	Incentive Measures for Agrobiodiversity Conservation and Use	Gauchan D, BK Joshi, B Bhandari, N Pudasaini, R Gurung, K Ghimire and KK Mishra	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 133-137
38.	Value Chain Development of Traditional Crops for Nutrition Sensitive Agriculture	Gauchan D, S Pant, R Gurung, N Pudasaini, B Bhandari, BK Joshi, K Ghimire and D Jarvis	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 138-144

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
39.	Community-based Mechanisms for Promoting Access and Benefit Sharing	Gauchan D, BK Joshi, B Bhandari, DS Shrestha, S Shrestha and D Jarvis	Good Practices for Agrobiodiversity Management (BK Joshi, D Gauchan, B Bhandari and D Jarvis, eds). NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal; pp. 145-151
40.	Sourcing and deploying new crop varieties in Mountain Production Systems	Sthapit B, D Gauchan, S Sthapit, KH Ghimire, BK Joshi, P De Santis and D Jarvis	Farmers and Plant Breeding: Current Approaches and Perspectives (OT Westengen and T Winge, eds). Issues in Agricultural Biodiversity. Routledge, pp. 196-216
41.	Neglected and Underutilized Species (NUS), and Future Smart Food (FSF) in Nepal.	Joshi BK, R Shrestha, IP Gautam, AP Poudel and TP Gotame	National Agriculture Genetic Resources Center (NAGRC, National Genebank), NARC, Khumaltar, Kathmandu, Nepal
42.	Catalog of Traditional Crop Landraces of Mountain Agriculture in Nepa	Gurung R, R Dhakal, N Pudasaini, PB Paneru, S Pant, AR Adhikari, S Gautam, RK Yadav, KH Ghimire, BK Joshi, D Gauchan, S Shrestha and DI Jarvis	Catalog of Traditional Crop Landraces of Mountain Agriculture in Nepal. LI-BIRD, Pokhara; NARC, Kathmandu and Bioversity International, Nepal
43.	Neglected, underutilized, and future smart crop species in Nepal	Joshi BK, R Shrestha, D Gauchan & A Shrestha	Journal of Crop Improvement, DOI: 10.1080/15427528.2019.1703230
44.	Future smart food crops in Nepal: A necessity for future food and nutritional security	Shrestha J, R Shrestha, BK Joshi and S Subedi	
45.	Agrobiodiversity and its Conservation in Nepal	Joshi BK, NA Gorkhali, N Pradhan, KH Ghimire, TP Gotame, P KC, RP Mainali, A Karkee and RB Paneru	Natural Resources and Sustainable Development 10 (1):46-56. DOI: 10. 31924/nrsd. v10i1. 043
46.	Agro-morphological diversity of high-altitude bean landraces in Kailash Sacred Landscape of Nepal	Aryal K, S Poudel, P Chaudhary, RP Chaudhary, KH Ghimire, DS Shrestha and BK Joshi	Journal of Nepal Agricultural Research Council 6: 14-33
47.	Advances in fruit breeding in Nepal	Gotame T, I Gautam, S Shrestha, J Shrestha and BK Joshi	Journal of Nepal Agricultural Research Council 6:1-13
48.	On-farm Conservation Approaches for Agricultural Biodiversity in Nepal	Joshi BK and D Upadhya	Journal of Agriculture and Natural Resources 3(1): 301-319
49.	Elite lines of Naked barley landraces for mountain agriculture	Karkee A, KH Ghimire and BK Joshi	Journal of Agriculture and Natural Resources 2: 14-35
50.	Genetic diversity in finger millet landraces revealed by RAPD and SSR markers	Joshi BK, D Joshi and SK Ghimire	Journal of Nepal Agricultural Research Council 6:34-43
51.	Adaptability of naked barley landraces in mountain agro-ecosystem of Nepal	Ghimire KH, BK Joshi, R Gurung, E Palikhe, N Pudasaini and A Parajuli	Nepal J Biotechnol 8(1):1-11

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52.	Twenty-Four Approaches for Conservation of Non-Orthodox Agricultural Plant Genetic Resources in Nepal	Joshi BK	Journal of Nepal Agricultural Research Council 5: 34-42
53.	Progress and Prospects of Agricultural Biotechnology and Biosafety in Nepal: Present Status, Challenges and Way Forward	Joshi BK, B Pandey and RC Adhikari	Journal of Nepal Agricultural Research Council. 5:22-33
54.	How to Write a Research Paper for Journal of Nepal Agricultural Research Council	Joshi BK and TB Gurung	Agricultural Biotechnology and Biosafety in South Asia: Progress and Prospects (PR Pandey, B Bajaj and A Islam, eds). SAARC Agriculture Centre, ILSI Research Foundation, South Asia Bioasfety Program, Bangladesh; pp. 59-75
55.	Assessing genetic diversity of Nepalese maize landraces using multivariate analysis	Ghimire KH, BK Joshi and A Karkee	Proceedings of the 30th National Winter Crops Workshop (D Bhandari, AK Gautam, R Shrestha, HK Upreti, YN Ghimire, KK Mishra, BK Joshi, AR Ansari, BP Tripati and P Paneru, eds). 15-16 February, 2017, Rampur, Chitwan Nepal; pp. 160-172
56.	Morphological variation in Nepalese cold tolerant rice accessions	Ghimire KH, BK Joshi and A Karkee	Proceedings of the 29th Summer Crops Workshop (D Bhandari, HK Upreti, R Shrestha, JJ Tripati, HK Shrestha, KK Mishra, BK Joshi, AR Ansari, BP Tripathi, S Baidya, J Shrestha, M Tripati, P Paneru, eds). 17-18 June 2018, Regional Agricultural Research Station, Lumle. Nepal Agricultural Research Council, Kathmandu; pp. 105-114
57.	Agrobiodiversity Status, Conservation Approaches, Good Practices, Neglected and Underutilized Species and Future Smart Foods in Nepal	Joshi BK, R Shrestha and TB Karki	Proceedings of the 29th Summer Crops Workshop (D Bhandari, HK Upreti, R Shrestha, JJ Tripati, HK Shrestha, KK Mishra, BK Joshi, AR Ansari, BP Tripathi, S Baidya, J Shrestha, M Tripati, P Paneru, eds). 17-18 June 2018, Regional Agricultural Research Station, Lumle. Nepal Agricultural Research Council, Kathmandu; pp. 115-123
58.	Agricultural Plant Genetic Resources and Working Groups: Concept, Diversity and Strategy in Nepal	Joshi BK, R Shrestha, RC Adhikari and RB KC	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 11-20
59.	Economical Plant and Crop Species behind the Eyes of Researchers and Policy Makers	Joshi BK and RC Adhikari	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 21-25

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
60.	Crop Groups based on National List: Released, Registered, DE notified, Formal and Informal	Thapa M, D Sapkota and BK Joshi	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC. 26-35
61.	Crop Groups based on Research Priority: Priority Crops, Neglected and Underutilized (NUS), Future Smart Food (FSF)	Shrestha R, BK Joshi, J Shrestha and A Timilsina	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 36-44
62.	Classification of Crop Plants based on Growing Season, Temperature Requirement and Photosynthetic Behavior	Gotame TP, SL Shrestha, BK Joshi and TB Karki	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 65-69
63.	Red Zoning and Red Listing of Agricultural Plant Genetic Resources	Joshi BK	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 103-120
64.	Crop Groups Based on Conservation Strategy	Ghimire KH and BK Joshi	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 167-173
65.	Wild and Semi-domesticated Agricultural Plant Genetic Resources in Chepang Community	Aryal K, S Poudel, P Chaudhary, S Bhatta, BK Joshi and AS Chepang	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 174-183
66.	Research Areas and Strategy Based on the Grouping of Agriculture Plant Genetic Resources	KC RB, D Gauchan and BK Joshi	Working Groups of Agricultural Plant Genetic Resources. Proceedings of National Workshop (APGRs) in Nepal (BK Joshi and R Shrestha, eds). 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 187-197
67.	Production technology for hybrid rice in Nepal	Sah SN and BK Joshi	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal (BK Joshi and R Shrestha, eds). Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal; pp. 258-260
68.	Integrated Approach of National Seed Systems for Assuring Improved Seeds to the Smallholder Farmers in Nepal	Joshi BK, R Humagain, LK Dhakal and D Gauchan	NARC and Karma Seed Company, Kathmandu; pp. 1-11

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
69.	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal	Gauchan D, BK Joshi, B Bhandari, HK Manandhar and DI Jarvis, eds	Strengthening Seed Systems- Promoting Community Based Seed Systems for Biodiversity Conservation and Food & Nutrition Security in South Asia (RB Shrestha, ME Penunia and M Asim, eds). SAARC Agriculture Center, Bangladesh; Asian Farmers' Association, the Philippines; and Pakistan Agricultural Research Council, Pakistan; pp. 181-194
70.	Good Practices for Agrobiodiversity Management	Joshi BK, D Gauchan, B Bhandari and D Jarvis, eds	Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal
71.	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal	Joshi BK and R Shrestha, eds	NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal
72.	Climate Change Trends and Disease Situations in Some Major Traditional Crops in the Mountains of Dolakha, Lamjung, Jumla and Humla, Nepal.	Karkee A, BK Joshi, KH Ghimire, R Gurung, N Pudasaini, S Pant, PB Paneru and D Gauchan	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and DI Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal; NAGRC, LI-BIRD, and the Alliance of Bioversity International and CIAT. PP 34-47.
73.	Evaluation of High Mountain Beans Germplasm against Rust Diseases (Uromyces appendiculatus) at Khumaltar, Lalitpur	Karkee A, DS Shrestha and SB Gurung	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and DI Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal; NAGRC, LI-BIRD, and the Alliance of Bioversity International and CIAT. PP 65-70.
74.	Efficacy of Fungicides Against Rhizoctonia solani inciting Rhizome rot diseases on large Cardamom (Amomum subulatum Roxb.)	Karkee A and DL Mandal	International Journal of Applied Science and Biotechnology 8(1):61-64
75.	Evaluation of Naked Barley Landraces for Agro-morphological Traits	Karkee A., KH Ghimire and BK Joshi	Journal of Nepal Agricultural Research Council 6:34-43
76.	Participatory Plant Diseases Identification and Management.	Karkee A, BK Joshi, KH Ghimire, N Pudasaini and Devendra Gauchan	Joshi BK, D Gauchan, B Bhandari and D Jarvis (eds.) Good practices for Agrobiodiversity Management. NAGRC, Li-BIRD and Alliance of Bioversity International and CIAT, Kathmandu, Nepal.

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
77.	Diseases observation in Wheat Diseases Screening Nursery (WDSN) at Agricultural Research Station, Pakhribas, Dhankuta during 2014/15 and 2015/16.	Karkee A, AR Ansari, R Basnet, DL Mandal and D Budhathoki	Proceedings of the 30th Winter Crop Workshop 15th-16th February, 2016 at NWRP Rampur, Chitwan.
78.	Compatibility study of Trichoderma Isolates with chemical fungicides	Manandhar S, RD Timila, A Karkee, SK Gupt and S Baidya	The Journal of Agriculture and Environment 21:9-18
79.	Agro-morphological Diversity in Nepalese Finger Millet Landraces.	Ghimire KH, SB Gurung, PM Mahat, A Karkee, D Gauchan, BK Joshi, SK Ghimire, HK Manandhar and MP Pandey	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal (D Gauchan, BK Joshi, B Bhandari, HK Manandhar and DI Jarvis, eds). Tools and Research Results of the UNEP GEF Local Crop Project, Nepal; NAGRC, LI-BIRD, and the Alliance of Bioversity International and CIAT. PP 55-64.
80.	Response of local potato cultivars to late blight disease (Phytophthora infestans (mont.) De bary) under field and laboratory conditions at Pakhribas, Dhankuta, Nepal	Shrestha S, HK Manandhar, SM Shrestha and A Karkee	Advances in Cytology and Pathology 4(1):10-13.
81.	Role of Intra-Specific Varietal Mixture in Pollination Services: A Case Study in Buckwheat (Fagopyrum esculentum Moench)	RP Mainali, S Bista, S Gurung, B Bhusal & R Gouli	International Journal of Environment, 9(1), 115-126. https://doi.org/10.3126/ije.v9i1.27651. 2020
Posters			
1	Bhandari GR, BK Joshi, D Gauchan, B Bhandari and S Panta	Development of Proso Millet Dehusker.	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur
2	Ayer DK, BK Joshi, B Bhandari, KH Ghimire, P Shrestha, S Shrestha and D Gauchan	Grassroots breeding: a simple participatory crop improvement approach	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur
3	Karkee A, BKJoshi, KH Ghimire, R Gurung, N Pudasaini, S Panta, PB Paneru and D Gauchan	Climate change trends in the Mountains of Nepal: Implications for Traditional Crops	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur
4	Joshi BK, DK Ayar, KH Ghimire, KK Mishra and D Gauchan	On-farm Trials and Preferential Ranking for Facilitated Decision on Choice and Registration of Crop Cultivars (Varieties and Landraces)	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur
5	Joshi BK, KH Ghimire, B Bhandari, D Gauchan, R Gurung and N Pudasaini	Red Zoning Agricultural Areas and Red Listing Landraces for Stopping Loss of Agricultural Genetic Resources through Priority Conservation Work	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
6	जोशी बालकृष्ण, देवेन्द्र गौचन, श्री प्रसाद विष्ट, सुक बहादुर गुरुङ र सुबास गौतम ।	जातिय मिश्रित खेती: जोखिम रहित खेति र जातीय आनुवंशिक स्रोत संरक्षण गर्ने एक सरल तरिका ।	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur
7	Joshi BK, D Gauchan and D Jarvis	Geographical Indication for Secure Marketing with Premium Price and Conserving Unique Landraces On-farm	National Sharing Workshop. GEF/UNEP Local Crop Project. NARC/LIBIRD/DoA/ Bioversity International. 24 Feb, 2020; Hotel Himalaya, Lalitpur

Annex 5.3 Editorial works in FY 2076/77 (2019/20) by staff

SN	Title of Paper	Authors	Name of Proceedings, Journal, Year
1	Journal	Joshi BK. Eds.	Journal of Nepal Agricultural Research Council, Vol 6
2.	Proceeding	Bhandari D, HK Upreti, R Shrestha, J J Tripati, H K Shrestha, K K Mishra, B K Joshi, A R Ansari, B P Tripathi, S Baidya, J Shrestha, M Tripati, P Paneru, eds.	Proceedings of the 29th Summer Crops Workshop 17-18 June 2018, Regional Agricultural Research Station, Lumle. Nepal Agricultural Research Council, Kathmandu.
3.	Traditional Crop Biodiversity for Mountain Food and Nutrition Security in Nepal.	Gauchan D, BK Joshi, B Bhandari, HK Manandhar and DI Jarvis, eds	Tools and Research Results of the UNEP GEF Local Crop Project, Nepal. NAGRC, LI-BIRD and the Alliance of Bioversity International and CIAT; Kathmandu, Nepal.
4.	Good Practices	Joshi BK, D Gauchan, B Bhandari and D Jarvis, eds	Good Practices for Agrobiodiversity Management. NAGRC, LI-BIRD and Alliance of Bioversity International and CIAT; Kathmandu, Nepal.
5.	Working Groups of Agricultural Plant Genetic Resources (APGRs) in Nepal	Joshi BK and R Shrestha, eds	Proceedings of National Workshop, 21-22 June 2018, Kathmandu; NAGRC, NARC, Nepal.
6.	Winter Crops Workshop	Bhandari D, AK Gautam, R Shrestha, HK Upreti, YN Ghimire, KK Mishra, BK Joshi, AR Ansari, BP Tripati and P Paneru, eds.	Proceedings of the 30th National Winter Crops Workshop, held on 15-16 February, 2017 at National Maize Research Program Rampur, Chitwan Nepal. Nepal Agricultural Research Council.

