

Characterization of Available Rice Varieties through Diversity Block In Makwanpur and Sarlahi Districts, Nepal

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Abstract

Diversity block was constructed in Makwanpur and Sarlahi district after assessing status of rice varieties by four cell analysis. The VDC selected for this purpose are Raigaun, Makwanpur and Parwanipur, Sarlahi. 32 and 27 varieties were planted and characterized respectively in these two districts. The varieties were found to be cultivated from a varied temporal sequence. The positive and negative traits were evaluated minutely to assess the preference of those varieties. The current trend of these varieties were also assessed which showed that total of 5 varieties has increasing trend, 12 varieties were constant whereas 38 varieties has decreasing trend. These varieties can be value added, marketed and enhancement can be done accordingly.

Keywords: Diversity block; Traits; Characterized; Trend

Abbreviations: CBS; Central bureau of statistics; Narc; Nepal Agriculture Research council

Introduction

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 B., *et al.* [1].

Rice is the most important and prestigious food crop of Nepal. It is grown in a diverse environment ranging from tropical plains to foot of the mountain at highest elevation (3050 masl) in Chhumchure, Jumla. Nepal is considered as one of the origin center of rice. It is one of the most important cereal crops in Nepal. Rice is grown in 1440 thousand ha and the productivity is 2.56 t/ha. It contributes nearly 20 per cent to the agricultural gross domestic product and provides more than 50 per cent of the total calorie requirement of the Nepalese people. Nepal has released fifty five (55) rice varieties with full package of growing practices in the last 40 years. The coverage by improved varieties is 85 percent of the total rice cultivated land.(NARC). Though Nepal is rich in diversity, but due to shift in cultivation practices, large landraces varieties of rice are on the verge of extinction. Thus this paper focuses to characterize major rice varieties present in central region of Nepal which can be a pioneer step in conservation of those varieties. In this regard the objective of the study is:

1. To characterize the landraces of rice in diversity block collected at local level
2. To observe and analyze actual diversity of different crops
3. To document special characters of different crop varieties
4. To assist in conservation of threatened land races

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Materials and Methods

Two case study districts of central Nepal were selected viz Makwanpur and Sarlahi. Desk study was followed by baseline study in different localities of these districts. For the study two pockets VDCs having rich in diversity namely Raigaun of Makwanpur district and Parwanipur of Sarlahi District was purposively selected. Makwanpur and Sarlahi districts lie in the Central Development Region and are well connected to major cities of Nepal and India. The Makwanpur 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 Makwanpur and Sarlahi district because they are one of the species rich districts of Nepal.

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***

Table 1: Biophysical and socio-economic characteristics of the study areas.

Adapted from: (KC)[2]

*: 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.

Results and Discussion

Morphometry of Districts

Geographically, Makwanpur 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 [3].

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 [3].

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 [3]. 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 [3].

Demographic Status of Respondents

The total population of Makwanpur 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) [3]. 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) [3].

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].

Varietal Diversity of Rice at Makwanpur and Sarlahi Districts

During the study at Makwanpur district 19 different varieties of rice was found in study location. Out of which 6 were landraces. Moreover, during field visit, 37 more varieties were documented. Among 43 varieties, we were unable to find seeds of 10 varieties. In the process of establishing diversity block of Rice, 47 varieties of rice were selected to be characterized. The traits were documented based on the farmer description. After completion of cropping period the data were analyzed based on farmer description and expert judgment. During this analysis, 32 varieties were characterized as distinct variety than that of other varieties and left 15 were similar to that of other varieties which is presented in table 2 and 3.

Moreover, during establishment of diversity block of Rice in Sarlahi, there were twenty nine varieties that are to be characterized. Out of twenty nine varieties; twenty seven varieties were characterized as distinct variety than that of other varieties and left two were similar to that of other varieties. During the process of characterization of available rice varieties history of cultivation, distinguishing traits, available positive and negative traits were assessed. Moreover the use tends whether the varieties were increasing or decreasing were also recorded as shown in table 2 and 4.

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 LIBIRD [4].

Rana, *et al.* 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.

