Integrating Traditional Crop Genetic Diversity into Technology:
Using a Biodiversity Portfolio Approach to Buffer against Unpredictable Environmental Change in the Nepal Himalayas

BASELINE SURVEY REPORT

JUNGU, DOLAKHA | DECEMBER 2016

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LI-BIRD (Pokhara, Nepal; http://www.libird.org)
Local Initiatives for Biodiversity, Research and Development (LI-BIRD) is a non-profit, non-governmental organization established in 1995 to reduce poverty and promote social justice by empowering rural poor and marginalized smallholder farmers, especially women, who depend primarily on agriculture, biodiversity, and natural resources for their livelihoods. To achieve these goals, LI-BIRD is committed to capitalizing on local initiatives, synergy, and partnerships for sustainable management of renewable natural resources. Through development-oriented research in agriculture and natural resource management, LI-BIRD contributes to several innovative methods and approaches, aiming to achieve a positive impact on the livelihoods of rural poor and marginalized farmers through appropriate technological, social, and policy changes. LI-BIRD plays an instrumental role in institutionalizing these approaches in national systems.

NARC (Singhadarbar Plaza, Kathmandu, Nepal; http://narc.gov.np)
The Nepal Agricultural Research Council (NARC), established in 1991 as an autonomous organization,is an apex body for agricultural research in Nepal. It includes many commodity programs, research stations located across the country, and disciplinary divisions as well as a national gene bank in Khumaltar. NARC carries out research on various aspects of agriculture, identifies solutions to existing problems in agriculture,and assists the government in formulating agricultural policies and strategies.

Bioversity International (Rome, Italy; https://www.bioversityinternational.org)
Bioversity International is a member of the CGIAR consortium. Its vision is that agricultural biodiversity nourishes people and sustains the planet. Bioversity International produces scientific evidence and develops management practices and policy options to safeguard agricultural and tree biodiversity and attain sustainable global food and nutrition security.

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ABBREVIATIONS AND ACRONYMS

ASC	Agriculture Service Centre
CBM	Community Biodiversity Managment
CBO	Community based Organization
CBS	Central Beauru of Statistics
CEAPRED	Center for Environment and Agricultural Policy Research, Extension and Development
CFUG	Community Forest User's Group
CSB	Community Seed Bank
DoA	Deparment of Agriculture
DADO	District Agriculture Development Office
DDC	District Development Committee
DLSO	Global Environment Facility
FAO	Food and Agriculture Organization
FCA	Four Cell Analysis
FFS	Farmers Field School
FGD	Focused Group Discussion
FYM	Farmyard Manure
GEF	Global Environment Facility
GESI	Gender Equity and Social Inclusion
HCRP	Hill Crop Research Programme
HDI	Human Development Index
HH	Household
HPI	Human Poverty Index
IFAD	International Fund for Agricultural Development
IRD	Informal Research and Development
LCP	Local Crop Project
LI-BIRD	Local Initiative for Biodiversity, Research and Development
MAPs	Medicinal and Aromatic Plants
masl	Meter Above the Sea Level
mm	Millimeter
NARC	Nepal Agricultural Research Council
NAGRC	National Agriculture Genetic Resurces Centre
NFC	Nepal Food Corporation
NUS	Neglected and Underutilized Species
PPB	Participatory Plant Breeding
PSE	Participatory Seed Exchange
PRA	Participatory Rural Appraisal
PVS	Participatory Variety Selection
UNEP	United Nation Environmental Programme
VDC	Village Development Committee
WCF	Ward Citizen Forum

1. INTRODUCTION

1.1 Background Information

The Himalayan ecosystem in Nepal, with its steep rises in elevation, rugged terrains, and patchworks of ethnic and cultural diversity, has imposed unique selection pressures on high mountain agricultural biodiversity. Cold tolerance acts as a severe bottleneck to diversity in this environment. Despite this, farming communities have been maintaining a rich diversity of food crops for generations. For instance, the Chhomrong Dhan, an indigenous variety of cold tolerant red rice from Nepal has now spread to over 85% of the rice growing areas of the world, and has reached countries as far as Bhutan (Matsushita et al., 2011; Ghaley et al., 2012) and Madagascar. This illustrates its immense value, which is largely due to its rare combination of cold tolerance, stable blast resistance, and wide adaptability.

Besides cold tolerant rice, farming communities in this region also rely on the diversity of under-researched but locally adapted crops, such as proso millet, foxtail millet, buckwheat, finger millet, naked barley, barley, amaranth, and the common bean. The Nepali Himalayas are the primary and secondary centres of diversity for rice, amaranths, barley, buckwheat, millets, and bean (Hawkes, 1998).

Despite tens of thousands of edible plants, only 10 cereal grains, legumes, and oilseeds dominate 80% of the world's cropland (Glover et al., 2007). Wheat, rice, and maize by themselves account for two-thirds of the world's arable lands. This is starkly reflected in the diets we consume, where 90% of our plant-based calories can be traced back to only 30 or so crops (FAO, 2009). Consequently, about 60% of the world's population is currently malnourished, either due to a lack of calories or because of too much of the wrong kind of calories (Pimentel, 2011).

In the context of climate change, over reliance on a handful of commodity crops puts our global food security at a great risk, as it can expose people to rampant speculation of food prices and even result in food crises and riots like those seen in 2008. Because traditional mountain crops are highly under-researched, mountain farming communities have not had the benefit of better yielding varieties and advanced processing services. High-mountain districts of Nepal, such as Humla (ranking 73rd out of 75 districts in human development index), already suffer from limited access to basic infrastructure, education, healthcare, and nutrition. According to the Nepal Human Development Report (2014), the Human Development Index (HDI) and Human Poverty Index (HPI) values of Dolakha are 0.459 and 35.7, respectively. Poor nutrition, especially in early childhood, can have dire repercussions into adulthood, as it compromises cognitive and social development (Ruel and Hoddinott, 2008), which puts these communities at elevated risk of further marginalization.

Furthermore, the climate change impacts are predicted to be more acute in the Himalayas. A changing climate in the high mountains is also likely to exacerbate the risk of crop disease damage. For instance, rice blast (fungus *Magnaporthe oryzae* B. Couch) is a major disease in Nepal and is affecting the beloved Jumli marshi variety of rice in Jumla. These high mountain areas are sources of water to over a billion people in the Indian sub-continent, and diversity-based and integrated pest management practices are needed to ensure the area can continue to provide clean, disease-free water for the foreseeable future.

1.2 Project Context

Considering the global and local importance of these high mountain crops, the Global Environment Facility (GEF) has funded a project titled, *Integrating traditional crop diversity into technology: Using a biodiversity portfolio approach to buffer against unpredictable environmental change in the Nepal Himalayas*. The objective of the project is "to mainstream the conservation and use of agrobiodiversity in the mountain agricultural production landscapes of Nepal to improve ecosystem resilience, ecosystem services and access and benefits sharing capacity in mountain ecosystems." It aims to develop and promote diverse sets of varieties, improve access to diverse sets of planting materials, create and distribute drudgery-reducing processing technologies, and promote an enabling environment for access to the benefit-sharing of seeds and other planting materials. The project focuses on supporting the use of the rich and unique intra-specific diversity of crops that are of global importance to mountain agricultural environments, in order to buffer against the increasing unpredictability in the amount and occurrence of rainfall, temperature extremes, and the frequency and severity of pest and pathogen occurrence in the mountains of Nepal and elsewhere. The project is known as the Local Crop Project (LCP) for short.

The project has set a mandate to work on eight neglected and underutilized mountain crops that are nutrient dense, climate resilient, and indigenous to the Nepal Mountains (Table 1). These crops are buckwheat (*Fagopyrum esculentum* and *F. tataricum*), cold tolerant rice (*Oryza sativa*), common bean (*Phaseolus vulgaris*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), grain amaranth (*Amaranthus caudatus, A. cruentus* and *A. hypochondriacus*), naked barley (*Hordeum vulgare* var. *nudum*), and proso millet (*Panicum miliaceum*).

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Table 1. Mandate crop species, their local and scientific names, type of pollination system, and genetic features

S.N.	Crop	नेपाली नाम	Scientific name/synonym Scientific name/ synonym	Pollination	Genetics
1.	Amaranth	लट्टे	*Amaranthus caudatus* L. *A. cruentus* L. *A. hypochondriacus* L.	SP	2n=32 2n=34
2.	Barley	जौ	*Hordeum vulgare* L.	SP	2n=2x=16
	Naked barley	उवा	*Hordeum vulgare* L. var. *nudum* Hook. f.	SP	2n=2x=14
3.	Bean	सिमि	*Phaseolus vulgaris* L.	SP	2n=22
4.	Buckwheat	मिठे फापर तिते फापर	*Fagopyrum esculentum* Moench *F. tataricum* Gaertn.	CP SP	2n=2x=16 2n=2x=16
5.	Finger millet	कोदो	*Eleusine coracana* Gaertn.	OS	2n=36
6.	Foxtail millet	कागुनो	*Setaria italica* Beauv.	SP	2n=18
7	Proso Millet	चिनो	*Panicum miliaceum* L.	SP	2n=36
8.	Rice	धान	*Oryza sativa* L.	SP	2n=2x=24

The project is being implemented from 2014 by the United Nations Environment Programme (UNEP) and is executed in Nepal by Bioversity International, National Agriculture Genetic Resources Centre (NAGRC) within the Nepal Agricultural Research Council (NARC), Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and the Department of Agriculture (DoA). This project has been designed through extensive consultation with Nepalese agricultural research scientists and extension experts with specializations in germplasm conservation, plant breeding, plant pathology and community empowerment. The project was endorsed by the Nepal Government's Ministry of Finance on 24 November 2010. The project is being implemented in four mountain Village Development Committees (VDCs) of four districts within Nepal (Figure 1).

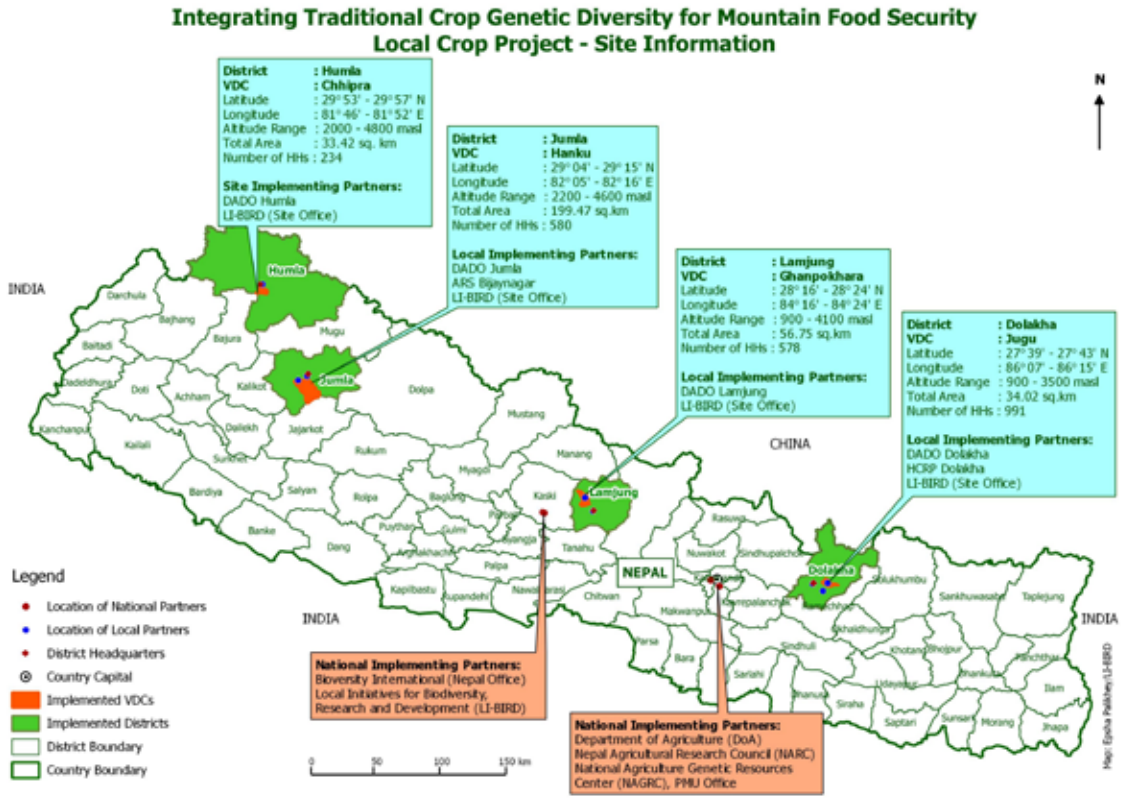

Figure 1. Project sites of the Local Crop Project (Illustration by: Epsha Palikhey/LI-BIRD)

In the first year of the project, a variety of field visits, participatory rural appraisal exercises, group discussions, diversity fairs, and household surveys were conducted to establish a benchmark for the project sites. This site baseline report provides a summary of the various facets of the mandate crops' genetic resources, traditional knowledges of the farmers, and socioeconomic contexts of the farming systems present in the project site.

1.3 Specific Objectives of Baseline Study

- To understand the socio-economic and demographic context of the farming communities
- To document the extent of genetic diversity in the mandate crops (amaranths, bean, buckwheat, naked barley, finger millet, proso millet, foxtail millet, cold tolerant rice) as well as associated traditional knowledge
- To assess the problems with the sustainable use of crop diversity and the factors that play important roles in maintaining diversity within crop species
- To understand the traditional knowledge of the area, especially regarding the use of intra-specific diversity, seed, and processing management of these crops

2. METHODOLOGY

Multiple social research tools and techniques were used to collect baseline information on the project site. Participatory Rural Appraisal (PRA) tools and household surveys were carried out to collect primary level data. Secondary information from related publications, reports, and articles were used.

2.1 Participatory Rural Appraisal (PRA)

PRA tools were adopted to gather a preliminary understanding of the local context of Jungu VDC. Information gathered through PRA was used to create relevant questions and options for a household level questionnaire. Other primary data generated from PRA were used as a complementary data source to consolidate the baseline findings.

2.1.1 Community Focus Group Discussion

Nine separate ward-level group discussions (Annex 3) were carried out on various dates to collect information regarding the local cropping system, crop diversity, seed management practice, and processing equipment. A predefined checklist was used to gather the required information regarding seed management practices and processing techniques of mandate crops (Annex 4). Participants were invited randomly with inclusive invitation that tried to be inclusive by gender ethnicity and castes as far as possible (Annex 3).

2.1.2 Four Cell Analysis (FCA)

The FCA tool (Sthapit et al., 2006) was used to explore the distribution of common and unique crop varieties, including those of mandate crops. For both crops and varieties, FCA of mandate crops was done during site selection and community group discussion.

2.1.3 Key Informant Interview

Key informant interviews were conducted among key community personnel, farmers, teachers and VDC office staff to gather additional information about the existing local crop diversities, seed systems, processing and management practices, available agricultural facilities, and other related topics. A list of key informants can be found in Annex 8.

2.1.4 Community Transect Walk

Community transect walks were completed in all nine wards of the VDC to collect and validate the collected information regarding mandate crops. All walks were accompanied by digital photographic documentations.

2.2 Household Questionnaire Survey

Household survey was conducted from 31 January to 3 February, 2015. Sampled households from each ward were visited and, after their approval, eligible members of the family were interviewed. A semi-structured questionnaire (Annex 1) was used to collect household level information by interviewing the each of the listed sample respondent. A well-being ranking of the household was not incorporated in the study deliberately in order to get generalized information. Key steps for designing and implementing of the household survey are presented in Figure 2.

2.2.1 Questionnaire Preparation and Pre-testing

The household survey was prepared by reviewing questionnaires of other similar projects, like the Strengthening the Scientific basis for on farm Conservation of Agrobiodiversity (*in-situ*) project (Rana et al., 2000) and the Community Biodiversity Management (CBM) project. It was decided to prepare a brief questionnaire because basic information had already been collected from the PRA

exercises and site selection surveys. The drafted questionnaire was shared with a team of experts from Bioversity Nepal, NARC Gene bank, and LI-BIRD for reviewing and commenting. The questionnaire was refined by incorporating the suggestions from the consulted experts, and was pre-tested with a few sample farmers in Arba, Kaski before field administration. The findings of pre-testing were used to finalize the survey (Annex 1).

2.2.2 Sample Size and Sampling Procedure

The total number households in the VDC and the name of the head of each house was collected through the active participation of Ama Samuha volunteers from each ward[1] of the VDC. In total, 991 residing households were listed and a sample size of 88 was calculated using a sample size estimation formula (equation i). This calculated sample size has a 95% confidence level within the 10% margins of error.

$$n_w = \frac{N_w}{N} \times n \quad \text{..... } (i)$$

Where,

n = sample size

Z = value of standard variate at a given confidence level and to be worked out from table showing area under normal curve

P = largest possible proportion (0.5) or sample proportion

q = 1 - p

d=the sampling error (0.10)

N=size of population

The probability to size proportion technique (equation ii) was used to distribute the calculated sample size among each ward with consideration of the total number of households within the ward. A total of 90 households were sampled[2] using numbers randomly generated from Windows MS-Excel 2013.

$$n_w = \frac{N_w}{N} \times n \quad \text{..... } (ii)$$

Where,

n_w = sample size for the ward

N_w = total number of households in the ward

N = total number of households in the VDC

n = total VDC sample size from equation (i)

2.2.3 Administration of the Survey

Along with project site members, three locally hired enumerators were involved in administering the household survey. Site members were given orientation on the questionnaire content, sampling, and interviewing process by the head office team and other project site staff who had already conducted baseline surveys in their sites. Locally hired enumerators were given orientation by Dolakha site staff on 30 January 2015 through practical demonstrations on the survey contents, interviewing methods, and data recording practices. At the end of each interview day the interviewee team and coordinator jointly cross checked the data collected in the field to minimize the effects of any response and recording errors. Due to the remoteness of the interview site, immediate data entry into a digital spreadsheet in the field was not possible.

1 Ward is the lowest administrative unit of government in Nepal

2 Rounding up of the values from probability proportion to size technique leads to increase two HHs in total and hence 90 HHs were surveyed which is more than calculated sample size.

Enumerator recording household level information during baseline survey. Photo: Niranjan Pudasaini, LI-BIRD

2.2.4 Data Entry, Cleaning and Analysis

Data entry was completed from the site office at the end of February 2015. Afterward, data were cleaned and units were standardized across the various surveys to allow for further data analysis. Explorative statistical analysis (mean, frequency, standard deviation and standard error) was done with Microsoft Excel 2013 and SPSS 16.

Various tables, graphs and charts were used to present the findings, and were interpreted to meet the objectives of the research. Information gathered from PRAs, household surveys, and secondary data sources were consolidated and used to validate the results.

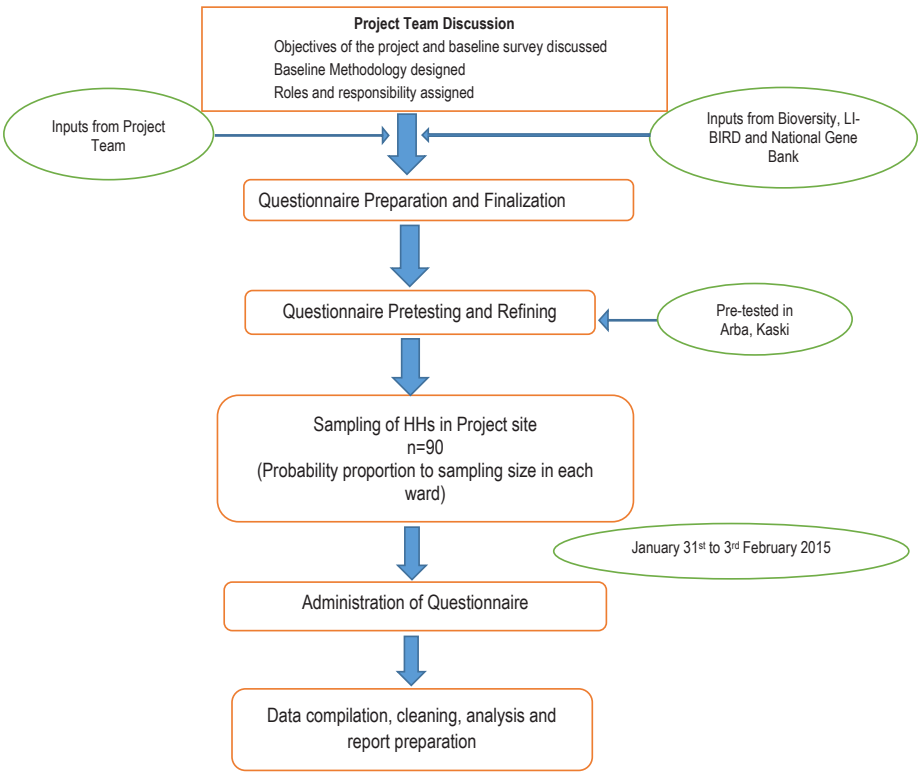

Figure 2. Diagrammatic representation of processes underlying the baseline household questionnaire survey

3. SITE CHARACTERISTICS

3.1. Overview of Dolakha District

3.1.1 Geographic Information

The Dolakha district lies within the Janakpur zone of Nepal's central development region. It is bordered in the east and northeast by the districts of Ramechhap and Solukhumbu, in the south and southwest by Ramechhap and Kabrepalanchok, in the north by Tibet of China, and in the west by Sindhupalchok. Dolakha district has 2 municipalities (Bhimeswor and Jiri) and consists of 47 VDCs. Charikot is the district headquarter. Dolakha is also famous for various pilgrimage sights for Hindus, including Dolakha Bhimsen temple and Kalinchowk Devi temple.

