Nepal Journal of Science and Technology 11 (2010) 9-16

Evaluation of Sponge Gourd Landraces in Line with the Reliability of Names Given by Farmers

Bal K. Joshi[1], Madhusudan P. Upadhyay[1], Bimal K. Baniya[1], Durga M.S. Dongol[1] Radha K. Tiwari[1] and Pitamber Shrestha[2]

[1]Nepal Agricultural Research Council, Khumaltar, Lalitpur

[2]LIBRID, Pokhara, Nepal

e-mail: durgadongol@yahoo.com

Abstract

Reliability study on the names of landraces given by farmers is useful for on-farm management of agro-biodiversity. This paper evaluated whether the names given by farmers to sponge gourd [*Luffa cylindrica* (L.) Roem.] are reliable. Information on sponge gourd landraces based on the local names was collected through household survey from Kaski and Bara districts of Nepal. Important landraces of these two sites were collected and grown in on-station in Kaski. A total of 25 qualitative data were studied in three individual plants of each landrace. Simple matching coefficients, cluster and principal components analyses were applied. Reliability analyses, number of farmers handling the landraces by same name, simple matching coefficients between all possible pairs, clustering and principal components plotting showed that the names of sponge gourd landraces given by farmers of Kaski and Bara districts were reliable or consistent in naming their varieties. Therefore, landraces richness based on the names of sponge gourd could reflect the genetic diversity and can be considered accordingly for conservation, either on-farm or *ex-situ*.

Key words: reliable names, sponge gourd, reliability analysis, qualitative traits, multivariate analysis

Introduction

Farmers manage crop diversity by the names they give to their local varieties or landraces. Generally, a landrace is named on the basis of few important traits. Within the community, most of the farmers use the same name for a variety. However, other communities may use a different name for the same genotype or they may use the same name or character but apply it to a different genotype. If names of landraces given by farmers represent the genetic diversity, it would be great support for developing conservation strategy. In some crops names are consistent and in some it is not on the basis of study at biochemical and DNA levels (Bajracharya *et al.*1999, 2003a,b,c). Different approaches may be applied to test the reliability of names given by farmers (Kebebew *et al.* 2001, Teshome *et al.* 1997, Sambatti *et al.* 2001). Study at morphological characters is simple and cost effective approach.

Both folk taxonomy and botanical taxonomy should be taken into account to facilitate the understanding of the challenges of variation and diversity for today's needs of holistic, comprehensive, yet clearly defined and scientifically acceptable biotic classifications (Teshome *et al.* 1997). Reliability means, how the genotypes based on the names are genetically different. If the basis of recognizable units is same to a particular variety in the community, this name may be reliable. In other words, if many farmers handle variety by the same names, it can be considered reliable. If name of landraces given by farmers has different characters or simple matching coefficient with other landraces is less than one, this also supports the reliability. Reliability is likely to vary among crop species and according to the extent of the reference area.

We sampled sponge gourd [*Luffa cylindrica* (L.) Roem.] landraces from Kaski and Bara districts of Nepal. Sponge gourd is a cross-pollinated crop and each household usually maintains a few (2-3) individual

plants (Rana *et al.* 2000a, b). Fruit characteristics are the basis of naming and distinguishing landraces in both districts (Baniya *et al.* 2005, Joshi *et al.* 2005). During baseline survey 16 and 15 landraces were reported from Kaski and Bara respectively (Rana *et al.* 2000a,b). These names given by farmers to sponge gourd landraces in both districts were analyzed to test their reliability.

Methodology

Information on sponge gourd landraces based on the local names was collected through household survey from Kaski and Bara districts of Nepal. The number of surveyed households was 188 in Kaski and 134 in Bara districts. The data obtained from the interview were treated in the binary form (presence or absence) and subjected to a reliability analysis to quantify the variations among informants and the varieties. Reliability analysis was carried out to quantify the rate of farmers' disagreement in naming their landrace varieties of sponge gourd. The number of households (HHs) growing landraces by the same name was also reported