Annex 6. Regular annual budget and expenditure record of FY 2076/77 (2019/20)

Code	Budget Head	Annual Budget		Expenses (NRs.)	Balance (NRs.)
		Budget (NRs.)	*Released (NRs.)*		
21111	Staff Basic Salary	10525000	10522352	10522352	2648
21121	Uniform Expenses	220000	220000	220000	0
21132	Dearness Allowance	504000	502000	502000	2000
21134	Staff Meeting Allowance	100000	100000	100000	0
21213	C.R. Insurance fund	101000	100400	100400	600
22111	Water and Electricity	4689000	4664708	4664708	24292
22112	Communication Expenses	156000	108987	108987	47013
22212	Fuel	399000	379258	379258	19742
22213	Repair & Maintenance-Vehicle	310000	201032	201032	108968
22214	Insurance	75000	46165	46165	28835
22221	Repair & Maintenance-Office equipment	820000	453044	453044	366956
22231	Repair & Maintenance- C.P. Asset	450000	23000	23000	427000
22291		100000	0	0	100000
22311	Office Expenses	530000	281177	281177	248823
22314	Fuel for other uses	100000	7025	7025	92975
22315	Books and Publication	100000	24837	24837	75163
22413		180000	0	0	180000
22512	Training/Workshops	600000	200000	200000	400000
22521	Production Materials Expenses	5688000	3232824	3232824	2455176
22611	Monitoring and Evaluation	300000	56787	56787	243213
22612	Travel Expanses	702000	286015	286015	415985
22711	Miscellaneous Expense	100000	55297	55297	44703
29611	**Public Construction**	**4500000**	**1618321**	**1618321**	**2881679**
31113	**Capital Renovation cost Building**	**500000**	**0**	**0**	**500000**
31122	**Machinery and Tools**	**2670000**	**430960**	**430960**	**2239040**
31123	**Furniture and Fixtures**	**425000**	**424898**	**424898**	**102**
	Total	***34844000***	***23939087***	***23939087***	**10904913**

Annex 7.1 Special project budget and expenditure record of FY 2076/77 (2019/20)

Name of the Project	Funded by	Project Period	Budget Received	Expenses	Balance
GEF	UNEP/GEF	5	1498246	981378	516868
PGR ASIA	NIAS	3	459067	233788	225279
SEED SYSTEM	SDC	3	1504200	826488	677712
EPB	IFAD	3	1267348	411079	856269
AKABERE	LIBIRD	3	265736	120537	145199
Total			**4994597**	**2573270**	**2421327**

Annex 7.2 Revenue status of FY 2076/77 (2019/20)

Source	Total	Remarks
Administrative Miscellaneous (Tender form)	103000	
Income from crop production		
Interest from bank		
Other Income		
Total	**103000**	

Annex 7.3 Beruju status of FY 2076/77 (2019/20)

Beruju	Amount	Remarks
Beruju till last year	2318413	
Beruju cleared this year	0	

Annex 8. Brief passport of accessions conserved in Genebank in this fiscal year

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08311	Barnyard Millet		*Echinochloa*	*frumentacea* Link	Abdul Rahim Ansari	Rautahat, Jayanagar M.	64
NGRC08312	Bean	जेरे बोडी	*Phaseolus*	*vulgaris* L.	Durga Rana Magar	Dhankuta, Pakhribas M., Sanne	1190
NGRC08313	Bean	कार्तिके बोडी	*Phaseolus*	*vulgaris* L.	Sumita Rai	Dhankuta, Pakhribas M., Phalate	836
NGRC08314	Rice	जवारो धान	*Oryza*	*sativa* L.	Januki Joshi	Bajura, Himali 6	1081
NGRC08315	Blackgram	सानो कालो दाल	*Vigna*	*mungo* (L.) Hepper	Dilli Jimi	Sankhuwasabha, Tamaphok-5, Tamaphok	1215
NGRC08316	Blackgram	कालो मास	*Vigna*	mungo (L.) Hepper	Sumitra Rai	Dhankuta, Leguwa	450
NGRC08317	Cowpea	माझी बोडी	*Vigna*	*unguiculata* (L.) Walp	Durga Rana Magar	Dhankuta, Pakhribas M., Sanne	1190
NGRC08318	Horsegram	कालो गहत	Macrotyloma	*unifioreum* (Lam.) Hepper	Manki Maya Rai	Dhankuta, Pakhribas M., Phalate	836
NGRC08319	Maize	राती मकै	*Zea*	*mays* L.	Dhurba Magar	Ilam, Phakphok thum, Lumde	
NGRC08320	Rice	सानो चिराखे धान	*Oryza*	*sativa* L.	Umes Dhakal	Ilam, Phakphok thum, Lumde	
NGRC08321	Rice	रुदवा धान	*Oryza*	*sativa* L.	Dhurba Magar	Ilam, Phakphok thum, Lumde	
NGRC08322	Rice	बसाने घैया धान	*Oryza*	*sativa* L.	Hira Bahadur Pun Magar	Baglung, Burtiwang, Burkot	1650
NGRC08323	Rice	पाखे धान	*Oryza*	*sativa* L.	Hira Bahadur Pun Magar	Baglung, Burtiwang, Burkot	1650
NGRC08324	Rice	सेतो घैया धान	*Oryza*	*sativa* L.	Hira Bahadur Pun Magar	Baglung, Burtiwang, Burkot	1650
NGRC08325	Rice	सेतो पुड्के घैया धान	*Oryza*	*sativa* L.	Hira Bahadur Pun Magar	Baglung, Burtiwang, Burkot	1650
NGRC08326	Rice	झुप्पे धान	*Oryza*	*sativa* L.	Sumita Bohora	Dhankuta, Pakhribas M, Legua	450
NGRC08327	Rice	डल्ले मसिनो धान	*Oryza*	*sativa* L.	Sumita Bohora	Dhankuta, Pakhribas M., Leguwa	450
NGRC08328	Ricebean	रातो मश्यांग	*Vigna*	*umbellata* (Thunb) chwi & ohahi	Hom Bahadur Shrestha	Dhankuta, Pakharibas M., Sanne	1150
NGRC08329	Ricebean	घोरे मश्यांग	*Vigna*	*umbellata* (Thunb) chwi & ohahi	Durga Rana Magar	Dhankuta, Pakhribas M, Sanne	1190
NGRC08330	Sarson				Dil Bdr. Chepang	Chitwan, Kalika M.-9, Darbetar	446
NGRC08331	Sarson				Santa Bdr. Chepang	Chitwan, Kalika M.-9, Darbetar	498
NGRC08332	Sarson				Santa Bdr. Chepang	Chitwan, Kalika M.-9, Darbetar	498
NGRC08333	Maize	सेतो मकै	*Zea*	*mays* L.	Kanchii Gurung	Gorkha, Gumda	1737
NGRC08334	Maize	पहेलो मकै	*Zea*	*mays* L.	Bhakta Thapa Magar	Gorkha, Saurpani	1025
NGRC08335	Maize	ठुलो सेतो मकै	*Zea*	*mays* L.	Santa Maya Tamang	Gorkha, Barpark-02	903

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08336	Maize	गंगा+ जमुना	*Zea*	*mays* L.	Pramila Poudyal	Kavre, Madhevsthan-2, Dhaitaar	833
NGRC08337	Maize	सेतो मकै	*Zea*	*mays* L.	Maichang Tamang	Kavre, Anakot-8, Rato Paira	
NGRC08338	Maize	सठिया मकै	*Zea*	*mays* L.	Bishnu Gautam	Kavre, Anakot-8, Rato Paira	
NGRC08339	Maize	मुरली मकै	*Zea*	*mays* L.	Maheswor Dahal	Kavre, Madhevsthan-2, Dhaitaar	833
NGRC08340	Maize	पहेलो मकै	*Zea*	*mays* L.	Fatta Bahadur Thapa	Kavre, Budhakhani-5	
NGRC08341	Maize	लोकल पहेलो	*Zea*	*mays* L.	Durga Raj Gurung	Lamjung, Ilampokhari-7	1112
NGRC08342	Maize	ढीडे मकै	*Zea*	*mays* L.	Janga Maya Gurung	Lamjung, Dhudhpokhari-5	1500
NGRC08343	Maize	स्थानिय मकै	*Zea*	*mays* L.	Ramani Tamang	Nuwakot, Kimtang-6, Mane Gaun	1600
NGRC08344	Maize	बेना मकै	*Zea*	*mays* L.	Jit Bahadur Sunar	Nuwakot, Kimtang-1, Swarlingtar	1950
NGRC08345	Maize	कालिम्पुरे मकै	*Zea*	*mays* L.	Sathat Bahadur Tamang	Nuwakot, Cahule-6	1400
NGRC08346	Maize	पलम चोख्या मकै	*Zea*	*mays* L.	Tasi Tamang	Rasuwa, Bridim	2175
NGRC08347	Maize	रातो मकै	*Zea*	*mays* L.	Kaisang Tamang	Rasuwa, Syafru	2175
NGRC08348	Maize	सेतो मकै	*Zea*	*mays* L.		Rasuwa, Syafru	2175
NGRC08349	Greengram	खैरो दाल	*Vigna*	*radiata* (L.) R. Wilczek	Harinarayan Jimi	Sankhuwasabha, Tamaphok-5, Tamaphok	1375
NGRC08350	Blackgram	रातो मस्याङ	*Vigna*	*mungo* (L.) Hepper	Bhokbir Jimi	Sankhuwasabha, Tamaphok-5, Tamaphok	1465
NGRC08351	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench		Rasuwa, Bhorle-1, Upallo Jibjibe	1532
NGRC08352	Soybean	कालो भट्ट	*Glycine*	*max* (L.) Merr		Tanahun, Damauli-1	1067
NGRC08353	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr		Gorkha, Gorakhakali	1844
NGRC08354	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr		Gorkha, Gorakhakali	1844
NGRC08355	Maize	तिमासे मकै	*Zea*	*mays* L.		Bajura, Jugada	2240
NGRC08356	Maize	पहेलो मकै	*Zea*	*mays* L.		Achham, Basali	1000
NGRC08357	Rice	मार्सी धान	*Oryza*	*sativa* L.	Durlam Joshi	Doti, Sayaal-5, Dadullegada	1549
NGRC08358	Bean	घ्यू सिमी	*Phaseolus*	*vulgaris* L.	Nirmala Ramtel	Kabhre, Mandandeupur	
NGRC08359	Ricebean	छिरबिरे मस्यांग	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Indira Lamsal	Kabhre, Mandandeupur	
NGRC08360	Blackgram	कालो मास	*Vigna*	*mungo* (L.) Hepper	Santi Rai	Kabhre, Mandandeupur	
NGRC08361	Ricebean	कान्छी मस्यांग	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Sita Maya Shrestha	Kabhre, Mandandeupur	