Dolakha lies between 27°28′ and 28°0′ north latitude and 85°50′ and 86°32′ east longitude, and the altitude ranges from 732 to 7148 metres above sea level (masl). The total area of the district is 2142.87 m^2 (DADO Report 2070/71 BS). From the north to the south, the district is made up of a high Himalayan region, fore Himalayan region (high hill region), and the Mahabharat hill range. Because of this, Dolakha is one of three hilly districts in the Janakpur zone. The district has 56,686 ha (26.4%) of cultivated land, 101,500 ha (47.3%) of forested area, 29,500 ha (13.7%) of grass land and 5,665 ha (2.6%) of snow covered mountain areas (DADO, 2015).

3.1.2 Climatic Information

Dolakha consists of sub-tropical, warm temperate, cool temperate (in mountain area), sub-alpine, and alpine climates. The average annual air temperature ranges from an 8°C minimum to a 19°C maximum and annual average rainfall is roughly 2044 mm (Jungu VDC Profile, 2009). Dramatic geographical variation has created diverse macro and micro climatic environments, and because of this the district is rich in floral and faunal diversity.

3.1.3 Demographic Information

The total population of the district is 186,557 people (99,554 females and 87,003 males) with a population density of 87 people per square kilometer. There is a total of 45,688 households, and an average household size of 4.08 people (CSB, 2011). The majority of the population is Hindu (71.05%), while 28.59% is Buddhist and 0.36% is classified as "Other". The ethnic composition of the district is 35.8% Chhetri, 15.9% Tamang, and 9.8% Brahmin. The remaining percentage is made up of a mixture of groups that accounts for small percentages, including the occupational castes: Kami (blacksmith 3.5%), Damai (tailor 1.8%) and Sarki (cobbler 1.7%) (CSB, 2011). The most common occupation of the district's population is agriculture and livestock (67.2%), followed by industry and business (17%), service (0.3%) and others (2.4%) (CSB, 2011). According to the Nepal Human Development Report (2014), the Human Development Index (HDI) and Human Poverty Index (HPI) values of Dolakha are 0.459 and 35.7, respectively.

3.2 Overview of Jungu VDC

3.2.1 Geographical Information

Jungu is a VDC of Dolakha, and lies in the northeastern region of the district. The VDC is extends from 27°50′ to 27°43′ North, and 86°8′ to 86°15′ East, and has an altitude range of 950 to 3000 masl, as well as a steep slope topography. It is located on the north-eastern slope of the Tamakoshi river watershed and the settlements are arranged facing south-west and west-north. The VDC covers an area of 33 km^2, where 60% of the land area is forested, and only 40% of land is cultivated. The land that is cultivated is done so primarily with the use of a terrace farming system (Jungu VDC Profile, 2009).

3.2.2 Climatic Information

Depending on the altitudinal gradient, the climate of Jungu VDC can be categorized as sub-tropical, warm temperate, or sub-

alpine. The average annual air temperature of Jungu ranges from a 3°C minimum to a 22°C maximum and the average annual rainfall is about 2000 mm per year. During the winter season, the temperature falls below 0°C and some high altitude hill tops receive snowfall.

3.2.3 Demographic Information

According to the National Population Census 2011, Jungu VDC has 938 households, a total population of 3882 (1791 male and 2091 female), and an average family size of 4.1 people. The literacy rate of the VDC is 56% for both males and females (CBS 2011). Brahmin, Chhetri, Dalit and Janjati are the major ethnic communities in the VDC. The household name list prepared by the project gave a household count of 991, which was used as the basis for sampling and conducting the survey in January 2015. The earthquakes on 25 April and 12 May 2015 damaged almost all the houses in Jungu and the community, like many in the district, were in need of humanitarian aid. After the earthquake, the number of nuclear families in the official records increased greatly as many joint families split to access aid distribution and the government's house reconstruction money given on per family or household basis. Officially, there are approximately 1700 households in Jungu now however most still live together as joint families.

3.2.4 Livelihood and Farming System

A crop-livestock integrated farming system is the most common livelihood strategy in Jungu VDC. Traditional terrace farming of local crops is the pillar of food security for the VDC. Besides personal crop production, livelihoods are often also supported by off-farm income sources, like seasonal migration for nonagricultural labour, foreign employments, and national services. Due to the huge trend of youth migration, farming systems have remained at the subsistence level and the drudgery of women has increased. A change in food habits, modernized living culture, and the introduction of modern/improved crop varieties, which is more common for non-mandate crops, has threatened local crop diversity and indigenous knowledge transfer.

Photograph showing up-land (Bari) with temporary livestok sheds for manuring. Photo: Niranjan Pudasaini, LI-BIRD

3.2.5 Irrigation Sources and Availability

Though the large perennial Tamakoshi River flows from the foot of the VDC, agricultural practices in Jungu VDC are heavily reliant on a natural rainfed irrigation system. While a few lowland areas are irrigated with locally made seasonal irrigation canals, upland areas are totally dependent on natural rainfall for irrigation. Natural springs and small rivulets are the major sources of water for small scale gravity-fed irrigation systems (earthen canals) in the area. Though no formal irrigation systems were reported in the VDC profile of 2009, a few small scale pipe irrigation systems were established with the support of DADO Dolakha for vegetable farming, but they currently are not functioning. A few proactive farmers have developed and managed their own small scale natural spring pipe irrigation systems for vegetable cultivation. In contrast, cereal crop cultivation areas are still far away from having managed irrigation facilities. Kaffle Khola, Jungu Khola, and Jhyaku Khola are rivers that can be potential water sources for developing small scale irrigation systems, but no formal efforts have been made to date. There are no natural or traditional

rainwater harvesting ponds within the VDC. After the earthquake of 12 April 2015, some natural springs have ceased to discharge water causing scarcity of drinking water.

3.2.6 Status of External Inputs in Agriculture

Jungu VDC lies in a remote area of Dolakha. As a result, modernization has been limited, and high input agriculture systems have not reached the area. Traditional and subsistence farming systems are predominant, and as a result the demand for chemical fertilizers and pesticides is negligible. Livestock farm yard manure is the major source of soil nutrients for all cultivated crops. Since a household's land parcels are scattered across the village, instead of composting or gathering manure in one spot and carrying to different land parcels, farmers practice shifting shed of livestock. Animals are rotated across their land parcels in temporary sheds for *in situ* manuring. Heap manuring is used for land parcels near the homestead only. A few farmers purchase chemical fertilizer (especially urea) from nearby markets. The average household use of urea is about 100 kg of urea per year, but only for the major cereal crops (rice, wheat and maize) and vegetables. There is no evidence of use of modern micronutrients, bio-fertilizers and chemical pesticides in the VDC.

3.2.7 Status of Access and Use of Modern Agriculture Technologies

Traditional farming systems are predominant in Jungu VDC. In terms of seed sources, agricultural tools/techniques, and farming information, the community greatly depends on their own local resources and traditional knowledge. Except for major cereal crops (rice, maize and wheat), almost all cultivated crops are local varieties/landraces. Informal seed sources make up a major proportion of the seed system, while a small contribution of formal seed sources exists for green vegetables such as cauliflower, pea, onion, and cabbage. Farm land ploughing, sowing, harvesting, and threshing are done in a traditional way with human manual labour and traditional tools. Besides electric huller mills, mechanized or modern tools for post-harvest processing have not been introduced in the VDC. In general, Jungu VDC is still far behind in terms of mechanized farming tools and machineries.

Figure 3. Map showing Jungu VDC location within Dolakha district and land use patterns

4. FINDINGS

4.1 Demography and Socioeconomic Status of the VDC

Out of 90 interviewed respondents, 41% of farmers were male and 59% were female. The ethnicity of the VDC can be grouped into three major categories: Brahmin/Chhetri, Janjati and Dalit (Annex 7). In the VDC, Brahmin/Chhetri are the dominant caste making up 69% of the total population followed by Janjati (20%) and Dalit (11%) respectively. The VDC has 40% joint and 60% nuclear families. Janjati have the highest percentage of nuclear families followed by Dalit and Brahmin/Chhetri (Figure 4).

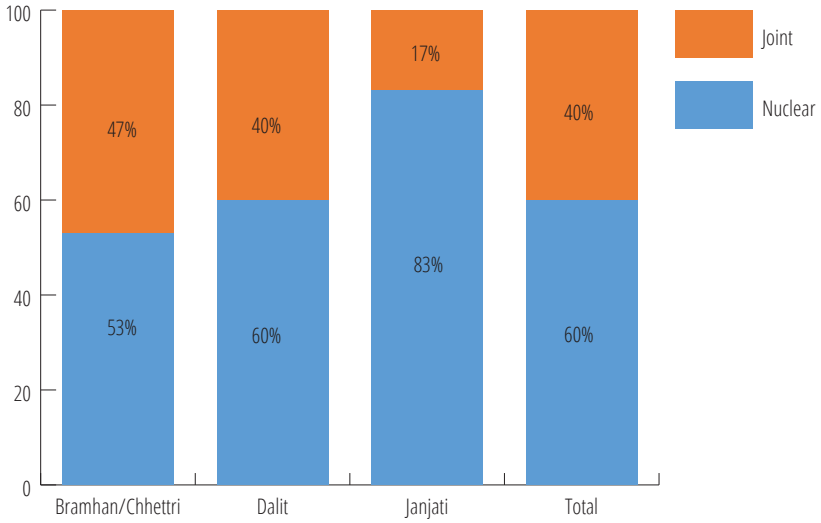

Figure 4. Ethnicity wise family type percentage in Jungu 2015

While the number of families increased in the official records after the earthquakes of 2015 due joint families splitting up into nuclear families, in practice they still live together. Since the survey was conducted before the earthquakes, it provides a snapshot of that time. The average family size of Jungu VDC is six people, which is higher than the district average of 4.1. The average size joint[3] family is higher than the total average while the average size nuclear[4] family is lower (Table 2). The average Dalit family size (both joint and nuclear) is larger than that of the two other ethnicities. Most households (92%) have a family member residing outside of the VDC either for the short term or the long term. Among households that have migrating family members, the percentage of households with male migrants is higher than those with female migrants (Table 2). In Jungu, it is common for males to seasonally migrate to Kathmandu or India for work as non-agricultural labour. This trend is most common in the Dalit ethnicity. The percentage of households with only female migrants is very low in comparison to the percentages of only male and both male and female migrants (Figure 5).

Table 2. Family and migration details of households in Jungu in 2015

Family Size*	Brahmin/Chhetri	Dalit	Janjati	Total
Nuclear	4.44 ± 0.9	5.5 ± 0.8	4.8 ± 0.5	4.9 ± 0.2
Joint	7.4 ± 0.4	7.5 ± 1.2	6.3 ± 1.7	7.3 ± 0.4
Total	6 ± 0.3	6.3 ± 0.7	5.1 ± 0.5	5.8 ± 0.2
Migrants**				
Total	62 (100)	8 (80)	13 (72)	83 (92)

Note: Figures in parenthesis are percentages of their respective columns.
** Average number of family members ± Standard Error (SE) of mean*
*** Number of HHs that have at least one migrant family member*

3 Families residing together with more than two generations
4 Families residing together with only one or two generations

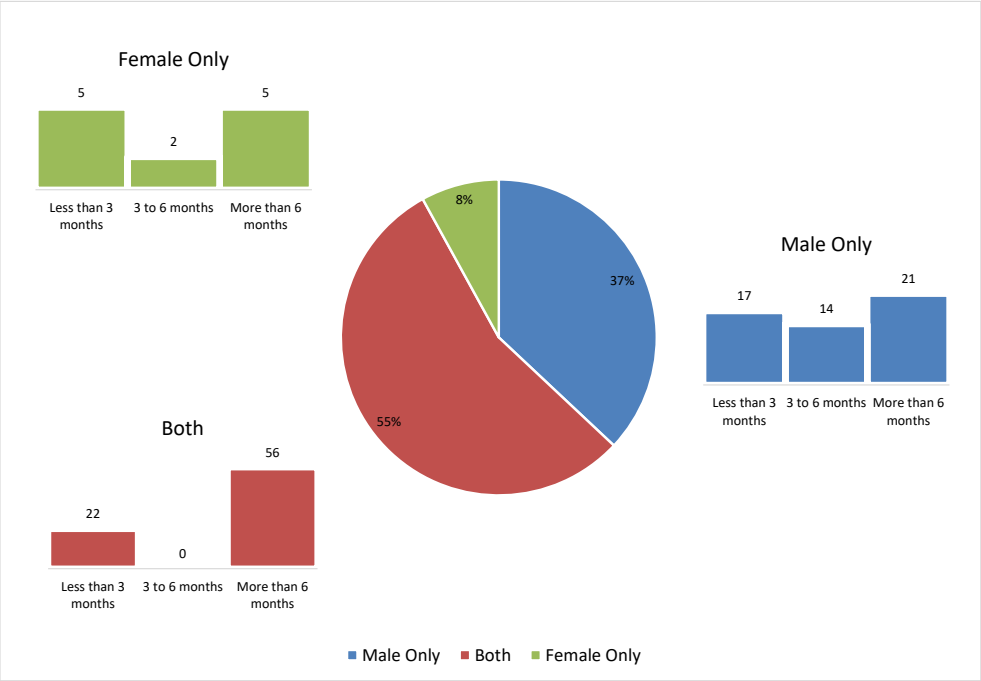

Figure 5. Migrant workers from Jungu VDC are predominantly men

Households with both male and female migrants are common in the area and most of them migrate for more than six months period (Figure 5). Additionally, native service holders (i.e., salaried employees of the government, non profit or businesses) and wives of foreign employees reside outside of the VDC for long periods, while students leave only for short periods of time. Households that have male migrants tend to have female migrants as well (Figure 5). Short term and midterm (three to six months) migration of households with male migrants is mainly for non-agricultural labour and is the most common phenomenon in these households.

In Jungu VDC, seven different major sources of family income are prevalent. Agriculture is the primary source of occupation for the majority of households (56%), followed by various forms of non-agricultural labour. In country service, remittance, business, agricultural labour (work for cash in other's farms), and the collection of medicinal and aromatic plants (MAPs) are the other major sources of income identified (Figure 6). Because of the common occurrence of seasonal migration for foreign off farm employment (Table 2), remittance and non-agricultural labour contribute as the major source of family income in 11% of households in the VDC. After agriculture, non-agricultural labour is the second most common occupation/income source. Non-agricultural labour is most common in the Dalit community, followed by Janjati and Brahmin/Chhetri (Figure 6). Brahmin/Chhetri have the most diversified family income sources, followed by Janjati. The Dalit community has only three types of income to sustain their livelihood.

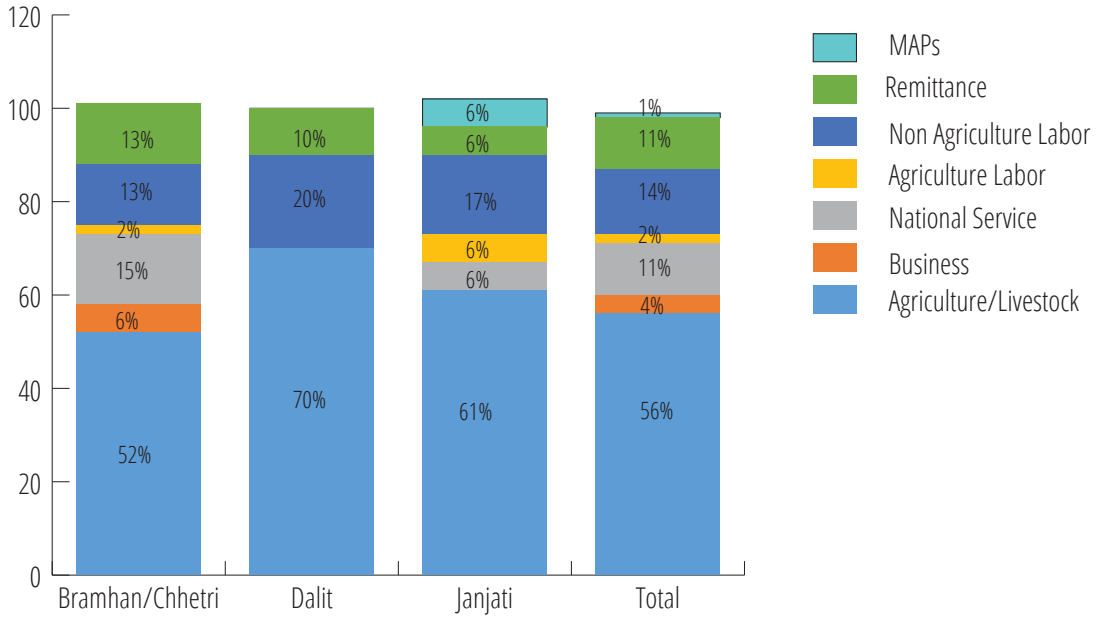

Figure 6. Primary occupation of households in Jungu in 2015

Joint decision making in agriculture is predominant (44%) in Jungu VDC, followed by female (38%) and male (18%) decision making on farming activities. Joint decision making is most common among members of the Brahmin/Chhetri ethnicity. In all ethnic communities, women tend to be decision makers in agriculture compared to men (Figure 7).

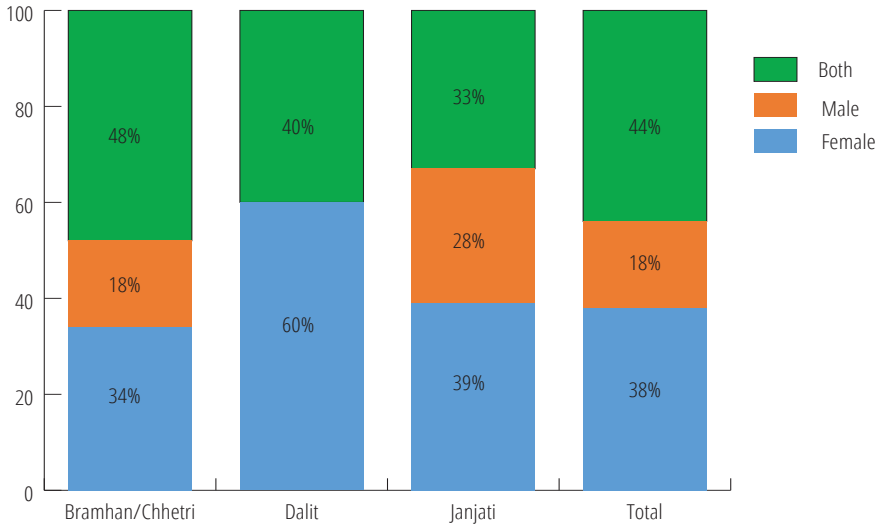

Figure 7. Gender of decision makers on farming matters at the household level in Jungu 2015

The community level average number of female and male family members involved in agricultural labour per household is equal, but the frequency of female operated households is much higher than that of male operated households (Table 3). Gender wise, involvement of women in agriculture is most common in the Dalit community. The average number of both male and female involvement in agriculture of a Dalit household is higher than the community average, which indicates that Dalit are mostly involved in agriculture work within this community for their own work and as a source of income (Table 3). Two findings, the involvement of women in agriculture and the greater decision making role of women, indicate the dominant role of women in the Jungu farming system (Table 3 and Figure 7).

In terms of agricultural resources, Brahmin/Chhetri families have above average aggregate landholding (9.6 ropani[5]) while Dalit and Janjati families have less than the average (Table 3). The average land holding is 8.25 ropani (0.42 ha), which is lower than national average of 0.68 ha (CBS, 2013). A trend of sharing-in of *khet*[6] and *bari*[7] exists in the VDC. The average shared-in *Khet* of Dalit is the highest among the groups, while share-in *bari* is highest with the Janjati community (Table 3). In all types of land resources, the Brahmin/Chhetri community has highest ownership values and also sharing-in practice is more common compared to the other ethnicities (Table 3).

Table 3. Household agricultural resource, family labour and farm land in Jungu in 2015

Resources	Brahmin/Chhetri	Dalit	Janjati	Total
Farm Labour*				
Male	1.3 ± 0.09 (61)	2 ± 0.5 (60)	1.3 ± 0.07 (83)	1.3 ± 0.09 (61)
Female	1.3 ± 0.06 (91	1.7 ± 0.4 (100)	1.1 ± 0.09 (61)	1.3 ± 0.07 (93)
Khet Land **				
HH Ownership	4.84 ± 0.4 (81)	2.9 ± 0.6 (50)	2.5 ± 0.7 (50)	4.3 ± 0.3 (71)
Shared-in	3.4 ±0.5 (29)	4 ± 0 (10)	2 ± 0 (6)	3.3 ± 0.4 (22)
Fallow	2.2 ± 0.3 (6)	1.5 ± 0 (10)	2 ± 0.5 (2)	2 ± 0.2 (7)
Bari Land (ropani)**				
HH Ownership	4.1 ± 0.4 (100)	2.4 ± 0.3 (100)	3.2 ± 0.4 (94)	3.8 ± 0.3 (99)
Shared-in	1.5 ± 0 (65)	1.5 ± 0.5 (30)	3.5 ± 1 (11)	2 ± 0.4 (9)

5 Ropani is a local unit for area measurement which is equivalent to 508.5 meter square.
6 Khet is land type used for cultivating rice crop and has bunds to collect the water.
7 Bari is land type used for cultivating rain-fed crops such as maize and millets and have no bunds for water management.