Important landraces of these two sites were collected and grown in on-station in Kaski district. Experimental site (Malepatan, Pokhara) lies between latitude 28° 15' N and longitude 84° 00' E at an altitude of 848 m in subtropical area having loamy soil. Climatic parameters (temperature, rainfall and relative humidity) during the growing period are given in Fig. 1. Six accessions of sponge gourd from Genetic Seed House of Nepal Agricultural Research Council (NARC), Kathmandu (commonly called gene bank), were also included in this experiment. A total of 25 qualitative data (Table 1) were studied in three individual plants of each landrace. These landraces were scored as per the descriptors of sponge gourd (Joshi *et al.* 2004). Simple matching coefficients were estimated between all possible pairs based on these qualitative data to know whether any pair of landrace matched. Cluster and principal components (PC) analyses were applied on these data to see how they are diverse and to know the most important traits in term of variability expressed.

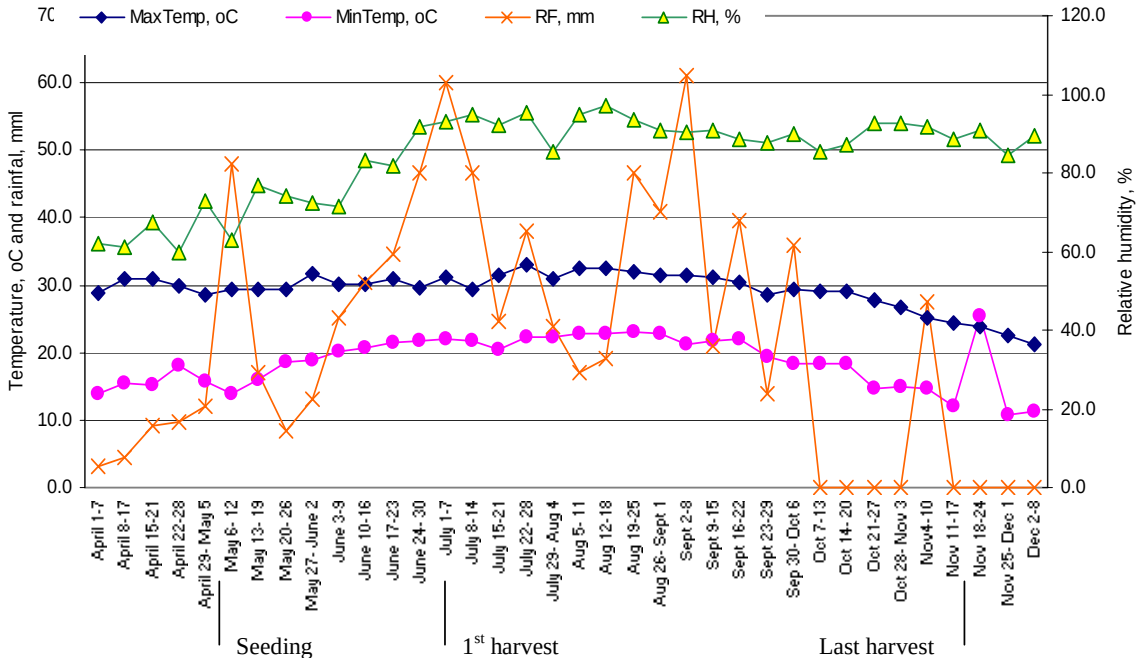


Fig. 1. Climatic parameters during growing season of sponge gourd in Malepatna, Pokhara. Seeding and harvesting dates are also indicated