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08362	Ricebean	कैलो सानो मस्यांग	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Nirmala Ramtel	Kabhre, Mandandeupur	
NGRC08363	Soybean	कालो भटमास	*Glycine*	*max* (L.) Merr	Nirmala Ramtel	Kabhre, Mandandeupur	
NGRC08364	Sarson	पहेलो र हरियो सर्सों	*Brassica*	*compestris* L.	Indra Bdr. Basnet	Chitwan, Ichchhakamana-2, Kaule	1550
NGRC08365	Bean	कार्तिके बोडी	*Phaseolus*	*vulgaris* L.		Nawalparasi, Kawasoti M.-4	
NGRC08366	Bean	मालेपाटन बोडी	*Phaseolus*	*vulgaris* L.		Nawalparasi, Kawasoti M.-4	
NGRC08367	Bean	प्रकाश बोडी	*Phaseolus*	*vulgaris* L.		Nawalparasi, Kawasoti M.-4	
NGRC08368	Grass Pea	लत्तरी केराउ	*Lathyrus*	*sativus* L.		Nawalparasi, Kawasoti M.-4	
NGRC08369	Horsegram	कालो गहत	*Macrotyloma*	*uniflorum* (Lam.) Verdc.		Nawalparasi, Kawasoti M.-4	
NGRC08370	Lentil	खैरो मुसुरो	*Lens*	*culinaris* Medik.		Nawalparasi, Kawasoti M.-4	
NGRC08371	Pigeon Pea	कान्छी केराउ	*Cajanus*	*cajan* (L.) millisp.		Nawalparasi, Kawasoti M.-4	
NGRC08372	Rice	कालो बासमती धान	*Oryza*	*sativa* L.		Nawalparasi, Kawasoti M.-4	
NGRC08373	Pigeon Pea	मंसिरे रहर	*Cajanus*	*cajan* (L.) millisp.		Nawalparasi, Kawasoti M.-4	
NGRC08374	Pigeon Pea	चैते रहर	*Cajanus*	*cajan* (L.) millisp.		Nawalparasi, Kawasoti M.-4	
NGRC08375	Soybean	AGS377	*Glycine*	*max* (L.) Merr		Lalitpur, Lalitpur Metropolitan City-15	
NGRC08376	Amaranth	रातो मार्से	*Amaranthus*	*spp.*	Bhane Buda	BaJura, Budinandan Municipality, Degebaarna Cholu	1500
NGRC08377	Amaranth	तिआइसे मार्से	*Amaranthus*	*spp.*	Bhane Buda	BaJura, Budinandan Municipality, Degebaarna Cholu	1600
NGRC08378	Barley	ठागे जौ	*Hordeum*	*vulgare* L.	Bhane Buda	BaJura, Budinandan Municipality, Degebaarna Cholu	1500
NGRC08379	Barley	जौ	*Hordeum*	*vulgare* L.	Bhane Buda	BaJura, Budinandan Municipality, Degebaarna Cholu	1500
NGRC08380	Broad Leaf Mustard	ठुलो भाजी साग	*Brassica*	*compestris var. rugosa*	Shyam Thapa	Pyuthan, Tiram-7, Dadakharka	678
NGRC08381	Broad Leaf Mustard	भाजी	*Brassica*	*compestris var. rugosa*	Top Bdr. Hauseli	Pyuthan, Nayagahun-1, Jaspur	985
NGRC08382	Broad Leaf Mustard		Brassica	juncea (L.) Czern.	Rambha Devi Bohara	Bajhang, Syandi-2, Malla Gaun	2084

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08383	Broad Leaf Mustard	छरे रायो	Brassica	juncea (L.) Czern.	Bharati KC	Rukum, Khalanga-5, Solabhang Chhere	
NGRC08384	Broad Leaf Mustard		Brassica	juncia czern &Coss	Prem Kumar Bhandari	Kavreplanchok, Simthali-4	1581
NGRC08385	Broad Leaf Mustard		Brassica	juncea (L.) Czern.		Siraha	
NGRC08386	Mustard		Brassica	juncea (L.) Czern & Cross.	Risang Lama	Nowakot, Manakamana-2, Manegau	1297
NGRC08387	Broad Leaf Mustard		Brassica	juncea (L.) Czern.	Sumitra Paudyal	Rasuwa, Bhorle-1, Upallo Jibjibe	1532
NGRC08388	Broad Leaf Mustard	भाजी साग	*Brassica*	*compestris var. rugosa*	Shyam Thapa	Pyuthan, Ramdi-8, Chachhel	620
NGRC08389	Mustard	तोरी	*Brassica*	*campestris* (L)		Siraha	
NGRC08390	Cucumber	हरियो काक्रो	*Cucumis*	*sativus L.*		Sindhuli	
NGRC08391	Foxtail millet	सेतो कागुनो	*Setaria*	*italica* (L.) P. Beauvois		BaJura, Budinandan Municipality, Degebaarna Cholu	2000
NGRC08392	Amaranth	लट्टे	*Amaranthus*	*spp.*	Sarswti Shiris	Gulmi, Satyawti Gaupa	1815
NGRC08393	Barley	लोकल जौ	*Hordeum*	*vulgare* L.	Yamlal Paudal	Arghakhachi, Chatradeb RM, Chauwa Thula Pokhara	889
NGRC08394	Bean	सिमी गहते	*Phaseolus*	*spp.*	Topla Rajali	Gulmi, Gulmi Darbar, Urlakot	1205
NGRC08395	Ricebean	सिल्तुंङ्	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Til Kumari Siris	Gulmi, Satyawti Gaupa	1814
NGRC08396	Bean	भट्टे सिमि	*Phaseolus*	*spp.*	Tej Kumar Thapa	Gulmi, Satyawti Gaupa	1648
NGRC08397	Ricebean	झिलंगी	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Topla Rajali	Gulmi, Gulmi Darbar, Urlakot	1205
NGRC08398	Bean	असोजे सिमी	*Phaseolus*	*spp.*	Deumaya Budathoki	Gulmi, Satyawti Gaupa, Vharse	1652
NGRC08399	Mustard	तोरी	*Brassica*	*campestris* (L)	Min Maya Tamang	Nowakot, Kaule-7, Dapchedanda	1509
NGRC08400	Buckwheat	मिठे फापर	*Fagopyrum*	*esculentum* Moench	Rama Saru	Palpa, Mathagadi RM, Sarai	668
NGRC08401	Buckwheat	तिते फाफर	*Fagopyrum*	*esculentum* Moench	Tara Bahadur Thapa	Gulmi, Baletaksar, Vhandari Dada	830
NGRC08402	Buckwheat	तिते फापर	*Fagopyrum*	*esculentum* Moench	Ram Kumari Darlami	Gulmi, Satyawti RM, Vharse	1648
NGRC08403	Finger millet	कोदो	*Eleusine*	*coracana* Gaertn.	Deumaya Budathoki	Gulmi, Satyawti RM, Vharse	1652
NGRC08404	Finger millet	कोदो	*Eleusine*	*coracana* Gaertn.	Tara Bahadur Thapa	Gulmi, Baletaksar, Vhandari Dada	830

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08405	Finger millet	सुनकोशी कोदो	*Eleusine*	*coracana* Gaertn.	Bum Bahadur Karki	Ramechap, Baetali	
NGRC08406	Finger millet	सुनकोशी	*Eleusine*	*coracana* Gaertn.	Jagat Bahadur Karki	Ramechap, Baetali	
NGRC08407	Maize	पहेली मकै	*Zea*	*mays* L.	Ram K. Karki/ Kabita Pande	Ramechap, Tilpung, Tanda Tole	
NGRC08408	Maize	सानो चौयली मकै	*Zea*	*mays* L.	Bhesraj Paudal	Arghakhachi, Chatradeb RM, Chauwa Thula Pokhara	889
NGRC08409	Maize	सेतो मकै	*Zea*	*mays* L.	Urmila Bohora-Ramrimaya Budathoki	Ramechap, Tilpung	
NGRC08410	Maize	सानो पहेली	*Zea*	*mays* L.	Chandrama Tamang	Sindupalchok, Petkau-7, Maak Tole	
NGRC08411	Maize	भालु मकै स्थानीय	*Zea*	*mays* L.	Rama Saru	Palpa, Mathagadi RM, Sarai	668
NGRC08412	Maize	मुरली मकै	*Zea*	*mays* L.	Maina Khadka	Sindupalchok, Petkau-7, Tanda tole	
NGRC08413	Maize	सेती मकै	*Zea*	*mays* L.	Ram Krishna Dahal	Dolakha, Namdu	
NGRC08414	Maize	मुरली	*Zea*	*mays* L.	Chitra Bahadur Khadka	Dolakha, Jugu, Rajapuu	1779
NGRC08415	Maize	सेतो मकै	*Zea*	*mays* L.	Maiya Tamang	Sindupalchok, Marming	1870
NGRC08416	Maize	ठुलो पहेलो	*Zea*	*mays* L.	Somsang Tamang	Sindupalchok, Marming	1682
NGRC08417	Maize	ठुलो मकै	*Zea*	*mays* L.	Luku Maya Nepali	Sindupalchok, Petku-4, Bhawan Tole	
NGRC08418	Maize	पहेलो स्थानीय	*Zea*	*mays* L.	Seeta B. K	Dolakha, Jugu	1727
NGRC08419	Maize	कालि	*Zea*	*mays* L.	Chatra Bahadur Khadka	Dolakha, Jugu, Darkha	1617
NGRC08420	Maize	थोप्ले पहेलो	*Zea*	*mays* L.	Karna Bahadur Karki	Dolakha, Jugu, Garigaun	1300
NGRC08421	Maize	सेतो चेप्टो	*Zea*	*mays* L.	Bishnu Kumari Khatri	Sindupalchok, Petkau-7, Khatri Tole	
NGRC08422	Maize	पहेलो मकै	*Zea*	*mays* L.	Deumaya Budathoki	Gulmi, Satyawti RM, Vharse	1652
NGRC08423	Maize	कौडे मकै	*Zea*	*mays* L.	Mahendra Shrestha	Arghakhachi, Shitganga RM, Thadadha	1298
NGRC08424	Maize	सेतो मकै	*Zea*	*mays* L.	Gankala Adhikari	Arghakhachi, Shitganga RM, Thadadha	1298
NGRC08425	Maize	कालो मकै	*Zea*	*mays* L.	Ganesh Prasad Banjade	Arghakhachi, Sandhikhark RM, Ghoche Khola	958
NGRC08426	Mustard	स्थानीय तोरी	*Brassica*	*napus* L.	Amar Bahadur Rana	Gulmi, Satyawti RM, Vharse	1723
NGRC08427	Mustard	लोकल तोरी	*Brassica*	*napus* L.	Bhesraj Paudal	Arghakhachi, Chatradeb RM, Chauwa Thula Pokhara	889
NGRC08428	Mustard	लोकल भदौरे तोरी	*Brassica*	*napus* L.	Rama Saru	Palpa, Mathagadi RM, Sarai	668
NGRC08429	Mustard	लोकल तोरी	*Brassica*	*napus* L.	Deumaya Budathoki	Gulmi, Satyawti RM, Vharse	1652

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NGRC08430	Niger	झुसे तिल	*Guizotia*	*abyssinica* (L.) Cass	Ranju Ghimire	Ramechap, Baetali	
NGRC08431	Pea	सानो केराउ	*Pisum*	*sativum* L.	Netr Lal Bhandari	Arghakhachi, Xatrdeb, Amildada	1521
NGRC08432	Pea	सानो केराउ	*Pisum*	*sativum* L.	Amar Bahadur Rana	Gulmi, Satyawti RM, Vharse	1723
NGRC08433	pea	कुच्चे केराउ	*Pisum*	*sativum* L.	Jagat Bahadur Pun	Gulmi, Satyawti RM, Vharse	1729
NGRC08434	Chickpea	पुरानो लोकल चना	*Cicer*	*arietinum* L.	Bhesraj Paudal	Arghakhachi, Chatradeb RM, Chauwa Thula Pokhara	889
NGRC08435	Pea	लतारी	*Pisum*	*sativum* L.	Tara Bahadur Thapa	Gulmi, Baletaksar, Vhandari Dada	830
NGRC08436	Perilla	कालो सिलाम	*Perilla*	*frutescens* (L.) Britton	Amar Bahadur Rana	Gulmi, Satyawti RM, Vharse	1723
NGRC08437	Pumpkin	डल्ले फर्सी	*Cucurbita*	*moschanta L.*	Amar Bahadur Rana	Gulmi, Satyawti RM, Vharse	1723
NGRC08438	Pumpkin	घर फर्सी	*Cucurbita*	*moschanta L.*	Bandhana Ghimire	Ramechap, Baetali	
NGRC08439	Rice	अनदी धान	*Oryza*	*sativa* L.	Shivaraj Rana	Gulmi, Satyawti RM, Vharse	1705
NGRC08440	Rice	जडान धान	*Oryza*	*sativa* L.	Tara Bahadur Thapa	Gulmi, Baletaksar, Vhandari Dada	830
NGRC08441	Rice	मनामुरी धान	*Oryza*	*sativa* L.	Deumaya Budathoki	Gulmi, Satyawti RM, Vharse	1652
NGRC08442	Rice	हँसराज धान	*Oryza*	*sativa* L.	Youbakali Vandari	Gulmi, Satyawti RM, Juhang	648
NGRC08443	Rice	काठे धान	*Oryza*	*sativa* L.	Chetnarayn Aryal	Arghakhachi, Shitganga RM, Thadadha	1298
NGRC08444	Rice	ढोलुवा धान	*Oryza*	*sativa* L.	Puarna Ram Adhikari	Arghakhachi, Shitganga RM, Thadadha	1298
NGRC08445	Rice	जुवागे ठुलो	*Oryza*	*sativa* L.	Gyan Prasad Baral	Gulmi, Baletaksar, Vhandari Dada	823
NGRC08446	Rice	देबिगोपाल धान	*Oryza*	*sativa* L.	Gopal Panthi	Arghakhachi, Chatradeb RM, Chauwa Thula Pokhara	889
NGRC08447	Rice	पोखेराली धान	*Oryza*	*sativa* L.	Mangale B. K	Ramechap, Baetali	
NGRC08448	Rice	टाईटन धान	*Oryza*	*sativa* L.	Gyan Prasad Baral	Gulmi, Baletaksar, Vhandari Dada	823
NGRC08449	Rice	अनादि	*Oryza*	*sativa* L.	Jagat Bahadur Karki	Ramechap, Baetali	
NGRC08450	Soybean	कालो सानो	*Glycine*	*max* (L.) Merr	Sumitra Khatri	Dolakha, Jugu	1732
NGRC08451	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Lal Dhoj Basnet	Ramechap, Baetali	
NGRC08452	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Kamala Khadka	Ramechap, Tilpung	
NGRC08453	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Goma Bhandari	Sindhupalchok, Marminga, Pyautali	1287
NGRC08454	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Suntali Mijar	Dolakha, Namdu	
NGRC08455	Soybean	रातो भट्ट	*Glycine*	*max* (L.) Merr	Sumitra Nepali	Gulmi, Satyawati Gaupa, Vharse	1648
NGRC08456	Soybean	कालो ठुलो	*Glycine*	*max* (L.) Merr	Chandra Kumari Jirel	Dolakha, Jugu, Darkha	1710

