



**CHARACTERIZATION OF MAIZE, WINTER BEANS AND FINGER MILLET  
VARIETIES THROUGH DIVERSITY BLOCK IN MAKWANPUR AND SARLAHI  
DISTRICTS, NEPAL**

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**Abstract**

*Diversity block was constructed for assessing the status of maize and finger millet and winter beans varieties in Chhatiwani V.D.C. and Parwanipur V.D.C. of Sarlahi and Makwanpur districts respectively and for winter Parwanipur (Sarlahi) and Raigaun, Makwanpur was propensively selected. 18, 21 and 22 varieties of maize, finger millet and winter beans were planted and characterized respectively in these locations. Upon analysis, varied temporal sequence of cultivation of these varieties was identified. The positive and negative traits were also evaluated minutely so as to assess the preference of these varieties. The current trend of these varieties were also assessed which showed that only one variety of maize and 3 varieties of finger millet has increasing trend. 2 varieties of maize were identified as threatened. Also, 5 varieties of maize and 1 variety of finger millet were gradually decreasing. These varieties can be value added, marketed and enhancement can be done accordingly.*

**Keywords:** *Diversity block, varieties, traits*



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**1. Introduction**

Agriculture is the backbone of Nepalese economy as it is still the main source of income and livelihood of 66% of rural population in Nepal as about 80% of population depends on subsistence farming (MOAD, Statistical Information of Nepalese Agriculture 2008/2009, 2009). The country has had major concerns on household food security and poor nutrition (FAO, 2004). FAO food deprivation data 2005-07 for Nepal showed that 4.5 million people live under the condition of undernourishment (FAOSTAT, 2011). Cereal crops are the staple food and contribute major share in area and production. Pulses (grain legumes) are important in terms of nutrition and subsistence farming as it plays role in enhancing the soil fertility by

symbiotic nitrogen fixation. Pulses supply the major part of the dietary protein (20-25% protein by weight, which is 2-3 times that of wheat and rice) for majority of poor who cannot afford expensive animal protein and vegetarians. Crop residues and by-products are valuable as fodder, feed and firewood (FAOSTAT, 2011).

Maize has been traditionally grown as a staple food crop for many years. In Nepal, there is about 9, 06,253 ha of area under maize cultivation and annual production is about 20,67,722 mt. with productivity of 2.28 mt/ha (MOAD, 2011). However, Nepal does not have its own hybrid till now for farmers to produce grain. In recent days, it has been developing itself as a multipurpose and cash crop. Twenty-four total maize varieties including two hybrids (Gaurav and Rampur hybrid 2) and one QPM (Poshilo Makai-1) have been released so far. Recommended varieties for different agri-environment are: High hills: Ganesh-1&2; Mid-hills: Manakamana 1, 2, 3, 4, 5 & 6, Deuti, Shitala, Poshilo Makai-1; Terai and Inner Terai: Rampur Composite, Arun-1& 2, hybrid “Gaurav and Rampur Hybrid-2. Moreover, the pipeline varieties are RML 32 x RML 17, RML 4 X RML 17, RML 95 X RML 96, RML 95 X RML 86 and RML 57 X RL 174. These hybrids have 8 to 10 ton/ha yield potential (NARC, 2016) . Around 325000 hectare of land in Nepal is covered by different minor crops as millet, buckwheat, uwa, kaguno and barley. Among these minor crops finger millet is the most important in terms of production and area as it is the fourth most important cereal crops of Nepal. These crops can be handy in terms of food security and biodiversity conservation point of view (CDD, 2016).

The diversity block is a technique to characterize local landraces under conditions of typical farmer management. Germplasm to be grown in the diversity block may be selected from the materials displayed in diversity fairs or from community member’s seed stocks. Farmers using traditional practices manage the crops, while farmers and scientists monitor the plants to observe and record agro morphological characteristics. In Nepal, it was used to measure and analyze agro morphological characters and to validate farmer descriptors. Farmers were invited to watch the diversity block in the field and determine whether the farmers are consistent in naming and describing varieties (Sthapit, Shrestha, & Upreti, 2012).

