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On-farm Conservation of Indigenous Vegetables by Strengthening Community Based Seed Banking in Seti River Valley, Pokhara, Nepal

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FOREWORD

Nepal is a small mountainous country with an area of 147,181 sq.km. However, geographical, ecological and socio-cultural variations have contributed to the extraordinary biological diversity in the country. The country's economy is predominantly agriculture based as 81 percent of the economically active population is engaged in farming. But the subsistence nature of farming places a challenge to address the problem of food security for the ever-increasing population of the country. This warrants to make relevant technologies available (and in most cases, location specific technologies) to the farming communities for increased production and productivity. The conventional approach so far has been to transfer technologies generated elsewhere to the farmers. But such an approach so far has not only been less efficient in the adoption of the technologies by the farmers, but has also led to replacement or erosion of local genetic resources. This raises the question as to how relevant and farmer preferred technologies could be generated on the one hand, while attempting to conserve, further utilize and manage the existing valuable genetic resources on the other.

Such is now a dilemma faced by researchers, development workers and policymakers. This would require innovative approaches in research and development- a departure from the conventional system. For this, specific circumstances may lead to adapt different approaches, but the bottom line should be: understanding of an learning about local genetic resources and knowledge as well as socio-cultural factors associates with them; identifying men and women farmers' real needs and problems; intensive dialogue with and involvement of the farming communities in research and development endeavor.

Local Initiatives for Biodiversity, Research and Development (LI-BIRD) is actively involved in the participatory methodological development for conservation, utilization and management of local genetic resources and is focussing on crop improvement and creating diversity through its participatory research and development approaches for the last three years. As a consequence, encouraging results have started to come up which need to be further disseminated to a wider audience. LI-BIRD has, thus, initiated the publication of the research findings as Technical Report Series.

It is hoped that the findings of our researches will contributed to 1) further understanding of local genetic resources and associated knowledge. 2) identifying untapped genetic diversity for further improvement, and 3) disseminating relevant information to other similar environments. It is also hoped that the series reports will be a reference source on the innovative methodologies and processes for those scientist, development workers and policy makers who are involved in research, conservation, improvement and promotion of genetic resources.

This series of research report intends to draw the attention on some indigenous vegetable species which have been underutilized and neglected in varying degrees by researchers and development workers for conservation, further improvement and utilization. Thus, suggestions are made on the value addition through market promotion, and participatory crop improvement for effective conservation and utilization of such indigenous vegetable species.

LI-BIRD highly appreciates the support extended to it by funding agencies, other collaborators and well wishers. Finally, the Technical Report Series are dedicated to the millions of farmers, both women and men, whose wisdom has played vital role in serving the humanity.

Acronyms and Abbreviations

CBO	Community Based Organization
FGD	Focus Group Discussion
GOs	Government Organizatons
IDRC	International Development Research Centre
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
NGOs	Non-government Organizations
PGR	Plant Genetic Resources
PVS	Participatory Variety Selection
SRV	Seti River Valley
WDR	Western Development Region