Table 1. Qualitative traits and their codes used in this study

SN	Character	Class and code
1.	Cotyledon size	Small (1), Medium (2), Large (3)
2.	Cotyledon color	Green (1), Intermediate (2), Dark green (3)
3.	Shape of stem	Rounded (1), Angular (2)
4.	Tendrils	Present (1), Absent (2)
5.	Leaf size	Small (1), Intermediate (2), Large (3)
6.	Leaf margin	Smooth (1), Dented (2)
7.	Leaf lobes	Absent (1), Shallow (2), Intermediate (3), Deep (4)
8.	Dorsal leaf pubescence	Absent (1), Low (2), Intermediate (3), High (4)
9.	Ventral leaf pubescence	Absent (1), Low (2), Intermediate (3), High (4)
10.	Growth habit	Bushy (1), Intermediate (2), Prostrate (3)
11.	Stem pubescence	Absent (1), Thin (2), Dense (3), Very dense (4)
12.	Flower color	White (1). Yellow (2), Orange (3), Other (4), Light yellow (5)
13.	Sex type	Monoecious (1), Hermaphroditic (2)
14.	Peduncle shape	Round (1), Semi angled (2), Sharp angled (3)
15.	Peduncle separation from fruit	Easy (1), Intermediate (2), Difficult (3)
16.	Blossom end fruit shape	Depressed (1), Flattened (2), Rounded (3), Pointed (4)
17.	Stem end fruit shape	Depressed (1), Flattened (2), Rounded (3), Pointed (4)
18.	Fruit shape	Oblong blocky (1), Elongate slim (2), Elongate Blocky (3), Elliptical (4), Elongate Tapered (5), Pyriform (6), Elongate elliptical (7)
19.	Fruit ribs	Absent (1), Super facial (2), Intermediate (3), Deep (4)
20.	Fruit color	Light Green (1), Dark Green (2), White Mottled (3), Blackish (4), Others (5), White (6)
21.	Fruit skin texture	Smooth (1), Grainy (2), Finley Wrinkled (3), Shallowly Wavy (4), Netted (5), With warts (6), Scabrous (7)
22.	Flesh color	White (1), Cream (2), Yellow (3)
23.	Flesh flavor	Insipid (1), Intermediate (2), Bitter (3), Favorable (4)
24.	Seed color	Black (1), Gray (2), Brown (3), White (4)
25.	Sponge quality	Soft (1), Intermediate (2), Hard (3)

Results

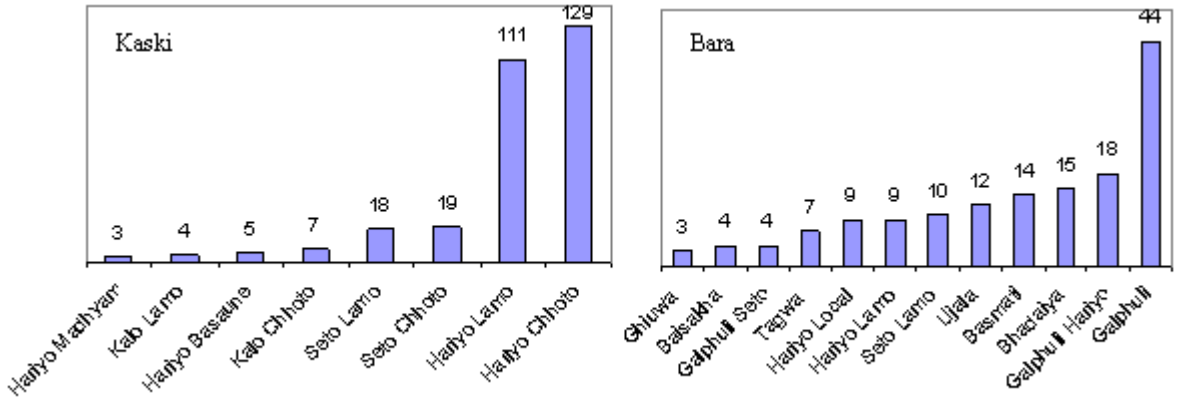
The reliability analysis (Table 2) revealed that there was no significant difference between informants in naming the landraces suggesting remarkable degree of consistency in naming the landrace varieties in both districts, Kaski and Bara. There were highly significant differences between farmers' varieties.

Table 2. Results of reliability of local names given by 188 farmers to 15 landraces in Kaski and by 134 farmers to 16 landraces of sponge gourd in Bara district

Source of variance	Kaski district				Bara district			
	df	S S	M S	F	df	S S	M S	F
Between farmers varieties	14	125.31	8.95	165.76***	15	12.70	0.85	13.14***
Between farmers	187	5.356	0.029	0.53 ns	133	1.69	0.013	0.20 ns
Residual	2618	141.36	0.054		1995	128.55	0.064	

*** Significant at 0.001, ns, Non significant.

The number of farmers handling the landrace by same name was minimum of three for Hariyo Madhyam to maximum of 129 to Hariyo Chhoto in Kaski and three for Ghiuwa to 44 to Galphuli in Bara (Fig. 2). It revealed that farmers were consistent in handling the landraces of sponge gourd by their names.