Though Nepal is said to be biodiversity hotspot, however, due to shift in cultivation practices, large landraces varieties of many cultivated crop are on the verge of extinction. Thus this paper focuses to characterize major crops (maize, finger millet and winter beans)

varieties present in central region of Nepal which can be a pioneer step in conservation of those varieties. Thus, this study specifically aims:

1. To characterize the landraces and improved varieties of maize, finger millet and winter beans collected at local level
2. To observe and analyse actual diversity of selected crops
3. To document special characters of selected crop varieties

## 2. Materials and Methods

Makwanpur and Sarlahi were selected as case study districts. First and foremost, desk study was done along with field observation. It was followed by a baseline study to record necessary preliminary information. Sanosudha community of Chhatiwan V.D.C was selected from Makwanpur district to characterize maize varieties. Similarly, for fingermillet Parwanipur VDC and for winter bean Parwanipur and Raigaun were selected. Both of these districts lie in the Central Development Region of Nepal and are well connected to major cities of Nepal and India. The Makawanpur district borders to the capital city Kathmandu and is traversed by both East-West and North-South highways. Sarlahi district is well connected to the East-West high way and has open border to India. The research was conducted in Makawanpur and Sarlahi districts because they are one of the species rich districts of Nepal and easily assessable for conduction of study.

**Table 1: Biophysical and socio-economic characteristics of the study area**

Characteristics	Makawanpur (Hill)	Sarlahi (Plain)
Temperature change	Medium*	Low*
Rainfall variability	Medium*	Low*
On-farm agricultural biodiversity	Medium**	Low**
Market access, access to modern technologies and inputs	Medium***	High***

Adapted from: (K.C., 2011)

\*: 1-0.787: very high, 0.6-0.786: high, 0.356-0.6: medium, 0.181-0.355: low and 0.186-0.000: very low. It is based on GIS study made by National Adaptation Program of Action to Climate change, Ministry of Environment, Kathmandu, Nepal. The study was targeted to map the current climate change scenario in Nepal.

\*\* High: subsistence level, with large variety of local biodiversity maintained on farm, medium: semi commercial, both local and improved varieties maintained on farm, low: commercial farming, mono cropping, very low biodiversity maintained on farm.

\*\*\*: High: easy access to market, black topped and functional roads, fertilizer and agricultural inputs available year round, medium: periodic assess to market, graveled road and agricultural inputs available on periodic basis, low: no road facilities, difficulty in marketing and availability of agricultural inputs making farming difficult.

PRA tools were used to identify and assess the rice diversity in the case study villages and to give an understanding of the socio economic and cultural diversity that influences agricultural diversity. The tools used in the PRAs were direct observations and group interviews. During this process, communities conserving the diversity of different crops were identified. For knowing the exact extent of diversity fair was conducted at local level. In the course of time, list of progressive farmers was prepared and site for constructing diversity block was selected. Diversity block was made so as to observe the different characters of rice varieties. After that foul cell analysis was done to identify threatened landraces. Nursery was prepared and seeds were sown accordingly. The layout was done accordingly and plants were transplanted. The field was monitored time and again during critical stages to note down the characters. During final stage village level workshop was conducted to share the result and increase the level of awareness.

### **3. Results and Discussion**

#### **3.1 Morphometry of Districts**

Geographically, Makawanpur has been expanded from 27° 10' north to 27° 40' north latitude and between 84° 41' east to 85° 31' East longitude and consists of 43 VDCs, three municipality, four electoral region and 13 Ilaka based on political and administrative system of Nepal. The altitude of the district is 166 m. to 2584 m from mean sea level (CBS, 2011). Similarly, Sarlahi has been expanded from 26° 45' north to 27° 10' north latitude and between 85° 20' east to 85° 50' East longitude and consists of 76 VDCs, three municipality, four electoral region and 15 Ilaka based on political and administrative system of Nepal. The altitude of the district is 60m to 659m from mean sea level (CBS, 2011).