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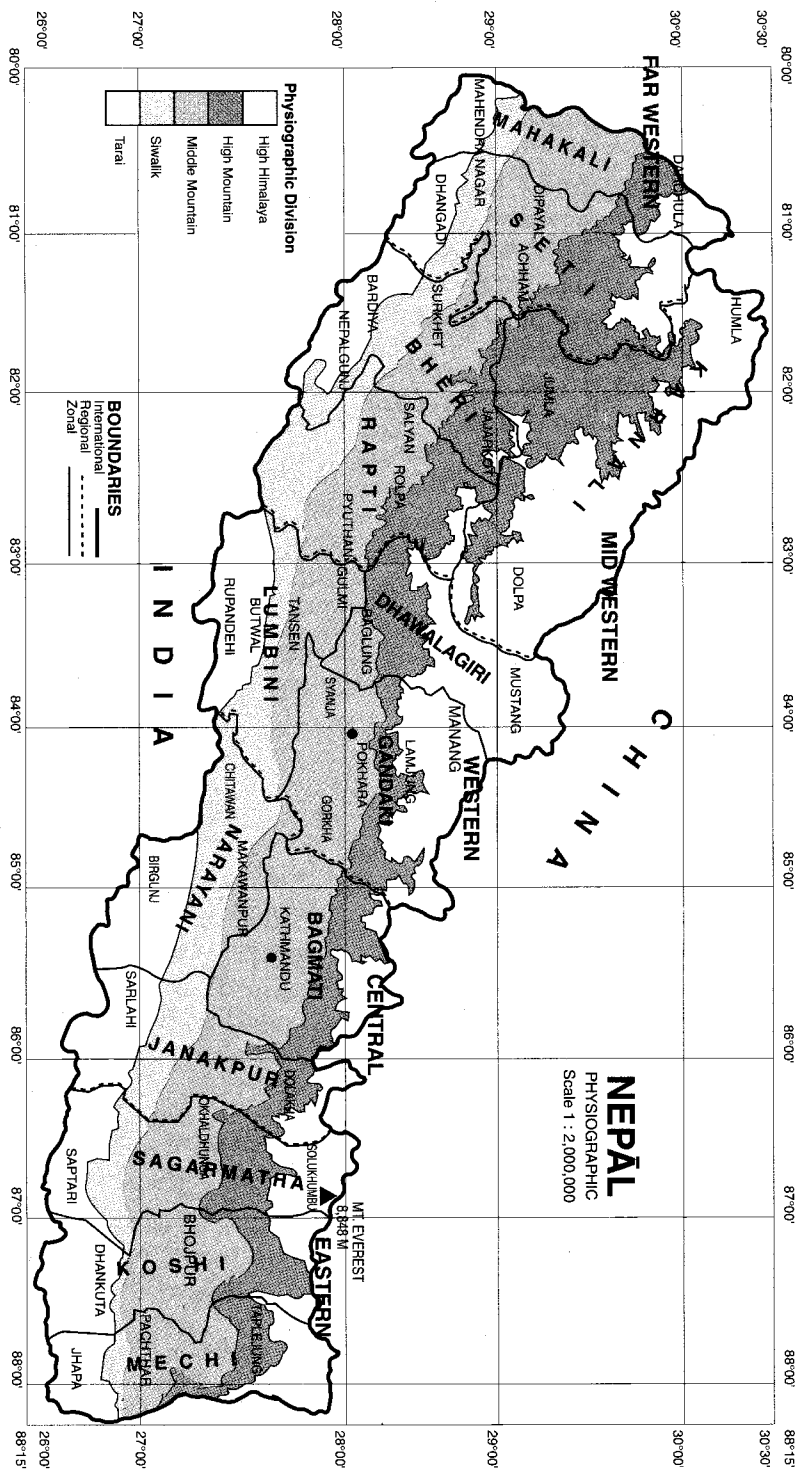
SUMMARY

The paper explores the status of varietal diversity in some selected summer and winter vegetables and the state of knowledge associated with them in the communities within the Seti River Valley of Nepal. Out of 14 species studied, the appreciable number of landraces exist in case of bitter gourd (6), snake gourd (4), sponge gourd (4), pumpkin (3) and Dolichos bean (3). Vegetables like broad leaf mustard and radish, though most common and important winter vegetable, have the least diversity with one landrace each. It was found that these vegetables are primarily grown for home consumption with minimum external inputs and management. But the same landraces when grown commercially, the status changes with input levels and management improving substantially. The level of varietal/landraces diversity was found to have inverse relation with the level of urbanisation. Contrary to the general belief that commercialisation decreases species and varietal diversity, the study found that commercialisation could, in fact, increase species and varietal diversity provided vegetable landraces are commercialised. Home gardens are managed by women farmers and have key role in maintaining active seed flow system within and outside the village. After analysing the findings of the study, ways forward have been suggested basically on three spheres: value addition and market promotion for vegetable landraces; awareness creation at different levels and reintroduction through participatory crop improvement processes.