Makwanpur District	
KaloJhinuwa Ghiukumari GajaleKanchhi	The varieties were phenotypically different at early stage but later on were found to be similar to KaloJhinuwa similar based on characteristics studied.
Anadi JhutteAnadi Anarasi	The varieties were phenotypically different at seed sowing but were found similar to Anadi based on characters studied.
Basmati Basnamati Basnamati-1 Basnamati-2	The varieties were phenotypically different at seed sowing but were found similar to Basmati based on characters studied.
Gamadi Kalomarsi	Gamadi and Kalomarsi were found to be phenotypically different at seed sowing but Kalomarsi was found similar to Gamadi based on characters studied.
Bagane Champasari-1 Champasari-2	The varieties were phenotypically different at seed sowing but later were found similar to Bagane based on characters studied.
Ghaiya Bhadaiya	Ghaiya and Bhadaiya were found to be phenotypically different at seed sowing but later Bhadaiya was found similar to Ghaiya based on characters studied.
Ghaiya Rato RatoJara Sikichan Ghaiya	The varieties were phenotypically different at seed sowing but later were found similar to Ghaiya Rato based on characters studied.
Himali Thema Usha	The varieties were phenotypically different at seed sowing but later were found similar to Himali based on characters studied.
Sarlahi district	
Ghaiya Tosar	Ghaiya and Tosar were found to be phenotypically different at seed sowing but later Bhadaiya was found similar to Ghaiya based on characters studied.
Radha 11 Janamorcha	Radha 11 and Janamorcha were found to be phenotypically different at seed sowing but later Bhadaiya was found similar to Radha11 based on characters studied.

Table 2: Varieties found to be similar to one another during characterization at Makwanpur and Sarlahi district.

S.N	Rice varieties	History of cultivation	Distinguishing traits	Positive traits	Negative traits	Cultivation trend
1	Sona Mansuli	3-4 years	Medium tillering, erect flag leaf, short and awn less grain , fast panicle initiation, medium height, early maturity	drought tolerant, good yield, high straw yield	Poor taste, less preferred straw , high input requirement, poor yield	Decreasing
2	KaloJhinuwa	Grown from generations	medium tillering, fine and small grain, soft straw, Black coloured husk, pests resistant, and drought tolerant	Good straw, fine rice, good taste, good price , drought tolerant, aromatic	Late maturity, lodging problem, low yield.	Decreasing
3	Murali	Grown from generations	Poor tillering, fine long grain, tall, early panicle initiation, and early maturity.	Can be grown in upland and lowland as well, good taste and good milling percentage.	Lodging problem.	decreasing
4	Rato Mansuli	15 years	Tall, high tillering, golden red grain, long grain, medium panicle initiation duration, medium maturing variety.	High Tillers	Lodging problem	Decreasing
5	Chhote	10 years	Medium tillers, semi prostate flag leaf, light yellow coloured long grain, medium height, early panicle initiation, good taste.	Good taste, glutinous	Late maturity, high insect infestation, bold grain	decreasing/ threatened
6	Sona Mansuli	Introduced from India	late maturity, tall plant , long grain, horizontal, medium tillers	good yield, good straw production	hard in threshing	constant
7	Anadhi	Grown from generations	Tall, poor tillering, erect flag leaf, wide leaf, yellow to red short grain, late panicle initiation, and late maturity.	good alcoholic recovery percentage, tasty, good for fried rice	low yield	decreasing
8	Khairo Andi	Grown from generations	Tall, medium tillers, prostate flag leaf, early panicle initiation and early maturity	good in taste, aromatic and soft rice	low yield	decreasing/ threaten
9	Ghiupuri	1 year	Tall, wide leaf, poor tillering, semi prostate flag leaf, light yellow grain color, small grain, early panicle initiation and early maturity	drought tolerant	Poor yield	New to this area
10	Amrika	Grown from generations	Medium tillering, semi prostate flag leaf, short bold grain, medium height, early panicle initiation and early maturity.		low yield	Decreasing
11	Jirasari	3-4 years	medium tillers, semi erect flag leaf, early to panicle initiation duration, dwarf, early maturity , fine grain	soft rice, non lodging, good market price	low yield, rice borer infestation, needs more irrigation	Decreasing
12	Basmati	Grown from generations	Poor tillering, semi erect flag leaf, small round grain, early panicle initiation, tall, aromatic, early maturity and high insect pest infestation	soft rice, high palatability of straw	high insects pests infestation	decreasing