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NGRC08457	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Krishna Thapa	Sindupalchok, Petkau-3, Bhandari tole	
NGRC08458	Wheat	मुडुले सेतो गहुँ	*Triticum*	*aestivum* L.	Ram Chandra Basnet	Ramechap, Baetali, Bhimsensthan	
NGRC08459	Barley	मुडेले जौ	*Hordeum*	*vulgare* L.	Sethkumari Khadka	Sindupalchok, Petkau-4, Khatri tole	
NGRC08460	Barley	स्थिनीय टुडे	*Hordeum*	*vulgare* L.	Jhalak Khumar Karki	Dolakha, Jugu, Darkha	1779
NGRC08461	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Karna Bdr. Oli	Bajhang, Dangaji-5, Simkhali	938
NGRC08462	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Nanda Adhikari	Bajhang, Sunkuda-8, Suwakot	1764
NGRC08463	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Dev Bdr. Gugung	Udayapur, Rauta-6	
NGRC08464	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Lagan Chaudhari	Udayapur, Triyuga M-16	
NGRC08465	Horsegram	स्थानीय गहत	*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Dhan Bdr. Rokaya	Jumla, Godhemahadev-9, Ghodesim	2135
NGRC08466	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Dan Bdr. Thakuri	Jumla, Talium-4, Talium	2387
NGRC08467	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Tul Bdr.Marsai	Pyuthan, Dhungegadi, Masaldada-5	682
NGRC08468	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Shyam Thapa	Pyuthan, Tiram-7, Dadakharka	678
NGRC08469	Horsegram	थोप्ले गहत	*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Jyan Bdr. Woli	Rukum, Chhibang-1, Chautara	902
NGRC08470	Horsegram	कुर्थी गहत	*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Arun Kumar Mahato	Siraha, Chandrodayapur-3	
NGRC08471	Rice	पोखरेली धान	*Oryza*	*sativa L.*	Sarda Khadka	Dolakha, Namdu, Marbu taar	
NGRC08472	Rice	मकवानपुरे	*Oryza*	*sativa L.*	Sarda Khadka	Dolakha, Namdu, Marbu taar	
NGRC08473	Rice	पोखेराली धान	*Oryza*	*sativa L.*	Purna Bahadur Bhujel	Ramechap, Baetali, Khoreya	
NGRC08474	Rice	पोखेराली धान	*Oryza*	*sativa L.*	Jagat Bahadur Karki	Ramechap, Baetali, Danda Gaun	
NGRC08475	Rice	पाखीमे	*Oryza*	*sativa L.*	Lok Bahadur Basnet	Dolakha, Jugu	1450
NGRC08476	Rice	सानो मार्सी	*Oryza*	*sativa L.*	Dan Bahadur Khadka	Dolakha, Jugu, Majhgaun	1554
NGRC08477	Rice	चिनाया धान	*Oryza*	*sativa L.*	Beed Bahadur Basnet	Ramechap, Baetali, Okherbhot	
NGRC08478	Rice	पानी घैया	*Oryza*	*sativa L.*	Padam Bahabur Karki	Dolakha, Jugu, Gairee	1295
NGRC08479	Rice	चरिकोटे	*Oryza*	*sativa L.*	Bhim Prasad Dahal	Dolakha, Namdu	
NGRC08480	Rice	पाखे घैया	*Oryza*	*sativa L.*	Sun Maya Giri	Dolakha, Namdu,Darmi	
NGRC08481	Rice	चिनिया धान	*Oryza*	*sativa L.*	Dhan Bahadur Nepali	Ramechap, Baetali, Danda Gaun	
NGRC08482	Rice		*Oryza*	*sativa L.*	Sumitra Bhandari	Sindupalchok, Petkau-7, Maak Tole	

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NGRC08483	Rice	पोखेरेली धान	*Oryza*	*sativa L.*	Arjun Prasad Siwakoti	Dolakha, Namdu, Marbu taar	
NGRC08484	Rice	आगा	*Oryza*	*sativa L.*	Thuli Kanchi Mijar	Dolakha, Jugu, Gairee	1632
NGRC08485	Rice	अनादी	*Oryza*	*sativa L.*	Dilli Nath Rimal	Dolakha, Namdu, Gharti gaun	
NGRC08486	Rice	भोटाङे	*Oryza*	*sativa L.*	Yagya Prasad Ghimire	Ramechap, Baetali, Padelbari	
NGRC08487	Rice	सानो पोखरेली	*Oryza*	*sativa L.*	Parvati Nepal	Sindupalchok, Petkau-7, Panikhola	
NGRC08488	Rice	सिगारे	*Oryza*	*sativa L.*	Laxmi Khatri	Dolakha, Jugu, Khoyesi	1700
NGRC08489	Wheat	जिरेल गहुँ	*Triticum*	*aestivum L.*	Srijana Sudas	Sindupalchok, Petkau-7, Bhawan tole	
NGRC08490	Wheat	छोटि गहुँ	*Triticum*	*aestivum L.*	Manuka Ghimire	Dolakha, Namdu, Maruwatar	
NGRC08491	Wheat	छोटी गहुँ	*Triticum*	*aestivum L.*	Harka Bahadur Tamang	Dolakha, Namdu, Maruwatar	
NGRC08492	Wheat	सेने गहुँ	*Triticum*	*aestivum L.*	Sanjaya Maya Tamang	Sindupalchok, Marming, Antali	1870
NGRC08493	Wheat	रातो गहुँ	*Triticum*	*aestivum L.*	Karsang Tamang	Sindupalchok, Marming, Antali	1885
NGRC08494	Wheat	कालो	*Triticum*	*aestivum L.*	Mahendra Khadka	Dolakha, Jugu	1766
NGRC08495	Wheat	मुडुले	*Triticum*	*aestivum L.*	Manju Khatri	Dolakha, Jugu	1702
NGRC08496	Wheat	गरिबी	*Triticum*	*aestivum L.*	Dipendra Khadka	Dolakha, Jugu	1803
NGRC08497	Amaranth		*Amaranthus*	*spp.*	Sanjaya Maya Tamang	Sindupalchok, Marming, Antali	1870
NGRC08498	Balsam apple	चुचेकेरेला	*Momordica*	*balsamina* L.	Ram Thapa	Sindupalchok, Petku-3, Bhandari tole	
NGRC08499	Balsam apple	चुचे केरला	*Momordica*	*balsamina* L.	Mangale B. K	Ramechap, Baetali, Raatmata	
NGRC08500	Bean		*Phaseolus*	*vulgaris* L.	Chatra Bahadur Jirel	Dolakha, Jugu, Darkha	1596
NGRC08501	Bean		*Phaseolus*	*vulgaris* L.	Chandra Kumari Tamang	Sindupalchok, Petkau-7, Maak Tole	
NGRC08502	Bean	सिमि ठुलो	*Phaseolus*	*vulgaris* L.	Shreejana Sundas	Sindupalchok, Petkau-7, Maak Tole	
NGRC08503	Bean	पहेलो	*Phaseolus*	*vulgaris* L.	Seeta B. K	Dolakha, Jugu	1727
NGRC08504	Bean	आसरे सिमि	*Phaseolus*	*vulgaris* L.	Parvati Nepali	Dolakha, Namdu, Sirbani	
NGRC08505	Bean	राजमा	*Phaseolus*	*vulgaris* L.	Chandra Kumari Tamang	Sindupalchok, Petkau-7, Maak Tole	
NGRC08506	Bean	आसरे सिमि	*Phaseolus*	*vulgaris* L.	Parvati Ghimire	Dolakha, Namdu, Maruwatar	
NGRC08507	Bean	आसरे	*Phaseolus*	*vulgaris* L.	Chitra Kumari K.C	Dolakha, Jugu	1604
NGRC08508	Blackgram	कालो मास	*Vigna*	*mungo* (L.) Hepper	Jay Devi Khadka	Sindupalchok, Petkau-7, Maak Tole	
NGRC08509	Blackgram	कालो मास	*Vigna*	*mungo* (L.) Hepper	Sharmila Mijar	Dolakha, Namdu	

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NGRC08510	Blackgram	कालो स्थानीय	*Vigna*	*mungo* (L.) Hepper	Dan Bahadur Khadka	Dolakha, Jugu, Majhgaun	1295
NGRC08511	Buckwheat	तिते फापर	*Fagopyrum*	*esculentum*	Ganga Bahadur Khadka	Dolakha, Jugu	1585
NGRC08512	Buckwheat	तिते फापर	*Fagopyrum*	*esculentum*	Geeta Devi Khatri	Dolakha, Jugu, Dandagaun	1805
NGRC08513	Buckwheat	तिते फापर	*Fagopyrum*	*esculentum*	Ishwori Shrestha	Dolakha, Namdu	
NGRC08514	Finger millet	लाफे	*Eleusine*	*coracana* (L.) Gaertn.	Reeta Khadka	Dolakha, Jugu, Kaseri	1337
NGRC08515	Finger millet	डल्ले कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Kamal Bahadur Gurung	Sindupalchok, Petkau-7, Maak Tole	
NGRC08516	Finger millet	कालो डल्लो	*Eleusine*	*coracana* (L.) Gaertn.	Sundari Budathoki	Dolakha, Jugu, Chaap	1540
NGRC08517	Finger millet		*Eleusine*	*coracana* (L.) Gaertn.	Ganga Devi Basnet	Ramechap, Baetali, Bhimsensthan	
NGRC08518	Finger millet		*Eleusine*	*coracana* (L.) Gaertn.	Makhana Khadka	Dolakha, Jugu, Rajapuu	1779
NGRC08519	Finger millet	किर्ने कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Chandra Kumari Tamang	Sindupalchok, Petkau-7, Maak Tole	
NGRC08520	Finger millet	किर्ने कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Goma Bhandari	Sindupalchok, Marming, Antali	1287
NGRC08521	Finger millet	सेतो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Kamal Bahadur Gurung	Sindupalchok, Petkau-7, Tanda tole	
NGRC08522	Finger millet	रातो	*Eleusine*	*coracana* (L.) Gaertn.	Bhoj Kumari Khadka	Dolakha, Jugu, Ukhabari	1301
NGRC08523	Finger millet	चल्टे कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Kaji Tamang	Sindupalchok, Marming, Antali	1549
NGRC08524	Finger millet	मुड्के	*Eleusine*	*coracana* (L.) Gaertn.	Deevika Karki	Dolakha, Jugu, Gairibhangunj	1601
NGRC08525	Finger millet	लरफने	*Eleusine*	*coracana* (L.) Gaertn.	Durga Khadka	Dolakha, Jugu, Chelpu	1760
NGRC08526	Finger millet		*Eleusine*	*coracana* (L.) Gaertn.	Prursotam Raj Giri	Dolakha, Namdu, Patle Gaun	
NGRC08527	Finger millet	लरीवरी	*Eleusine*	*coracana* (L.) Gaertn.	Binda Khatri	Dolakha, Jugu, Ukhabari	1368
NGRC08528	Finger millet	पहेलो डल्ले	*Eleusine*	*coracana* (L.) Gaertn.	Purna Maya Jirel	Dolakha, Jugu, Chelpu	1772
NGRC08529	Finger millet	पहेली कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Sun Maya Giri	Dolakha, Namdu, Darmee	
NGRC08530	Finger millet	सेतो सिलामे	*Eleusine*	*coracana* (L.) Gaertn.	Hira Kaji Basnet	Dolakha, Jugu	1352
NGRC08531	Finger millet	सैलुंगे रातो	*Eleusine*	*coracana* (L.) Gaertn.	Kanchi Maya Tamang	Dolakha, Jugu, Tamang Gaun	2143
NGRC08532	Finger millet	सेतो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Somsang Tamang	Sindupalchok, Marming, Antali	1672
NGRC08533	Horsegram	रातो गहत	*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Jamuna Thapa	Sindupalchok, Marming, Antali	1549
NGRC08534	Horsegram		*Macrotyloma*	*uniflorum* (Lam.) Verdc.	Chitra Bahadur Khadka	Dolakha, Jugu, Chaap	1520
NGRC08535	Lentil	कालो मसुरी	*Lens*	*culinaris* Medik.	Gyanu Gurung	Sindupalchok, Petkau-3, Bhandari tole	
NGRC08536	Mustard	ठुलो तोरी	*Brassica*	*napus* L.	Ramesh Khadka	Sindupalchok, Petkau-4, Khatri tole	
NGRC08537	Mustard	कालो तोरी	*Brassica*	*napus* L.	Renuka Ghimire	Ramechap, Baetali, Gaun Khet	