Resources	Brahmin/Chhetri	Dalit	Janjati	Total
Shared-out	2.6 ± 0.4 (11)	-	3 ± 0 (6)	2.6 ± 0.4 (9)
Fallow	2.2 ± 0.6 (27)	-	-	2.3 ± 0.3 (29)
Orchard **	1.4 ± 0.3 (16)	-	0.7 ± 0 (6)	1.3 ± 0.3 (12)
Khar Bari **	0.8 ± 0.3 (3)	-	1 ± 0 (6)	0.9 ± 0. (3)
Forest**	2.7 ± 0.4 (45)	2.3 ± 1.2 (20)	2.8 ± 0.6 (50)	2.7 ± 0.3 (43)
Total Own Land** (All types)	9.59 ± 0.8	4.27 ± 0.86	5.87 ± 0.87	8.25 ± 0.62
Total Cultivated Land** (All types)	8.84 ± 0.82	4.05 ± 0.81	4.69 ± 0.95	7.48 ± 0.62

Note: Figures in parenthesis are HH percentages of their respective columns.
** Average number of family members per HH ± SE*
*** Average area unit in Ropani ± SE per HH*

After *khet* and *bari* landholding, forest land is the third most common (43%) form of land ownership in Jungu (Table 3). The demand for fodder and forage for livestock is fulfilled with personal forest areas and agricultural lands because *khar bari*[8] holding is rare. Specified orchard areas were only found in the Brahmin/Chhetri and Janjati communities, but having a few fruit trees in the home garden or nearby areas is common throughout Jungu VDC. In aggregate, the total average cultivated land is lower than the total average landholding of the community, but the amount of cultivated land follows the same ethnicity based trends as total land ownership.

Orange, lemon (*Citrus limon*)[9], and banana are the most common fruits in the VDC. Mostly Bramhin/Chhetri have own the orchard land in the community, and thus have the largest variety of fruit trees in their HHs, followed by the Janjati and Dalit communities (Table 4). In Nepali culture, fruits play an important role in many festive occasions and religious rituals. They are considered one of the most auspicious foods offered to deities as a part of devotional worship offerings.

Table 4. Fruit crop status in Jungu VDC

Fruit*	Bramhin/Chhetri	Dalit	Janjati	Total
Orange	4.55 ± 1.31 (20)	1 (0) 1	1.5 ± 0.5 (2)	4.13 ± 1.16 (23)
Khurpani	1.62 ± 0.26 (8)	0	0	1.62 ± 0.26 (8)
Pear	1 ± 0 (1)	0	0	1 ± 0 (1)
Plum	1.41 ± 0.19 (12)	1 ± 0 (2)	1 ± 0 (2)	1.31 ± 0.15 (16)
Peach (aaru)	1.22 ± 0.14 (9)	1.66 ± 0.33 (3)	2.5 ± 0.5 (2)	1.5 ± 0.17 (14)
Alucha	1.75 ± 0.47 (4)	1 ± 0 (1)	1 ± 0 (1)	1.42 ± 0.29 (7)
Lemon (nibuwa)	1.66 ± 0.23 (21)	1.33 ± 0.33 (3)	1 ± 0 (0)	1.6 ± 0.2 (25)
Guava	4.69 ± 0.96 (13)	1 ± (2)	1 ± 0 (3)	3.66 ± 0.8 (18)
Lime (kagati)	5.12 ± 1.92 (8)	1 ± 0 (1)	2.5 ± 0.5 (2)	4.27 ± 1.44 (11)
Persimmon	1.66 ± 0.33 (3)	0	1 ± 0 (1)	5 ± 3.51 (3)
Pomegranate	7 ± 5 (2)	0	1 ± 0 (1)	5 ± 3.51 (3)
Mango	2.33 ± 0.88 (3)	0	2.3 ± 1.33 (3)	2.33 ± 0.71 (6)
Jack Fruit	3 ± 2 (3)	0	1 ± 0 (1)	2.5 ± 1.5 (4)
Pineapple	12 ± 0 (1)	0	0	12 ± 0 (1)
Ground Apple	0	0	10 ± 0 (1)	10 ± 0 (1)
Banana	14.79 ± 5.22 (29)	8 ± 7 (2)	9.83 ± 4.01 (6)	13.62 ± 4.15 (37)

Note: Figures in parenthesis are the number of HHs that have each of listed fruit trees
** Average number of trees per HHs ± SE of mean*

8 Khar bari is a type of bari land that is kept fallow to allow for grasses to grow which is harvested and used as fodder for livestock.
9 Citrus limon is called nibuwa in Nepal. However, if one were to use the common English name "lemon" most people in Nepal will think of the fruit kagati, which is lime (*Citrus aurantifolia*).

Goat is the most common livestock animal, as it is reared by 91% of households. The next are poultry (81%), buffalo (42%), oxen (37%), and cow (36%). Oxen are mainly kept for ploughing the fields, while goat, cow, and buffalo are used for the production of farmyard manure (FYM), milk, and meat (except cow, which is not used for meat) at the household level. Goats and buffalo are mostly reared by the Brahmin/Chhetri community, oxen are most commonly raised by Janjati, and cows by Dalit (Table 5). As Brahmin/Chhetri and Janjati have more land in comparison to Dalit (Table 3), they generally keep more livestock (especially goats) for immediate cash flow and FYM production (Table 5).

Table 5. Household ownership of animal resources in Jungu 2015

Animal*	Brahmin/Chhetri	Dalit	Janjati	Total
Bee Hives	1 ± 0 (3)	-	-	1 ± 0 (2)
Cow	1.8 ± 0.5 (32)	1.8 ± 0.2 (50)	3 ±0.2 (39)	3.5 ± 0.1 (36)
Buffalo	1.6 ± 0.1 (48)	1.2 ± 0.2 (40)	1.7 ±0.4 (22)	1.6 ± 0.1 (42)
Goat	6 ± 0.4 (94)	3.3 ± 0.5 (80)	4.6 ± 0.7 (89)	5.5 ± 0.1 (91)
Poultry	6.7 ± 1.9 (81)	5 ± 0.8 (90)	3.4 ± 0.4 (78)	5.8 ± 1.3 (81)
Pig	2 ± 0 (2)	-	-	2 ± 0 (1)
Sheep	1 ± 0 (2)	-	1 ±0 (1)	1 ± 0 (1)
Ox	1.8 ± 0.1 (37)	1.5 ± 0.5 (20)	1.8 ± 0.2 (44)	1.8 ± 0.08 (37)

Note: Figures in parenthesis are HH percentages of their respective columns
** Average number of livestock per HH ± SE of mean*

Livestock stall-feeding is predominant in the site. Farmers use fodder and forage collected from their own agricultural land and forest areas as the major form of livestock feed. Fodder trees are common sights around *bari* land and along natural drainage. Agricultural residues like rice and finger millet straw are major sources of cattle feed, while goats are allowed to free-graze seasonally. Besides fodder and forage, the grains of cereal crops like finger millet, maize and barley are also used for livestock feeding.

A total of seven species of cereals, eight pulses, 19 vegetables, five oilseeds, 17 spices, and 16 fruits species are found in the site (Annex 2). Rice, wheat, maize, finger millet, buckwheat, and barley are the major cereal crops of the VDC. Beans are consumed as a green vegetable instead of pulses. In all crops, the Brahmin/Chhetri average food sufficiency is higher or the same as the community average (Table 6). Similar to landownership, Dalit have the lowest crop sufficiency period among all ethnic groups regarding major cereals except in spices and pulses. In general, Jungu VDC is most food sufficient in terms of major cereal crops and spices.

Table 6. Food sufficiency in Jungu VDC 2015

Food self-sufficiency*	Brahmin/Chhetri	Dalit	Janjati	Total
Cereal	8.03 ± 0.3	5.4 ± 0.3	5.1 ± 0.5	7.1 ± 0.3
Leafy vegetables	6.05 ± 0.3	4.2 ± 0.6	4.7 ± 0.6	5.5 ± 0.3
Other vegetables	3.9 ± 0.3	2.5 ± 0.4	4.2 ± 0.8	3.8 ± 0.2
Pulses	3.5 ± 0.3	3.6 ± 1.3	3.4 ± 0.9	3.5 ± 0.3
Spices	7.8 ± 0.5	7.6 ± 1.4	7.4 ± 1.1	7.7 ± 0.4

**Average months within a year ± SE of mean*

In Jungu, four mandate crops were found to be purchased by locals for household consumption. Rice was the most commonly purchased crop (87%) with an average purchased amount of 275.4 kg/year (highest of all crops) and a minimum to maximum range of 54 to 720 kg/year. The next most highly purchased mandate crops (per year) were finger millet and beans (Table 7). The trade of finger millet is widespread mainly for alcohol brewing, not for human or livestock consumption. Hence, the Janjati and Dalit communities purchase much more finger millet than Brahmin/Chhetri (Table 7) because of having alcoholic beverage making tradition. Bean grains are purchased to consume as curry and pulses. For the most part, the seeds of Chaumase and Trishuli beans are purchased for commercial farming as a green vegetable, not as a grain

The trade of buckwheat is very limited in comparison to other mandate crops, and it is mainly purchased by the Brahmin/Chhetri community, who also transport buckwheat flour to their relatives residing in urban areas. Buckwheat has cultural significance in the Janjati community.

Table 7. Mandate crop purchasing status in Jungu 2015

Crops*	Brahmin/Chhetri	Dalit	Janjati	Total
Beans	4.35 ± 1.78 (60)	10 ± 1.15 (20)	12.33 ± 2.66 (20)	7.27 ± 1.47 (17)
Buckwheat	10.75 ± 5.10 (71)	1.1 ± 0 (14)	12 ± 0 (14)	9.55 ± 3.79 (8)
Finger Millet	6.2 ± 0 (10)	155.8 ± 36.78 (30)	165.88 ± 36.78 (60)	146.89 ± 29.11 (11)
Rice	249.03 ± 17.41 (65)	398.12 ± 49.67 (13)	282. 49 ± 37.11 (22)	275.44 ± 16.10 (87)

Note: Figures in parenthesis are HH percentages in their respective columns
** Crop average amount in kg ± SE of mean*

Most surveyed households that purchase these crops mentioned that there is an increasing purchasing trend in all four crops (Figure 8). Increased purchasing of rice was due to a change in food habits and an increase in economic well-being, which has been accelerated after road connection to the VDC. In the case of finger millet and buckwheat, farmers said that cultivation is decreasing due to a lack of manpower and lower yields in comparison to previous years. As a result, it is currently necessary to purchase more of these grains. The trend driving an increase in bean purchasing was slightly different, as it was due to an increase in market access and availability of Chaumase and Trisuli bean seeds.

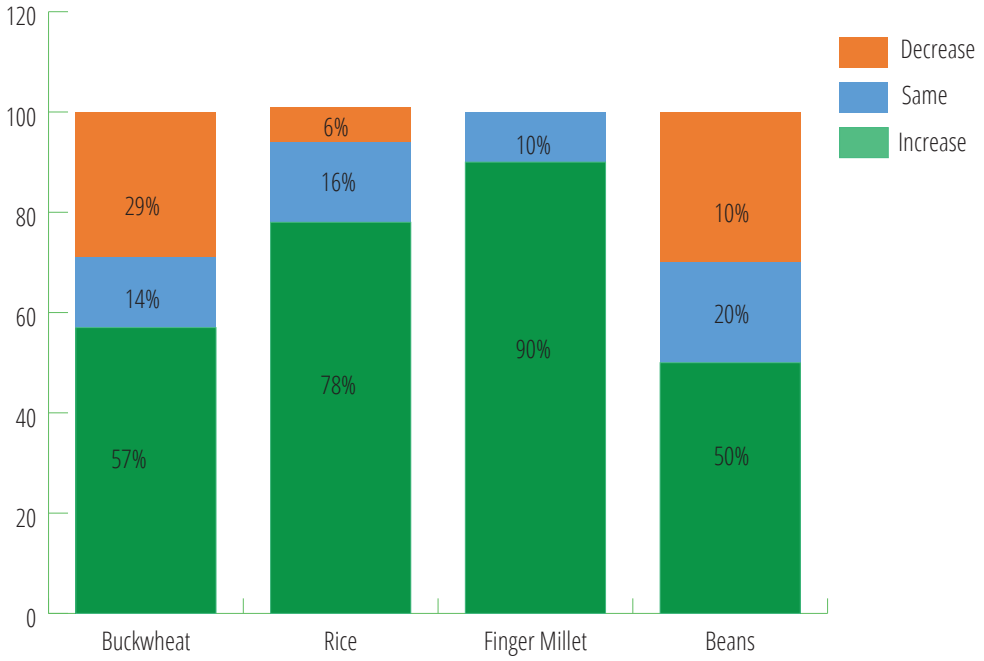

Figure 8. Frequency graph showing purchasing trend of mandate crops

4.2 Cropping Pattern and Mandate Crop's Calendar in Jungu

Jungu has two separate cropping patterns for low lands (*khet*) and uplands (*bari*). In the lowlands, wetland agriculture[10] is practiced, but in the uplands only rainfed agriculture[11] is possible. Cropping patterns also vary depending upon altitudinal zones (Table 8). In high altitudes (>2000-3000 masl) upland crops, mainly maize – potato/wheat – buckwheat, make up the dominant pattern, but in the upper-mid altitude (1500-2000 masl) and mid altitude (900-1500 masl) both lowland and upland cropping patterns are similar. Rice-wheat is a common pattern in the *Khet* of both mid and upper-mid altitudes, while maize-finger millet is dominant in the uplands of mid and upper-mid altitudes.

10 Except rainfall, irrigation can be managed during summer for high water demanding crops in summer like rice. Mainly irrigated lands are in this category.
11 Non-irrigated lands or where less water demanding crops are cultivated are in this category.

Table 8. Existing cropping pattern in Jungu VDC

Altitudinal Zones	Land Types	Cropping Pattern (Crop Rotation/Cycle)
Higher Altitude (>2000-3000masl)	*Bari* (uplands)	Maize/Potato→Wheat /Buckwheat
Upper Middle Altitude (1500-2000masl)	*Bari* (uplands)	Maize→Finger Millet→Wheat/Buckwheat→Maize
	Khet (lowlands)	Rice→Wheat→Rice
Middle Altitude (900-1500masl)	*Bari* (uplands)	Maize→Finger Millet →Wheat/Buckwheat→Maize
	Khet (lowlands)	Rice→Wheat/Buckwheat/Mustard→Rice

Source: Ward level community group discussions and key informant interviews 2014

The timing of cropping systems (sowing, inter-culturing and harvesting) is slightly different below 1500 masl in lower altitudes (*besi* or *aul),* and above 1500 masl in upper altitudes (*lekha*). The details of crop cycles and production activities ranging from sowing, intercultural operating, and harvesting is presented in Table 8 and Figure 9, respectively. Leguminous crops are cultivated in mix cultivation practices such as maize + beans + cowpea + soyabeans; blackgram, ricebean and horsegram in terraces/bounds of rice field; and finger millet + lentil. Figure 9 explains the details of the cropping seasons of the project's mandate crops at two different elevations within the VDC.

4.3 Existing Diversity in Mandate Crops

Six of the eight mandate crops are grown in Jungu VDC; amaranth, beans, buckwheat, naked barley, finger millet and rice. Foxtail millet (*Setaria italica*) and proso millet (*Panicum milliaceum*) is not present now because it does not seem to have been introduced in the past. Amaranth is found, but is uncultivated. Instead, it regenerates and dies on its natural cycle, and is occasionally consumed as a green leafy vegetable (Figure 12). Three data sets of varietal richness have been recorded from three separate collection methods. In all three methods, the highest varietal richness was found in rice, followed by finger millet and beans (Table 9). In all crops, local varietal richness is higher than modern/released variety richness. These studies indicate that Jungu VDC is rich in local landraces of mandate crops. Though the project focuses only on high altitude rice (cold tolerant rice), the baseline collection, and other methods of assessment, have incorporated all varieties of rice (including lower belt rice). Barley and naked barley are also discussed separately for easy understanding. Interestingly, naked barley (*uwa*) was explored through the baseline survey but was unknown to many farmers of the VDC.

Table 9. Mandate crop diversity richness based on different study methods in Jungu, Dolakha

Crop	Site Selection Report 2011	Group Discussion 2014/15	Baseline 2015
Amaranth	2(2)	2 (2)	3 (3)*
Barley	2(1)	2 (2)	1 (1)
Beans	9 (7)	10 (8)	11 (9)*
Buckwheat	2 (2)	2 (2)	2 (2)*
Finger millet	8 (5)	13 (12)*	12 (10)
Foxtail millet	0	0	0
Naked barley	0	0	1 (1)*
Proso millet	0	0	0
Rice	12 (4)	25 (17)*	16 (9)
Total	35 (26)	54 (43)	46 (35)

Note: Numbers in parenthesis are richness of local varieties.
** Indicates the highest richness among the methods used*

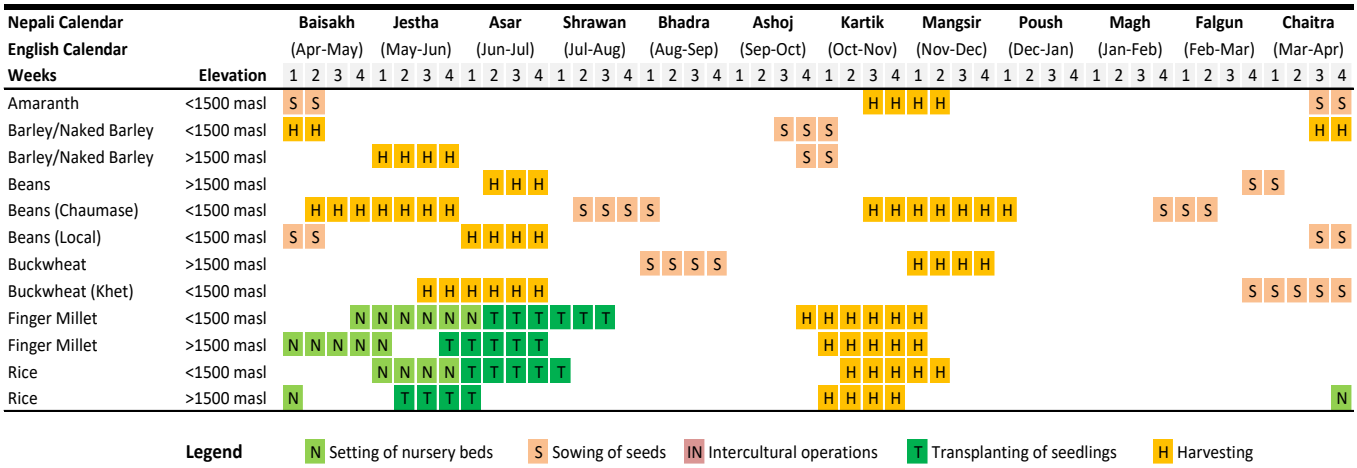

Figure 9. Seasonal cropping calendar of the project's mandate crops in Jungu developed from PRA 2014

Household level richness and overall evenness are highest in finger millet, while community level richness is highest in rice, followed by finger millet and beans. In terms of household level evenness, beans ranked third, after finger millet and rice (Table 10). Among all explored mandate crops of the project, rice and finger millet are the most commonly cultivated crops in large areas and also have the highest productivity, indicating their important contribution to food security in Jungu VDC. Both crops have the highest varietal richness followed by beans, amaranth, buckwheat and hulled barley, which indicates that farmers in Jungu have given priority to maintaining the diversity of their widely cultivated crops. Barley, beans, and buckwheat are cultivated by many households, but only in a small area.

Barley and buckwheat have cultural values in Hinduism and thus are cultivated by many households but only in small areas. Naked barley is rare in the community, and was recorded only in the baseline survey.

Table 10. Community and HH level richness and evenness of mandate crops as well as their average area and productivity

Crop	Area*	Productivity**	HHs no.	Four Cell Analysis	HH Richness***	Community Richness	Evenness
Amaranth	NA	NA	10 (11)	Few HHs in small area	NA	3	NA
Barley	1.1 ± 0.19	53.3 ± 14.43	34 (38)	Many HHs in small area	1 ± 0	1	0
Bean[12]	13.2 ± 1.96	1.2 ± 0.12	73 (81)	Many HHs in small area	1.83 ± 0.1	11	0.77
Buckwheat	2.46 ± 0.64	28.36 ± 5.70	32 (36)	Many HHs in small area	1.4 ± 0.08	2	0.45
Finger Millet	3.5 ± 0.19	86.86 ± 5.13	87 (97)	Many HHs in large area	2.81 ± 0.09	12	0.9
Foxtail Millet	NA	NA	NA	NA	NA	NA	NA
Naked Barley	0.7 ± 0.1	16.3 ± 4.21	6 (7)	Few HHs in small area	1 ± 0	1	0
Proso Millet	NA	NA	NA	NA	NA	NA	NA
Rice	4.9 ± 0.45	125. 2 ± 9.35	62 (69)	Many HHs in large area	1.59 ± 0.08	16	0.81

Note: Figures in the parenthesis are the HH percentage within total sampled HHs in the baseline survey. FCA results are from RPA 2014/15
** Average area in Ropani ± SE of the mean, **Average productivity in kg/Ropani ± SE of mean, *** Average HH level richness ± SE of mean*

12 Beans area is calculated in meter square and hence productivity is also in Kg/meter square. The amount of bean's grain production is measured after the consumption of green pods as a green vegetable.