13	Ram Dhan	4 years	medium tillering , medium panicle initiation duration , medium height, medium maturing variety, high insect pest infestation and drought tolerant	good yield, soft rice, needs less irrigation	high insect pest infestation	Increasing
14	Bagane	4 years	high tillering, semi erect flag leaf, long grain, medium time to panicle initiation duration, tall, aromatic, late long maturity period	Aromatic, soft good consistency for "Sel-Roti" and rice, good for rice pudding and low water requirement	low yield	constant
15	Himali	6 years	Tall, medium tillering , semi erect flag leaf, golden colored grain, long grain, medium panicle initiation period and medium maturing variety		low yield, poor taste	Decreasing
16	Rambilash	10-15 years	Tall, high tillering, semi erect flag leaf, golden small long grain, medium panicle initiation duration, medium time to maturity	good taste,	Poor palatability of straw, more inputs requirement	Decreasing
17	Purano Mansuli	grown from generations	Tall, medium tillering, semi erect flag leaf, small grain, medium panicle initiation duration, medium time to maturity	good yield and market price	drought susceptible, lodging problem	Decreasing
18	China Bheraiti	Grown from generations	Tall, poor tillering, semi erect flag leaf, small short grain, early panicle initiation, early maturity.	Short duration, high yield	Short straw, lodging problem	Increasing
19	Ganga	Grown from generations	Tall, poor tillering, prostate flag leaf, bold short grain, medium panicle initiation period, medium maturing variety	Good taste	bold short grain, few tillers	Decreasing
20	Ghaiya Rato	Grown from generations	Poor tillering, tall, semi erect flag leaf, short bold and aromatic grains, medium height, medium panicle initiation duration, medium maturity period.	Aromatic, long grain, early maturity, drought tolerant	rice borer and panicle breakage problem	Decreasing
21	Meghdut	Grown from generations	Tall, medium tillering, semi erect flag leaf, small short grain, medium panicle initiation duration and early maturity.	Low yield	Lodging problem	Decreasing
22	Krishi	Grown from generations	Tall, medium tillering, semi erect flag leaf, small short grain, medium panicle initiation and early maturity	Low yield	lodging	decreasing
23	Marich	New in the area	Medium tillering, semi erect flag leaf, white short grain, medium panicle initiation period, medium height and early maturity.		Low yield	decreasing
24	Anpjhutte	Grown from generations	Tall, medium tillering, erect flag leaf, golden colored grain, bold & flat grain.	Big sized grain, good baking quality, drought tolerant and insect pest resistant	Poor taste and shattering problem during harvesting	Decreasing

25	Minikit		5 years	Poor tillering, semi erect flag leaf, medium panicle initiation duration, medium height and early maturity.		Low yield
26	Gamadi	Grown from generations	Medium height, panicle covered by base of flag leaf, erect flag leaf, high tillering, brownish black colored grain, bold & short grain and drought tolerant	Low husk, medicinally important for treatment of dysentery, less preferred by rodents	Hard in threshing.	Decreasing/threatened
27	Chhote Mansuli	10 years	Medium tillering, semi erect flag leaf, medium height, early panicle initiation and early maturity	Good taste	susceptible to pests	decreasing
28	Jhapali Mansuli	5-6 years before	fine grain, soft	more straw	low yield	Decreasing
29	Gauri	5-10 years before	short and bold grain	dwarf	low yield	Decreasing

Table 3: Assessing varietal diversity of Rice through discussion with community and characterization in diversity block at Makawanpur.

S.No	Rice varieties	History of cultivation	Distinguishing traits	Positive traits	Negative traits	Cultivation trend
1	Harinath-1	10 years	Early maturity, long grains , medium height, erect flag leaf	good yield, early maturity	low straw, susceptible to excessive rain	constant
2	Kachorwa-4	3 years	Dwarf, early maturity, long grains, dwarf, erect flag leaf and heavy tillering variety.	good taste	low yield	constant
3	Sunaulo Sugandha	3 years	Tall, late maturing variety, long grains , tall and prostate flag leaf	Aromatic rice, high valued	low yield, susceptible to Rice Bug	Decreasing
4	Ghaiya	Grown from generations	Tall, late maturing variety, whitish yellow color grain, medium roundish grain, prostate flag leaf	Early maturity	poor taste	constant
5	Shreshtha	5 years	Early maturity, dwarf, long grain, erect flag leaf and heavy tillering variety.	Early maturity	low yield	constant
6	Radha-4	10 years	Early maturity, heavy tillering, erect flag leaf, drought tolerant, long grains	Early maturity	shattering problem	decreasing
7	Chhotemarsi	Cultivated from generations	Late maturing , long grains , erect flag leaf, medium tillering variety , slightly yellow colored grain and medium height	Good taste	low yield	decreasing
8	Chaite-4	10 years	Early maturing variety, medium height, long grains, drought resistant, horizontal flag leaf, high tillers	drought tolerant	pest susceptible	decreasing
9	Barkhe-1027	2 years	Early maturity, medium height, drought tolerant, long grains, erect flag leaf and heavy tillering variety	early maturity, good yield	Problems in threshing	Increasing