The simple matching coefficients between all possible pairs of 21 sponge gourd landraces are given in Table 3. The highest matching coefficient was between Lamka Ujarka and Hariharka and the lowest between 4 pairs (Jhingani Hariyo Lamo, Sagputi Ghiraunla and Hariyo Lamo, Seto Basaune and Sano Ghiraunla, and Seto Lamo and Sano Ghiraunla). As the coefficient increased, their similarity also increased. All pairs were not matched i.e. names given by farmers did not overlap and it reflected the diversity.

Table 3. Simple matching coefficients between all possible pairs of 21 sponge gourd landraces based on 25 qualitative traits

SN	Landrace	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Basaune	1																				
2	HarihaTagwa	0.6	1																			
3	Hariharka	0.8	0.72	1																		
4	HariyoBasaune	0.8	0.52	0.8	1																	
5	HariyoBose	0.76	0.56	0.6	0.8	1																
6	HariyoChhoto	0.72	0.44	0.72	0.76	0.64	1															
7	HariyoLamo	0.72	0.68	0.8	0.72	0.68	0.76	1														
8	JangaliGhiraula	0.56	0.6	0.6	0.52	0.56	0.44	0.52	1													
9	Jhimni	0.56	0.48	0.56	0.48	0.6	0.56	0.52	0.56	1												
10	Jhingani	0.6	0.48	0.56	0.52	0.56	0.56	0.4	0.52	0.64	1											
11	LamkaUjarka	0.76	0.72	0.88	0.68	0.64	0.68	0.76	0.56	0.6	0.56	1										
12	LamoBose	0.8	0.56	0.64	0.72	0.84	0.76	0.76	0.56	0.56	0.52	0.64	1									
13	SagputiGhiraula	0.48	0.44	0.48	0.44	0.52	0.44	0.4	0.56	0.8	0.8	0.48	0.48	1								
14	SanoGhiraula	0.48	0.44	0.56	0.44	0.4	0.48	0.44	0.52	0.68	0.76	0.56	0.4	0.76	1							
15	SetoBasaune	0.68	0.56	0.6	0.72	0.76	0.56	0.6	0.56	0.56	0.48	0.68	0.64	0.48	0.4	1						
16	SetoBose	0.72	0.52	0.64	0.64	0.64	0.84	0.6	0.48	0.56	0.6	0.64	0.72	0.44	0.44	0.6	1					
17	SetoLamo	0.76	0.6	0.68	0.8	0.76	0.72	0.64	0.56	0.44	0.6	0.6	0.8	0.44	0.4	0.64	0.68	1				
18	Toriya	0.52	0.64	0.56	0.6	0.68	0.52	0.6	0.76	0.52	0.52	0.6	0.6	0.52	0.44	0.64	0.52	0.6	1			
19	Ujarka-B	0.72	0.64	0.76	0.68	0.6	0.64	0.56	0.52	0.52	0.68	0.72	0.56	0.48	0.48	0.64	0.72	0.68	0.52	1		
20	Ujarka-N	0.88	0.56	0.76	0.8	0.76	0.68	0.64	0.6	0.52	0.6	0.72	0.72	0.44	0.44	0.68	0.72	0.72	0.52	0.76	1	
21	Ujarka-R	0.8	0.56	0.68	0.72	0.72	0.76	0.64	0.56	0.6	0.64	0.72	0.76	0.48	0.44	0.68	0.68	0.76	0.56	0.76	0.8	1

UPGMA (unweighted pair group method of arithmetic mean) clustering and principal components plotting also revealed their identity with respect to names (Fig. 3 and 4). Each landrace made separate cluster at coefficient 0.89. Collections from gene bank of NARC were tended to make a separate cluster. Similarly, landraces from Kaski and Bara districts were separated each other except some landraces.