4.4 Mandate Crop Details at Jungu VDC

4.4.1 Amaranth (Amaranthus spp.)

Amaranth is commonly known as "latte" in Jungu VDC. Three varieties (red, black, and white grained) of amaranth were reported, but no formal cultivation practice was found among surveyed households. Only 10% of households reported to have amaranth in their farmlands but there was no trend of harvesting or storing grains. Because of this, information regarding area and production of amaranth cannot be estimated from this study. Group discussions revealed that most households have amaranth plants on their farmlands (mixed with maize) because of its natural seeding cycle. However, most people treat it as useless weed and do not cultivate or harvest it. A few farmers feed it to their livestock as green fodder but livestock do not prefer it much. Though some households reported consuming amaranth as a green leafy vegetable during dry season, demand for this form of consumption is fulfilled by the naturally regenerating amaranth plants. While amaranth was consumed as a grain in the past, many current community members were unaware of this use for the plant.

4.4.2 Buckwheat (*Fagopyrum* spp.)

Buckwheat is commonly known as "fapar" in the site. Two different types of buckwheat, Mithe (*Fagopyrum esculentum)* and Tite (*F. tataricum*), are found in Jungu. However, within each type the specific names of landrace/varieties are not known. Only 36% of HHs in Jungu VDC cultivate buckwheat in their fields. Intraspecific diversity was not apparent. Tite fapar is more widely cultivated than mithe fapar in Jungu despite its bitter taste because it has other multiple preferable traits (Table 11).

Table 11. Buckwheat area, productivity, percentage of HH growing crop and preferred/un-preferred traits in Jungu, Dolakha

Variety	Area (ropani)	Productivity (Kg/ropani)	HHs (%)*	FCA	Un-preferred Traits	Preferred Traits
Tite (*F. tataricum*)	1.82 ± 2.0	27.91 ± 28.14	87	Many HHs in small area	Bitter taste	High flour value, large plant, good as leafy vegetable, can be grow in less fertile soil
Mithe (*Fagopyrum esculentum)*	1.64 ± 2.40	40.6 ± 42.60	58	Few HHs in small area	Less grain setting, hard processing and milling	Tasty, large grains, culturally important

Note: Data for area per HH, productivity and % HH are from the baseline survey conducted with 90 households in Jungu. Information on un-preferred and preferred traits and FCA were gathered from PRA and site selection report in 2011.

** Percentage of surveyed households that cultivate buckwheat (n=32).*

4.4.3 Finger Millet (*Elusine coracana*)

Finger millet is widely known as "kodo" in Jungu VDC. It is one of the most widely cultivated crops (96.6% of HHs) in the community. Among the 12 varieties recorded in the baseline, Bikase, Ladibadi, Chyalthe, and Dalle are the dominant ones, as they have the higher average area of cultivation and HHs percentage (Table 12). Among the three commonly cultivated varieties, Ladibadi has the highest productivity, followed by Dalle and Chyalthe. Finger millet is mainly used for the preparation of liquor or food (*dhindo*, *roti* and *puwa*[13]) and livestock feed. Finger millet grain can be kept in storage for long periods without damage from pests and hence is important for periods of food scarcity.

13 Puwa is toasted flour in ghee with added sugar for sweet flavor and can be consumed as afternoon snack and breakfast.

Table 12. Varieties of finger millet with area, productivity and growing HH percentage in Jungu, Dolakha

Variety	Area (ropani)	Productivity (Kg/ropani)	HHs (%)*	FCA	Un-preferred Traits	Preferred Traits
Ladibadi	2 ± 0.17	104 ± 13.31	31	Many HHs in large area	Low performance in shaded areas	Early maturing, easy to harvest, threshing and processing and high production
Chyalthe	2.4 ± 0.28	73 ± 7.32	28	Many HHs in large area	Not so tasty to eat and low production	Cold tolerant, Easy harvesting, threshing & de-husking
Dalle	2.5 ± 0.25	85.8 ± 9.95	25	Few HHs in small area	Harvesting, threshing and processing is difficult	Fit to all the areas, production is good
Kalo	2.1 ± 0.33	71 ± 10.92	17	NA	Black colour	High Production and good straw
Paheyli	2.1 ± 0.27	87.8 ±18.58	15	Few HHs in small area	Late maturing, poor straw	High production, tasty to eat and drought tolerant
Bhotange	1.3 ± 0.3	94.6 ± 20.76	10	Few HHs in small area	NA	Early maturing, perform well in shade and straw is good
Bikase/ Kabre	2.7 ± 0.66	98.8 ± 12.30	10	NA	Straw is less preferred by cattle	High production
Nangre	1.4 ± 0.30	233 ± 118.98	8	NA	NA	Big ear size, easy to harvest
Seto/Jwai	2.2 ± 0.40	147 ± 14.90	7	Few HHs in small area	Low production, straw less likely by cattle, less resistant to drought	Tasty to eat and good appearance
Okhale	2.3 ± 0.8	81.3 ± 30.07	3	Few HHs in small area	NA	Large finger, high production, straw is good, disease resistant
Mudke	7.5 ± 0	233 ± 0	1	Few HHs in small area	NA	Short and dense finger
Sailunge	1.5±0	37.2 ± 0	1	Few HHs in small area	NA	High production

Note: Data for area per HH, productivity and % HH are from the baseline survey conducted with 90 households in Jungu. Information on un-preferred and preferred traits and FCA were gathered from PRA and site selection report 2011.

** Percentage of surveyed households that cultivate finger millet (n=87).*

4.4.4 Barley (*Hordeum vulgare*) and Naked Barley (*Hordeum vulgare* var. *nudum*)

The common or hulled barley is locally known as "*Jau*" while the hulless or naked barley is known as "*Uwa*." Local varieties of both crops are cultivated, but only by a few households in a small area (Table 13). As barley has cultural value in Hinduism, it is cultivated more commonly and has a higher area of cultivation than naked barley. Naked barley is so rare in the community that very few people knew about it and as a result it did not even come up during FGDs.

Table 13. Varieties of Barley and Naked Barley with area, productivity and growing HH percentage in Jungu, Dolakha

Crops	Area (ropani)	Productivity (Kg/ropani)	HHs (%) *	FCA	Un-preferred Traits	Preferred Traits
Local Barley	1.1 ± 0.19	53.3 ± 84.19	34	Few HHs in small area	Long awn and small seeds	Culturally important, higher production than wheat, early maturing, straw is good for cattle
Naked Barley	0.7 ± 0.26	16.3 ± 10.32	6	NA	NA	Easy to thresh, less prickly and high yielding

Note: Data for area per HH, productivity and % HH are from the baseline survey conducted with 90 households in Jungu. Information on un-preferred and preferred traits and FCA were gathered from PRA and site selection report.

** Percentage of total surveyed households (n=90) that grow barley and naked barley.*

4.4.5 Beans (*Phaseolus vulgaris*)

Beans are commonly known as "*simi*" in Jungu VDC. About 68.9% of households cultivate various varieties of beans in their farm lands. Among them, the *Barkhe/Soste* bean is the most common and has the highest area coverage (Table 14). *Barkhe/Soste simi* is intercropped with maize and hence is more common due to this practice. Approximate seeding ratio of *Barkhe simi* to maize is approximately 1:3, which has been incorporated during the area and productivity calculation. Ghiu Simi, Paheyli Simi, Kalo Simi are other common varieties but are only cultivated in a small area. Farmers primarily use beans as a green vegetable, which leads to lower grain yields. The productivity data shown is of grain production after their consumption as a green vegetable (Table 14). *Paheyli and Ghiu Simi* are found most common and also have the most appeal in terms of productivity and preferred traits. Except Chaumase and Trisuli, all varieties are considered local. *Bikase Simi*, literally means "improved beans" and may refer to a number of introduced varieties including Chausame, Trisuli and Rajma. These varieties were introduced most recently by a national NGO called CEAPRED for a project on commercial seed production[14] over 6 years ago.

Table 14. Varieties of beans with their area, productivity and growing HH percentage in Jungu, Dolakha

Variety	Area (m^2)	Productivity (kg/m^2)	HHs (%)*	Four Cell Analysis	Un-preferred Traits	Preferred Traits
Barkhe Simi/ Soste	52.3 ± 11.9	0.7 ± 0.69	58	Many HHs in large area	Early maturing	High yielding, no need of stacking
Panheyli Simi	8 ± 1.64	1.4 ± 0.3	40	Many HHs in small area	NA	Long pods, soft, tasty
Ghiu Simi	10.41 ± 2.66	1 ± 0.16	27	Many HHs in small area	NA	Soft and tasty
Kalo Simi	7.7 ± 1.55	0.8 ± 0.13	23	NA	NA	Tasty, high production
Simtame	7.7 ± 2.32	0.9 ± 0.21	18	Few HHs in small area	NA	Long pods, soft, tasty
Chaumase	9.1 ± 2.59	0.8 ± 0.28	16	Few HHs in small area	Black colour even after cooked	High production
Trisuli	1.7 ± 0.37	2 ± 0.26	11	Few HHs in small area	Lower production than four season bean	High production
Singare	12.7 ± 6.45	1.8 ± 1.15	7	NA	NA	Good looking, tasty
Seto Simi	12.3 ± 4.96	1.19 ±75	5	NA	NA	White seeds, tasty
Bikase	16 ± 7.50	0.9 ± 46	5	NA	NA	High grain yield
Rajma	14 ± 5.93	0.23 ± 0.07	2	NA	NA	Big grains, tasty

Note: Data for area per HH, productivity and % HH are from the baseline survey conducted with 90 households in Jungu. Information on un-preferred and preferred traits and FCA were gathered from PRA and site selection report.

* Percentage of surveyed households growing beans (n=73).

4.4.6 Rice (*Oryza sativa* L.)

Rice is the commonly cultivated crop that occupies large areas in Jungu VDC and is known as "*dhan*". Among all studied varieties, Himali (released in 1982 with recommendation domain of high altitude) and Taichung (released in 1966 with recommendation domain of mid-hills and Kathmandu valley) are the only two notified cold tolerant varieties in the VDC (Table 15). Himali is a cold tolerant rice that is widely cultivated in higher elevation (up to 1600-2000 masl) regions of the VDC, while Taichung is cultivated up to 1600 masl. Modern varieties are more common in lower altitudes of the VDC, however, the local variety Marsi has the largest

14 Through the project, a few vegetable seed prodcution groups were established and trained for seed production of beans, broadleaf mustard (rayo) and radish. Interestingly, several farmers think the trainings were conducted by Tuki Sangh of Dolakha, another NGO with strong presence in agriculture sector in the district. Hence several farmers use Tuki Sangh as a blanket term for NGOs that work in agriculture.

area coverage of the VDC (Table 15). Four varieties, Marsi, Athahattar (local name for Khumal-10 released in 2011), Himali, and Pokhreli, are cultivated by a majority of farmers in a large area. Many other local landraces of rice are cultivated in small areas throughout the community, largely because of their various preferred traits (Table 15).

Table 15. Varieties of rice with area, productivity and growing HH percentage in Jungu, Dolakha

Variety	Area (ropani)	Productivity (Kg/ropani)	HHs (%)*	FCA	Un-preferred Traits	Preferred Traits
Marse	3.8 ± 0.68	131.2 ± 20.36	51	Many HHs in large area	Late maturing	Tasty, high biomass (Straw)
Athahattar	3.5 ± 63	174 ± 63.19	19	Many HHs in large area	NA	Medium production, tasty
Himali	2.08 ± 0.31	94.7 ± 15.03	19	Few HHs in large area	Hard rice to eat, red grain	Cold tolerant
Pokhreli	2.9 ±0.45	185 ± 22.82	18	Many HHs in small area	Low production, Leaf roller problem	Tasty, soft straw preferred by cattle
Jhingamali	1.75 ± 0.21	142 ± 28.77	3	NA	NA	NA
Ghaiya	1.25 ± 0	219 ± 0	2	NA	Susceptible to leaf roller, hard if cooked food is eaten late	Grows well in less fertile/ up lands
Chauhattar	2.2 ± 0.98	131 ± 20.12	8	Few HHs in small area	Not so tasty	Medium production
Ramsare Marse	3.3 ± 1.47	147 ± 16.32	8	NA	NA	NA
Mansara	2 ± 0	98.2 ± 72.69	3	Few HHs in small area	NA	NA
Taichung	2 ± 0.46	98.6 ± 20.20	5	Few HHs in small area	Hard while eating	Tasty flattened rice, suitable for cold areas
Mansuli	3.5 ± 0	176 ± 0	2	NA	NA	Tasty, Dwarf
Tilpunge	3.25 ± 0.63	44.4 ± 9.69	5	NA	NA	Long seeds
Gudule Marse	2.8 ± 1.61	171 ± 52.19	5	NA	Low production, less preferred by cattle for straw	High biomass (straw)
Chhote	0.11 ± 0.25	171 ± 47	6	Few HHs in small area	Less preferred by cattle for straw	High tillering capacity
Rambilas	2.3 ± 0.69	230 ± 56.92	5	NA	Dwarf, small grain	Good production
Atte	4.5 ± 0	152 ± 0	2	NA	Early sowing	High production, high biomass

Note: Data for area per HH, productivity and % HH are from the baseline survey conducted with 90 households in Jungu. Information on un-preferred and preferred traits and FCA were gathered from PRA 20145/15 and site selection report 2011.
** Percentage of surveyed households that cultivate rice (n=62)*

4.5 Seed Sources and Management Practices in Mandate Crops

4.5.1 Seed Sources of Mandate crops

Farmers access seed through formal and the informal systems. A system is formal if the seeds in the system are traceable in the system to its origin. This is usually applicable for certified seeds of notified varieties, which require a label that allows for tracing to the source. On the other hand, a system is considered informal if the seeds are difficult to trace to the origin using a paper trail as seeds do not require a label. The seed can get to farmers through a variety of avenues with agro-vets and public breeding

programmes being more typical for formal seed system while farm saved seeds and farmer to farmer seed exchanges being more typical of informal seed systems. Local markets such as *Haat Bazaar* can be seed sources for both formal and informal sector depending on whether the seed is sold with or without labels.

The seed system for mandate crops in Jungu is mostly local and informal (Figure 10). In Jungu, informal seed sources included farm-saved seeds, seeds obtained from neighbours or relatives and *Haat Bazaar*, whereas formal seed sources agro-vet, government agencies, NGOs, cooperatives and *Haat Bazaar*. More than 60% of households within Jungu keep their own seed for the next planting season for all mandate crops. Amaranth grows spontaneously and no seed saving is practiced. A total of eight different seed sources were recorded, with the largest contributing seed source being a farmer's own source, followed by neighbours and relatives (Figure 10).

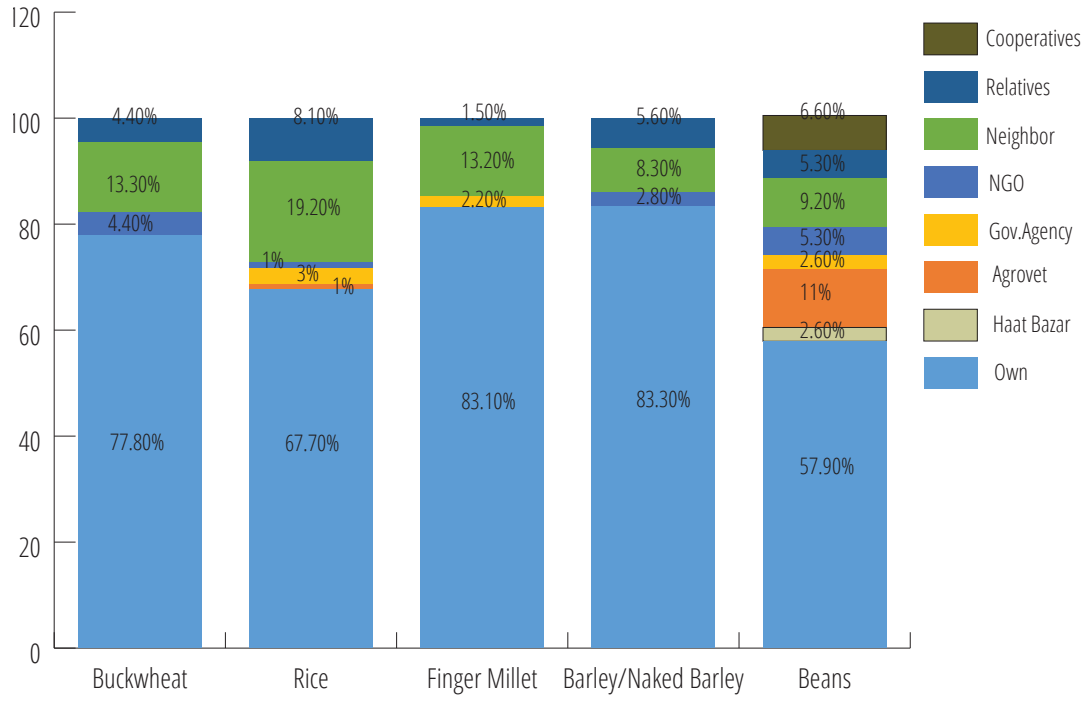

Figure 10. Different seed sources of mandate crops that are prevalent in Jungu VDC

Rice and beans are the only two crops whose seeds are occasionally purchased from an agro-vet. Beans have the most diversified seed sources among all mandate crops because of smaller amount of seed requirement. About 71% of the household's annual seed use is met by own farm-saved seed (Table 16). Dalit families were found to rely more than average on outside sources, Janajati families were found to rely more on self-saved seed, where the Brahmin/Chhetri were close to the overall average.

Table 16. Frequency of seed sources used by ethnicity for planting decisions in a year

Seed Source	Brahmin/Chhetri	Dalit	Janjati	Total
Own saved	250 (70)	34 (64)	56 (81)	340 (71)
Neighbours	50 (14)	8 (15)	2 (3)	60 (13)
Relatives	21 (6)	1 (2)	2 (3)	24 (5)
Agrovet	9 (3)	4 (8)	4 (6)	17 (4)
NGO	8 (2)	0 (0)	4 (6)	12 (3)
Government	6 (2)	4 (8)	0 (0)	10 (2)
Cooperatives	8 (2)	1 (2)	1 (1)	10 (2)
Haat bazaar	3 (1)	1 (2)	0 (0)	4 (1)

Figure in parenthesis is the percentage of the ethnicity's seed need met by the seed source

4.5.2 Seed Management Practices in Mandate Crops

Among the eight mandate crops of the project, only six crops exist in Jungu. Though amaranth exists, it has not been included in the formal cultivation system. Foxtail millet and proso millet does not appear to have been cultivated even in the past. After compiling the information collected from all ward level discussions, six major steps of seed processing and management were identified and are presented in Table 17. All processes and techniques used during selection, processing, and storage (Annex 10) of mandate crop seeds are completely traditional and guided by the indigenous knowledge of farmers (Table 17).

Table 17. Mandate crop seed management practices in Jungu Dolakha

Crops	Varietal Choice	Step 1: Seed Selection	Step 2: Drying	Step 3: Threshing	Step 4: Cleaning/ Refining	Step 5: Storage	Step 6: Seed Utilization and Exchange
Rice	Land suitability, yield, and taste	Best panicles are selected and harvested separately from field before harvesting the whole crop	Sun dried for 4-5 days on *Tripal* or *Mandro*	After drying, threshed by gentle stick beating	Seed grains are cleaned and separated from husk by winnowing (*Nanglo le nifanne*).	Filled in sacks, *Dalo, Bhakari, Ghyampo* and stored in dry place inside home	Seed is sown or exchanged between neighbours as per farmer's requirement/decision
Finger Millet	Taste, yield, and easy threshing	Best panicles are selected and harvested separately from field before harvesting whole crop	Sun dried for 4-5 days on clean floor, *Tripal,* or *Mandro*	After sun drying, threshed by beating with sticks, *Mungro,* or *Gyapli*	Grains are cleaned by separating the husk by winnowing (*Nanglo le nifanne*).	Filled in sacks, *Dalo, Bhakari, Ghyampo* and stored in dry place inside home	Seed is sown when required and exchanged between neighbours/ relatives to get desired varieties
Buckwheat	Good for leafy vegetable, high yielding	*No separate selection, whole plant/yield is harvested in bulk*	Whole plant sun dried on *Tripal*	After drying, threshed by gentle stick beating or leg rubbing	Grains are cleaned by winnowing (*Nanglo le nifanne*).	Filled in sacks, *Dalo, Bhakari, Ghyampo* and stored in dry place inside home	After consumption, remaining grains are used as seeds. Exchanged between neighbours/ relatives to get desired varieties
Barley	Not in Practice	No separate selection, whole yield (only panicles) is harvested in bulk	Only panicles are sun dried for 4-5 days on *Tripal* or *Mandro*	After sun drying, threshed by beating with sticks, *Mungro*	Grains are cleaned by winnowing (*Nanglo le nifanne*).	Filled in sacks, *Dalo, Bhakari, Ghyampo* and stored in dry place inside home	After consumption, remaining grains are used as seeds. Exchanged between neighbours/ relatives to get desired varieties
Bean	Good taste, late maturity to consume as green vegetable	Best and matured pods are selected for seed	Sun dried on *Nanglo* or clean floor	Threshed by simply hand rubbing	Cleaned by hand, damaged grains are screened	Stored in plastic bags or cloths (*Talo ma poko parne*)	Seed are used when needed and exchanged between neighbours/ relatives to get desired varieties
Amaranth	Not in Practice	No seed selection, simply harvested, mostly ignored	No	No	No	No	Grows naturally, no seed exchange practice

Source: Ward level community group discussions and key informant interview 2014

4.6 Post Harvest Processing Tools and Techniques in Mandate Crops

Both harvesting and post-harvesting activities of mandate crops, especially threshing and cleaning, are done in traditional way using traditional tools. Sticks, *mungro*, *gyalbi, musli*, *okhal, janto, dhiki,* and *nanglo* are the commonly used tools for threshing and winnowing at the household level (Annex 10). Especially in finger millet, threshing is found to be a major problem of post-harvest processing, as it is both labour intensive and time consuming. The flouring/grinding process is done by electric huller mills, which have replaced the conventional method of flouring by *janto* (stone grinder). Traditionally, a *dhiki* is used to dehusk rice, but currently electric mills are being used for this task. Finger millet, barley, and buckwheat are still dehusked by women using a *musli* or *dhiki* at the household level (Table 18).