#### **3.2 Climate and Soil**

Makwanpur has sub-tropical climate lower flat terrains, sub-temperate climate in lower hills and temperate climate in high mountains. The district receives, on an average; an annual precipitation of 2650 ml, maximum temperature 17.7°C and minimum temperature 7.6°C (CBS, 2011). Moreover, Sarlahi district has tropical type of climate. The district

receives, on an average; an annual precipitation of 1700 ml, maximum temperature 31°C and minimum temperature 20°C (CBS, 2011).

### **3.3 Demographic Status of Respondents**

The total population of Makawanpur district is 392604. The number of male is 199144 and female number is 193460. The population growth rate is 2.22 and average family size is 5.5. The population density of the district is 162 people per square kilometer (CBS, 2011). The average literacy rate of the district is 54.1% out of which 53.9% female and 72.6% male. Within the district there are 358 primary school, 49 lower secondary school, 60 secondary school 8 higher secondary school and 5 campus comprising of 108870 total student of the district (CBS, 2011).

The total population of Sarlahi district is 635701. The number of male is 329182 and female number is 306519. The population growth rate is 2.55 and average family size is 5.72. The population density of the district is 505 people per square kilometer (CBS, 2011) [3]. The average literacy rate of the district is 36.53% out of which 25.36% female and 46.86% male. Within the district there are 279 primary school, 63 lower secondary school, 54 secondary school, 6 higher secondary school and 3 campus comprising of 113713 total student of the district (CBS, 2011).

### **3.4 Varietal Diversity of maize, finger millet and winter beans at study areas**

During the study of maize, 18 varieties were documented. These varieties were minutely analysed in diversity block. The traits were documented based on the farmer description. For assuring quality, experts and farmers analysed the data based on their judgment to maintain accuracy and minimize error. During this analysis, 8 varieties were characterized as distinct varieties while remaining were found to be similar to one or another. Moreover, with the same procedure the case for finger millet was analysed based on farmer descriptor and during the process 8 varieties were characterized as distinct varieties out of 13 while remaining was found to be similar to one to another. Also, out of 22 varieties selected for winterbeans 21 were found distinct. This information are presented in table 2. In addition to that, the characterization and use trends of all the selected varieties are presented in table 3, 4 and 5.

Similar study was conducted in Kaski, Nepal where farmers maintain and increase crop genetic diversity and have vast knowledge on variety identification, selection, crop management, and microenvironments acquired from generations of hands-on experience

(Tiwari, 1999). (Bajracharya, Rana, Gauchan, Sthapit, Jarvis, & Witcombe, 2000) pointed that diverse production environment, fragmented land holdings, fragile agro ecosystem, and socio cultural needs are reasons for growing diverse crop varieties and landraces in the country. Khanal and Badal, 2015 have also done similar study on characterization of rice varieties in Nepal.

**Table 2: Varieties of maize, finger millet and winter beans found to be similar to one another during characterization at Makwanpur and Sarlahi district.**

<b>Maize</b>	
Rampur Yellow Local yellow	Five varieties were phenotypically different at early stage but later on were confirmed to be Rampur Yellow.
Local Black (kalo makai), Kalo jya makai, Rato dale	The varieties were phenotypically different at seed sowing but were found similar to local black based on characters studied.
Local red, Rato makai	These varieties were phenotypically different at sowing. But was later confirmed to be Local red.
Local white and Daare Makai	Local white and Dare makai were found to be phenotypically different at seed sowing but Daare makai was found similar to Local white based on characters studied.
Pop corn and Murali Makai	The varieties were phenotypically different at seed sowing but later were found similar to Popcorn based on characters studied.
Local yellow, Shankar Pahelo, Raithane makai, Murali Pahelo, Rasane	Shankar yellow, Raithane makai, Murali pahelo and Rasane were found to be phenotypically different at seed sowing but later were confirmed to be Local yellow based on characters studied.
Khumal yellow and Khumaltare makai	Khumaltare Makai was phenotypically different at seed sowing but later was confirmed to be Khumal yellow based on characters studied.
<b>Finger millet</b>	
Makwanpure and Hetaude	These varieties were phenotypically different at seed sowing but later the characteristics were found similar. So, both were regarded as Makwanpure based on characters studied.
Mukde and Dalle	Dalle was phenotypically different than Mukde but was found to be Mukde based on its characters studied.
Barkhe and Bhadaure	Bhadaure was phenotypically different than barkhe but was found to be barkhe based on its characters studied.
Hiude and Kartike	Kartike was phenotypically different than Hiude but was found to be Hiude based on its characters studied later on.