INTRODUCTION

Nepal is a landlocked country lying between latitudes 26° 22' and 30° 27' North, and between longitudes 80° 45' and 88° 12' East with land area of 147,141 km². Nepal is divided into five physiographic regions viz. *Terai*¹, Siwalik, Middle Mountain, High Mountain and High Himalayas (Figure 1). *Tarai* occupies the southern flat land of the country, and enjoys tropical to subtropical climate. Siwalik ranges in altitude from 300 to 1500 m asl and has sub-tropical climate. Middle Mountain comprises hills with altitude between 1500-2500 m. There are longitudinal tectonic valleys between Siwalik and Middle Mountain, and in Middle Mountain region. The Middle Mountain has a favorable climate and produces wide range of cereals and horticultural crops. High Mountain is rugged and steep, its lower slopes are terraced, whereas upper slopes are covered by forests. High Himalayan region is steep, rugged and rocky, and most of the time it is covered with snow. Similarly the variation in socio-economic settings of the inhabitants in these regions is also very wide. *Terai*, inner *terai* and low hill regions of the country is predominantly inhabited by people of Indo-Aryan origin whereas mid and high hills are dominated by people of Tibeto-

¹ Terai represent the southern most fertile plains stretching from east to west of Nepal, and the extension of Indo-gangetic region.



Burmese origin. These groups differ not only in their economic, social and cultural settings but also in their food habit and preferences for crop species. As a result of diverse agro-ecological and socio-economic conditions high crop genetic diversity at farm level can be observed.

Richness in genetic diversity of plants in Nepal is evident from the fact that more than 7000 species of flowering plants are estimated to be growing in the country and 79% of them have been collected, identified and preserved in the National Herbarium and Plant Laboratories, Godawari (NAA, 1995). Out of 7000 species, 400 comprise of food and horticultural crops, and of them, 200 species are in vegetable category (NAA, 1995). Fifty species of vegetables have already been domesticated in Nepal. Among vegetable crops, broad leaf mustard (*Brassica juncea* var. *rugosa*/ *integrifolia* group), gourds (*Cucurbitaceae*), pumpkin (*Cucurbita moschata*), cucumber (*Cucumis sativus*), tomato (*Lycopersicon esculentum*), chilli (*Capasicum annum/frutescence*), garlic (*Allium sativum*), cowpea (*Vigna unguiculata*) etc. have greater genetic diversity. However, these species do not receive much emphasis in national agricultural programs (Budathoki *et al.*, 1993; Lohar *et al.*, 1993). With the introduction of new high yielding varieties and hybrids, genetic erosion of vegetable species and varieties along with the knowledge base of the farming community has been accelerated in Nepal and ultimately farmers indigenous seed supply system has been weakened. Similarly over exploitation of natural resources can also be held responsible for the loss of local plant genetic resources (Lohar *et al.*, 1995).

Genetic diversity has enormous value for present and future generations, and more strenuous efforts must be made for its conservation and sustainable utilization (Brush, 1995). In the present context, conservation of genetic resources is done through *ex situ*² or *in situ*³ methods. Both the methods are complementary in nature with their strengths and weaknesses, and lately later method has been advocated mainly for the reason that dynamics of evolutionary processes are not disrupted, and resembles to the reality in farmers' fields.

The essence of *in situ* conservation strategy of agricultural diversity is to understand farmers' circumstances and encourage them to maintain the special habitat that generated such diversity in the first place. But to actually implement *in situ* conservation is easier said than done. This is mainly so because *in situ* conservation is difficult to plan and implement since it involves farmers as well as their crops. Yet

² *ex situ*, according to CBD, is defined as "conservation of components of biological diversity outside their natural habitats".

³ *in situ*, as defined in CBD, is "conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties".

for *in situ* conservation to be effective and successful, farmers must understand and be able to perceive the benefit from participating in the program (Sthapit, *et al.*, 1996).