Table 18. Processing techniques in mandate crops

Crops	Threshing	De-husking	Cleaning	Flouring/ Grinding	Splitting/ Cracking	Problems in processing
Rice	Shattered by hand in field *(Jhatani hanne or Khalo banai chutne)*	Electric huller mill	Winnowing by *Nanglo* or natural wind stream	Electric huller mill	No	Main problem is threshing as human manual labour is the only method.
Finger Millet	After sun drying of panicles, smashed by sticks/*Mungro/ Gyalpi*	Using *Musli/Okhal/ Dhiki* (manual labour)	Winnowing by *Nanglo* or natural wind stream	Electric huller mill	No	Threshing and dehusking of finger millet is completely dependent on human labour. Threshing is the most laborious part.
Buckwheat	After sun drying whole plant, smashed by sticks	Musli/Dhiki	Winnowing by *Nanglo* or natural wind stream	*Janto*/Mill	No	Main problem is dehusking and milling/ flouring, human labour is only option because electric mills do not process buckwheat.
Barley / Naked Barley	After sun drying of panicles, smashed by sticks/*Mungro*	*Okhal/Dhiki*	Winnowing by *Nanglo* or natural wind stream	Electric huller mill	No	Except flouring, threshing and dehusking is done manually. Dehusking is major problem.
Beans	After sun drying of pods, smashed by hands/sticks	No	No	No	Use *Janto/ Silauto* to grind	No specific problems in processing
Amaranth	Shattering	No	No	No	No	Stinging/skin irritation while threshing

Source: Ward level community group discussions and key informant interview 2014

4.6.1 Status of Processing Mills in Jungu

A total of sixteen functional mills exist in Jungu VDC. Seven of these mills are large capacity or commercial scale and require a three phase power supply (Table 19). They can process rice, wheat, finger millet, and maize in large quantities. Physical structures of all electric mills were damaged by the earthquake in April and May 2015 which led to their closure for several months. Now they are all operational.

Traditional household level mills such as *dhiki*, *janto* and *musli* that were damaged by the earthquake have not been re-established by many households due to other more convenient options. Among these traditional mills, *musli* is preferred over *dhiki* for its mobility and may still have a future. There are also modern machines installed in homes that provide household scale flouring and grinding services. They operate using household level power supply (Annex 10). Only two water mills are in a functional state in the VDC, and only one of those is an improved water mill capable of processing (dehusking) rice. The other water mill can be used for flouring only.

Female family members threshing finger millet using *Gyalpi*. Photo: Niranjan Pudasaini, LI-BIRD

Table 19. Categorized total number of mills existing in Jungu VDC

Ward No.	Electric huller rice mills *(Rice + flouring Mill)*	Household level electric mills *(Flouring mills only)*	Watermills *(Paani Ghatta)*
1	1	0	1 *(only flouring mill)*
2	1	1	0
3	1	0	0
4	1	2	0
5	0	1	0
6	1	0	0
7	1	1	0
8	1	1	0
9	0	1	1 *(rice mill + flouring mill)*
Total	7	7	2

Source: Ward level community group discussions, transect walk and key informant interview 2014

4.7 Key Production and Post-Production Constraints in Mandate Crops

Existing constraints on production and post-production activities such as harvesting, processing, and utilization have caused mandate crops to become minor and underutilized crops in Jungu (Table 20). The key constraints on mandate crop production and utilization are: traditional farming system, non-mechanized processing method, and lack of easily adoptable food recipes. For instances, new recipes of finger millet such as cake, bread, do nuts, etc. are promising but more suited for bakeries and restaurants. Home cooks in villages that also produce finger millet may not have the equipment or power supply to take advantage of such recipes. Hence, there is a need for recipes suitable for home cooks as well.

Table 20. Key production and post-production constraints on mandate crops

SN	Crops	Production Constraints/Problems	Post Production Constrain/Problem
1	High altitude rice	Rough terrain and limited cropping areas, rain-fed irrigation system, low local varietal richness and limited access to improved varieties, low productivity, pests and disease damage	Manual threshing, low preference in terms of taste
2	Finger millet	Traditional farming system, limited access to improved varieties, pest and disease, lack of necessary man power; lack of access to competitive crop diversity	Tedious manual threshing, dehusking and cleaning process, no market linkage for product (grain) sale, less preferred as staple food, changed food habits, limited preferable food recipes
3	Bean	Subsistence farming trend, tradition of using only as a green vegetable, lack of technical knowledge on farming technology like spacing and staking, viral disease	Less knowledge of market value as grains, low market linkage, limited food recipes
4	Buckwheat	Less productivity compared to other crops, unavailability of quality/improved seeds; new diversity does not exists	Manual threshing and tedious dehusking procedure, milling problem, unavailability of preferable food recipes, no market value or linkage
5	Naked barley/ barley	Unavailability of quality/improved seeds, tradition as minor crop; diversity not available	Laborious manual threshing, changed food habits, unavailability of preferable food recipes, no market value, lack of proper food recipe
6	Amaranth	No tradition of formal cultivation (considered a wild edible plant/weed), unaware of nutritional value, only utilized as green leafy vegetable from the wild, not in regular seed system; no access to new diversity	No known food recipes with grain, tedious/irritating threshing (due to prickly nature)

SN	Crops	Production Constrain/Problems	Post Production Constrain/Problem
7	Proso millet	NA (Crop does not exist); access to seed not available	NA
8	Foxtail millet	NA (Crop does not exist); access to seed not available	NA

Source: Household questionnaire survey 2015, ward level community group discussions, transect walk and key informant interview 2014

4.8 Status of use of Amaranth and Buckwheat as Green Leafy Vegetable

When amaranth and buckwheat plants are green, they can be consumed as green vegetables. Consuming buckwheat leaves is very common in Jungu VDC as 94% of surveyed households reported this practice (Figure 11). Comparatively, fewer households (41%) consume amaranth as a green leafy vegetable. However, neither vegetable is bought or sold for this purpose in the village, suggesting a practice of consuming from one's own home garden or sharing with relatives and neighbours. The consumption of amaranth is twice as common among Dalit households compared to the village average (Figure 11).

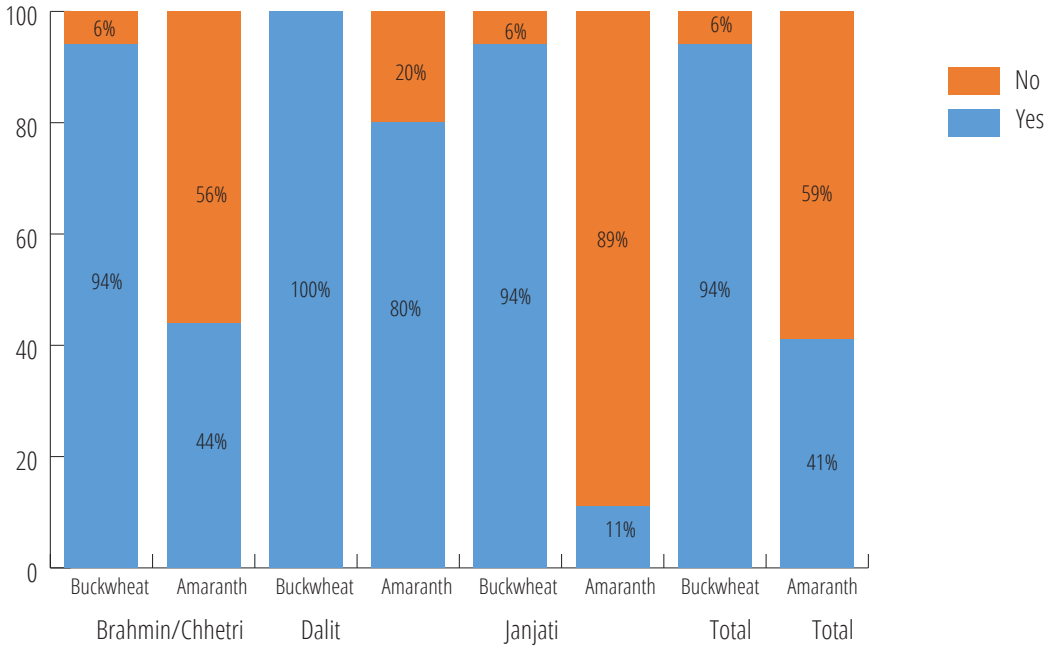

Figure 11. Proportion of households that consume buckwheat and amaranth as green leafy vegetable

4.9 Perception and Awareness Regarding Mandate Crops

Most survey respondents (64%) voiced for the need of promotional work on local crops in this area, while 36% said that there was no need. Interestingly, 85% said conservation of local crops is necessary, while 16% said that there is no need for conservation. The widespread urgency expressed for conservation is a reflection that these crops are becoming rare and the community's desire to have them around for their option value. The comparatively fewer households seeing the need for promotion might indicate their skepticism about these crops being commercially viable compared to other cash crops.

Among 64% who responded positively for the need of promotion of local crops, most (45%) chose finger millet. The crops prioritized next were rice and buckwheat, which each received 18% of the respondents' votes (Figure 12). Finger millet is a widely cultivated crop in the VDC, and it has a strong potential for high production and successful promotion. The top three crops to be promoted are all mandate crops of the project, which indicates the relevancy of this project's activities within the Jungu VDC context.

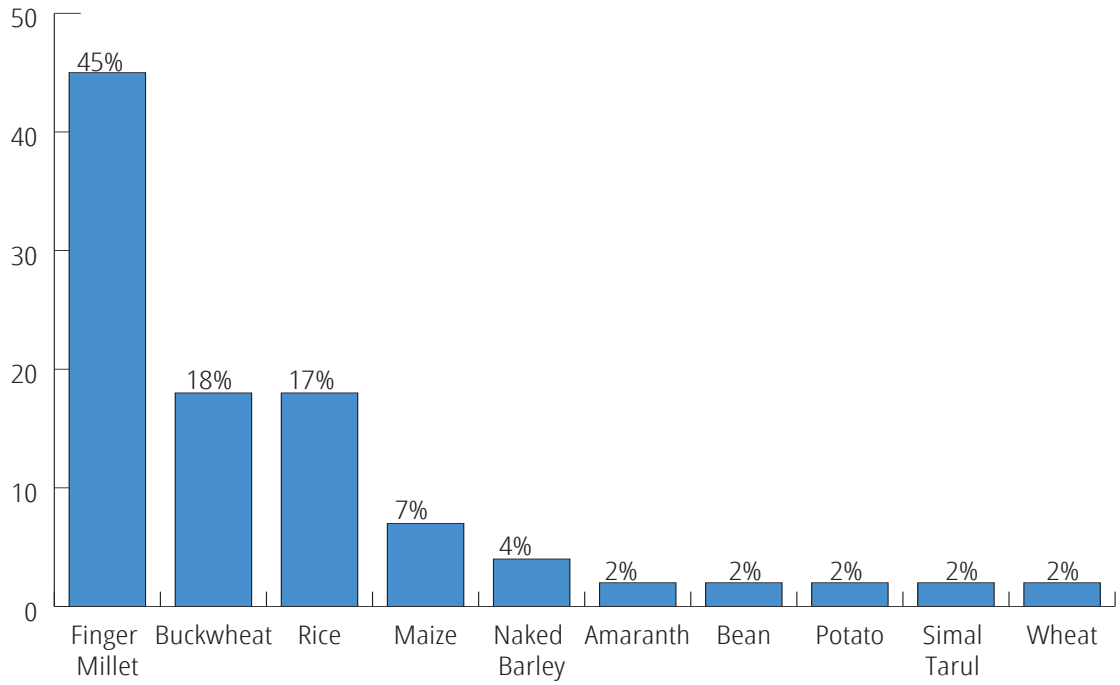

Figure 12. Respondent prioritization of local crops to be promoted

The crop perceived by the highest number of respondents (30%) to require conservation was buckwheat, as they reported that it is currently being neglected by farmers. Finger millet is the second most prioritized crop by respondents, as it is one of the most important crops in the area and its varietal diversity is currently at risk. Barley, bean, and amaranth were also mentioned by respondents as requiring conservation work (Figure 13).

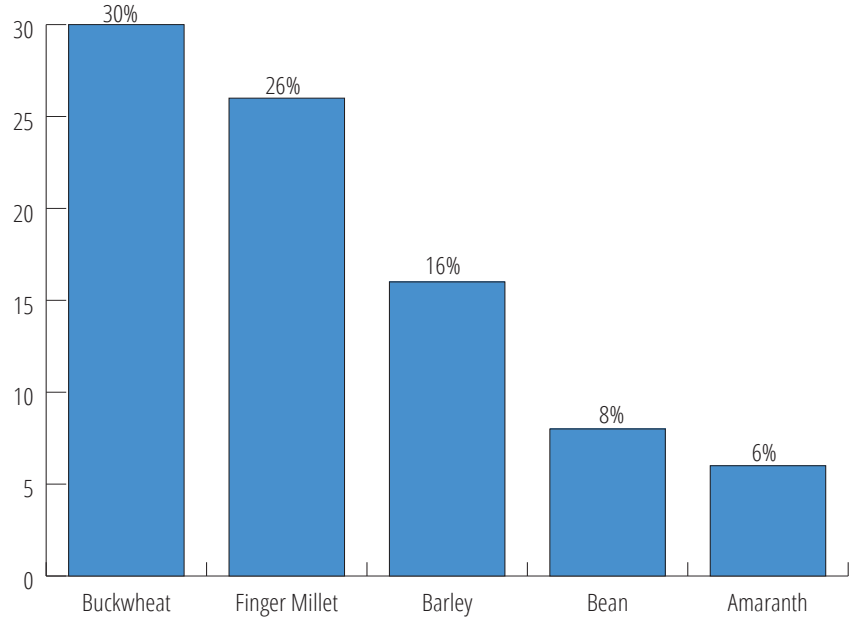

Figure 13. Mandate crops that are perceived by respondents to require conservation

Among all interviewed respondents, only 1% have received training on mandate crops especially Farmers' Field School in rice and training in bean from DADO and CEAPRED. Except those few, most of the population of Jungu VDC have not received any kind of training related to better cultivation practices, production enhancements, or pest and disease control methods of mandate crops (Figure 14). Majority of respondents were also unaware that Nepal Food Corporation (NFC) purchase local crops and every more were unaware about CSB or have attended an FFS (Figure 14).

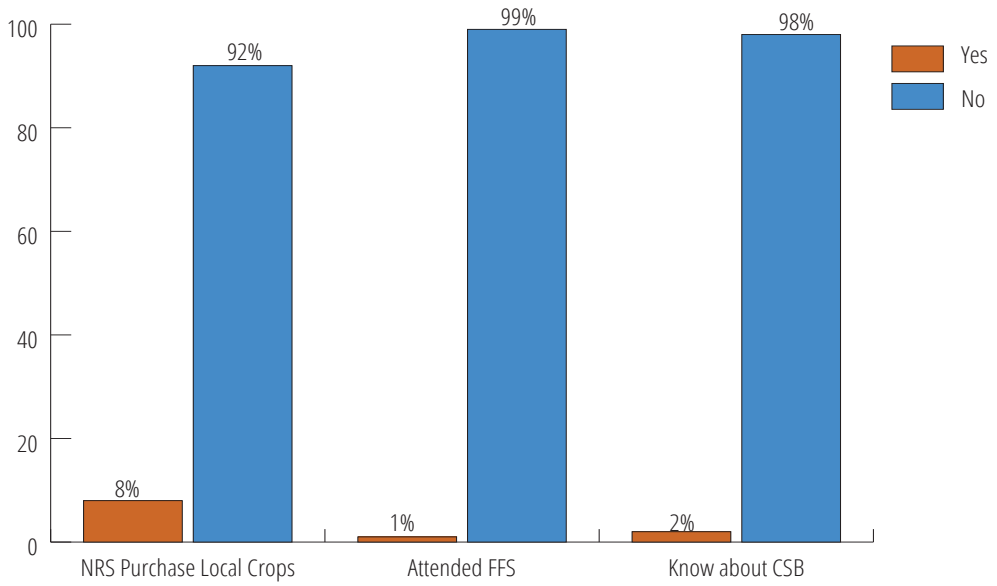

Figure 14. Knowledge of respondents in different institutions and approaches

4.10 Existing Local Groups/Institutions in Jungu VDC

Through community group discussions, a local level organizational listing was created that included the scope (in terms of members/household coverage) and major activities (Table 21 and Annex 6) of each community organization. A total of 6 cooperatives, 26 mothers groups, and 9 women's groups were recorded. Saving and credit schemes are the most common and primary activities of all groups/organizations. However, an agriculture cooperative (*Krishi Sahakari*) and a multipurpose cooperative (*Bahu-uddhesiya Sahakari*) have undertaken a few agricultures related activities, including: off season vegetable farming, bean grain production, and marketing (Annex 6). Most of the community groups have focused on the major objectives mentioned in their legal documents (*Bidhan*).

Table 21. Existing community level groups/organizations in Jungu

Community Groups/Organizations	Number	Remarks
Community Forest User Groups (CFUGs)*	8	Functional, conduct money saving and credit within members
Mother's Groups	26	Functional, used for small scale monthly money saving and credit
Cooperatives*	6	Functional, mainly focused on saving and credit
Youth Clubs	3	Not active
Women's Groups*	9	Not active
Development Groups	3	Not active
Farmer's Groups*	3	Not active
Children's Clubs	3	Not active
Total	52	

**Legally registered groups/organizations*
Source: Ward level community group discussion 2014 and site selection report 2011

The majority of social groups in the VDC are currently inactive. Though three farmer's groups have been registered in DADO Dolakha, they are currently dormant. Financial institutions, especially cooperatives, are well established and functional. Existing CFUGs are also functioning well in the community, and work to equitably serve forestry products. In terms of saving money and access to loans, the community is well serviced by several institutions, especially mother's groups, cooperatives, and even the CFUGs. The approximate financial status including household beneficiaries is presented in Annex 6 of this report.

In terms of community group mobilization and social interactions the community organizations in Jungu VDC are advanced in some aspects. They are especially good at coming together to form youth clubs, farmers' groups, mothers' groups and cooperatives and participate actively in the early stages. The cooperatives have large finances. However, over time, political interferences, rent-seeking behaviour and mistrust creep in plaguing these groups with loss of effectiveness, trustworthiness and hence sustainability.

5. DISCUSSION

5.1 Socioeconomic Context and its Implications on Agriculture

The majority of families in Jungu VDC reside on the same land they have occupied for generations and are using a livestock integrated agriculture system as their primary source of livelihood. Brahmin/Chhetri have more diversified income sources than Dalit and Janjati communities. The degree of vulnerability of livelihood depends on availability and accessibility of the resources such as arable land, forest and water resources, farming technology and inputs, crops varieties, knowledge, infrastructure, agricultural extension, marketing and storage system, rural finance market and wealth (Smit and Pilifosova, 2001). In Jungu, Dalit community is the most vulnerable ethnic community after Janjati in terms of food security and livelihood due to small land and livestock holdings and lack of multiple income sources which is also supported by the findings of Regmi et al. (2008).

The average family size of the site is larger than the national average of 4.1 individuals per household (CBS, 2011). Nuclear families are more common with Dalit and Janjati communities than Brahmin/Chhetri due to a tradition of early marriage in those communities. At the household level, more females are involved in agriculture and they have greater roles in agricultural decision making.

This is partly due to the out migration of male members of the family for income opportunities. A report suggests that more than 50% of the Nepalese households have at least one member living in other district or aboard (CBS, 2011). In Jungu, 92% of the households have either a male or female member in out-migration for more than 3 months period in a year. Short to long term migration of married couples and men is common due to insufficient crop production from their own farmlands, unavailability of off-farm employment and search for better income. There is a shift in gender roles because of out-migration in developing countries (Kaspar, 2005; Song, 1998) and the context apples with Jungu as well. This trend of migration for off-farm income sources has directly or indirectly increased the agricultural workload of family members especially for women residing in the village. According to Gartaula et al. (2010), male labour out migration leads to increase in women's labour in agriculture, more significantly in for non-migrant family members. Migration have caused feminization in traditional agriculture system in Jungu VDC and the similar findings has been reported by Cornhiel (2006), Kelkar (2010) and Gartaula et al. (2010).

There is shortage of labour in villages causing gradual decrease in cultivated area in all communities. The average landholding of Jungu is lower than the national average of 0.68 ha (CBS, 2011) and disproportionately affects the Dalit and Janjati communities, which have lower land tenure and therefore are suffering the most from higher food deficiency conditions than the Brahmin/Chhetri community. Though Jungu communities are greatly engaged in agriculture and livestock, there is still a food deficiency in the VDC.