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10	Radha-11	15 years	Late maturity, medium height, drought tolerant, long, grains, horizontal flag leaf, medium tillers	Good yield, non-sticky rice, drought tolerant	Low milling percentage	Increasing
11	Chaite-2	Grown from generations	Early maturity, drought tolerant, medium sized grain, erect flag leaf, medium tillering variety	Drought tolerant	low yield	constant
12	Himali	10 years	Late maturity, dwarf, slightly aromatic, susceptible to rice borer, long grain, erect flag leaf and poor tillering variety.	drought tolerant	low yield	constant
13	Mala	5 years	Early maturing and dwarf, susceptible to rice blast, long grains, horizontal flag leaf and poor tillering variety	Drought tolerant, good yield	Brown rice, poor milling percentage and quality.	decreasing
14	Makawanpur-1	5 years	Late maturity, medium height, long grains, erects flag leaf and high tillering variety.	good yield	Wet consistency when cooked.	constant
15	Sabitri	20 years	Late maturing, medium height, medium long grain, erect flag leaf and heavy tillering variety	good yield, good milling percentage and non-sticky rice	drought susceptible and problem in threshing	constant
16	Masuli	30 years	Tall, late maturity, small and slightly red colored grain, horizontal flag leaf and poor tillering	Good yield and taste.	Susceptible to pests.	decreasing
17	Panas	4 years	Dwarf and late maturing, medium sized grain, horizontal flag leaf, heavy tillering and drought tolerant variety	drought tolerant	Wet consistency when cooked	decreasing
18	Anadi	Grown from generations	Tall and late maturing variety with short awn, bold and red colored grain, horizontal flag leaf and poor tillering capacity.	Soft and glutinous rice with medicinal value and high straw production	low yield	decreasing/threatened
19	KaloMasino	Grown from generations	Tall, late maturing and aromatic rice, susceptible to bug, small and slightly black colored grain, prostate flag leaf and heavy tillering variety.	Soft, tasty and aromatic rice	low yield	Decreasing/threatened.
20	Ram	5 years	Dwarf and late maturing, long grains with erect flag leaf and medium tillering variety.	good yield	Poor taste	Decreasing
21	Pokhareli	Grown from generations	Tall and late maturing variety with long and slightly yellow grain, erect flag leaf with medium tillering capacity.	Soft rice, soft straw and good milling percentage.	low yield	decreasing
22	Chhote-Mansuli	10 years	Tall and late maturing variety, small grains with slightly yellow colored grains, horizontal flag leaf and poor tillering capacity.	good taste	susceptible to pest	decreasing

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23	Kisan	15 years	Dwarf and late maturing variety with dwarf, drought tolerant characters, long and slight yellow colored grain with horizontal flag leaf and poor tillering capacity.	drought tolerant	low yield	constant
24	Yamesh- wori	2 years (introduced from India)	Tall and late maturing variety, slightly long grains with horizontal flag leaf and medium tillering capacity.	good straw production	low yield	decreasing
25	Katarni	2 years (introduced from India)	Tall and late maturing variety with short and small grain with slight yellow color horizontal flag leaf and medium tillering capacity.	Good taste	low yield	decreasing
26	Rambilash	15 years	Tall and late maturing variety with bold grain, slight yellow color, horizontal flag leaf and poor tillering capacity.	Bold grains, high straw production and good appetite after eating	Poor quality straw, less preferred by animals.	increasing
27	SonaMan- suli	Introduced from India	Tall and late maturing variety, long grains with horizontal flag leaf and medium tillering capacity.	good yield, good straw production	Difficulty in threshing.	constant

Table 4: Assessing varietal diversity of Rice through discussion with community and characterization in diversity block at Sarlahi district.

** The yield was characterized based on National standard made by Ministry of Agriculture Development (MOAD) [5], which can be stated as : yield less than 3.17 ton/ha as low yielding variety , yield equal to 3.17 ton/h as medium yielding variety and yield more than 3.17 ton/ha as high yielding variety. Moreover in case of height variety less than 100 cm was characterized as dwarf variety, height more than 100 cm as tall variety and variety height equal to 100 cm as medium variety.

In the study done at Makwanpur district, a we found that cultivation trend of 24 varieties was decreasing, 2 varieties were constant, 2 varieties showed increasing trend and 1 variety was new to the area so trend analysis could not be done.

Similarly, upon trend analysis of cultivation, 10 varieties were constant, 14 varieties cultivation trend was found to be increasing whereas 3 varieties were found to be decreasing. The trend was documented based on group discussion, focused group discussion and key informant interview. It was further clarified during village level workshop. The trend of use of certain varieties is governed by many factors. As pointed by BR Upreti and YG Upreti. [6], 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 [7].

Conclusion

Nepal being highly diverse country in terms of biodiversity can be considered as biodiversity hotspot. Rice is main staple crop of the country. Large number of varieties has been used for cultivation so far. However, there is lack of proper characterization of available rice varieties. This study was more focused to use diversity block so as to find the similarities and differences of the preferred rice varieties. 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 rice varieties.

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