Community level seed banking, in which farming communities take active part in the maintenance, use and exchange of indigenous genetic resources, is one of the ways of *in situ* conservation. A research project was signed between Local Initiatives for Biodiversity, Research and Development (LI-BIRD) based in Pokhara, Nepal and International Development Research Centre (IDRC), Canada for implementing one year project on “On-farm conservation of vegetable by strengthening community based seed banking in Seti River Valley, Pokhara, Nepal”. The paper presents the findings of the study, and suggests ways forward.

OBJECTIVES OF THE STUDY

The specific objectives of the study were:

- To document the diversity and value of indigenous vegetable genetic resources within the study area, and understand the reasons and causes, nature and the extent of erosion.
- To document seed management system of indigenous vegetables by the farming community.
- To provide landraces to National Plant Genetic Resources (PGR) Unit for *ex situ* conservation and their utilization in breeding program.

METHODOLOGY

To fulfil the above mentioned objectives, a number of tools and techniques were used from PRA repertoire which are as follows:

- Field visits in different parts of the Western Development Region (WDR) for situation analysis and collecting seeds of vegetable landraces.
- Individual interviews with the farmers[§] using checklist to document and understand the diversity at household level, reasons for species and varietal erosion, preferred traits of landraces etc.

- Focus Group Discussions (FGD) with the members of the Community Based Organizations (CBOs) for their possible involvement and role in the conservation of vegetable biodiversity.
- Transect walk within the village to understand the variation in farming systems and the natural vegetation.
- Personal observation by the researchers of the vegetable plants and their growing conditions.

The study area

The Pokhara Seti River Valley (SRV) was selected for the study to represent the middle altitude (700-1300 m) crop production ecosystem of Nepal (Figure 2). Rationale for selecting the SRV area were:

- Presence of genetic diversity on vegetables with indigenous knowledge among farming communities.
- High adoption of exotic vegetable varieties in pocket areas (commercialization).
- Genetic erosion reported from the area.
- Local market existing for local vegetables but the potential/opportunities not explored.
- Lack of institutions involved in the field of PGR conservation, promotion and utilization.

Selection of representative sites

Once the study area was finalized, identification of representative sites within the area was accomplished using both primary and secondary sources of information:

- District Development Committee publications, e.g. District Profile.
- District Agriculture Development Office Reports and interaction with officials.
- Interaction with the experienced farmers from the project area.

Finally the researchers expert knowledge gained through working in the project area was employed to add onto the selection process.