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NGRC08538	Niger	झुसे तिल	*Guizotia*	*abyssinica* (L.) Cass	Chandra Maya Basnet	Dolakha, Jugu, Gairee	1549
NGRC08539	Niger	झुसे तिल	*Guizotia*	*abyssinica* (L.) Cass	Krishna Maya Bhujel	Sindupalchok, Marming, Antali	1282
NGRC08540	Pea	छिरविरे ठुलो	*Pisum*	*sativum* L.	Tej Bahadur Khadka	Dolakha, Jugu, Majhgaun	1675
NGRC08541	Pea	सानो हरियो	*Pisum*	*sativum* L.	Tapendra Khadka	Dolakha, Jugu, Cheetpu	1883
NGRC08542	Pumpkin	सेतो फर्सी	*Cucurbita*	*moschanta L.*	Tej Bhadur Khadka	Dolakha, Jugu, Gairee	1295
NGRC08543	Ricebean	सेतो घोरे	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Khem Bahadur Karki	Dolakha, Jugu, Ukhubari	1360
NGRC08544	Ricebean	घोगे मास सेतो	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Sumitra Bhandari	Sindupalchok, Petkau-7, Maak Tole	
NGRC08545	Barnyard Millet	सामा	*Echinochloa*	*frumentacea* L	Ram Nibas Shaha	Rauthat, Gadimai M., Binagare	67
NGRC08546	Finger millet	डाडापखार	*Eleusine*	*coracana* (L.) Gaertn.	Niru Karki	Dolakha, Jugu-8	
NGRC08547	Finger millet	मरुवा	*Eleusine*	*coracana* (L.) Gaertn.	Ram Rikh Saha Kanu	Rauthat, Paroha M., Laukaha	81
NGRC08548	Finger millet	पहेलो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Bam Bahadur Karki	Ramechap, Betali, Patidunga	
NGRC08549	Green Gran Mung Bean	देहाती मुंग	*Vigna*	radiata (L.) R. Wilczek	Sekha Sehajad	Rauthat, Gadimai M., Binagare	67
NGRC08550	Green Gran Mung Bean	देहाती मुंग	*Vigna*	radiata (L.) R. Wilczek	Sekha Sehajad	Rauthat, Gadimai M., Binagare	67
NGRC08551	Maize	स्थानीय मकै	*Zea*	*mays* L.	Apsara Pandey	Bajura, Himali 6, Boldik	1081
NGRC08552	Linseed	स्थानीय आलस	*Linum*	*usitatissimum* L.	Binu Gurung	Achham, Sanfe Bagar-5, Thulasen	1869
NGRC08553	Linseed	आलस तिसी	*Linum*	*usitatissimum* L.	Aalsan Khan	Rauthat, Laxmipur	
NGRC08554	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Mohachanda Pandey	Bajura, Himali 6, Boldik	1081
NGRC08555	Wheat	दौड खाने गहुँ	*Triticum*	*aestivum* L.	Thakmaya Joshi	Doti, Sayaal-5, Dadullegada	1529
NGRC08556	Mustard	कालो तोरी	*Brassica*	*napus* L.	Sarda Debi	Rauthat, Laxmipur	72
NGRC08557	Pea	मटर	*Pisum*	*sativum* L.	Samim Ansari	Rauthat, Garuda M., Garuda	65
NGRC08558	Rice	सरिहन कर्तनी धान	*Oryza*	*sativa* L.	Wahab Ansari	Rauthat, Gadimai M., Binagare	67
NGRC08559	Wheat	विजय गहुँ	*Triticum*	*aestivum* L.	Sona Lal Yadabe	Rauthat, Madhabharayan M., Manpur	54
NGRC08560	Wheat	अनेल गहुँ	*Triticum*	*aestivum* L.	Sona Lal Yadabe	Rauthat, Madhabharayan M., Manpur	54
NGRC08561	Sarson	सर्सो	*Brassica*	*compestris* L.	Kekni Debi Yadab	Rauthat, Laxmipur	72
NGRC08562	Large Cardamom	रामसाई अलैची	Amomum	Subulatum	Nirjala Multipurpose Krishi Fam	Taplejung, Phungling-6	1600

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NGRC08563	Large Cardamom	गोलसाई अलैची	Amomum	Subulatum	Kenchaki Multipurpose Nursery Fam	Terathum, Laligurash-9	1050
NGRC08564	Large Cardamom	डम्बरसाई अलैची	Amomum	Subulatum	Kanchanjunga Alaichi Krishi Sahakari Sastha	Bhojpur, Arun RM-2, Champa	650
NGRC08565	Large Cardamom	भरलाङ्गे अलैची	Amomum	Subulatum	Balkrishna Krishi Fam	Ilam, Sandakpure RM-4, Mabu	1700
NGRC08566	Large Cardamom	जिर्मले अलैची -पाखे, सलकपुरे_	Amomum	Subulatum	Resham Adhikari	Ilam, Rong RM-6, Salakpur	1200
NGRC08567	Amaranth	गंगा बासी लट्टे	*Amaranthus*	*sp.*	Ganga Maya Magar	Dhankuta, Sangurigari RM-6, Thumke	1613
NGRC08568	Amaranth	सेतो लट्टे	*Amaranthus*	*sp.*	Nikesh Rijal	Ilam, Ilam M-4, Dharapani	1607
NGRC08569	Amaranth	हरियो लट्टे	*Amaranthus*	*sp.*	Ramila Rijal	Ilam, Ilam M-4, Dharapani	1667
NGRC08570	Amaranth	रातो लट्टे	*Amaranthus*	*sp.*	Shi Bahadur Darlami Magar	Dhankuta, Pakhribas-3, Jordhara	1764
NGRC08571	Amaranth	रातो लट्टे	*Amaranthus*	*sp.*	Kumari Paudel	Dhankuta, Pakhribas-3, Pakhribas	1745
NGRC08572	Amaranth	सेतो लट्टे	*Amaranthus*	*sp.*		Dhankuta, Pakhribas-3, Pakhribas	1724
NGRC08573	Amaranth	सेतो लट्टे	*Amaranthus*	*sp.*		Dhankuta, Pakhribas-3, Pakhribas	1724
NGRC08574	Rice	भोटागे धान	*Oryza*	*sativa* L.	Citramaya Budathoki-Phulmaya Tamanga	Ramechap, Tilpung	
NGRC08575	Common buckwheat	तिते फापर	*Fagopyrum*	*esculentum* Moench	Ram Krishna Dahal	Dolakha, Namdu	
NGRC08576	Common buckwheat	मीठे फापर	*Fagopyrum*	*esculentum* Moench	Sun Maya Bhujel	Dolakha, Namdu, Dandajaun	
NGRC08577	Tartary buckwheat		*Fagopyrum*	*tataricum* (L.) Gaertn.	Ram Krishna Dahal	Dolakha, Namdu, Namdu	
NGRC08578	Common buckwheat	स्थिनीय मिठे	*Fagopyrum*	*esculentum* Moench	Tilak Pandey	Dolakha, Jugu, Gairee	1276
NGRC08579	Tartary buckwheat		*Fagopyrum*	*tataricum* (L.) Gaertn.	Mitra Lal Jirel	Dolakha, Jugu, Chetpu	1914
NGRC08580	Amaranth	कालो लट्टे	*Amaranthus*	*sp.*	Ganga Bhadur Gurung	Lamjung, Ghanpokhara-1, vache	1400
NGRC08581	Amaranth	सेतो लट्टे	*Amaranthus*	*sp.*	Ful Maya Gurung	Lamjung, Ghanapokhara-6, Ghimrang	1689
NGRC08582	Amaranth	रातो लट्टे	*Amaranthus*	*sp.*	Maya Tamang	Nuwakot, Kimtang-4, Mane gaun	1750
NGRC08583	Amaranth		*Amaranthus*	*sp.*	Lakpa Gelbu Tamang	Rasuwa, Bridim, Dhodme tole	2175
NGRC08584	Amaranth	लामा वाला लट्टे	*Amaranthus*	*sp.*	Luk Kumari Thakuri	Sindhuli, Ranibas-9, Ranibas	345
NGRC08585	Amaranth	कालो	*Amaranthus*	*sp.*	Community Seed Bank	Dhading, Jogimara-9, Majhimtar	300

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NGRC08586	Rice	बासमती धान	*Oryza*	*sativa* L.	Bed Bahadur Shrestha	Ramechap, Tilpung, Sahu Tole	
NGRC08587	Amaranth	लोकल लट्टे	*Amaranthus*	*tricolor* L.	Ram Maya Gurung	Gorkha, Barpak-2	903
NGRC08588	Rice	जुना धान	*Oryza*	*sativa* L.	Kashi Chand Pandey	Bajura, Himali 6, Boldik	1081
NGRC08589	Bean	घिउ सिमि	*Phaseolus*	*vulgaris* L.	Lok Bdr. Kisan	Myagdi, Babiyachowr	
NGRC08590	Bean	हल्लुडे सिमी	*Phaseolus*	*vulgaris* L.	Lok Bdr. Kisan	Myagdi, Babiyachowr	
NGRC08591	Bean	भट्टे सिमि	*Phaseolus*	*vulgaris* L.	Lok Bdr. Kisan	Myagdi, Babiyachowr	
NGRC08592	Rice	भोतांगे धान	*Oryza*	*sativa* L.	Rewan Tamang	Ramechap, Tilpung, Ghalegaun	
NGRC08593	Bean	छिर्के सिमी	*Phaseolus*	*vulgaris* L.	Gopal Hirachan	Mustang, Lete-5	2507
NGRC08594	Rice	भोटांगे धान	*Oryza*	*sativa* L.	Puyam Shrestha	Ramechap, Tilpung	
NGRC08595	Bean	हाडे सिमी	*Phaseolus*	*vulgaris* L.	Indra Bahadur Niraula	Ilam, Royung-8, Kolbung	1428
NGRC08596	Rice	मार्से धान	*Oryza*	*sativa* L.	Prem Nepali	Doti, Sayaal-5, Dadullegada	1549
NGRC08597	Bean	रातो सिमी	*Phaseolus*	*vulgaris* L.	Radhika Shrestha	Panchthar, Phalgunanagha RM-3, Rake	2162
NGRC08598	Rice	मास्रो धान	*Oryza*	*sativa* L.	Man Bahadur Raut	Bajura, Budinandan-9, Kaandh	2515
NGRC08599	Choto	चोतो	*Raphanus*	*raphanistrum*		Doti	
NGRC08600	Adzukin bean	अछामे गुराँसे	*Vigna*	*angularis* (Willd.) Ohwi & H. Ohashi	Binu Gurung	Achham, Sanfebagar-5, Thulasen	1869
NGRC08601	Bean	खैरो सिमी	*Phaseolus*	*vulgaris* L.	Dhem Khadka	Ilam, Ilam-5, Okhrebarbote	
NGRC08602	Bean	घिउ सिमी	*Phaseolus*	*vulgaris* L.	Goma Sahi	Dhankuta, Dhankuta M-1, Nigale	1704
NGRC08603	Bean	जरे सिमी	*Phaseolus*	*vulgaris* L.	Durga Shrestha	Dhankuta, Dhankuta M-7, Hulak Tol	1125
NGRC08604	Bean	कान्छी (हाडे)	*Phaseolus*	*vulgaris* L.	Dil Kumar Acharya	Ilam, Royung RM-3, Kolbung	1482
NGRC08605	Bean	रातो सिमी	*Phaseolus*	*vulgaris* L.	Indra Bahadur Niraula	Ilam, Royung-7, Kolbung	1427
NGRC08606	Bean	रातो सिमी	*Phaseolus*	*vulgaris* L.	Dil Kumar Acharya	Ilam, Royung-3, Kolbung	1482
NGRC08607	Soybean	कालो भटमास	*Glycine*	*max* (L.) Merr	Prem Nepali	Doti, Sayaal-5, Dadullegada	1529
NGRC08608	Bean	सेतो सिमी	*Phaseolus*	*vulgaris* L.	Chakra Bahadur Mukhiya	Ilam, Santapur RM-1, Maipokhari	2113
NGRC08609	sorghum	जुनेलो	*Sorghum*	*bicolor* (L.) Moench	Sangita Pandey	Bajura, Himali-6, Boldik	1081
NGRC08610	Soybean	कैलो भटमास	*Glycine*	*max* (L.) Merr	Karna Bdr Thapa + Joshi Baje	Doti, Sayaal-5, Dadullegada	1504
NGRC08611	Wheat	गहुँ	*Triticum*	*aestivum* L.	Karma Thapa	Doti, Sayaal-5, Dadullegada	1504
NGRC08612	Wheat	नौतुने गहुँ	*Triticum*	*aestivum* L.	Thakmaya Joshi	Doti, Sayaal-5, Dadullegada	1529

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NGRC08613	Rice	अनदि	*Oryza*	*sativa* L.	Dillip Bhandari	Ramechap, Baetali, Dandagaun	
NGRC08614	Okra	लोकल भिंडी	*Abelmoschus*	*esculentus* (L.) Moench.	Jit Bahadur Rumba	Makwanpur, Phaparbari-9, Tallo Bhawani	341
NGRC08615	Cowpea	भागाथोक सेतो	*Vigna*	*unguiculata* (L.) Walp.	Jyamoti Rai	Bhojpur, Hatuwagadi-6, Lankha	
NGRC08616	Bean	धनकुटे सिमी	*Phaseolus*	*vulgaris* L.	Ram Bahadur Thapa	Panchthar, Phidim M-4, Tapatar	624
NGRC08617	Proso millet	हाडे	*Panicum*	*miliaceum* L.	Til Bahadur Rawal	Jumla, Taliuma-2, Shreedhuska	
NGRC08618	Akabare Khursani		*Capsicum*	*annuum* L.	Tula Gurung	Ilam, Ilam M-6, Barbote	1460
NGRC08619	Akabare Khursani		*Capsicum*	*annuum* L.		Dhankuta, Dhankuta M-1, Hile	
NGRC08620	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Udaypur, Laxmipur	183
NGRC08621	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Sallyan, Dandagaon	1100
NGRC08622	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Jhapa, Manishpur-6	
NGRC08623	Okra	चुच्चे कालो भिंडी	*Abelmoschus*	*esculentus* (L.) Moench.		Morang, Madhomalla	
NGRC08624	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Jhapa, Jalthal-5	
NGRC08625	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Morang, Tetaria	
NGRC08626	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Morang, Horabhag-8	
NGRC08627	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Siraha, Chandrayodhapur-1	120
NGRC08628	Okra		*Abelmoschus*	*esculentus* (L.) Moench.		Siraha, Phulkahakatti	110
NGRC08629	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Kathmandu, Naubishe	1300
NGRC08630	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Saptari, Lahan city	50
NGRC08631	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Sunsari, Laukaha	50
NGRC08632	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Saptari, Kalyanpur	100
NGRC08633	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Mahottary, Lalbandi	
NGRC08634	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Makwanpur, Nawalpur	
NGRC08635	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Makwanpur, Nawalpur	
NGRC08636	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Dang, Pokharapani	250
NGRC08637	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Syangja, Ramachha	780
NGRC08638	Okra	रामतोरिया	*Abelmoschus*	*esculentus* (L.) Moench.		Mahottary, Lalbandi	