Winter beans	
Lamte Hariyo lamo kosha	Hariyo lamo kosha was phenotypically different than Lamte but was found to be as lamte based on its characters studied later on.

**Table 3: Assessment of maize varieties in diversity block at Chattiwan VDC, Makawanpur**

S. N.	Maize varieties	Local name	History of cultivation	Distinguishing traits	Positive traits	Negative traits	Cultivation trend
1	Rampur Yellow	Rampure	Old variety grown since 35-40 years when people settled in the area	Dark Yellow and rounded shape grain	High yield, plant height (medium), early maturity, good weight, good cooking quality (softness of porridge)	-	Increasing
2	Khupal yellow	Khumaltare	Introduced 20-25 years before	Bold and flat shaped yellow grain	Good yield	poor taste (porridge), late maturity, susceptible to store pest (weevil)	Decreasing
3	Rasane	Egharsale	Introduced 20-25 years before	Tall plant, Big Size grain, Red color cob.	Good yield, price high than local white, drought tolerant	-	Decreasing
4	Popcorn (Yellow)	Murali	NA (need to explore)	Small and thin plant, slender ear, round light yellow grain	Good for popping, tolerant to store pest (weevil)	Poor yield, late maturity, poor husk cover	Decreasing
5	Local (yellow)	Raithane, Sathiya, Pahelodalle	Grown from generations in the area	Small and thin plant, yellowish round grain, Early maturity,	Early maturity, Good eating quality (both porridge and roasted cobs)	Low yield, low grain recovery,	Decreasing
6	Local (Black)	Kalo Dhinde	Migrants of South Lalitpur introduced some 25 years before	Black and flat grain, late maturity	Tolerant to drought, good for home made alcohol	Low yield, Late maturity, poor eating quality (porridge)	threatened
7	Local (Red)	Rato	NA (need to explore)	Red and flat grain, Medium maturity	-	Low yield,	threatened
8	Local (white)	Dare	Introduced some 20 years before	White and flat and dented grain, medium maturity	Good yield,	Susceptible to store pest (weevil), poor cooking quality (porridge)	Decreasing

\*\* The yield was characterized based on National standard made by Ministry of Agriculture Development (MOAD), 2009 which can be stated as : yield less than 2.35 ton/ha as low yielding variety , yield equal to 2.35 ton/h as medium yielding variety and

yield more than 2.35 ton/ha as high yielding variety. Moreover in case of height variety less than 150 cm was characterized as dwarf variety, height more than 150 cm as tall variety and variety height equal to 150 cm as medium variety.

**Table 4: Assessment of finger millet varieties in diversity block at Parwanipur VDC, Sarlahi**

S. N	Finger Millet Varieties	Local name	History of cultivation	Distinguishing traits	Positive traits	Negative traits	Cultivation trend
1	Makawanpure	Hetaude,	Introduced 25 years before	long flag leaf, green blade pubescence, white flower, late flowering, tall, long, medium dense, high shattering of inflorescence, intermediate tillers, lodging problem, poor moisture stress tolerance	good recovery percentage of grain and flour	Tall, lodging problem	Constant
2	Dalle	Dalle, Mudke	Introduced 15 years before	long flag leaf, green blade pubescence, white flower, late flowering, medium height, short, medium dense, no shattering of inflorescence, yellow color grain, brown color husk, intermediate tillers, not lodging problem, poor moisture stress tolerance	good taste, high yield	hard to thresh	increasing
3	Barkhe	Bhadraure	introduced 30 years before	long flag leaf, green blade pubescence, white flower, medium flowering period, medium height, short, medium dense, no shattering of inflorescence, low tillers, no lodging problem, intermediate moisture stress tolerance	early maturity, good yield	not good taste	Decreasing
4	Pangdure		Grown from generation in the area	long flag leaf, green blade pubescence, white flower, medium flowering period, dwarf, short, medium dense, high shattering of inflorescence, slightly red grain, brown color husk, low tillers, no lodging problem, intermediate moisture stress tolerance	have medicinal use for breast and knee rupture	straw is not preferred by animals	Increasing
5	Pahelo		introduced 25 years before	medium flag leaf, green blade pubescence, white flower, medium flowering period, dwarf, short, low dense, medium shattering of inflorescence, yellow color grain, brown color husk, low tillers, no lodging problem, intermediate moisture stress tolerance	good taste, straw preferred by animals		Increasing
6	Hiude	Kartike	Grown from generation in	long flag leaf, green blade pubescence, white flower, late flowering period, medium height, short, medium dense,	drought tolerant, not shattering		constant