KASKI DISTRICT

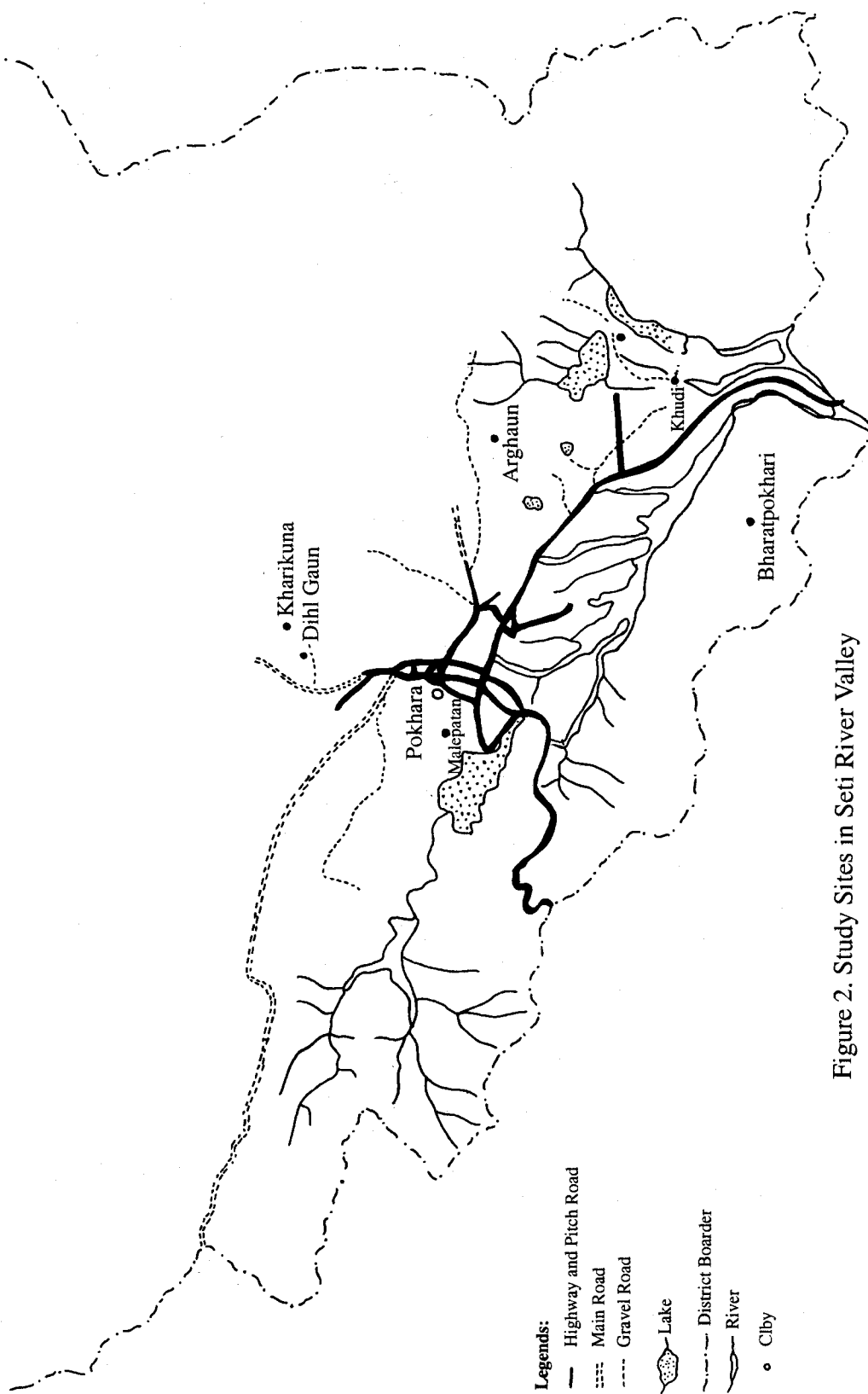


Figure 2. Study Sites in Seti River Valley

FINDINGS AND DISCUSSION

Characteristics of the selected sites in the study area

Major characteristics of the selected sites are presented in Table 1. Malepatan in Pokhara is a highly commercialized fresh vegetable growing pocket area. Wide range of vegetables such as cole crops, cucurbits, leafy vegetables etc., are produced and marketed. Farmers at Bharatpokhari are renowned for producing and marketing rainy season tomatoes. In recent years farmers have diversified their produce by growing vegetables such as broad leaf mustard (*rayo*), beans and cucumbers for Pokhara market. Unlike in commercialised areas such as Malepatan and Bharatpokhari, places like Arghaun and Khudi only a limited number of households are involved in vegetable cultivation for market purpose. In places like Dihi Gaun and Khari Kuna, vegetable cultivation is subsistence oriented and mainly operates at kitchen garden scale.

Table 1: Major characteristics of the sites visited in the study

Sites visited within SRV	Extent of commercialisation	Road Accessibility	Dominant community	Land type	Altitude (m asl)
Malepatan	High	High	Brahmin	Flat/ <i>Khet</i> ⁴	850
Bharatpokhari	High	Low	Brahmin	Flat/ <i>Bari</i> ⁵	700
Dihi Gaun	Low	Low	Mixed	Sloping	900-1300
Khari Kuna	Low	Low	Gurung	Sloping	900-1100
Khudi	Medium	High	Brahmin	Flat/ <i>Khet</i>	750
Arghaun	Medium	High	Mixed	Flat/ <i>Khet</i>	750

Varietal diversity in important local vegetables

Need for varietal diversity on vegetables cannot be over emphasized. But one must view this issue from farmers' perspective. Has farmer perceived the importance of varietal diversity? and how farmer is making use of the diversity? Discussions with farmers' groups at various places reveal that most of the farmers do not make deliberate effort to maintain varietal diversity *per se*. Rather the level of diversity depends on various factors, and some of them are illustrated in the following paragraphs.