5.2 Diversity and Cropping System of Mandate Crops

It is widely expected that patterns of diversity reflects differences in climate, altitude and other agro-ecological factors. Jungu VDC also covers wide range of altitudinal variation and holds different micro-climatic conditions that has supported noteworthy crop and varietal diversity. The overall inter-specific crop diversity of the VDC is quite rich, especially in vegetables and spices. Local micro-environments created by altitudinal variation provide suitable settings for the continuous evolution of crop cultivars, resulting in a wide range of local landraces. However, two mandate crops, proso millet and foxtail millet, have not been recorded during the baseline study and were not common even in the past. Furthermore, intraspecific diversity within the six commonly grown mandate crops are high in Jungu.

The assessment of diversity provides the necessary description of the extent and distribution of genetic diversity of traditional varieties and of the way in which that diversity is partitioned within and among varieties at household and community levels. Research has provided substantial evidence that significant crop genetic diversity continues to be maintained in farmers' fields in the form of traditional varieties (Brush, 1995; Jarvis et al., 2004; Bezancon et al., 2009; Bisht et al., 2007; FAO, 2010). Though the extent of varietal diversity cannot be assessed only by farmer named varieties because the same variety may have different names depending upon locality (Rana et al., 2000). Local farmer selects suitable landraces/varieties for their farmlands and maintain household level varietal richness which is a good indicator of recognizing and utilizing agro biodiversity at local level.

Richness is a measure of the total diversity available in an area whereas evenness measures diversity of crop varieties distributed in an area (i.e., its distribution pattern). In the case of Jungu, there is no such dominance found in mandate crops except in buckwheat. Mandate crops having higher varietal richness also have higher evenness value (especially in rice, finger millet and beans) indicating evenly distributed varietal diversity within the VDC. In the case of buckwheat, there exist only two varieties Tite Fapar and Mithe Fapar with the latter being more dominant due to is high yielding capacity and having tradition of consuming as green leafy vegetable. For buckwheat, barley and naked barley, diversity deployment is needed in order to increase cultivation area and reduce dominancy of of the few varieties.

The cropping system of Jungu VDC differs according to the altitudinal gradient of the farm. There is no difference in crops rotation but the time of cultivation and harvesting varies depending on the altitude and aspects of terrace slopes. The two important altitudes are commonly known as "*lekha*" (highland) and "*besi/aull*" (lowland) with distinct cropping patterns determined by cumulative thermal regimes. This has favored for evolutionary processes in local landraces due to gene and environment interaction. Similarly, two land types; lowlands and uplands, are being used for different cropping systems. "*Khet*" is used for rice cultivation primarily in the lowlands with partially irrigated or wetlands conditions, while "*bari*" is used for rainfed agriculture in the uplands.

In summary, the findings suggest that the agricultural system of Jungu VDC is traditionally well adapted to the local agro-climatic and geographical conditions by maintaining local crop varietal diversity. High varietal richness and evenness is due to traditions of mixed and terrace farming with rich traditional knowledge associated with local agrobiodiversity. Identification, documentation, registration and release of the most promising local varieties will be area of intervention in the local crop project.

5.3 Crop Preference and Use of Mandate Crops

Crop preference depends on its utilization, tradition and culture of the local community. Ethnicity also pays a determining role on defining crop utilization. Minor crops are neglected and underutilized due to socio cultural norms/tradition, changing food habit and availability of better options in other crops (partly due to greater research investment in them). Cultural importance and medicinal values of certain crops leads to the existence of certain crops in the community despite limited utilization in daily life.

Crops like barley and buckwheat are associated with cultural rituals of Jungu community. Results showed that 36% of households in the VDC cultivate buckwheat for grain production. There is a tradition of eating a buckwheat recipe called *"Fulaura"* in auspicious occasions as a blessing. The Jirel community of Jungu also use buckwheat in their death and birth rituals. Similarly, barley is considered sacred for worshiping in Hinduism. Barley has high importance in the Brahmin/Chhetri community due to the culture of consuming *saatu*[15] on special occasions and its special value in Hindu rituals. Evidence indicates that cultural importance of ethnic community plays a vital role on use and on-farm conservation of local crops on farm.

Farmers also cultivate buckwheat when farmers run out of finger millet's seedlings at the time of transplanting. The remaining land is planted with buckwheat as it is a short duration crop and leaves can be used as leafy vegetable. About 87% of farmers that cultivate buckwheat choose *Tite Fapar* (bitter type) over *Mithe Fapar* (sweet type) because of its preferred traits as a green leafy vegetable. Amaranth is another mandate crop that is also consumed as green leafy vegetable, a use more common among the marginalize Dalit households in Jungu. There is no practice of seeding amaranth however as naturally growing plants are kept around and used for green vegetables. These plants shatter seeds and provide plants for subsequent years. Despite having good farming and production potential of amaranths and buckwheat, changing food habits and lack of awareness on nutritional values of amaranth and buckwheat green leaves have reduced production and utilization of these crops.

A common preference of consuming rice as staple food makes it a highly preferred and widely grown crop both in low land and high altitude areas of Jungu VDC (69%). The share cropping practice, high purchasing amount and carefully managed seed system are good indicators that farmers of Jungu give high value to this crop. Among rice varieties, only two varieties of high altitude rice (Himali and Taichung) are being cultivated by a few households in the VDC. This finding is consistent with those from four cell analysis, which placed high altitude rice/cold tolerant rice grown by a few households in a large area. Because an increase in altitude limits the productivity of rice (Sthapit and Subedi, 1990), the yields of Himali and Taichung are lower than the average rice yield of the VDC

Finger millet is another widely cultivated (97%) and preferred crop in the site. The crop is considered relatively drought tolerant,

15 Saatu is a flour of roasted (Bhuteko) barley grains mixed with other spices and sugar. It can be consumed by mixing with milk, tea, hot water etc. or even in dry form.

and can grow on less fertile lands where other crops cannot perform better (Subedi, 1991). Jungu's farmers grow finger millet mainly in rain-fed *bari* lands. Among varieties, Ladibadi is the most common and largely grown because its average productivity is higher than that of other finger millet varieties. The tradition of consuming finger millet as *dhindo* and *roti* has changed largely, but cultivation of finger millet is still dominant because of its use as major livestock feed (as fodder and flour) and the ethnic tradition of preparing and consuming alcoholic beverages made from finger millet especially in the Dalit/Janjati community.

A handful of farmers have brought seed of naked barley from their relatives, especially from Solukhumbu district and are growing it in Jungu VDC. Since it is new crop for the area, no traditional recipes for consumption exist and it is mostly grown for livestock feed. Seed management and processing is similar to barley, as it is also managed in a traditional manner. Diversity deployment, awareness raising on parts of utilization and seed dissemination activities would be important to promote such crops (Sthapit et al. 2006).

Bean is the second most commonly cultivated mandate crop in the VDC (81%) after finger millet with high varietal richness and evenness. Beans are mostly cultivated for consumption as fresh vegetable. After consuming green pods, surplus bean pods are left to produce seed and grain, which is generally consumed as *daal*. Community is unable to fully utilize existing diversity of beans for increased production, fulfill nutrition and reduce risks of climate and diseases. The project area has a high potentiality of producing bean in terms of fresh pods, seeds, grains if provided technical and marketing services. We can learn from other places particularly of Mustang and Jumla where dry beans marketing has been done successfully.

5.4 Seed System of Mandate Crops

The seed system is composed of individuals, networks, institutions and organizations involved in the development, multiplication, processing, storage, distribution and marketing of seeds (Maredia and Howard, 1998; Loch and Boyce, 2003; Dominguez and Jones, 2005). In Jungu, farmers managed seed system is prevalent in all traditional crops including project's mandate crops. According to Almekinders and Louwaars (2002), 60-100% of the seed systems are farmer managed in developing countries which is applicable in Jungu too. Local seed system also relies on traditional management practices of crops and seeds playing role in allowing landraces/varieties to evolve in the local environment. As a result, farmers' knowledge and management practices like selection, harvesting, drying and storing play a key role in determining seed quality, production status and ultimately shaping the genetic diversity of crop varieties. Farmer managed seed systems have a significant role in allowing landraces/varieties to evolve in a local environment, thus making them important contributors to the management of global plant genetic resources for food and agriculture (FAO, 1998).

5.4.1 Seed Sources

Farmers predominantly use the informal seed system and lack wider network and linkage with formal seed sources. There is weak connection between informal and formal seed system which is important to strengthen. Access to quality seeds of traditional varieties is often limited within the community due to exclusion of local crops in development programmes. There is also indication that access to diversity and quality of seeds is relatively more of a struggle for Dalit households. Studies have indicated that access to information, social networks and institutional mechanisms for collective actions is necessary for strong seed systems (Sthapit and Joshi, 1996; Shrestha et al., 2006). Recent studies that quantify the amounts of farmers' own saved seeds versus seeds obtained from friends, relatives, neighbours or local markets show that farmers prefer to save their own seeds in most situations (Gildemacher et al., 2009; Rana et al., 2008; Hodgkin et al., 2007; Lipper et al., 2010). Therefore, adding diversity and strengthening the informal seed sources can be an area of intervention. This can be achieved by mobilizing and empowering local organizations by employing CBM principles. Expanding seed exchange networks through organizing Participatory Seed Exchange (PSE) can quickly make the existing diversity in the village more widely available. Identification of custodian farmers and dissemination of seed related knowledge through diversity fair and distributing diversity kits and IRD would be relevant to enhance coverage of new crop diversity. Furthermore, establishment of Community Seed Bank (CSB) will be effective on linking formal and informal seed sources and make local seed system more resilient which is also suggested by Mazhar (2000) and Sthapit et al. (2006a).

5.4.2 Seed management Practices

Seed management practices include step by step processes after production of seeds until its utilization in the next planting season. Seed selection, threshing, drying, cleaning and storage are major activities of seed management practices. As in other

on-farm activities in Jungu, female farmer's involvement in seed management is higher than male farmers. Practice of seed selection is not new in Jungu, but farmers are practicing it only for certain crops (rice, finger millet and beans). These principles need to be replicated in other crops for good harvest due by improving the quality of seeds used. Farmers' traditional knowledge and scientific knowledge can be integrated for better seed management practices. Enhancing skills of seed selection by providing technical trainings will be relevant through knowledge sharing platforms at local level.

Drying and storage are important processes of seed management. Farmers in Jungu practice traditional drying and storage methods to keep seeds dry and safe. They use locally made vessels which often do not prevent rat damage or keep out moisture. They also do not monitor for moisture after seed is placed in storage and risk of damage and loss in quality due to humidity in storage. Improving the air-tightness of storage containers (Wambugu et al., 2009; Thamaga-Chitja et al., 2004), heat treatment (Beckett et al., 2007), manual seed cleaning are some easily applicable methods that combine traditional practices and principles of modern seed storage technology to reduce the post-harvest loss of seeds in storage.

The project's intervention on proper seed storage and awareness of quality monitoring might be relevant to strengthen the existing seed management practices of Jungu VDC. As women farmer's involvement is dominant in seed management, knowledge and skill enhancement programmes should be targeted to them for effective results.

5.5 Processing Tools, Techniques and Services in Mandate Crops

Except milling, post-harvest processing of mandate crops is fully dependent on traditional tools and techniques in Jungu. Threshing and dehusking is the most tedious and laborious task as it fully relies on human labour and traditional tools. Except in rice threshing, all post-harvest processing are carried out by women farmers in Jungu. Hence women bear the brunt of drudgery associated with traditional processing practices. For milling purpose, electricity operated processing mills are now available in the VDC. Flouring/grinding service is the most common service provided by electric mills. As the community grows crops like maize, finger millet and wheat in larger amounts than rice, flouring mills are common in the VDC. As the community has stable access to electricity from the national grid, water mills can be upgraded for efficient processing service.

Major processing constraints are in threshing and dehusking process for mandate crops particularly in buckwheat, finger millet and proso millet. Farmer (especially female farmers) need to spend significant time for threshing and dehusking of finger millet. Improving the existing processing tools is not enough to address existing constraints. Testing or introducing newer tools for mechanization of threshing and dehusking process should be a major area of project's intervention in processing technology enhancement. When it comes to mandate crops, finger millet thresher is the most needed technology as it can alleviate processing related drudgery for the greatest number of households. Mechanization in traditional crop processing can help directly to reduce women's drudgery as well as lowering time consumption for post-harvest processing. Saved time from efficient technologies can be utilized in other productive activities or income generative work. Introduction of appropriate processing technologies for mandate crops can also help addressing multiple cross cutting issues like youth migration induced labour shortage, option for income generative work at local level.

5.5.1 Existing Production Constraints in Mandate Crops

Understanding production constraints of traditional local crop diversity is key to develop suitable interventions (Jarvis et al., 2011). There are a number of production constraints that have limited optimum production of mandate crops. Labour intensive production and post-production practices of mandate crops like land preparation, ploughing, harvesting, threshing, dehusking and milling have compelled farmers to decrease area of cultivation. The National Census of 2011 revealed that the area under cultivation of crops like finger millet, barley and buckwheat has decreased by 19%, 35% and 40%, respectively during the last 10 years (CBS, 2011). Human induced production constraints are more responsible though natural constraints persists. Similarly, migration induced labour shortage and changed food habits have added fuel to the fire. The key existing production constraints are discussed follow:

- **Limited access on quality seeds**

There is a lack of quality seeds of released and registered varieties from formal sectors to meet the requirements of farmers. Room for improvement exist for the heavily used informal seed system too. Most of the farmers use surplus grains as seed for next season planting for buckwheat, barley/naked barley sometimes even finger millet. Most farmers also do not employ good

practices for seed storage. Hence, establishing a community seed bank would be helpful to address this constraint as it can improve the local availability of quality seeds.

- **Low external inputs and services**

Farmyard manure is the major input for mandate crops cultivation. Due to widely distributed land parcels, farmers use to practice shifting/temporary livestock shed for *in situ* manuring of farm lands. In addition, poor manure management is also nutrient leaching. Inadequate farmyard manure application seems to be the norm for the mandate crops. However, farmers use both farmyard manure and chemical fertilizers in rice cultivation. As mandate crops are considered as minor crops (except rice), timely wedding/thinning, intercultural operations, regular field monitoring are given lower priority which has ultimately contributed for low production. Unavailability of support services from formal sectors like ASC, DADO are another production constraint in mandate crops.

- **Climatic hazards, pest and disease damage**

Prolonged droughts and hailstorms are the major climatic hazards for mandate crops in Jungu VDC. Hence, drought tolerant and early maturity is a desirable trait. Climate change has brought unpredictable changes in environment, putting mountain areas at high risk largely because of rainfed agricultural systems. Changes in rainfall patterns, erratic weather and increased temperatures have introduced additional complexities by shifting planting season and occurrence of new pests and diseases at site.

Leaf blast and neck blast in rice, cercospora leaf spot, neck blast and finger blast in finger millet are major disease problems while rust and viral diseases persist on beans. Yellow rust and barley stripe disease are dominant in barley and naked barley. As such, identification and promotion of varieties that can withstand these complexities could be the area of work for the project.

- **Migration and labour shortage**

Rural to urban migration and increasing youth out-migration for foreign employment has caused a labour shortage which has led to decrease in area of cultivation of mandate crops. Increasing workload in female farmers and non-migrating family members have forced a reduction in cultivation area of mandate crops. Introduction of labour efficient cultivation and processing technologies will help to grow and utilize mandate crops.

- **Inadequate initiative from governmental sectors**

Government has focused on generating varieties and increasing production of major staple crops like rice and maize. Despite key role of local crops in food and nutrition security due to their hardiness, resilient to stresses and nutritional value, investment in research and development from public sector has been scarce. Without involvement of governmental agencies, the conservation and promotion of local crops cannot be mainstreamed. Since a large number of rural families still rely on these crops despite their hardships, it is important for the government research and extension sectors to alleviate the rudimentary constraints that are holding these crops back. Policy advocacy is needed to mobilize changes in national policies, strategies and plans.

5.6 Local Institutional Settings and Awareness Level

Local institutions and community groups are social assets of the community which play vital role in community resource mobilization and capacity building of local farmers for better livelihood. Jungu VDC has more than 50 community based groups/organizations and most active ones are saving and credit groups and cooperatives. Though the community has three farmers' groups, they all are passive, which indicates that developing the agricultural sector has received less priority in the community. Hence, there is need of activities to sensitize and build capacity of CBOs to active and drive them towards utilizing locally available agrobiodiversity. Lower awareness levels of the local people about the value of agrobiodiversity are the proxy indicator of gaps in the knowledge and sharing/learning platforms among community members. Low participation status in FFS and limited understanding of CSB approach are other indicators that the community has very limited exposure to information regarding agricultural issues. Despite low awareness levels of NUS crops regarding their nutritional values, potential market value and utilization, most of the surveyed respondents are in favor of conserving mandate crops, which is a self-realization of the local farmers. Wider community sensitization through diversity fair and food fair needs to be organized to highlight local crops importance. Mobilizing local institutions like cooperatives and mother's groups on local crop conservation and promotion could be an area of intervention for the project. According to Poudel et al. (2005), communities with weak social networks are more vulnerable to accessing locally adapted seeds in adverse conditions, compared to those with strong social networks. Introducing the concept of CSB by mobilizing local CBOs and establishing learning and sharing platform through diversity fair, PSE, food fair are some of the possible way to capacitate local organization on conservation, promotion and utilization of local crops.

5.7 Potential Opportunities

There are several good opportunities of production increment and promotion of local crops through sensitization, value addition and developing market linkage.

- As Jungu holds rich varietal diversity in landraces of mandate crops, there is huge possibility of identification of most promising varieties in terms of production, disease and climatic stress tolerant trait (especially in finger millet and beans).
- There are several established CBOs exist in the community which can be mobilized in sensitization about valuing local crops, establishing CSB for conservation and seed production, value addition and marketing of local crops with local branding.
- As Jungu VDC is connected with road network up to district headquarter and capital city, viable technology introduction, local product transportation and developing market linkage is economic, reliable and full of scopes.
- As Dolakha district comprises famous pilgrimage sites like Dolakha Bhimsen temple and Kalinchowk Devi temple and many other touristic places such as Jiri, there is an appreciable flow of domestic as well as foreign tourists. Local products with value addition and branding can have good marketing opportunity by linking with tourism sectors particularly with hotels, home stays and souvenir shops.

As Dolakha districts has several local radio stations, awareness raising and knowledge dissemination regarding local crop conservation and marketing can be done via radio networks for wider dissemination.

6 SUMMARY AND WAY FORWARD

6.1 Summary

The population of Dolakha is primarily Brahmin/Chhetri followed by the Janjati and Dalits. The resource base is also higher with Brahmin/Chhetri followed by Janajati and then Dalits. A growing number of nuclear families and the trend of seasonal migration of male family members has increased the agricultural work load on women and non-migrant family members which has ultimately led to a decrease in the cultivation of local crops. A change in food habits and tedious processing are major reasons for neglecting minor crops including mandate crops and deemed low priority crops.

The VDC has high crop varietal diversity in local crops including project's mandate crops. However, their utilization remains low and traditional rather than optimized for marketing and income. Among the eight mandate crops of the project, only six crops exist within the VDC; five are formally cultivated, while one (amaranth) is autonomous. Among the mandate crops, finger millet, rice, bean, buckwheat, and barley are common and important crops in the existing farming and utilization system. The on-farm diversity in terms of richness and evenness is also higher in rice, finger millet and beans followed by buckwheat, barley and amaranth.

Varietal diversity of mandate crops are evenly distributed within the VDC except in buckwheat. Introducing new varietal diversity of cold tolerant rice and naked barley would be an area of work for the project while participatory varietal improvement would be relevant for finger millet and beans. Introduction of new crops like foxtail millet and proso millet would be worthy in order to maintain broad genetic based resource utilization on site. Promotion of finger millet, buckwheat and bean's production as well as establishing market linkages for these crops will be appropriate activities on site.

Seed management and post-harvest processing of mandate crops are largely dependent on traditional methods using indigenous tools and techniques which are time consuming, labour intensive and remain the key post-production constraints. Interventions to improve post-harvest processing and mechanization are needed which will also contribute to address cross cutting issues like women drudgery reduction and unemployment at local level. A lack of formal and informal seed source linkage and unscientific seed management practices are major issues of the existing seed system.

Presence of CBOs is good but they have been less active on agriculture related activities including promotion and conservation of local crops. Building good leaders in community based organizations is clearly needed to make local organization active and effective. Lack of awareness of the potential of mandate crops, access to improved seeds, processing technologies, limited product diversification and market linkage are the main constraints. Hence, even simple research and promotion to address rudimentary constraints and access to basic technologies can help improve the cultivation of these traditional mountain crops in Jungu VDC.

6.2 Way Forward: Suggestions for project planning and implementation

The baseline study has attempted to understand the socio-economic context with its implications on traditional farming system of Jungu VDC. In contrast, study has assessed and analyzed existing on-farm diversity of mandate crops, access to their diversity and extent of use of available materials and associated information, existing seed system of mandate crops, processing tools and techniques, benefits obtained by the farmer or farming community from the use of local crop diversity. This baseline study has explored the existing production and post-production constraints in mandate crops. According to Jarvis et al. (2010), understanding the production constraints of traditional local crop diversity is key to develop suitable interventions at local level.

Based on site situation analysis and with the support of relevant global literature, following areas of intervention have been identified as way forward for the project.

- **Grassroot breeding and PVS:** Identification and characterization of promising landraces of mandate crops should be a top priority at the beginning of the project. Registration of promising local landraces through grassroots breeding is important at this stages as no notified varieties exists for many mandate crops. Rare varieties of mandate crops should be restored to prevent them from being extinct through seed multiplication and diversity deployment. Farmer preference for these varieties can be assessed using participatory varietal selection (PVS). Climatic stress tolerant, disease and pest tolerant varieties should be identified in order to optimize the utilization of existing in agrobiodiversity.