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NGRC08639	Okra	भिंडारी	*Abelmoschus*	*esculentus* (L.) Moench.		Makwanpur, Nawalpur	300
NGRC08640	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Chhipra-9	
NGRC08641	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Saya-5	
NGRC08642	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Darma-7	
NGRC08643	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Darma-5	
NGRC08644	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Dandafaya-3	
NGRC08645	Foxtail millet		*Setaria*	*italica* (L.) Beauv.		Humla, Gothi-3	
NGRC08646	Foxtail millet		*Setaria*	*italica* (L.) Beauv.	Radha Devi Bhatta	Dadeldhura, Amargadhi-9	
NGRC08647	Foxtail millet		*Setaria*	*italica* (L.) Beauv.	Maya Chaulagain	Jumla, Narakot-4, Jaubada	2375
NGRC08648	Okra		*Abelmoschus*	*esculentus* (L.) Moench.	Surya Narayan Yadav	Sunsari, Laukahi-2	
NGRC08649	Maize	पहेलो मकै	*Zea*	*mays* L.	Bimala Thapa	Sindhuli, Kamalamai M. Dhurabajar	
NGRC08650	Maize	बङ्गारे मकै	*Zea*	*mays* L.	Ganesh Prasad Ghimire	Sindhuli, Kamalamai M-5, Madhutar	450
NGRC08651	Maize	पहेलो मकै	*Zea*	*mays* L.	Minuka Bhandari	Ramechhap, Manthali-10, Chankhu	
NGRC08652	Maize	खुमल पहेलो	*Zea*	*mays* L.	Kanchha Shrestha	Nuwakot, Bidur-3, Pipaldada	
NGRC08653	Maize	सेतो मकै	*Zea*	*mays* L.	Nimacheki Sharpa	Ramechhap, Umakunda RM-7, Vhuji	2100
NGRC08654	Maize	पहेलो मकै	*Zea*	*mays* L.	Nimacheki Sharpa	Ramechhap, Umakunda RM-7, Vhuji	2100
NGRC08655	Maize	पहेली मकै	*Zea*	*mays* L.	Ran Bahadur Sunuwar	Ramechhap, Gokulganga RM-3, Rasnalu	
NGRC08656	Wheat	विकासे गहुँ	*Triticum*	*aestivum* L.	Kumar Ghimire	Ramechhap, Betali-4, Padelbari	
NGRC08657	Wheat	मुडुले गहुँ	*Triticum*	*aestivum* L.	Umadebi Karki	Ramechhap, Gunteshower-6, Jhagare	2900
NGRC08658	Wheat	छुगा गहुँ	*Triticum*	*aestivum* L.	Nimacheki Sharpa	Ramechhap, Umakunda RM-7, Vhuji	2100
NGRC08659	Wheat		*Triticum*	*aestivum* L.	Padam Bahadur Sunuwar	Ramechhap, Gokulganga RM-3, Rasnalu	
NGRC08660	Cucumber	लामा काँक्रो	*Cucumis*	*sativus L.*	Prem Ghale	Dhading, Gumdi-6, Satdobato	1184
NGRC08661	Cucumber		*Cucumis*	*sativus L.*	Bhutari Sharma	Dang, Lamhi	
NGRC08662	Rice	मन्सुली धान	*Oryza*	*sativa* L.	Binod Parsad Dahal	Sindhuli, Sunkosi RM, Kotagau	
NGRC08663	Rice	कन्चन धान	*Oryza*	*sativa* L.	Kanchha Shrestha	Nuwakot, Bidur-3, Pipaldada	
NGRC08664	Rice	सुख्खा धान	*Oryza*	*sativa* L.	Minuka Bhandari	Ramechhap, Manthali-10, Chankhu	

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NGRC08665	Rice	कालो धान	*Oryza*	*sativa* L.	Nimacheki Sharpa	Ramechhap, Umakunda RM-7, Vhuji	2100
NGRC08666	Cucumber	लामो चेपांगे काँक्रो	*Cucumis*	*sativus L.*	Megh Bdr. Budhathoki	Chitwan, Ichhakamana RM-2, Kaule	1504
NGRC08667	Cucumber	सेतो काँक्रो	*Cucumis*	*sativus L.*	Shiba Kumari Paudyal	Rasuwa, Bhorle-6, Jibjibe	1253
NGRC08668	Cucumber	कालो	*Cucumis*	*sativus L.*	Gaumati Kumari Adhikari	Bajhang, Sunkuda-8, Suwakot	1764
NGRC08669	Cucumber		*Cucumis*	*sativus L.*	Narayan Bdr.Shrestha	Nowakot, Bidur M-7	
NGRC08670	Cucumber	स्थानीय काँक्रो	*Cucumis*	*sativus L.*	Tarsang Tamang	Rasuwa, Chilime-2, Chilime	1933
NGRC08671	Cucumber	ठुलो काँक्रो	*Cucumis*	*sativus L.*	Chandra Bdr. Rana	Pyuthan, Dhungedi-3, Bhangari	916
NGRC08672	Cowpea	बोडी	*Vigna*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08673	Ricebean	सेतो मस्यांग	*Vigna*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08674	Ricebean	खैरो मस्यांग	*Vigna*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08675	Ricebean	कालो मस्यंग	*Vigna*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08676	Horsegram	कालो गहत	*Macrotyloma*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08677	Bean	रातो सोस्ता	*Phaseolus*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08678	Bean	पहेलो सोस्ता राजमा	*Phaseolus*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08679	Bean	पाटे सोस्ठा राजमा	*Phaseolus*		Charghare Krishi Tatha Pasupaln Karishk Samuh	Ramechhap, Ramechhap M-5, Charghare	1100
NGRC08680	Rice	गुराँसे	*Oryza*	*sativa* L.	Agriculture Market	Udayapur, Triyuga M, Hawai field	142
NGRC08681	Rice	हिमाली धान	*Oryza*	*sativa* L.	Minuka Bhandari	Ramechhap, Manthal-10, Chankhu	
NGRC08682	Rice	बासमती धान	*Oryza*	*sativa* L.	Kumar Ghimire	Ramechhap, Betali-4, Padelbari	
NGRC08683	Rice	अगौटे धान	*Oryza*	*sativa* L.	Kumar Ghimire	Ramechhap, Betali-4, Padelbari	
NGRC08684	Rice	घैया धान	*Oryza*	*sativa* L.	Bishnuman Shrestha	Nuwakot, Bidur-3, Pipaldada	
NGRC08685	Rice		*Oryza*	*sativa* L.	Mukunda Acharya	Nuwakot, Cahule-8	1100
NGRC08686	Rice		*Oryza*	*sativa* L.	Sarita Tamang	Nuwakot, Kimtang-9, Tallo kimtang	1600

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NGRC08687	Rice		*Oryza*	*sativa* L.	Tar Ghale	Nuwakot, Balchye-9	1800
NGRC08688	Rice	जर्नालि धान	*Oryza*	*sativa* L.	Jagat Bahadur Karki	Ramechap, Baetali, Dandagaunu	
NGRC08689	Naked barly		*Hordeum*	*vulgare*	Balbhadra Gautam	Myagdi, Mangala-1, Thaiwang	1,878
NGRC08690	Rice	कालो ढुडे बासमती	*Oryza*	*sativa* L.	Kanchan Jaebik Tatha Bikash Samiti	Jhapa, Shiwasatasi M-3	
NGRC08691	Bean	असारे सिमी	*Phaseolus*	*vulgaris* L.	Sangamaya Tamang	Sindhupalchok, Marminga, Anthali	1870
NGRC08692	Bean	सिमी	*Phaseolus*	*vulgaris* L.	Ishika Upadhyaya	Bajura, Himali-6, Dadabada	1141
NGRC08693	Bean	स्थानिय सिमी	*Phaseolus*	*vulgaris* L.	Man Bahadur Raut	Bajura, Himali-9, Kaandh	2515
NGRC08694	Bean	पहेलो सिमी	*Phaseolus*	*vulgaris* L.		Dolakha	
NGRC08695	Bean	सिमताने खैरो	*Phaseolus*	*vulgaris* L.	Til Bahadur Rawat	Jumla, Taliwob-2, Shree Thuska	2968.1
NGRC08696	Bean	सोट्टा	*Phaseolus*	*vulgaris* L.	Bir Singh Dhami	Darchula , Dhamidada	1536
NGRC08697	Bean	कालो सानो माले	*Phaseolus*	*vulgaris* L.	Til Bahadur Rawat	Jumla, Taliwob-2, Shree Thuska	
NGRC08698	Back gram	कालो केलाई	*Vigna*	mungo (L.) Hepper	Agriculture Market	Udayapur, Triyuga M, Hawai field	142
NGRC08699	Blackgram	स्थानिय कालो मास	*Vigna*	mungo (L.) Hepper	Bir B. Karki-Ratna B. Karki-Rajan Paudal	Ramechap, Tilpung	
NGRC08700	Blackgram	स्थानिय मास	*Vigna*	mungo (L.) Hepper	Sunumaya Thapa	Doti, Sayaal-5, Dadullegada	1504
NGRC08701	Blackgram	कालो मास	*Vigna*	mungo (L.) Hepper	Nimacheki Sharpa	Ramechhap, Umakunda RM-7, Vhuji	2100
NGRC08702	Blackgram	कालो मास	*Vigna*	mungo (L.) Hepper	Paebati, Gita, Shanta, Padm K. Ghimire	Ramechhap, Betali-4	
NGRC08703	Wheat	दोलखा गहुँ	*Triticum*	*aestivum* L.	Laldoj Basnet	Ramechap, Betali	
NGRC08704	Linseed		*Linum*	*usitatissimum* L.	Agriculture Market	Udayapur, Triyuga M, Hawai field	142
NGRC08705	Finger millet	स्थानिय कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Hari Joshi	Doti, Sayaal-5, Dadullegada	1529
NGRC08706	Finger millet	पहेली कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Puyam Shrestha	Ramechap, Tilpung	
NGRC08707	Finger millet	नौतुड़े कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Sabitri Timilsina	Doti, Sayaal-5, Dadullegada	1529
NGRC08708	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Purna Kumari Gurung	Lamjung, Dhanpokhara-2, Sene	1300
NGRC08709	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Sunits Gurung	Lamjung, Dhanpokhara-7, Paiyukhola	971
NGRC08710	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Bil Bahadur Tamang	Lamjung, Dhanpokhara-8, Prowi	1595
NGRC08711	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Chandra Kasi Gurung	Lamjung, Dhanpokhara-9, Nayu	1215
NGRC08712	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Purna Kumari Gurung	Lamjung, Dhanpokhara-1, Vache	1529
NGRC08713	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Chandi Kumari Gurung	Lamjung, Dhanpokhara-1, Vache	1530

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NGRC08714	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Dan Bahadur Gurung	Lamjung, Dhanpokhara-1, Kafaldada	1402
NGRC08715	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Dil Kumari Gurung	Lamjung, Dhanpokhara-6, Ghimrang	1671
NGRC08716	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Ram Bhadur Tamang	Lamjung, Dhanpokhara-8, Prowi	1595
NGRC08717	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Ran Kaman Gurung	Lamjung, Dhanpokhara-7, Paiyukhola	950
NGRC08718	Foxtail millet	कालो कागुनो	*Setaria*	*italica* (L.) Beauv.		Humla, Simikot-7	
NGRC08719	Foxtail Millet	कालो कागुनो	*Setaria*	*italica* (L.) Beauv.		Humla, Raya-2	
NGRC08720	Foxtail Millet	रातो कागुनो	*Setaria*	*italica* (L.) Beauv.		Humla, Raya-2	
NGRC08721	Foxtail millet	पहेल्नो	*Setaria*	*italica* (L.) Beauv.		Humla, Simikot-7	
NGRC08722	Finger millet	सेतो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Sita Darlami Magar	Ramechap, Tilpung	
NGRC08723	Foxtail Millet	कालो	*Setaria*	*italica* (L.) Beauv.		Humla, Melcham-3	
NGRC08724	Foxtail millet	कालो कागुनो	*Setaria*	*italica* (L.) Beauv.		Humla, Kharpunath-7	
NGRC08725	Niger	झुसे तिल	*Guizotia*	*abyssinica* (L.) Cass	Sabitra Budathoki -Phulmaya	Ramechap, Tilpung	
NGRC08726	Balsam Apple	सानो चटेला	*Momordica*	*balsamina* L.	Tej Kumar Thapa	Gulmi, Satyawti Gaupa, Vharse	1648
NGRC08727	Broad Leaf Mustard	अछामी रायो	Brassica	juncea (L.) Czern & Cross.	Binu Gurung	Achham, Sanfebagar-5, Thulasen	1869
NGRC08728	Broad Leaf Mustard	स्थानिय रायो	Brassica	juncea (L.) Czern & Cross.	Man Bahadur Raut	Bajura, Budhinanda-9, Kaandh	2515
NGRC08729	Broad Leaf Mustard	बन्जी रोयो	Brassica	juncea (L.) Czern & Cross.	Janaki Chaudhary	Kailali, Sripur-7, Majhgaon	
NGRC08730	Broad Leaf Mustard	रायो	Brassica	juncea (L.) Czern & Cross.	Hari Prasad Pakurel	Nowakot, Gerkhu-4, Nuwakot	
NGRC08731	Lapha sag	लाफा साग			Kanchan Jaebik Tatha Bikash Samiti	Jhapa, Shiwasatasi M-3	
NGRC08732	Tartary buckwheat		*Fagopyrum*	*tataricum* (L.) Gaertn.	Phulmaya Tamang	Ramechap, Tilpung, Jhakri Tole	
NGRC08733	Common buckwheat	फापर	*Fagopyrum*	*esculentum* Moench	Ishika Upadhyaya	Bajura, Himali-6, Dadabada	1081
NGRC08734	Common buckwheat	मिठे फापर	*Fagopyrum*	*esculentum* Moench	Tek Bahadur Budathoki	Ramechap, Tilpung, Raatmata	