⁴ banded and irrigated/rainfed land, mainly puddled rice is grown.

⁵ unbanded and unirrigated upland.

Table 2: Inventory of vegetable landraces and their relative importance as ranked by the farmers

Vegetable species	Number of landraces/varieties											
	Malepattan		Bharat Phokhari		Khudi		Aghaun		Khair Kuna		Dihl Gaun	
	No. of Landrac	Preference Ranking	No. of Landrac	Preference Ranking	No. of Landrac	Preference Ranking	No. of Landrac	Preference Ranking	No. of Landrac	Preference Ranking	No. of Landrac	Preference Ranking
Winter Vegetables												
Rayo (<i>Brassica juncea</i>)	I	I	I	I	I	I	I	I	I	I	I	I
Radish (<i>Raphanus sativus</i>)	II	II	II	II	II	II	II	II	II	II	II	II
Bean (<i>Dolichos lab lab</i>)	2	III	3	III	3	III	2	III	3	III	3	III
Summer Vegetables												
Sponge gourd (<i>Luffa cylindrica</i>)	3	I	3	I	4	I	4	I	4	I	4	I
Snake gourd (<i>Trichosanthes cucumerina</i>)	3	II	4	II	4	II	1	II	2	II	4	II
Bitter gourd (<i>Momordica charantia</i>)	6	III	2		1	III	1	III	2		4	
Pumpkin (<i>Cucurbita pepo</i>)	3		2	III	2	III	1		2		3	III
Common bean (<i>Phaseolus spp.</i>)									2	II	2	
Cowpea (<i>Vigna unguiculata</i>)			1		1		1		2	III	2	
Cucumber (<i>Cucumis sativus</i>)	2		2		1		1		2		2	
Bottle gourd (<i>Lagenaria siceraria</i>)	2		1									
Chilli (<i>Capiscum annum</i>)			3		1		1		1		1	
Brinjal (<i>Solanum melongena</i>)	1		1						3		1	
Tomato (<i>Lycopersicon esculentum</i>)	1		1		1		1		1		1	
Total	23		24		19		13		26		29	

It is interesting to note that broad leaf mustard and radish, though ranked as the most common and important vegetables in winter, do not have many landraces. These two crops have one landrace each at only a few sites. Since the plant part used as vegetable is different from the fruit (leaf for broad leaf mustard and root for radish) in these vegetables, farmers neglect the seed production. Moreover, seed of widely grown varieties of these crops is readily available in the market, and hence farmers mostly use the seeds bought from the market and traditional skill of growing and maintenance of *rayo* seed has already been lost. Table 2 shows the inventory of vegetable landraces present at different sites in the study area.

Availability of vegetables in Nepal is variable with seasons. The important vegetables as ranked by farmers for different seasons are given in Table 2. Farmers while ranking vegetables in their home garden have excluded tuber crops such as potato and *taro* though their contribution in diet is significant, and in some places these crops are cultivated as cash crops. It is clear from Table 2 that the ranking of vegetables at different sites is almost consistent. Sponge gourd, snake gourd, bitter gourd, pumpkin, bean, cowpea and common bean are important traditional vegetables for the summer season. Whereas for winter season, across sites broad leaf mustard (*rayo*) and radish are the two most important vegetable crops followed by bean in two out of six sites visited.

More diversity of vegetable landraces are observed in summer as compared to winter season mainly because there is less intervention on summer season vegetables from research and development agencies including multinational seed companies. The story is completely different for winter season vegetables especially cole crops and tomato where a lot of intervention has been done from outside. As a result, farmers even in remote villages are used to growing a few plants of cabbage, cauliflower and tomato in their home garden.