			the area	high shattering of inflorescence, yellow grain, brown color husk, high tillers, no lodging problem, poor moisture stress tolerance	g problem of grain		
7	Kalo		Grown from generation in the area	long flag leaf, green blade pubescence, white flower, medium flowering period, tall, medium long, medium dense, no shattering of inflorescence, yellow color grain, brown color husk, medium tillers, no lodging problem, intermediate moisture stress tolerance	good taste, good recovery percentage of flour	disease problem	Constant
8	Laibari			long flag leaf, green blade pubescence, white flower, late flowering period, tall, long high dense, high shattering of inflorescence, yellow color grain, brown color husk, medium tillers, lodging problem, intermediate moisture stress tolerance	good recovery percentage of grain and flour	Tall, lodging problem	Constant

\*\* The yield was characterized based on National standard made by Ministry of Agriculture Development (MOAD), 2009 which can be stated as : yield less than 1.11 ton/ha as low yielding variety , yield equal to 1.11 ton/h as medium yielding variety and yield more than 1.11 ton/ha as high yielding variety. Moreover in case of height variety less than 100 cm was characterized as dwarf variety, height morethan 100 cm as tall variety and variety height equal to 100 cm as medium variety.

**Table: 5 Assessment of winter bean varieties in diversity block at Parwanipur, Sarlahi and Raigaun VDC, Makawanpur**

S . N	Winter Bean Varieties	Local name	History of cultivation	Distinguishing traits	Positive traits	Negative traits	Cultivation trend
1	Tate Thulo		Newly Introduced	Green stem color, green leaf, large and wide leaf, white flower, light red pod color, medium size pod length and wide, five seed per pod, soft pod, average in yield, aromatic, tasty, pod rot major problem	tasty,	pod rot problem	Newly Introduced
2	Hariyo Sano Karange		Newly Introduced	green stem color, green leaf, small and tapering leaf, white flower, green pod color, short pod length and narrow, four seed per pod, soft pod, average in yield, aromatic, not tasty, viral disease is major problem		not tasty, hard pod	Newly Introduced
3	Madane		Newly Introduced	green stem color, green leaf, small and tapering leaf, yellow flower, green pod color, long wide pod, hard	high yield	not tasty	Newly Introduced

SRIJS/BIMONTHLY/ MAHESH BADAL & SUBODH KHANAL (3650-3661)