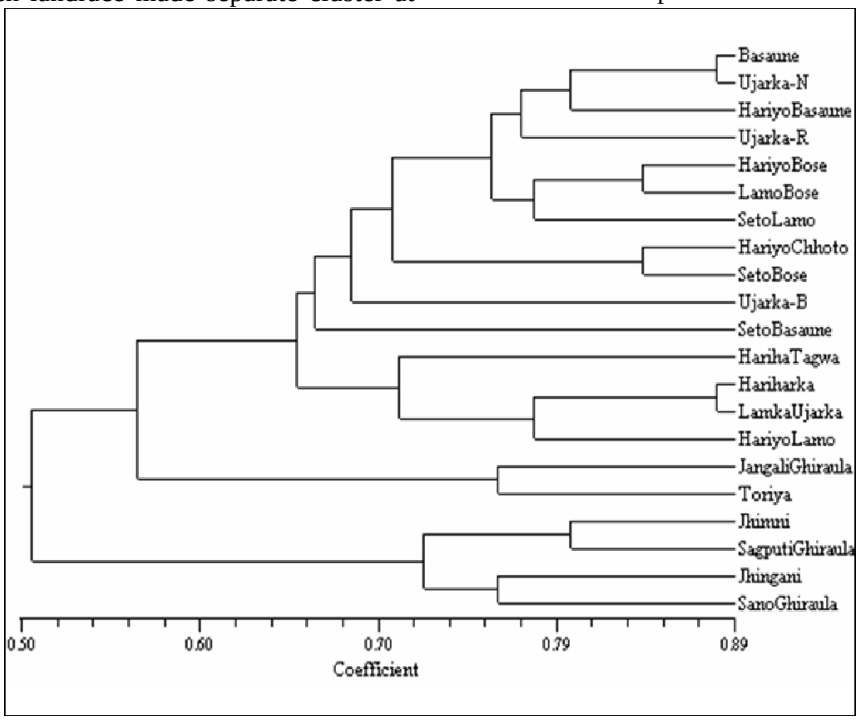


Fig. 3. UPGMA clustering of 21 sponge gourd landraces based on 25 qualitative traits

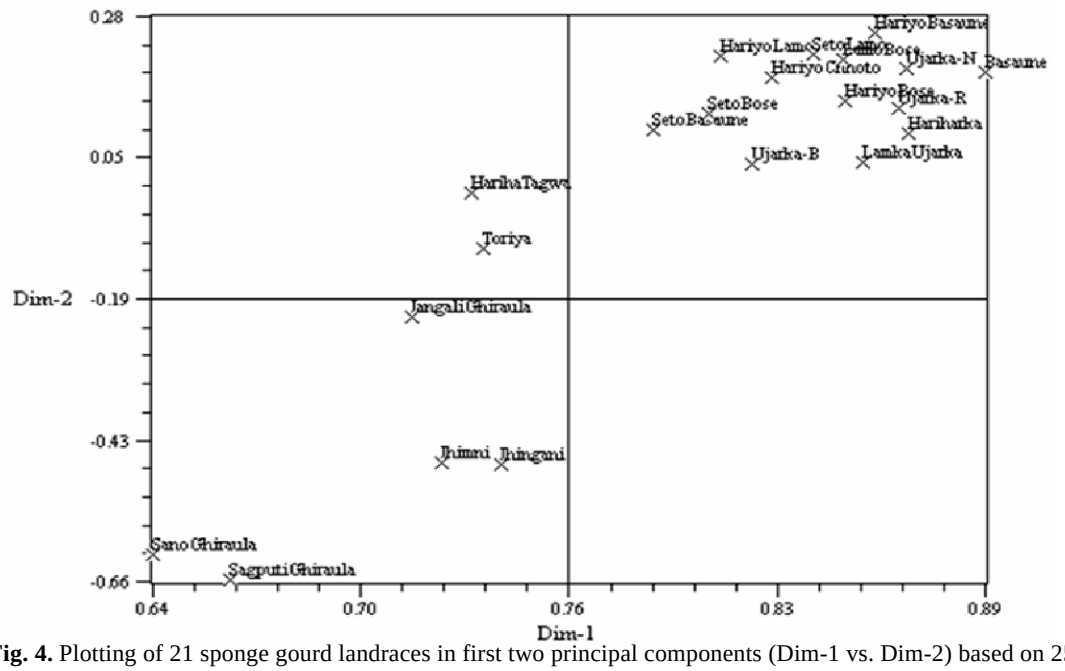


Fig. 4. Plotting of 21 sponge gourd landraces in first two principal components (Dim-1 vs. Dim-2) based on 25 qualitative traits