- **Diversity introduction and dissemination:** Introducing new crops (proso millet and foxtail millet in Jungu) and varieties (released and promising landraces from similar agro-ecological zone or National Genebank) should be done in order to broaden the genetic base of farming system. Promotion of rare and unique varieties with specific preferable traits might be useful for solving specific shortcoming as well as on farm conservation of local diversity. Diversity dissemination through IRD and diversity kits should be adopted while diversity blocks can be useful method to demonstrate reliability of newly introduced varieties and crops.

- **Strengthening local seed system:** Strong informal seed system exist in Jungu VDC but strengthening is need in order to make more resilient. Widening seed exchange network and improving technical aspects on seed selection and proper storage should be on priority work of the project. Awareness raising on seed management along with viable technology introduction of drying, cleaning, storage would be relevant. Linking informal seed system to formal seed system by mobilizing CBOs should be another priority. Implementation of CSB approach will be more relevant to address this issue. Organizing PSE regularly before planting seasons will help more farmers access pre-existing diversity in the village.

- **Addressing production and post-production constraints:** In the context of production constraints, increase in access to quality seeds from formal sectors, disease and pest management utilizing genetic diversity, promotion of stress tolerant varieties and practicing improved farming technologies for better utilization of soil fertility should be done. To address post production constraints, viable technologies of processing mechanization should be a priority. Energy efficient and convenient technologies/tools for rural areas (easily operate-able and portable) should introduced and demonstrated. Studying present practices and analyzing their mechanical deficiencies of conventional tools/techniques will be more helpful to develop efficient new technologies or viable mechanical modification on existing tools. Studying value chain, demand and supply potentialities, and willingness to pay analysis for organic products can contribute to solve post production constraints of marketing. Product diversification and value addition should be used to maximize utilization and marketing of local products. Local branding as well as truthful labeling of local products on marketing will be added benefit to create dependable market.

- **Social capital building:** Social capital building is the most essential part to sustain project's intervention for longer term. Capacity enhancement of technical farming, strengthening organizational management skills of local organization and regular technical support are very crucial. Without participation and ownership of the local community, interventions cannot be sustained. Since this project is first of its kind in Jungu regarding conservation and promotion of local crops, it needs to invest significant effort on community sensitization. Along with raising awareness through different local activities like school programmes, farmer visits to experimental trials, organizing diversity fair, providing platforms for farmers to learn and share their knowledge will be helpful. Community seed banks (CSB) and other well established approaches in conservation and management of agro-biodiversity need to be replicated. Providing technical guidance among farmers on diverse farming matters through knowledge sharing platforms like diversity field schools will be relevant.

- **Developing linkage and coordination among local stakeholders:** To mainstream the project findings and interventions, effective mechanism of local stakeholder's involvement and mobilization has to be developed. Information

sharing, continued communication and partnership with local stakeholders like farmer's groups, CBOs and government lien agencies is crucial in making project's intervention sustainable. Also, conducting studies involving university students can add value to the project's outreach and knowledge dissemination. Coordination with local stakeholders is crucial on leveraging resource to support project activity implementation and to create synergic impact. Linking community group, CBOs to district to national level line agencies will enable to develop sustainable mechanism to continue project's intervention even after the phase out of the project. Since Jungu VDC lies near to NARC high hill crop's research station HCRP, linking CBOs seed related activity or CSB will be more relevant. Similarly, involving of local schools, technical schools for agrobiodiversity related knowledge sharing will be beneficial.

- **GESI responsible activity design and implementation:** Implementation GESI responsive field activities are crucial to address gender and social discrimination on the ground as well as complying with project and institutional policies. In the case of Jungu, resource holding and utilization vary with ethnicity which needs to be considered during project activities. Female farmer targeted capacity building activities would be relevant as there is higher involvement of female farmers in local crop production and management. Equitable participation of all gender and caste in project's activities should be kept as serious issue in order to maintain GESI related accountability.

- **Documentation and wider sharing:** Maintaining data records and documentation are essential any type project. Internal as well as external sharing of those documents will be helpful for efficient planning and maintaining work accountability. New findings should be shared with community and related stakeholders to demonstrate the relevance of work and maintain transparency. Sharing of knowledge and findings also help in providing motivation and insights for new innovations. Wider sharing of documented materials and findings also help to demonstrate project's impact/achievements in real ground. In addition, proper documentation (meeting minutes, planning and progress reports etc.) and timely sharing among line agencies is important to maintain local government compliance.

REFERENCES

Almekinders, Conny JM and Louwaars, Niels P (2002) The Importance of the Farmers' Seed Systems in a Functional National Seed Sector, *Journal of New Seeds*, 4(1):15-33.

Beckett, SJ, Fields, PG and Subramanyam, BH (2007) Disinfestation of stored products and associated structures using heat. *Heat Treatment for Post Harvest Pest Control.* pp 182.

Bezançon, G, Pham, JL, Deu, M, Vigouroux, Y, Sagnard, F, Mariac, C, Kapran, I, Mamadou, A, Gérard, B, Ndjeunga, J and Chantereau, J (2009) Changes in the diversity and geographic distribution of cultivated millet (Pennisetum glaucum (L.) R. Br.) and sorghum (Sorghum bicolor (L.) Moench) varieties in Niger between 1976 and 2003. *Genetic Resource Crop Evolution* 56:223-236.

Bisht, IS, Mehta, PS and Bhandari, DC (2007) Traditional crop diversity and its conservation. On-farm for sustainable agricultural production in Kumaon Himalaya of Uttaranchal state: a case study. *Genetic Resource Crop Evolution* 54: 345–357.

Brush, S, Kesselli, R, Ortega, R, Cisneros, P, Zimmerer, K and Quiros, C (1995) Potato diversity in the Andean center of crop domestication. *Conservation Biology* 9(5):1189-1198.

CSB (2011) *National Population and Housing Census 2011*. Central Bureau of Statistics (CBS), National Planning Commission Secretariat, Kathmandu, Nepal.

CBS (2013) *National Sample Census of Agriculture Nepal, 2011/12*. Central Bureau of Statistics (CBS), National Planning Commission, Government of Nepal, Kathmandu.

Cornhiel, S (2006) *Feminization of Agriculture: Trends and Driving Forces*. Background Paper for the World Development Report. Rimisp-Latin American Center for Rural Development.

DADO (2015) *Annual Progress Report 2014/15*, District Agriculture Development Office, Dolakha, Government of Nepal.

Dominguez, CE and Jones, RB (2005) The dynamics of local seed systems in Mozambique, and the roles played by women. *Seed Systems and Crop Genetic Diversity On- Farm, Proceedings of a workshop, 16–20 September 2003, Pucallpa, Peru*, eds Jarvis, DI, Sevilla-Panizo, R, Chavez Servia, JL and Hodgkin, T. *International Plant Genetic Resources Institute*, Rome, Italy, pp 140–146.

FAO (1998) Developing seed security strategies and programmes for food security in developing countries. *Proceedings of the International Workshop on Seed Security for Food Security, 30 November to 1 December 1997, Florence, Italy*. Food and Agriculture Organization of the United Nations, Seed and Plant Genetic Resources Service, Rome, Italy.

FAO (2009) *FAO and traditional knowledge: the linkages with sustainability, food security and climate change impacts* (Rome, Italy).

FAO (2010) *Second report on the world's plant genetic resources for food and agriculture.* [*in press*]. Electronic version ftp://ftp.fao.org/docrep/fao/meeting/017/ak528e.pdf. United National Food and Agricultural Organization (FAO), Rome, Italy.

Gartaula, HN, Niehof, A and Visser, L (2010) Feminization of Agriculture as an Effect of Male out Migration: Unexpected Outcomes from Jhapa District, Eastern Nepal. *The International Journal of Interdisciplinary Social Sciences* 5(2):565-577.

Ghaley, BB, Christiansen, JL and Andersen, SB (2012) Genetic diversity in blast resistance of Bhutan rice landraces. *Euphytica*. 184:119–130. DOI 10.1007/s10681-011-0582-z.

Gildemacher, PR, Demo, P, Barker, I, Kaguongo, W, Woldegiorgis, G, Wagoire, WW, Wakahiu, M, Leeuwis, C and Struikl, PC (2009) A description of seed potato systems in Kenya, Uganda and Ethiopia. *Am. J. Pot. Res.* 86:373–382

Glover, JD, Cox, CM and Reganold, JP (2007) *Future farming: a return to roots?* Scientific American. pp 82-89

Hawkes, JG (1998) Back to Vavilov: Why Were Plants Domesticated in Some Areas and Not in Others?

Hodgkin, T, Rana, R, Tuxill, J, Didier, B, Subedi, A, Mar, I, Karamura, D, Valdivia, R, Collado, L, Latournerie, L, Sadiki, M, Sawadogo, M, Brown AHD and Jarvis, D (2007) Seed systems and crop genetic diversity in agroecosystems. *Managing Biodiversity in Agricultural Ecosystems*, eds Jarvis, DI, Padoch, C and Cooper, D (Columbia University Press, NY,USA) http://www.bioversityinternational.org/fileadmin/bioversity/publications/Web_version/47/ch06.htm, pp 77-116

Jarvis, DI, Zoes, V, Nares, D and Hodgkin, T (2004) *On-farm management of crop genetic diversity and the convention on biological diversity's programme of work on agricultural biodiversity*. Plant Genetic Resource Newsletter. 138: 5-17

Jarvis, D, Hodgkin, T, Sthapit, BR, Fadda, C and Lopez Noriega, I (2011) A Heuristic Framework for Identifying Multiple Ways of Supporting the Conservation and Use of Traditional Crop Varieties within the Agricultural Production System. *Critical Reviews in Plant Sciences.* 30(1-2): 1-49

Jungu VDC Profile (2009) *Village Profile and Situation Analysis*. Village Development Committee Office, Jungu, Dolakha.

Kaspar, H (2005) *"I am the Household Head Now!" Gender Aspects of Out-Migration for Labour in Nepal*. Nepal Institute of Development Studies, Kathmandu

Kelkar, G (2010) *The feminization of agriculture in Asia: Implications for women's agency and productivity*. UNIFEM South-Asia Regional Office. Available: http://www.agnet.org/library/eb/594/

Lipper, L, Anderson, CL, Dalton, TJ and Keleman, A (2010) Conclusions and policy implications. *Seed trade in rural markets: implications for crop diversity and agricultural development,* eds Lipper, L, Anderson, CL and Dalton, TJ (United National Food and Agricultural Organization (FAO)), Rome, Italy, pp 209-222

Loch, DS and Boyce, KG (2003) *Balancing public and private sector roles in an effective seed supply system*. Field Crop Research 84:105–122

Maredia, M and Howard, J (1998) *Facilitating Seed Sector Transformation in Africa: Key Findings from the Literature.* Food Security II Coperative Agreement between U.S. Agency for International Development, Global Bureau, Economic Growth Center, Office of Agriculture and Food Security and Department of Agricultural Economics, Michigan State University.

Matsushita, K, Yasuda, N, Thinlay, Koizumi, S, Ashizawa, T, Sunohara, Y, Iida, S, Ideta, O, Maeda, H and Fujita, Y (2011) A novel blast resistance locus in rice (*Oryza sativa* L.) cultivar, Chumroo, of Bhutan. *Euphytica*. 180:273-280

Mazhar, F (2000) Seed conservation and management: participatory approaches of Naya Krishi seed network in Bangladesh. *Participatory approaches to the conservation and use of plant genetic resources,* eds Friis-Hansen, E and Sthapit, BR, International Plant Genetic Resources Institute, Rome, Italy, pp 149-153

Nepal Human Development Report (2014) Beyond Geography, Unlocking Human Potential Government of Nepal, National Planning Commission

Pimentel, D (2011) Food for thought: a review of the role of energy in current and evolving agriculture. *Critical Reviews in Plant Sciences* 30:35-44

Poudel, D, Rijal, D, Johnsen, FH, Synnevag, G and Subedi, A (2005) Conservation of crop genetic resources in community genebank: farmers' willingness to pay for conservation of rice landraces in Kaski, Nepal. *On-farm conservation of agricultural biodiversity in Nepal. VolumeII: Managing Diversity and Promoting its Benefits. Proceedings of the second national workshop, 25-27 August 2004, Nagarkot, Nepal* eds Sthapit, BR, Upadhyay, MP, Shrestha, PK and Jarvis, DI, NARC, International Plant Genetic Resources Institute and LI-BIRD, Kathmandu, Nepal, pp 149-160

Rana, RB, Rijal, DK, Gauchan D, Sthapit, BR, Subedi A, Upadhyaya MP, Pandey YR, and Jarvis DI (2000) *In-situ crop conservation: Findings of agro-ecological, crop diversity and socioeconomic baseline survey of Begnas ecosite, Kaski, Nepal*. NP working paper No. 2/2000. NARC/LI-BIRD/IPGRI (Bioversity International) Nepal

Rana, RB, Garforth, C and Sthapit, BR (2008) *Farmers' management of rice varietal diversity in the mid hills of Nepal: Implications for on-farm conservation and crop improvement*. Plant Genetic Resource Charact. Utiliz. 28:1-14.

Regmi, BR, Thapa, L, Sharma, GB and Koirala, S (2008). *Climate change risk, vulnerability and adaptation strategies at community level*. Local Initiatives for Biodiversity, Research and Development (LI-BIRD). Pokhara, Nepal

Ruel, M and Hoddinott, J (2008) *Investing in early childhood nutrition*. IFPRI Policy Brief. November

Shrestha, P, Subedi, A, Sthapit, S, Rijal, D, Gupta, SK, Sthapit, B (2006) Community seed bank: reliable and effective option for agricultural biodiversity conservation. *Good practices: On-farm management of agricultural biodiversity in Nepal, eds* Sthapit, BR, Shrestha, PK and Upadhyay, MP, NARC, LI-BIRD, International Plant Genetic Resources Institute and IDRC, Kathmandu, Nepal, pp 42-45

Smit, B and Pilifosova, O (2001) *Adaptation to Climate Change in the Contex of Sustainable Development and Equity*. Contribution of the Working Group to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, UK, pp 879-912

Song, Y (1998) *"New" Seed in "Old" China: Impact of CIMMYT Collaborative Programme on Maize Breeding in South-Western China.* PhD Thesis, Wageningen Agricultural University, Wageningen

Sthapit, BR, Joshi, KD and Witcombe, JR (1996) *Farmer participatory crop improvement. III: Participatory plant breeding, a case study for rice in Nepal.* Exp. Agric. 32:479-496

Sthapit, BR and Subedi, M (1990) *Fingermillet production system in the midhills of Lumle area: its household importance, constraints and research need.* Technical Paper No. 3 LAC, Pokhara, Nepal

Sthapit, BR, Shrestha, P and Upadhyay, MP eds. (2006) On-farm management of Agriculture Biodiversity in Nepal: Good Practices. NARC/LI-BIRD/Bioversity International, Nepal.

Sthapit, BR, Shrestha, PK and Upadhyay, MP, eds (2006a) *Good practices: On-farm management of agricultural biodiversity in Nepal.* NARC, LI-BIRD, International Plant Genetic Resources Institute and IDRC, Kathmandu, Nepal

Subedi, M (1991) *The findings of finger millet samuhik bhraman: Dansing, Ghandruk, Lumle and Dhikurpokhari area of Kaski district*. Working paper No.1/91. LAC, Pokhara, Nepal.

Thamaga Chitja, JM, Hendriks, SL, Ortmann, GF and Green, M (2004) Impact of maize storage on rural household food, security in Northern Kwazulu-Natal. *J. Fam. Ecol. Cons. Sci.* 32:8-15. http://ajol.info/index.php/jfecs/article/viewFile/52843/41445

Wambugu, PW, Mathenge, PW, Auma, EO and Van Rheenen, HA (2009) *Efficacy of traditional maize (Zea mays L.,) seed storage methods in Western Kenya*. Afr. J. Food Agric. Nutr. Dev. 9(4):1110-1128. http://www.ajfand.net/Issue25/PDFs/Wambugu8010.pdf

ANNEXES

ANNEX 1. Household Survey Questionnaire

"उच्च पर्वतीय क्षेत्रको खाद्य सुरक्षाको लागि स्थानीय बाली विविधता"
आधारभूत घरधुरी सर्वेक्षण, २०७१

नमस्ते ! म **"उच्च पर्वतीय क्षेत्रको खाद्य सुरक्षाको लागि स्थानीय बाली विविधता"** कार्यक्रममा कार्यरत छु । म तपाईंलाई एक अनुसन्धानमा सहभागी हुन अनुरोध गर्दछु । शुरूमा नै तपाइलाई हामीले गर्नलागेको कामको बारेमा संक्षिप्त परिचय दिन चाहन्छु । यी जानकारीहरूलाई ध्यान दिएर सुन्नुहोस्, आफुले नबुझेको कुनै कुरा भए सहभागी हुने वा नहुने निर्णय गर्नु भन्दा पहिले नै हामीलाई सोध्नुहोस् ।

यो अध्ययन किन गरिदै छ? Justification to the respondents about why are we doing this survey?
विश्व वातावरण कोषको आर्थिक सहयोग र बायोभर्सिटी इण्टरनेस्नलको संयोजनमा ली-बर्ड र नार्कको साझेदारीमा हुम्ला, जुम्ला, लम्जुङ्ग र दोलखा जिल्लामा यो परियोजना पांच वर्षका लागि सञ्चालनमा रहेको छ । यो कार्यक्रमको मूख्य उद्देश्य, स्थानीय कृषि जैविक विविधताको ब्यबस्थापनका लागि उपयुक्त प्रविधिहरूको विकास गर्नु, बर्तमान अबस्थामा रहेको बीउ उत्पादन प्रणालीको अध्ययन गरी बीउको गुणस्तर र उपलब्धतामा सुधार ल्याउर्नु, कृषि जैविक विविधताको दिगो ब्यबस्थापनका लागि भएका नीति नियमहरूको अध्ययन गरी आवश्यकतानुसार नीतिगत छलफल तथा वकालत गर्नु र उच्च पहाडी कृषि जैविक विविधताको संरक्षण तथा प्रयोगलाई मुल प्रवाहमा ल्याउनु रहेको छ । कार्यक्रम सञ्चालन पूर्वको अवस्था के कस्तो थियो भनी जानकारी लिन यो सर्वेक्षणले मद्दत पुर्‍याउनेछ ।

गोपनीयता We will keep the information secret provided by you.
तपाईंको घरधुरी सम्बन्धि सम्पूर्ण जानकारीहरू अति गोप्य राखिनेछन् । कुनै प्रतिबेदन वा प्रकाशनमा तपाईं र तपाईंको घरको पहिचान गरिनेछैन । आंकडाहरू GEF/LI-BIRD अनुसन्धानकर्ताहरूबीच मात्र आदान प्रदान गर्न सकिनेछ । पूर्ण गोप्यताको सुनिष्चितताको लागि हामी कटिबद्द छौं ।

सहभागिता If you are interested to particpate in this study we are going to do.
यो अध्ययनमा सहभागिता ऐच्छिक हो । अध्ययनमा सहभागी नहुन तपाईंलाई अधिकार छ । सहभागी हुन ईच्छुक भएमा, प्रश्न सोध्ने क्रममा कुनै पनि समयमा तपाईंले रोक्न सक्नु हुनेछ तथा प्रश्नावलीका कुनै प्रश्नको उत्तर दिन ईन्कार गर्न सक्नुहुनेछ । कुनै पनि अवस्थामा तपाईंले सहभागितामा भाग नलिन बिचार गर्नु भएमा, यसबाट कुनै असर हुनेछैन ।

यो सर्भेक्षणमा सोधिने प्रश्नहरूको जवाफ दिन के तपाई ईच्छुक हुनुहुन्छ? छु :____ छैन:___
If you are interested to answer those questions which will be asked in this survey? (Yes, No)

घरधुरी नं.: ..... *Household No.* मितिः *Date* ...../...../.....

A. सामान्य जानकारी *General Information*

१. जिल्लाः ..... *District* २.गा.वि.स.: *VDC* .....

३. गाउँ / टोलको नामः .....*Village Name* ४.वडा नं.:*Ward #* .....

५. उत्तरदाताको नाम : *Respondent's Name*.

६. लिङ्ग :*Gender* १. महिला ☐ २. पूरुष ☐

७. उमेर :*Age* .....बर्ष

८. थर/ जात :*Ethnicity* .....

९. सर्म्पक नं : *Phone number*.....

१०. कृषिसम्बन्धी कार्यकोलागि निर्णय कसले गर्नु हुन्छ ?

Who takes agriculture related decision in the household? (Female, Male, both)

महिला ☐ पुरुष ☐ दुवै ☐

११. तपाई यो ठाउँमा बसोबास गर्न थाल्नु भएको कति वर्ष भयो ?

How long have you been living in the village?

वर्ष ☐ पुस्तौ देखि ☐

१२. परिवारको प्रकार : *Family Type (Single Family or Joint Family)*

एकल परिवार ☐ संयुक्त परिवार ☐

१३. परिवार सदस्य सख्या : *No. of Family Members (Total, Female, Male and Under 16 years)*

जम्मा .....

महिला ☐ पुरुष ☐ १६ वर्ष मुनि ☐

१४. तपाईको परिवारमा कति जना सदस्य कृषि सम्बन्धी कार्यमा संलग्न हुनुहुन्छ ?