Farmers at Dihi Gaun and Khari Kuna reported that radish and broad leaf mustard have long crop duration for seed (about 9 months) and the crop period coincides with the hailstone occurrence. Thus farmers find it difficult to maintain the seed. They expressed that it is easier and cheaper to buy seed from the market than to produce these crops by themselves. These factors will certainly have negative implication for vegetable seed banking program. Therefore, elaborate understanding of the decision making criteria of the farming household for maintaining any crop variety at individual level is important. Perhaps this should form the first step for any program of conservation and utilization of agro-biodiversity.

The maximum varietal diversity was reported in bitter gourd. Sponge gourd, snake gourd, bean and pumpkin are the other crops which have considerable diversity at different locations. Favourable factors which contribute to the varietal diversity in

case of gourds include easy to keep the seeds, limited modern varieties, improved seed is not available, high seed multiplication ratio and several seeds in a single fruit, and open-pollination behaviour. Other vegetable crops, however, have relatively less varietal diversity (Table 2).

Characteristics of some important local vegetable landraces

Characteristics of some important local vegetable landraces reported in the study area are summarised in Appendix 1. Apart from the account given in Appendix 1, vegetables such as bottle gourd, chilli, tomato, cowpeas etc. have a large varietal diversity in the area. However, the genetic basis of such a diversity is yet to be proved. Many times it is difficult to give a discrete identification to a particular landrace due to the presence of several intermediate forms resulting from free out-crossing in case of cross-pollinated species. It is likely that a landrace known by the same name in different areas (e.g. *Hariyo Lamo* sponge gourd) may be genetically different. It might also be that landraces known by different names in different areas are genetically the same. This is an inherent problem while dealing with indigenous knowledge system. The issue is understandable as farmers make distinction between two varieties on the basis of few obvious morphological traits without having much idea of the difference in genetic level. Therefore, at some point it would be necessary to validate farmers' information with the scientific knowledge.

The study tried to understand the reasons for growing different landraces of a vegetable species at household level. Farmers at Dihi Gaun reported that growing different landraces of the same crop was not intentional. They use seeds from the most preferred plant as is common in other food crops such as maize, leguminous crops etc. But to the surprise of the farmers, the resulting plants from the same seed source become variable in cross-pollinated species. While farmers at Khari Kuna reported that some farmers do not make conscious efforts to select and preserve the seed for the following season, instead use the seeds obtained from different sources and plant in the home garden. As a result, diversity is created and maintained in the home garden. However, the resulting biodiversity does not seem to be the legitimate effect of conscious effort of the farming communities. Given the fact, the biodiversity reported on selected vegetables is quite fragile as any relatively profitable opportunity could easily erode it at any time. Without farmers being aware of the existing biodiversity and their importance for present and future generation, whatever the level of diversity it could be easily eroded. Therefore, a concerted effort by international and national institutions to raise awareness on the issue is a prerequisite for any long-term program on biodiversity conservation and utilization.

Plates 1 to 8 show variations for fruit characteristics in different vegetable landraces. These landraces are *Seto Chhoto* (short white), *Hariyo Chhoto* (short green), *Hariya*

Lamo (long green) and *Seto Lamo* (white long) of snake gourd; *Madhyam Seto* (medium white), *Lamo Hariyo* (long green), *Seto Chhoto* (short white), *Lamo Seto* (long white) and *Chhoto Hariyo* (short white) of bitter gourd; *Hariyo Lamo* (green long) and *Hariyo Chhoto* (green short) of sponge gourd; Malepatan Local cucumber; and Pokhara Lurki brinjal, respectively.

Farmers' knowledge on vegetable landraces diversity

Specific questions were asked to farmers to understand their perception of diversity on vegetable landraces. Responses from farmers suggest that the knowledge base of farmers on local vegetable genetic resources vary from person to person and area to area (Table 3).