The first five principal components gave Eigen values greater than 1.0 and all together explained 77.01% of the accumulated variation (Table 4). The first principal component explained 34.39% of the variation and was associated with fruit color, fruit skin texture, flesh color, flesh flavor, seed color and sponge quality (Table 5). The second principal component explained 23.61% of the variation and was associated with cotyledon size, shape of stem, tendrils, leaf margin, sex type and peduncle shape. The third component explained 8.36% of the variation and was associated with stem end fruit shape, fruit skin texture and fruit ribs. The plot of first two PCs showed clear differences among these landraces. Collections in gene bank of NARC tended to have more negative values along the second PC. Landraces from Kaski and Bara districts tended to have positive values along both axes.

Table 4. Eigen value, percent of the variability explained by each principal component (PC)

PC	Eigen value	Percent variability	Cumulative variability
1	8.59	34.39	34.39
2	5.90	23.61	58.01
3	2.09	8.36	66.37
4	1.48	5.94	72.32
5	1.17	4.69	77.01

Table 5. Eigen vectors of each character with respect to its principal component (PC)

SN	Character	PC 1	PC 2	PC 3
1.	Cotyledon size	0.64	0.60	0.07
2.	Cotyledon color	0.57	0.47	-0.004
3.	Shape of stem	0.68	0.61	0.14
4.	Tendrils	0.70	-0.63	0.06
5.	Leaf size	0.57	0.30	0.001
6.	Leaf margin	0.66	0.67	0.14
7.	Leaf lobes	0.46	0.42	-0.43
8.	Dorsal leaf pubescence	0.60	0.18	-0.13
9.	Ventral leaf pubescence	0.54	0.14	-0.16
10.	Growth habit	0.69	-0.68	0.05
11.	Stem pubescence	0.63	-0.44	0.05
12.	Flower color	0.57	0.57	0.24
13.	Sex type	0.66	0.67	0.14
14.	Peduncle shape	0.69	-0.68	0.05
15.	Peduncle separation from fruit	0.52	-0.54	-0.15
16.	Blossom end fruit shape	0.21	0.08	-0.71
17.	Stem end fruit shape	0.09	0.03	-0.76
18.	Fruit shape	0.32	0.05	-0.27
19.	Fruit ribs	0.19	0.18	-0.64
20.	Fruit color	0.59	0.26	0.04
21.	Fruit skin texture	0.72	0.42	0.25
22.	Flesh color	0.69	-0.68	0.05
23.	Flesh flavor	0.52	-0.36	-0.12
24.	Seed color	0.69	-0.52	0.04
25.	Sponge quality	0.70	-0.59	0.07

Discussion

Reliability analysis, coefficients of all possible pairs and multivariate analyses clearly showed that, names given by farmers to sponge gourd landraces were reliable in both districts, Kaski and Bara of Nepal. Kebebew *et al.* (2001) also reported that there was a remarkable positive degree of consistency between farmers naming of landrace varieties and consistent in naming of sorghum landraces was reported by Teshome *et al.* (1997). Farmers know which crops and

which varieties of each crop are grown in their village or district or are being sold in the local market. Local names of landraces may not always correspond to botanical distinctness but they are often quite descriptive of the cultivar grown. However, loose taxonomic system was reported for cassava by Sambatti *et al.* (2001).

Farmers maintain 2-3 individual plants of sponge gourd per household and they maintain seeds by themselves. In such a crop, which has few numbers of plants in a farm, names of landraces were reliable and they were morphologically different. Reliability of names in other crops which has large population of each landrace in a farm e.g. rice may be more consistent or reliable. Fruit characters were the most important descriptors used by farmers for distinguishing and naming the sponge gourd landraces (Yadav *et al.* 2003, Pandey *et al.* 2003, Bajracharya *et al.* 1999). Bajracharya *et al.* (1999) also reported that farmers were consistent in identifying the landraces of sponge gourd.