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NGRC08735	Common buckwheat	मिठे फापर	*Fagopyrum*	*esculentum* Moench	Binod Parsad Dahal	Sindhuli, Sunkosi RM-4, Kotgau	
NGRC08736	Common buckwheat	मिठे फापर	*Fagopyrum*	*esculentum* Moench	Bimala Thapa	Sindhuli, Kamlamai M, Dhurabajar	
NGRC08737	Foxtail millet	पहेलो	*Setaria*	*italica* (L.) Beauv.		Humla, Chhipra-9	
NGRC08738	Sesame	कैलो चामले तिल	*Sesamum*	*indicum* L.		Kavre, Mandn Deupur N. Pa -6	
NGRC08739	Sorghum	स्थानिय जुनेलो	*Sorghum*	*bicolor* (L.) Moench		Ramechhap	
NGRC08740	Foxtail millet	कागुनो	*Setaria*	*italica* (L.) Beauv.	Om Kumari Gurung	Lamjung, Dhanpokhara-6, Ghimrang	1400
NGRC08741	Soyabean	कैलो भटमास	*Glycine*	*max* (L.) Merr	कृषि हाट बजार, गाईघाट	Udayapur, Triyuga M, Hawai field	142
NGRC08742	Maize	मकै माले घोगा	*Zea*	*mays* L.	Bishnum Kathayt	Achham, Bannigadi-6, Kaakot	1800 - 1900
NGRC08743	Maize	मकै सल्ले घोगा	*Zea*	*mays* L.	Nabraj Kathayt - Po. No - 9861798083	Achham, Bannigadi-6, Kaakot	1800
NGRC08744	Bean	माले	*Phaseolus*	*vulgaris* L.		Humla, Darma-9	
NGRC08745	Proso millet	बस्यर	*Panicum*	*miliaceum* L.	Bharat Bahadur Sunuwar	Ramechhap, Kubukasthali-5	1900
NGRC08689	Naked barly	उवा	*Hordeum*	*vulgare*	Balbhadra Gautam	Myagdi, Mangala-1, Thaiwang	1,878.00
NGRC08746	Bean	घ्यू सिमी	*Phaseolus*	*vulgaris* L.	Mansuwa Gautam	Myagdi, Mangala-1, Thaiwang	1,878.00
NGRC08747	Buckwheat	मिठे फापर	*Fagopyrum*	*esculentum* Moench	Keshar Bahadur Karki	Ramechhap, Gokulganga RM-2, Those	1,829.00
NGRC08748	Buckwheat	तिते फापर	*Fagopyrum*	*esculentum* Moench	Lila Bahadur Sunuwar	Ramechhap, Gokulganga RM-3, Rasnalu	1665
NGRC08749	Finger millet	नङ्कटुवा कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Goma Debi Khadka	Ramechhap, Gokulganga RM-2, Dorja	2018
NGRC08750	Finger millet	कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Purana Magar	Myagdi, Mangala-1, Thaiwang	1849
NGRC08751	Cannabis	भागो	*Cannabis*	*spp.*	Gaumaya Purja Magar	Myagdi, Mangala-1, Thaiwang	1849
NGRC08752	Maize	पहेलो सठीया	*Zea*	*mays L.*	Nirmala Giri	Dhading, Salyanter, Buttar	543
NGRC08753	Maize	सठीया मकै	*Zea*	*mays L.*	Buddhi Man Darai	Gorkha, Aarughat, Chusimara Phaat	517
NGRC08754	Maize	ठुलो सेती मकै	*Zea*	*mays L.*	Jaya Kumar Rai	Udayapur, Triyuga M-14, Bayotar	628
NGRC08755	Maize	सानो सेती मकै	*Zea*	*mays L.*	Jaya Kumar Rai	Udayapur, Triyuga M-14, Bayotar	628
NGRC08756	Maize	पहेली मकै	*Zea*	*mays L.*	Sukumaya Tamang	Udayapur, Sirise, Ghumti Chok	949
NGRC08757	Maize	राती मकै	*Zea*	*mays L.*	Dhurba Magar	Ilam, Phakphok thum, Lumde	
NGRC08758	Maize	सेती मकै	*Zea*	*mays L.*	Madan Kumar Basnet	Uadyapur, Chhaudandi M-1, Kanchanpur	868

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NGRC08759	Maize	पहेली मकै	*Zea*	*mays L.*	Madan Kumar Basnet	Uadyapur, Chhaudandi M-1, Kanchanpur	868
NGRC08760	Maize	रातो मकै	*Zea*	*mays L.*	Madan Kumar Basnet	Uadyapur, Chhaudandi M-1, Kanchanpur	868
NGRC08761	Mustard	स्थानीय तोरी	*Brassica*	*napus* L.	Goma Debi Khadka	Ramechhap, Gokulganga M-2, Dorja	2018
NGRC08762	Mustard	ठुलो तोरी	*Brassica*	*napus* L.	Padam Bahadur Sunuwar	Ramechhap, Gokulganga M-3, Rasnalu Darkha	1665
NGRC08763	Rice	भोटाङ्गे धान	*Oryza*	*sativa* L.	Rabilal Ghimire	Ramechhap, Gokulganga M-4, Betali Jaubari	1473
NGRC08764	Rice	अनदी धान	*Oryza*	*sativa* L.	Rabilal Ghimire	Ramechhap, Gokulganga M-4, Betali Jaubari	1473
NGRC08765	Rice	बासमती धान	*Oryza*	*sativa* L.	Ganga Ghimire	Ramechhap, Gokulganga M-4, Betali Jaubari	1473
NGRC08766	Rice	सेतो मार्सी	*Oryza*	*sativa* L.	Padam Bahadur Sunuwar	Ramechhap, Gokulganga M-3, Rasnalu Darkha	1665
NGRC08767	Rice	अधेरे धान	*Oryza*	*sativa* L.	Mamata Hamal	Kaski, Machhapuchre-3, Ghachok	1236
NGRC08768	Rice	रातो दर्नाली धान	*Oryza*	*sativa* L.	Balbhadra Gautam	Myagdi, Mangala-1, Thaiwang	1878
NGRC08769	Rice	गौरिया धान	*Oryza*	*sativa* L.	Sita Subedi	Myagdi, Mangala-2, Salyan	1209
NGRC08770	Rice	भोटो धान	*Oryza*	*sativa* L.	Madan Kumar Basnet	Uadyapur, Chhaudandi M-1, Kanchanpur	868
NGRC08771	Wheat	जुगे गहुँ	*Triticum*	*aestivum* L.	Yubaraj Basnet	Ramechhap, Gokulganga RM-2, Those	1350
NGRC08772	Wheat	सेतो गहुँ	*Triticum*	*aestivum* L.	Keshar Bahadur Karki	Ramechhap, Gokulganga RM-2, Those	1829
NGRC08773	Wheat	मुडुले गहुँ	*Triticum*	*aestivum* L.	Pram Bahadur Basnet	Ramechhap, Gokulganga RM-2, Dorja	2011
NGRC08774	Wheat	कालो खपाली गहुँ मुडुले	*Triticum*	*aestivum* L.	Kul Bahadur Karki	Ramechhap, Gokulganga RM-3, Rasnalu	1665
NGRC08775	Wheat	गहुँ	*Triticum*	*aestivum* L.	Balbhadra Gautam	Myagdi, Mangala-1, Thaiwang	1878
NGRC08776	Maize	मुरली मकै	*Zea*	*mays L.*	Laxman Bdr. Singh	Dailekh, Padeka-5, Pauwa	1424
NGRC08777	Maize	सेतो मकै	*Zea*	*mays L.*	Nadi Pun	Rukum, Garela-8, Jyamire	1120
NGRC08778	Maize	सठिया मकै	*Zea*	*mays L.*	Shiva Kumari Rai	Nuwakot, Ratmate-1, Raigaun	1387
NGRC08779	Perilla		*Perilla*	*frutescens* (L.) Britton	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100
NGRC08780	Bean	सेतो सिमी	*Phaseolus*	*vulgaris* L.	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100.
NGRC08781	Bean	कालो सिमी	*Phaseolus*	*vulgaris* L.	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100.
NGRC08782	Blackgram	कालो मास	*Vigna*	*mungo* (L.) Hepper	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100.

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NGRC08783	Linseed	स्थानीय आलस	*Linum*	*usitatissimum* L.	Bimala Thapa	Sindhuli, Kamalamai M, Dhurabajar	
NGRC08784	Maize	सेतो मकै	*Zea*	*mays* L.	Sanumaya Waiba	Lalitpur, Bagmati-4, Pyutar	955
NGRC08785	Oat	जई घाँस	*Avana*	*fatua L.*	Padam Bahadur Sunuwar	Ramechhap, Gokulganga RM-3, Rasnalu	
NGRC08786	Rice Bean	मस्यांङ्	*Vigna*	*umbellata* (Thunb.) Ohwi & Ohashi	Sanumaya Waiba	Lalitpur, Bagmati-4, Pyutar	955
NGRC08787	Mustard	कालो तोरी	*Brassica*	*napus* L.	Menuka Thing	Lalitpur, Bagmati-4, Pyutar	850
NGRC08788	Barley		*Hordeum*	*vulgare* L.	Lupta Kumari Dahal	Lalitpur, Bagmati-7, Beshishahar	530
NGRC08789	Tartary buckwheat		*Fagopyrum*	*tataricum* (L.) Gaertn.	Basnti Khadka	Ramechhap, Gokulganga RM-2, Those	1350
NGRC08790	Garden cress	चम्सुर	*Lepidium*	*sativum* L.	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100
NGRC08791	Finger millet	पहेलो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Nanda Kumari Ghimire	Lalitpur, Bagmati-6, Syauri gaun	1165
NGRC08792	Mustard	लोकल तोरी	*Brassica*	*napus* L.	Menuka Thing	Lalitpur, Bagmati-4, Pyutar	850
NGRC08793	Niger	झुसे तिल	*Guizotia*	*abyssinica* (L.) Cass	Kul Bahadur Karki	Ramechhap, Gokulganga RM-3, Rasnalu	1665
NGRC08794	Perilla	सेतो सिलाम	*Perilla*	*frutescens* (L.) Britton	Ashok Dulal	Lalitpur, Mahakal-6, Gumrang	1013
NGRC08795	Radish	४० दिने मुला	*Raphanus*	*raphanistrum*	Menuka Thing	Lalitpur, Bagmati-4, Pyutar	850
NGRC08796	Rice	होचो बास्मती धान	*Oryza*	*sativa* L.	Lupta Kumari Dahal	Lalitpur, Bagmati-7, Beshishahar	530
NGRC08797	Sarson	सर्स्यु	*Brassica*	*compestris* L.	Nanda Kumari Ghimire	Lalitpur, Bagmati-6, Syauri gaun	1165
NGRC08798	Wheat	रातो गहुँ	*Triticum*	*aestivum* L.	Bolmaya Bomjan	Lalitpur, Bagmati-4, Pyutar	
NGRC08799	Bean	आस्रांगे सिमी	*Phaseolus*	*vulgaris* L.	Maduraj Ghimire	Lalitpur, Bagmati-6, Syauri gaun	162
NGRC08800	Bean	रातो सिमी	*Phaseolus*	*vulgaris* L.	Krishi Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08801	Buckwheat	मिठे अग्लो फापर	*Fagopyrum*	*esculentum* Moench	Sarita - Sarswati Dulal	Lalitpur, Bagmati-7, Beshishahar	530
NGRC08802	Finger millet	माउ कोदो - डल्ले	*Eleusine*	*coracana* (L.) Gaertn.	Narayan Basnet	Ramechhap, Umakunda RM-2, Pagaa	2122
NGRC08803	Finger millet	सेतो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Ashok Dulal	Lalitpur, Mahakal-6, Gumrang	1013
NGRC08804	Finger millet	बरमन्दी कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Krishk Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08805	Finger millet	कातिके कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Bhim Kumari Gurung	Parbat, Mod RM, Chitre	1560
NGRC08806	Maize	पहेलो स्थानीय	*Zea*	*mays* L.	Narayan Basnet	Ramechhap, Umakunuda RM-2, Pagaa	2122
NGRC08807	Maize	स्थानिय पहेलो मकै	*Zea*	*mays* L.	Krishi Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08808	Maize	पहेलो मकै	*Zea*	*mays* L.	Bhim Kumari Gurung	Parbat, Mod RM, Chitre	1560
NGRC08809	Maize	पहेली मकै	*Zea*	*mays* L.	Yubaraj Basnet	Ramechhap, Gokulganga RM-2, Those	1350
NGRC08810	Maize	बङ्गारे मकै	*Zea*	*mays* L.	Bhim Bahadur Basnet	Ramechhap, Umakunda RM-2, Pagaa	2103