How many members of your family are involved in agriculturerelated activities?(Female, Male)

महिला ☐ पूरुष ☐

१५. तपाईको परिवारमा कुनै सदस्य गा.वि.स. बाहिर काम गर्नुहुन्छ ?

Do any of your family members work outside the VDC? (Yes, No)

१. हुन्छ ☐ २. हुन्न ☐

१६. यदि हुन्छ भने, गा.वि.स. बाहिर गएर काम गर्ने सदस्यहरुको निम्न विवरण दिनुहोला ।

If yes then, provide detail of those members working outside the VDC.

कार्य अवधि *Work Duration*	पुरुषको संख्या *No. of Male*	महिलाको संख्या *No. of Female*
३ महिना *Upto 3 months*		
३–६ महिना *3 -6 months*		
६ महिना भन्दा बढी *>6 months*		

१७. तपाईको परिवारको आम्दानीको मुख्य श्रोतहरु के के हुन् ?

What are the major sources income for your family?

१. कृषि तथा पशुपालन *(Agriculture and Livestock)* २. व्यवसाय*(Business)*

३. जागिर/नोकरी*(Job / Service)* ४. कृषि श्रमिक*(Agricultural Labour)*

५. गैर कृषि श्रमिक *(Non- Agricultural Labour)* ६. रेमिटेन्स *(Remitance)*

७. जडीबुटी संकलन *(Herbs Collection)*

१. ..... २. ..... ३. .....

B. कृषि सम्बन्धी विवरण *(Detail about Agriculture)*

१८. तलको विवरणहरु लिनुहोस । *(Take details of following given below)*

जग्गा/जमिनको प्रकार *Type of Land*	आफ्नै खेतबारी (परिमाण/ईकाई) *Own Land (Qty/ Unit)*	अधिया (परिमाण/ईकाई) *Qty/ Unit*		भाडामा/बन्दकी (परिमाण/ईकाई) *Leased (Qty/ Unit)*		बाँझो छोडेको (परिमाण/ईकाई) *Barren Land (Qty/ Unit)*
		लिएको *Taken*	दिएको *Given*	लिएको *Taken*	दिएका *Given*	
खेत *Low Land*						
बारी *UpLand*						
फलफुल बगैँचा *Fruit Orchard*						
खरबारी *Pasture*						
निजी वन *Own Forest*						
अन्य *If others then specify* (खुलाउनुहोस्)						

१९. पशुको विवरण *(Detail about Livestock)*

क्र. सं	पशु वस्तु *(Livestocks)*	संख्या *(Number)*
१		
२		
३		
४		
५		

२०. आफ्नो कृषि उत्पादनले तपाईको परिवारलाई बर्षमा कति महिना खान पुग्छ?

How many months does your own agriculture production sustain your family in a year?

खाद्य प्रकार *Type of Food*	महिना *Month*
मुख्यवाली / अन्नवाली *Main Crop / Food Crop*	
हरियो सागपात *Green Leafy Vegetables*	
तरकारीवाली *Vegetable Crops*	
दलहनवाली *Pulse Crops*	
अन्य *Others*	

२१. तपाइँले कुन कुन फलफुल लगाउनु भएको छ ?

Which fruits trees have you grown in your home?

क्र. सं *S.No.*	फलफुलको नाम *Fruit Name*	बोट संख्या *No. of Trees*	क्र. सं *S.No.*	फलफुलको नाम *Fruit Name*	बोट संख्या *No. of Trees*

२२. तपाइँले आफ्नो खेत बारीमा तल उल्लेखित कुन कुन बालीहरु लगाउनुहुन्छ ?

Which of the following below listed crops do you grow in your field?

बालीको नाम *Crop Name*	जात *Variety*	बीउको श्रोत *Source of seed*	क्षेत्रफल *Area*		जम्मा उत्पादन (के जी) *(KG) Total Production*	उत्पादन बेच्नुहुन्छ? (के जी)*(KG) Do u Sell Prodtn?*
			परिमाण *Quantity*	इकाइ *Unit*		
लट्टेवाली *Amaranth*						
फापर *Buckwheat*						
चिसो सहने धान *Cold Tolerant Rice*						
कोदो *Finger Millet*						
चिनो *Porso Millet*						

कागुनो *Foxtail Millet*						
उवा वा जौ *Naked Barley/ Barley*						
सिमि *Beans*						

बीउको श्रोतः १. आफ्नै घरको बीउ २. हाट बजार वा बजार, ३. एग्रोभेट, ४. सरकारी संस्था, ५. गैरसरकारी संस्था, ६. छिमेकी ७. नातेदार, ८. सामुदायिक बीउ बैंक, ९. सहकारी संस्था, १०. अन्य (खुलाउनुहोस्)

Source of Seed: Own Households, Haat or Market, Agrovet, Government Organisation, NGO, Neighbours, Relatives, Community seed bank, Cooperative, If others then specify.

२३. माथि उल्लेखित बालीहरुको खेती प्रविधि सम्बन्धि कुनै तालीम पाउनु भएको छ ?(धान बाहेक)
Have you received any trainings related to cultivation practices of above listed crops (except that for rice)? (Yes, No)

१. छ ☐ २. छैन ☐

छ भने कहाँबाट पाउनु भयो ? ***if Yes then , from where did you get it?***

.....

२४. फापरको साग खानुहुन्छ ? ***Do you consume buckwheat as green leafy vegetable? (Yes, No)***

१. छ ☐ २. छैन ☐

२५. फापरको साग बेच्नुहुन्छ ? ***Do you sell green leaves of buckwheat ? (Yes, No)***

१. छ ☐ २. छैन ☐

२६. फापरको साग किन्नुहुन्छ ? ***Do you buy green leaves of buckwheat ? (Yes, No)***

१. छ ☐ २. छैन ☐

२७. लट्टेको साग खानुहुन्छ ? ***Do you consume amaranth as green leafy vegetable? (Yes, No)***

१. छ ☐ २. छैन ☐

२८. लट्टेको साग बेच्नुहुन्छ ? ***Do you sell green leaves of amaranth ? (Yes, No)***

१. छ ☐ २. छैन ☐

२९. लट्टेको साग किन्नुहुन्छ ? *Do you sell green leaves of amaranth ? (Yes, No)*

१. छ ☐ २. छैन ☐

३०. तल उल्लेखित कुन कुन बाली खानको लागि किन्नुहुन्छ ?

Which of the below listed crops do you purchase/buy for consumption?

बालीको नाम *Crop Name*	बाली खानको लागि किनेका *Crops purchased for consumption*	
	परिमाण *Quantity*	इकाइ *unit*
लट्टेवाली *Amaranth*		
फापर *Buckwheat*		
चिसो सहने धान *Cold Tolerant Rice*		
कोदो *Finger Millet*		
चिनो *Proso Millet*		
कागुनो *Foxtail Millet*		
उवा वा जौ *Naked Barley*		
सिमि *Beans*		

३१. तपाईंको विचारमा यस ठाउंमा कुन कुन स्थानीय बालीको प्रवर्द्धन गर्न आवश्यक छ ?

In your view which of the local crops should be promoted ?

.....

३२. तपाईंको विचारमा कुन कुन स्थानीय बालीको संरक्षण गर्न आवश्यक छ ?

In your view which of the local crops should be preserved? (Not Needed , No said anything)

.....

नभनेको ☐ आवश्यक छैन ☐

संरक्षण गर्नुपर्ने लोपोन्मुख स्थानीय जातहरुको नाम र अमुल्य गुणहरु उल्लेख गर्नुहोस् ।

स्थानीय बाली	जातको नाम	अमुल्य गुणहरु *(Unique Traits)*

३३. नेपाल खाद्य संस्थानले यी स्थानीय बालीहरु खरिद गर्ने कुरा तपाइलाई थाहा छ ?

Do you know that Nepal Food Corporation purchase these crops? (Yes, No)

१. छ ☐ २. छैन ☐

३४. तपाईंको परिवारको कुनै सदस्य कृषक पाठशालामा सहभागी हुनुभएको छ ?

Has any of your family members taken part in FFS? (Yes, No)

१. छ ☐ २. छैन ☐

३५. यदि छ भने, कृषक पाठशालाको बारेमा के थाहा छ ?

If yes then, what do you know about FFS? (Yes, No)

.....

३६. सामुदायिक बीउ बैंकको बारेमा थाहा छ ?

Do you know about Community Seed Bank? (Yes, No)

१. छ ☐ २. छैन ☐

संकलनकर्ताको नाम : ***Name of Enumerator***.....

हस्ताक्षर : ***Signature***..... मिति :***Date*** .....

तपाइको अमूल्य समय र सुचनाको लागि धन्यवाद !

Thank you so much for your valuable time and information.

ANNEX 2. Crop inventory prepared from ward level FGDs

SN	Cereals	Pulses	Vegetables	Oil Seeds	Spices	Fruits
1	Barley	Black gram	Amaranths	Aalas	Alaichi	Aaru
2	Buckwheat	Common Bean	Balsam Apple	Jhuse til	Carrot	Almond
3	Finger Millet	Cowpea	Bitter Gourd	Mustard	Chilli	Banana
4	Maize	Horse gram	Bottle Gourd	Rayo	Coriander	Bhogate
5	Naked Barley	Lentil	Brinjal	Sarseu	Cucumber	Grapes
6	Rice	Pea	Cabbage		Garlic	Guava
7	Wheat	Rice bean	Cauliflower		Ginger	Haluwabed
8		Soybean	Chamsur		Jimbu	Junar
9			Chayote		Methi	Kiwi
10			Fava bean		Mint	Khurpani
11			Ladies Finger		Onion	Lemon
12			Niguro		Sup	Nibuwa
13			Potato		Timur	Orange
14			Pumpkin		Tomato	Pear
15			Radish		Tree Tomato	Pineapple
16			Rayo Saag		Turmeric	Pomegranate
17			Sponge Gourd		Xyapi	
18			Taro			
19			Yam			

ANNEX 3. Ward level discussion meeting record

Discussion Date	Ward No.	Janjati		Dalit		Brahmin/Chhetri		Total
		Female	Male	Female	Male	Female	Male	
23rd Aug 2014	1	1	0	3	0	14	5	23
20th Aug. 2014	2	3	5	5	0	1	7	21
21st Aug. 2014	3	6	1	6	2	20	7	42
24th Aug. 2014	4	0	0	0	0	30	13	43
21st Aug. 2014	5	0	0	0	0	16	13	29
22nd Aug. 2014	6	0	0	0	0	5	8	13
11th Aug. 2014	7	10	5	0	0	5	5	25
12th Aug. 2014	8	3	5	0	0	11	10	29
13th Aug. 2014	9	29	8	0	0	3	6	46
Total		52	24	14	2	105	74	271

ANNEX 4. Check List for Seed Management Practice

- Do you keep your own seeds of these crops?
- Where do you select seeds? Before harvesting whole yield (on farm) or after harvesting?
- What are the criteria to select or distinguish seeds from normal grain?
- Do you process seeds separately or all together? Is any technique of processing different for seeds?
- Is there any special treatment for seed after process?
- Do you refine or filter seeds after they are processed?
- How do you store seeds? What are the tools/containers that you use to store seeds?
- Where do you store seeds? Inside or outside of home?
- Do you to recheck or maintain the seeds after storage?

Check List for Processing Practice

- How do you thresh your crops after harvesting?
- What are the tools that you use to thresh and what are the difficulties?
- Does it need further processing? What are the processes and steps?
- What are the tools that you use? Are there any modern tools?
- What are the problems after the threshing process?
- Which crop has the most difficulty with processing and in which particular step/stage?
- Do you have facility of electric mills? What type of services do they provide?
- Are electric mills on feasible distance? What about its easy access and distribution?

ANNEX 5. Table showing various socio-economic finds of baseline survey.

Family type	Brahmin/Chhetri	Dalit	Janjati	Total No. (%)
Nuclear	33 (53%)	6 (60%)	15 (83%)	54 (60%)
Joint	29 (47%)	4 (40%)	3 (17%)	36 (40%)
Total	62 (69%)	10 (11%)	18 (20%)	90 (100%)
Family size				Avg ± SE
Nuclear	4.8 ± 0.9	5.5 ±0.8	4.8 ± 0.5	4.9 ±0.2
Joint	7.4 ± 0.4	7.5 ± 1.2	6.3 ± 1.7	7.3 ± 0.4
Total	6 ± 0.3	6.3 ± 0.7	5.1 ± 0.5	5.8 ± 0.2
Migrants	Brahmin/Chhetri	Dalit	Janjati	No. (%)
Male	46 (74)	6 (75)	9 (69)	61 (73)
Female	16 (26)	2 (25)	4 (31)	22 (27)
Total	62 (100)	8 (80)	13 (72)	83 (92)
Major Source of Income	Brahmin/Chhetri	Dalit	Janjati	No. (%)
Agri/Livestock	32 (52%)	11 (70%)	11 (61%)	50 (56%)
Business	4 (6%)	0	0	4 (4%)
National Service	9 (15%)	0	1 (6%)	10 (11%)
Agri Labour	1 (2%)	0	1 (6%)	2 (2%)
Non Agri Labour	8 (13%)	2 (20%)	3 (17%)	13 (14%)
Remittance	8 (13%)	1 (10%)	1 (6%)	10 (11%)
MAPs	0	0	1 (6%)	1 (1%)
Gender of Ag decision maker	Brahmin/Chhetri	Dalit	Janjati	No. (%)
Female	21 (34%)	6 (60%)	7 (39%)	34 (38%)
Male	11 (18%)	-	5 (28%)	16 (18%)
Both	30 (48%)	4 (40%)	6 (33%)	40 (44%)
Ag. Labour	Brahmin/Chhetri	Dalit	Janjati	Avg ± SE (%)
Male	1.3 (±0.09) 61%	2 (±0.5) 60%	1.3 (±0.07) 83%	1.3 (±0.09) 61%
Female	1.3 (±0.06) 91%	1.7 (±0.4) 100%	1.1 (±0.09) 61%	1.3 (±0.07) 93%
Land type	Brahmin/Chhetri	Dalit	Janjati	Avg ± SE (%)
Own khet (ropani)	4.84 (±0.4) 81%	2.9 (±0.6) 50%	2.5 (±0.7) 50%	4.3 (±0.3) 71%
Share khet out (ropani)	-	-	-	-
Share khet in (ropani)	3.4 (±0.5) 29%	4 (±0) 10%	2 (±0) 6%	3.3 (±0.4) 22%
Fallow khet	2.2 (±0.3) 6%	1.5 (±0) 10%	2 (±0.5) 2%	2 (±0.2) 7%
Bari own	4.1 (±0.4) 100%	2.4 (±0.3) 100%	3.2 (±0.4) 94%	3.8 (±0.3) 99%
Shared bari in	1.5 (±0.6) 5%	1.5 (±0.5) 30%	3.5 (±1) 11%	2 (±0.4) 9%
Shared bari out	2.6 (±0.4) 11%	-	3 (±0) 6%	2.6 (±0.4) 9%
Fallow Bari	2.2 (±0.6) 27%	-	-	2.3 (±0.3) 29%
Orchard	1.4 (±0.3) 16%	-	0.7 (±0) 6%	1.3 (±0.3) 12%
Khar bari	0.8 (±0.3) 3%	-	1 (±0) 6%	0.9 (±0.2) 3%
Forest	2.7 (±0.4) 45%	2.3 (±1.2) 20%	2.8 (±0.6) 50%	2.7 (±0.3) 43%
Livestock	Brahmin/Chhetri	Dalit	Janjati	Total Avg ± SE (%)

Family type	Brahmin/Chhetri	Dalit	Janjati	Total No. (%)
Cow	1.8 (±0.5) 32%	1.8 (±0.2) 50%	3 (±0.2) 39%	3.5 (±0.1) 36%
Bee	1 (±0) 3%	-	-	1 (±0) 2%
Buffalo	1.6 (±0.1) 48%	1.2 (±0.2) 40%	1.7 (±0.4) 22%	1.6 (±0.1) 42%
Goat	6 (±0.4) 94%	3.3 (±0.5) 80%	4.6 (±0.7) 89%	5.5 (±0.1) 91%
Hen	6.7 (±1.9) 81%	5 (±0.8) 90%	3.4 (±0.4) 78%	5.8 (±1.3) 81%
Pig	2 (±0) 2%	-	-	2 (±0) 1%
Sheep	1 (±0) 2%	-	1 (±0) 1%	1 (±0) 1%
Ox	1.8 (±0.1) 37%	1.5 (±0.5) 20%	1.8 (±0.2) 44%	1.8 (±0.08) 37%
Food self-sufficiency	Brahmin/Chhetri	Dalit	Janjati	Avg. no of months ± SE
Cereal	8.03 (±0.3)	5.4 (±0.3)	5.1 (±0.5)	7.1 (± 0.3)
Leafy vegetables	6.05 (±0.3)	4.2 (±0.6)	4.7 (±0.6)	5.5 (± 0.3)
Other vegetables	3.9 (±0.3)	2.5 (±0.4)	42 (±0.8)	3.8 (±0.2)
Pulses	3.5 (±0.3)	3.6 (±1.3)	3.4 (±0.9)	3.5 (±0.3)
Spices	7.8 (±0.5)	7.6 (±1.4)	7.4 (±1.1)	7.7 (±0.4)

Annex 6. List of existing community level organizations and groups with beneficiaries, activities, and financial status

Group Name	Total Member	Major activities within the VDCs	Financial Status in Rs (Approximate amount)
Janaupakar Saving and Credit Cooperative	3000	Saving and credit	90 Million
Himchuli Cooperative	1200	Saving and credit and off seasonal vegetable farming support schemes	10 Million
Bajusthan Krishi cooperative-8	380	Saving and credit, fertilizer and vegetable seed distribution of farmers	1.2 Million
Chaharasori sana kisan Cooperative	450	Saving and credits	1.6 Million
Unik Bachat tatha Rin Cooperative-8	200	Saving and credit	0.6 Million
Pargatisil Bahuudhesye Cooperative	700	Saving and credit	10 Million
Women's Group	180 (nine groups)	Social work	0.7 Million
Phulbari Women Organization	200	Skill development (*silai, bunai* etc.)	NA
Community User Forest Group	Nine	Sustainable use and management of forest and small scale saving	0.2 Million
Mother's Groups	25 Groups	Saving and credit	NA

Annex 7. Table showing surveyed households during the baseline sutdy with their respective ethnicities.

Elite castes				Janjati	HH No.	Dalit	HH No.
Brahmin	HH No.	Chhetri	HH No.				
Neupane	2 (25)	Basnet	8 (15)	Bhujel	1 (6)	Damai	3 (30)
Pandey	4 (50)	Buathoki	2 (4)	Jirel	11 (61)	Kami	1 (10)
Poudel	1 (13)	Karki	21 (39)	Magar	1 (6)	Sarki	6 (60)
Uppreti	1 (13)	Khadka	11 (20)	Sherpa	1 (6)		
		Khatri	11 (20)	Tamang	4 (22)		
		Raut	1 (2)				
Total	8 (9)		54 (60)		18 (20)		10 (11)
Figures in parenthesis are percentage of respective columns							

Annex 8. Detail of key informants interviewed during baseline information collection

SN	Key Informant's Name	Address	Designation/Affiliation
1	Tej Kumar Dhamala	Charikot, Dolakha	Secretariat of Jungu VDC
2	Shant Lama Sherpa	Jungu-9, Dolakha	Principle of local higher secondary school, social worker
3	Jhalak Kumar Karki	Jungu-7, Dolakha	Cooperative president, local farmer, teacher
4	Netra Bhadur Khadka	Jungu-8, Dolakha	Local farmer, social worker
5	Makhana Khadka	Jungu-8, Dolakha	Experienced women farmer
6	Goma Jirel	Jungu-7, Dolakha	Proactive women farmer
7	Gyan Bhadur Jirel	Jungu-8, Dolakha	President of cooperative, local farmer
8	Tej Bahdur Khadka	Jungu-2, Dolakha	Experienced local farmer
9	Roshan Karki	Jungu-6, Dolakha	Teacher, social worker
10	Laxmi Baraili	Jungu-2, Dolakha	Teacher, progressive women farmer

ANNEX 9. Local unit and conversion table

Food Stuff	Local Unit	Standard Unit
Rice	1 Muri	68.4 Kilogram
Finger Millet	1 Muri	62.4 Kilogram
Foxtail Millet (unprocessed)	1 Muri	60 Kilogram
Foxtail Millet (Processed)	1 Muri	68.8 Kilogram
Buckwheat_Tite	1 Muri	60.8 Kilogram
Amaranth	1 Muri	
Naked Barley	1 Muri	69.6 kilogram
Barley	1 Muri	60 Kilogram
Wheat	1 Muri	69.6 Kilogram
Land Area		
1 Hal	2 Ropani	based on local people
1 Ropani	16 Aana	508.5 Sq.metres

ANNEX 10: PHOTO GALLERY

Household level electric flouring mill in Jungu VDC

Maize grains in Bhakari

Finger millet seeds Steel Ghyampo

Seeds storing Bora/Sacks

Rice seeds stored in Bhakari

Maize being sun dried

Traditional seed storing practices in Jungu VDC

Mungo

Gyalpi

Jato

1

2

Traditional post-harvest processing tools for threshing, grinding and dehusking processes

Picture 1: A farmer showing *Musli*
Picture 2: A female farmer dehusking finger millet in *Okhal*

Local Crop Project Mandate Crops

Amaranth

Finger Millet

Naked Barley

Foxtail Millet

Beans

Proso Millet

Buckwheat

Cold Tolerant Rice

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