Researchers make partition of the available variation and assign name to each variation. If they get new variation over generation, it is assigned new name. However, farmers give names considering certain important traits and do not consider each variation to be assigned separate name. The given name remains same over generations within community. Therefore, variation within landraces based on names may be high and only the varietal richness index might not be enough to assess diversity of landraces within community. Farmers talk, exchange and sell landraces based on the local names; therefore, names given by local authority can be considered reliable.

For reliability study, we planted each landrace in separate plot and observation was made accordingly. In such condition, some bias could be imposed during data recording. Growing all landraces together and recording data on the basis of individual plant would be better option for reliability study. The data obtained from such an experiment should have a provision to link with the names of landraces given by farmers.

The names of sponge gourd landraces in these areas were mostly associated with exhibited fruit characters such as fruit shape, fruit color, fruit size, etc. For example, the local names Hariyo Lamo refers to the green and long fruit, Basaune refers to its aroma during cooking, etc. The farmers in both districts were consistent in naming their varieties. This shows that farmers know best their landraces and what genetic traits they possess. Since farmers are in constant interaction with the environment, the conservation and selection of genetic references is in a dynamic process. Their keen observation and selection activities generate and provide genetic traits valuable to their needs.

Name of sponge gourd landraces given by farmers of Kaski and Bara districts of Nepal were reliable or consistent in naming their varieties. Qualitative traits also revealed the consistency within communities. Therefore, the name of landraces can be considered to manage crop diversity. In addition to this, molecular tools can be better to link in such study taking samples from more communities.

References

Bajracharya, J., D.K. Rijal, B.R. Sthapit and D.I. Jarvis. 2003a. Genetic diversity of farmers' named taro cultivars of Kaski ecosite, Nepal. In: *Proceedings of national workshop on on-farm management of agricultural biodiversity in Nepal* (Eds. B.R. Sthapit, M.P. Upadhyay, B.K. Baniya, A. Subedi & B.K. Joshi). NARC, LIBIRD and IPGRI, Lumle, Nepal. pp.79-86.

Bajracharya, J., D.K. Rijal, S.P. Khatiwada, C.L. Poudel, M.P. Upadhyay, Y.R. Pandey, P.R. Tiwari, R.B. Yadav and P. Chaudhary. 1999. Farmer selection of germplasm using agromorphological and isozyme characteristics. In: *A scientific basis of in-situ conservation of agrobiodiversity on-farm. Nepal's contribution to the global project* (Eds. B. Sthapit, M. Upadhyay & A. Subedi). NP Working paper no. 1/99. NARC, LIBIRD and IPGRI. pp.49-66.

Bajracharya, J., K. Steele, J. Witcombe, P.R. Tiwari, B.R. Sthapit and D.I. Jarvis. 2003c. A study of genetic relationships in rice landraces of Jumla using microsatellite DNA markers. In: *Proceedings of national workshop on on-farm management of agricultural biodiversity in Nepal* (Eds. B.R. Sthapit, M.P. Upadhyay, B.K. Baniya, A. Subedi & B.K. Joshi). NARC, LIBIRD and IPGRI, Lumle, Nepal. pp.103-111.

Bajracharya, J., P.R. Tiwari, D.M. Shakya, B.K. Baniya, M.P. Upadhyay, B.R. Sthapit and D.I. Jarvis. 2003b. Farmer management and isozyme variation in barley landraces, Jumla Nepal. In: *Proceedings of national workshop on on-farm management of agricultural biodiversity in Nepal* (Eds. B.R. Sthapit, M.P.

Upadhyay, B.K. Baniya, A. Subedi & B.K. Joshi). NARC, LIBIRD and IPGRI, Lumle, Nepal. pp.87-94.