				pod, high yield, non aromatic, not tasty			
4	Rato Simi		Newly Introduced	Red color stem, small tapering leaf, violet flower, light violet pod color, medium length and wide pod, soft pod, low yield, aromatic, tasty	tasty	low yield	Newly Introduced
5	Hariyo Chhoto		Newly Introduced	small stem, green leaf, large tapering leaf, violet flower, light violet pod color, short and narrow pod, soft pod, low yield, aromatic, tasty	tasty	low yield	Newly Introduced
6	Seto Simi		Newly Introduced	Green color stem, green leaf, large tapering leaf, white color flower, light green color pod, medium length and narrow pod, soft pod, average in yield, aromatic, tasty	tasty, average in yield		Newly Introduced
7	Thulo Pate		Newly Introduced	green color stem, green leaf, medium size tapering leaf, green color flower, medium length narrow pod, soft pod, low in yield, aromatic, not so tasty		not so tasty, low in yield	Newly Introduced
8	Karang e Thulo	NG		Germination failure			
9	Winter Bean	NG		Germination failure			
10	Lamo Simi		Newly Introduced	Green color stem, green leaf, large tapering leaf, white flower, light green color pod, long wide pod, soft pod, brown color seed, low yield, aromatic, tasty	tasty,	low yield	Newly Introduced
11	Seto Chhoto		Newly Introduced	Green stem color, green leaf, medium size tapering leaf, red flower, green pod color, medium length wide pod, soft pod, black seed, low yield, aromatic, not tasty		not tasty, low yield	Newly Introduced
12	Hariyo Simi			Germination failure			
13	Rato Sano		Newly Introduced	green color stem, green color leaf with red venation, small tapering leaf, violet flower, light red pod, short and wide pod, soft pod, brown seed, medium in yield, aromatic	average in yield		Newly Introduced
14	Kerau Simi		Newly Introduced	Green color stem, green color leaf, small tapering leaf, white flower, green pod, short and thin pod, hard pod, brown color pod, low yield, aromatic		low yield	Newly Introduced
15	Karang e Majhau la		Newly Introduced	green stem, green leaf, tapering leaf, red color flower, green color pod, long wide pod, soft pod, brown seed, medium in yield, aromatic, not tasty	medium in yield	not tasty	Newly Introduced
16	Rato Bhadaure		Newly Introduced	green stem, green leaf, tapering leaf, white flower, light white color pod, short		low yield	Newly Introduced

				and wide pod, soft pod, black seed, low yield, aromatic			
17	Lamte	Hariyo Lamo Kosh	Newly Introduced	green stem, green leaf, large tapering leaf, white color flower, light green color pod, long wide pod, soft pod, brown seed, low yield, aromatic, tasty	tasty	low yield	Newly Introduced
18	Sano Chhoto		Newly Introduced	Green stem, green leaf, large tapering leaf, white flower, light green pod, long wide pod, soft pod, red color seed, low yield, aromatic, tasty		low yield	Newly Introduced
19	Matarkosha		Newly Introduced	Green stem. green leaf, medium size tapering pod, red flower, green pod, long and wide pod, soft pod, brown color seed, low yield, aromatic, not tasty		not tasty, low yield	Newly Introduced
20	Seto lamo		Newly Introduced	Germination failure			
21	Hariyo Lamo Jhuppa		Newly Introduced	Green stem, green leaf, small tapering leaf, white flower, green pod, long and wide pod, soft pod, black seed, low yield, aromatic, not tasty		not tasty, low yield	Newly Introduced

Only 1 variety of maize seems to possess increasing cultivation whereas 2 varieties were threatened and remaining 5 varieties cultivation trend was gradually decreasing. However, 3 varieties of finger millet were being popular, 1 variety's acreage was decreasing and 4 varieties cultivation trend was constant. Moreover, all the selected varieties of winter beans were comparatively new so cultivation trend could not be assessed. Group discussion and key informant interviews were done to document the trend of these varieties. Also, further clarification of information was done during village level workshop. The trend of selection of these varieties is governed by several factors. According to (Upreti & Upreti, 2002), the decreasing trend of landraces and other varieties are governed by cumulative effects of change in land use, weak regulatory framework, migration and socio economic transformation.

### **Conclusion**

Nepal is considered to be biodiversity hotspots and a biologically diverse country. Maize is one of the important cereal crops of Nepal, finger millet being highly hardy and nutritive in local context and winter beans a very potential legume crop. Many improved and landraces are used for cultivation so far. However, proper characterization of available varieties has not been done. This study was more focused to use diversity block so as to

find the similarities and differences of the preferred varieties of these crops. Distinguishing traits were identified, history of cultivation was explored, positive and negative traits were assessed. Moreover, the overall trends in the use of varieties were known so as to assist in better management practices of the selected varieties.

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