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NGRC08811	Maize	लोदिङ्गे पहेलो मकै	*Zea*	*mays* L.	Chhatra Bahadur Karki	Ramechhap, Umakunda RM-2, Bamtilubu	2188
NGRC08812	Maize	सेतो मकै	*Zea*	*mays* L.	Krishk Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08813	Maize	कालो मकै	*Zea*	*mays* L.	Goma Debi Khadka	Ramechhap, Gokulganga RM-2, Dorja	2018
NGRC08814	Maize	लोकल सेतो मकै	*Zea*	*mays* L.	Sabitri Karki	Ramechhap, Gokulganga RM-3, Rasnalu	1675
NGRC08815	Maize	पहेली मकै	*Zea*	*mays* L.	Pram Bahadur Basnet	Ramechhap, Gokulganga RM-2, Dorja	2011
NGRC08816	Maize	लोकल मकै	*Zea*	*mays* L.	Bhim Prasad Dulal	Lalitpur, Mahakal-6, Gumrang	1013
NGRC08817	Pea	सानो केराउ	*Pisum*	*sativum* L.	Sun Maya Ghalan	Lalitpur, Bagmati-4, Thangsing tar	935 .
NGRC08818	Rice	पाखे कालो धान	*Oryza*	*sativa* L.	Rup Bahadur Basnet	Ramechhap, Umakunda RM-2, Pagaa	2099
NGRC08819	Rice	विकासे धान	*Oryza*	*sativa* L.	Chandra Maya Basnet	Ramechhap, Umakunda RM-2, Ratnajoti	2201
NGRC08820	Rice	जुम्ली धान	*Oryza*	*sativa* L.	Bhim Kumari Gurung	Parbat, Mod RM, Chitre	1560
NGRC08821	Rice	अग्लो बास्मती धान	*Oryza*	*sativa* L.	Lupta Kumari Dahal	Lalitpur, Bagmati-7, Beshishahar	530
NGRC08822	Rice	रातो धान	*Oryza*	*sativa* L.	Aambika Basnet	Ramechhap, Umakunda RM-2, Pagaa	2005
NGRC08823	Rice	गुड्डी धान	*Oryza*	*sativa* L.	Bhim Kumari Gurung	Parbat, Mod RM, Chitre	1560
NGRC08824	Rice	बासमती धान	*Oryza*	*sativa* L.	Maduraj Ghimire	Lalitpur, Bagmati-6, Syauri gaun	1162
NGRC08825	Rice	मगाने धान	*Oryza*	*sativa* L.	Krishna Bahadur Bhujel	Ramechhap, Umakunda RM-2, Rosi	180
NGRC08826	Rice	भौईमाली धान	*Oryza*	*sativa* L.	Surendra Basnet	Ramechhap, Umakunda RM-2, Ratnajoti	2210
NGRC08827	Rice	आपझुते धान	*Oryza*	*sativa* L.	Bhim Kumari Gurung	Parbat, Mod RM, Chitre	1560
NGRC08828	Soybean	हरियो भटमास	*Glycine*	*max* (L.) Merr	Menuka Thing	Lalitpur, Bagmati-4, Pyutar	850
NGRC08829	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Bhim Bahadur Basnet	Ramechhap, Umakunda RM-2, Pagaa	2103
NGRC08830	Soybean	स्थानीय ठुलो भटमास	*Glycine*	*max* (L.) Merr	Krishk Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08831	Soybean	ठुलो रातो भट्ट	*Glycine*	*max* (L.) Merr	Chandra Maya Basnet	Ramechhap, Umakunda RM-2, Ratnajoti	2201
NGRC08832	Soybean	भटमास	*Glycine*	*max* (L.) Merr	Susila Bajagain	Lalitpur, Bagmati-4, Pyutar	100 .
NGRC08833	Soybean	कालो भटमास	*Glycine*	*max* (L.) Merr	Bolmaya Bomjan	Lalitpur, Bagmati-4, Pyutar	
NGRC08834	Soybean	सेतो माईली भटमास	*Glycine*	*max* (L.) Merr	Purna Kumar Banjara	Lalitpur, Mahakal-6, Silingge	1013
NGRC08835	Soybean	लोकल भटमास	*Glycine*	*max* (L.) Merr	Krishk Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08836	Soybean	कालो भटमास	*Glycine*	*max* (L.) Merr	Krishk Samaha	Lalitpur, Bagmati-4, Pyutar	

ACCESSION	Crop	जात (Cultivar)	Genus	Species	Farmer's /Donor's Name	District	Altitude (m)
NGRC08837	Wheat	रातो ठुलो लोकल	*Triticum*	*aestivum* L.	Narayan Basnet	Ramechhap, Umakunda RM-2, Pagaa	2122
NGRC08838	Wheat	बैशाखे ठुलो गहुँ	*Triticum*	*aestivum* L.	Aambika Basnet	Ramechhap, Umakunda RM-2, Pagaa	2005
NGRC08839	Wheat	स्थानीय सेतो गहु	*Triticum*	*aestivum* L.	Krishna Bahadur Bhujel	Ramechhap, Umakunda RM-2, Rosi	1803
NGRC08840	Wheat	ठुलो गहुँ	*Triticum*	*aestivum* L.	Chandra Maya Basnet	Ramechhap, Umakunda RM-2, Pagaa	2004
NGRC08841	Wheat	रातो गहुँ	*Triticum*	*aestivum* L.	Bhim Bahadur Basnet	Ramechhap, Umakunda RM-2, Pagaa	2103
NGRC08842	Wheat	सेतो स्थानीय गहुँ	*Triticum*	*aestivum* L.	Ganesh Lamichhane	Ramechhap, Umakunda RM-2, Lubu	2184
NGRC08843	Bean	छिरबिरे सिमी	*Phaseolus*	*vulgaris* L.	Hari Maya Bajagain	Lalitpur, Bagmati-4, Pyutar	100 .
NGRC08844	Bean	काजु सिमी	*Phaseolus*	*vulgaris* L.	Nanda Kumari Ghimire	Lalitpur, Bagmati-6, Syauri gaun	1165
NGRC08845	Field bean	सरादे सिमि	Phaseolus	sp.	Cbsb, Rampur Dang	Dang, Rampur-3, Rampur	
NGRC08846	Bean	बाख्रा मर्ने सिमी- दाल सिमी	*Phaseolus*	*vulgaris* L.	Raj Sunar - Susila Sunar	Lalitpur, Bagmati-3, Bhatte dada	1365
NGRC08847	Bean	कालेशवरी सिमी	*Phaseolus*	*vulgaris* L.	Sun Maya Ghalan	Lalitpur, Bagmati-4, Thangsing tar	935
NGRC08848	Bean	रातो सिमी	*Phaseolus*	*vulgaris* L.	Krishi Samuha	Lalitpur, Bagmati-4, Pyutar	
NGRC08849	Soybean	सेतो भटमास	*Glycine*	*max* (L.) Merr	Tara Debi Joshi	Doti, Disi M-5, Silgadi	900
NGRC08850	Bean	हिउदे सिमी	*Phaseolus*	*vulgaris* L.	Ram Bahadur Thapa	Panchthar, Phidim M-4, Tapatar	624
NGRC08851	Bean	चिरिबिरे सिमी	*Phaseolus*	*vulgaris* L.	Dil Kumar Acharya	Ilam, Royung RM-3, Kolbung	1482
NGRC08852	Bean	कालो सिमी	*Phaseolus*	*vulgaris* L.	Chek Bdr. Budhathoki	Mustang, Marpha-1	2695
NGRC08853	Finger millet	नंग्रे कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Santa Tamang	Lamjung, Kolki-9, Dobhan	709
NGRC08854	Finger millet	डल्ले कार्तिके कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Lalita Gurung	Lamjung, Kolka-8, Bansar besi	829
NGRC08855	Finger millet	कार्तिके कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Gauri Gurung	Lamjung, Ilampokhari-6, Udhi	1284
NGRC08856	Finger millet	मंग्सिरे कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Gauri Gurung	Lamjung, Ilampokhari-6, Udhi	1284
NGRC08857	Barnyard millet	सामा	*Echinochloa*	*frumentacea* Link	Sita Neopane	Gorkha, Saurpani	1160
NGRC08858	Finger millet	सेतो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Bhakti Ram Aryal	Makwanpur, Khairang-1, Belghari	724
NGRC08859	Finger millet	कालो कोदो	*Eleusine*	*coracana* (L.) Gaertn.	Bhakti Ram Aryal	Makwanpur, Khairang-1, Belghari	724

Annex 9.1. Passport format in English

Genebank-NARC, Khumaltar, PO Box 3055, Kathmandu. Tel: 01 500 3331, 500 3125. www.genebank-narc.gov.np

Passport Descriptors for Collection of Agricultural Genetic Resources

A. SAMPLE IDENTIFICATION
Collection /Donor number:
Crop (English name):
बाली (नेपाली नाम):
बाली (स्थानिय नाम):
Name of cultivar (in Nepali and local language with meaning):

Genus:
Species:
Subspecies/ var:
Parentage:

B. COLLECTING SITE
Farmer's or Donor's name:

I. General
District: VDC:
Ward: Village/Tole:
Distance (from VDC office):
Nearest market/ famous place:
Latitude (N):
Longitude (E):
Altitude (m):

II. Collection source (circle one)
1. Wild 2. Farmland
3. Farm store 4. Kitchen garden
5. Village market 6. Commercial market
7. Institute (name) 8. Other (specify)

III. Cultivating domain (circle one)
1. Mountain 2. High hill 3. Mid hill
4. Foot hill 5. Tarai and Inner Tarai

IV. Collection/ growing site (circle one)
1. Sloppy 2. Swampy land 3. Plain
4. Terrace 5. River basin 6. Other (specify)

V. Associated wild, weedy and crops species (specify):

C. CHARACTERIZATION AND MANAGEMENT
Sowing month (Nepali):
Harvest date of this sample in Nepali Calendar (YYYY/MM):
Usage (specify):

Important traits or reason of growing:

Disease & insect pest in field and store (specify):

D. SAMPLE
I. Status of sample (circle one)
1. Landrace 2. Cultivar (advanced/ improved)
3. Wild 4. Weedy 5. Breeder's line
6. Other (specify)

II. Original source (circle one and give name)
1. Own 2. Local 3. Market
4. Institute 5. Other (specify)

III. When it is introduced & from where?

IV. Frequency (circle one)
1. Widely cultivated 2. Localized 3. Rare

V. Population variability (circle one)
1. Uniform 2. Not uniform 3. Mix type

VI. Sampling method (circle one)
1. Bulk 2. Random 3. Selective

VII. Number of plants or farmers sampled:

VIII. Quantity of material (number of seeds, fruits or wt /sample):

IX. Type of sample (circle one)
1. Vegetative 2. Seed
3. Both 4. Fruit

X. Herbarium sample: 1. Yes 2. No

XI. Photo: 1. Yes 2. No

XII. Cultural practices
1. Irrigated 1. Yes 2. No
2. Transplanted 1. Yes 2. No
3. High inputs 1. Yes 2. No
4. Others (specify):

E. OTHER OBSERVATIONS & COMMENTS:

Collector's name & institute:

Date of collection (English calendar as DD/MM/YYYY):

Annex 9.2. Passport format in Nepali

जिन बैंक, नार्क, खुमलटार, पोष्ट बक्स ३०५५, काठमाण्डौं. फोन: ०१ ५०० ३३३१, ५०० ३१२५. www.genebank-narc.gov.np

कृषि आनुबंशिक स्रोत सङ्कलन पासपोर्ट फारम

क. नमुनाको परिचय
सङ्कलन वा दाताको नं:
बाली (Crop):
बाली (स्थानिय नाम):
जाति (Genus):
प्रजाति (Species):
उपप्रजाति (Subspecies):
पूर्ख्यौंली (Parentage):
जातको नाम (नेपाली तथा स्थानिय भाषामा) र अर्थ:

ख. सङ्कलन स्थान
कृषक वा दाताको नाम:

I. साधारण
जिल्ला: गा.वि.स.:
वार्ड नं: गाउँ:
गा.वि.स. देखिको दुरी:
नजिकको बजार वा प्रसिद्ध ठाउँ:
सङ्कलन स्थानको अक्षांस (उ):
सङ्कलन स्थानको देशान्तर (पू):
सङ्कलन स्थानको उचाई (मि):

II. सङ्कलन श्रोत स्थान (गोलो लगाउनुस्)
१. जङ्गली २. कृषि जमिन ३. भण्डारण ४. घर वगैचा
५. गाउँको बजार ६. ब्यापारिक बजार ७. संस्था
८. अन्य (कुनै भए लेख्नुस्)

III. खेती गरिने क्षेत्र (गोलो लगाउनुस्)
१. उच्च पर्वत २. उच्च पहाड ३. मध्य पहाड
४. वेसी ५. तराई तथा भित्री मधेश

IV. संकलित वा उत्पादित क्षेत्रको अवस्था (गोलो लगाउनुस्)
१. भिरालो २. दलदल ३. समथल ४. उबड खाबड
५. नदि-किनार ६. अन्य (कुनै भए लेख्नुस्)

V. बालीसङ्ग फिल्डमा संलग्न झारपात, प्रजातिहरु (उल्लेख गर्नुस्):

ग. जातको गुणहरु तथा व्यवस्थापन
बाली रोप्ने महिना:
संकलित बाली भित्र्याएको साल र महिना:
प्रयोग:

महत्वपूर्ण गुणहरु:

रोग तथा किराहरु (फिल्ड र भण्डारमा):

घ. सङ्कलित नमुना
I. नमुनाको अवस्था (गोलो लगाउनुस्)
१. स्थानिय जात २. उन्नत जात ३. जङ्गली
४. झारपात ५. प्रजनन् ६. अन्य (कुनै भए उल्लेख गर्नुस्)

II. सङ्कलित जातको स्रोत (गोलो लगाउनुस् र नाम लेख्नुस्)
१. आफ्नै २. स्थानिय ३. बजार ४. संस्था
५. अन्य (उल्लेख गर्नुस्)

III. कहिले र कहाँबाट ल्याइएको:

IV. सङ्कलित जातको अवस्था
१. धेरै ठाउँमा खेती गरिने २. थोरै ठाउँमा खेती गरिने
३. लोपोन्मुख

V. सङ्कलित जातमा विविधता
१. एकैनास २. एकैनास नभएको ३. मिश्रित

VI. नमुना संकलन तरिका (गोलो लगाउनुस्)
१. मिश्रित २. छानेर ३. हचुवा

VII. नमुना संकलनमा संलग्न बिरुवा वा कृषकको संख्या:

VIII. सङ्कलित बस्तुको परिमाण (बीउ वा बिरुवाको संख्या वा तौल प्रति नमुना):

IX. नमुनाको प्रकार (गोलो लगाउनुस)
१. वानस्पतिक २. बीउ ३. दुबै ४. फल

X. हर्बेरियम् (बिरुवा वा बिरुवाको अङ्ग) को नमुना:
१. छ २. छैन

XI. फोटो लिएको: १. छ २. छैन

XII. खेती गरिने तरिका:
१. सिंचित खेती १. छ २. छैन
२. रोप्ने वा सार्ने १. छ २. छैन
३. उच्च प्रविधि खेती १. छ २. छैन
४. अन्य (उल्लेख गर्नुस्):

ङ. अन्य कुनै अवलोकन तथा सुझावहरु :

संकलनकर्ताको नाम र संस्था:

सङ्कलन मिति (YYYY/MM/DD):

Annex 10. Agrobiodiversity components

Phool tarul

Sano Kankro

Dalle Kankro

Seto Kankro

Hariyo Kankro

Lauke Kankro

Kande Kankro

Lamcho hariyo Kankro

Achare Kankro

Achare Kankro

Cucumber Diveristy at Genebank

Fingermillet Diveristy at Genebank