Baniya, B.K., H.B. KC., R.K. Tiwari, R.B. Amagain, B.K. Joshi, P. Shrestha, S. Gyawali, K.P. Baral and D.M.S. Dongol. 2005. Traditional seed supply system of sponge gourd in mid hills and plains of Nepal. In: *Proceedings of 2nd national workshop on on-farm management of agricultural biodiversity in Nepal. Vol I. Assessing the amount and distribution of genetic diversity on-farm*, Nagarkot, Nepal (Eds. B.R. Sthapit, M.P. Upadyay, S.K. Shrestha & D.I. Jarvis). IPGRI, Rome. pp.132-140.

Joshi, B.K., H.B. KC., R.K. Tiwari, M. Ghale, B.R. Sthapit and M.P. Upadhyay. 2004. *Descriptors for sponge gourd (Luffa cylindrica* L Roem). NARC, LIBIRD and IPGRI, Kathmandu.

Joshi, B.K., R.K. Tiwari, H.B. KC., H.N. Regmi, B.H. Adhikari, M. Ghale, B. Chaudhary, S. Gyawali, M.P. Upadhaya and B.R. Sthapit. 2005. Evaluation of sponge gourd (*Luffa cylindrica* L.) diversity for vegetable production. In: *Proceedings of 2nd national workshop on on-farm management of agricultural biodiversity in Nepal. Vol I. Assessing the amount and distribution of genetic diversity on-farm, Nagarkot, Nepal* (Eds. B.R. Sthapit, M.P. Upadhyay, S.K. Shrestha & D.I. Jarvis). IPGRI, Rome. pp.122-131.

Kebebew, F., Y. Tsehaye and T. McNeilly. 2001. Morphological and farmers cognitive diversity of barley at Bale and North Shewa of Ethiopia. *Genetic Resources Crop Evolution* **48**:1-10.

Pandey, Y.R., D. Rijal, M.P. Upadhyay, B. Sthapit and B.K. Joshi. 2003. *In-situ* characterization of morphological traits of sponge gourd at Begnas, Kaski, Nepal. In: *Proceedings of national workshop on on-farm management of agricultural biodiversity in Nepal* (Eds. B.R. Sthapit, M.P. Upadhyay, B.K. Baniya, A. Subedi & B.K. Joshi). NARC, LIBIRD and IPGRI, Lumle, Nepal. pp.63-70.

Rana, R.B., D.K. Rijal, D. Gauchan, B.R. Sthapit, A. Subedi, M.P. Upadhyay, Y.R. Pandey and D.I. Jarvis. 2000a. *In-situ crop conservation: Findings of agro-ecological, crop diversity and socio-economic baseline survey of Begnas ecosite, Kaski, Nepal*. NP Working paper no. 2/2000. NARC, LIBIRD and IPGRI.

Rana, R.B., P. Chaudhary, D. Gauchan, S.P. Khatiwada, B.R. Sthapit, A. Subedi, M.P. Upadhyay and D.I. Jarvis. 2000b. *In-situ crop conservation: Findings of agro-ecological, crop diversity and socio-economic baseline survey of Kachorwa ecosite, Bara, Nepal*. NP Working paper no. 1/2000. NARC, LIBIRD and IPGRI.

Sambatti, J.B.M., P.S. Martins and A. Ando. 2001. Folk taxonomy and evolutionary dynamics of cassava: A case study in Ubatuba, Brazil. *Economic Botany* **55**:93-105.

Teshome, A., B.R. Baum, L. Fahrig, J.K. Torrance, T.J. Arnason and J.D. Lambert. 1997. Sorghum landrace variation and classification in North Shewa and South Welo, Ethiopia. *Euphytica* **97**:255-263.

Yadav, R., P. Chaudhary, S. Khatiwada, J. Bajracharya, R.K. Yadav, M. Upadhyay, B. Sthapit, A. Gautam and B.K. Joshi. 2003. Agro-morphological diversity of sponge gourd (*Luffa cylindrica* L.) in Bara, Nepal. In: *Proceedings of National workshop on on-farm management of agricultural biodiversity in Nepal* (Eds. B.R. Sthapit, M.P. Upadhyay, B.K. Baniya, A. Subedi & B.K. Joshi). NARC, LIBIRD and IPGRI, Lumle, Nepal. pp.58-62.