Table 3: Farmers' knowledge on the diversity of vegetable landraces and seed maintenance

Site	Extent of Knowledge on				
	Landraces diversity	Use of vegetable diversity	Status of landraces diversity	Mode of pollination	Special techniques for seed maintenance
Malepatan	Good	Poor	Fair	Good	No
Bharatpokhari	Good	Poor	Good	No	No
Khudi	Good	Poor	Poor	No	No
Arghaun	Good	Poor	Fair	Fair	No
Khari Kuna	Good	Fair	Fair	No	No
Dihi Gaun	Good	Poor	Fair	No	No

Farmers at all sites were generally well aware of the existence of diversity in vegetables. But farmers' knowledge on present use of such diversity and the future potential were found to be either poor or fair. At many sites, farmers have a fair amount of knowledge on the dynamics of varietal replacement process. This was reflected by the fact that farmers could name and count several landraces, which have disappeared over time from the locality. In some instances, they could also point out the possible causes for such a change. Farmers only at Malepatan and Arghaun knew the mode of pollination of selected vegetables. Despite this, farmers at Malepatan expressed the difficulty to maintain their preferred landrace of bitter gourd, i.e., *Seto Madhyam* (white medium) due to open pollination. Thus it is obvious that farmers anywhere in the selected sites did not practice the use and knowledge of special techniques such as bagging and artificial pollination.

Status of home garden in the area

Farming in Nepalese context is largely subsistent in nature. Farmers primarily produce food crops including vegetables for home consumption. In a typical Nepalese homestead, home gardening is an integral part, and plays a vital role in

supplying household members with the relish food. Therefore, it was not unusual to find farmers in the study area growing different types of vegetables in their home garden. However, the nature and practice to maintain a home garden vary, and the factors that influence farmer decision is also quite variable.

In Malepatan, most of the farmers are producing vegetables at commercial scale, and only a few farmers practice home gardening. It was observed that commercial farmers do not maintain a separate home garden for local vegetables. In Bharatpokhari, most of the farmers grow local vegetables for household consumption. This practice is prominent for crops other than tomato. As expected, some farmers maintain home garden more actively than others. Similar is the case at Khudi and Arghaun sites. Only a limited number of farmers buy and sell vegetables at these sites. At Dihi Gaun, home gardening is a key practice to supply vegetables to the household. At Khari Kuna, all the 17 households had home garden, nevertheless, only seven of them maintained actively. Farmer maintaining home garden actively keeps the seed for the next season planting and is interested in selecting the seed and maintaining the crop. Other farmers just look for few seeds from the active farmers during planting time and grow the crop. Farmers at this site, reported that all farmers were maintaining a home garden actively about 20-30 years ago. However, the situation has now changed due to easy access to the Pokhara market, and increased opportunity for off-farm employment. The situation has been correctly depicted by a case from Bharatpokhari. Previously all households actively did home gardening. However, the tradition is dwindling. Tradition in the village was to maintain the equal number of brinjal (*Solanum melongena*) plants as the number of family members in a household plus one plant for the plowman, and one more for guests for regular supply. This tradition has now disappeared.

Nomenclature of local vegetables

Vernacular nomenclature of any crop varieties signifying a particular meaning can be considered as the symbol of richness of indigenous knowledge about PGR and this holds good for crops like rice in Nepal. Perhaps that is so because rice is the most prestigious crop and has economical, social, religious and cultural significance in Nepalese way of life.

When farmers knowledge in vegetable landraces were analyzed, it was nowhere close to that of rice. The situation was that no particular name for a majority of vegetable landraces existed suggesting that farmers accord low priority to these vegetables within the farming systems. Farmers basically recognize and differentiate one landrace from the others based on morphological traits viz. fruit shape, size, colour and in some cases, season of maturity and the main crop on which the vegetable is associated as mixed crop. For example *Hariyo Lamo* (green long) sponge gourd is

different from *Seto Lamo* (white long). A landrace of cowpea having low fibre and high flesh in the pod is known as '*Bose Bodi*' which means 'fatty cowpea'. *Kattiki Bodi* (a landrace of cowpea) becomes available for harvest in the month of *Kartik* (October/November). Likewise, the cowpea landrace mixed cropped with maize is called '*Makai Bodi*' (*Makai* meaning maize and *Bodi* meaning cowpea).

Crop management practices for vegetable landraces

There are two main growing seasons for vegetables; the summer and the winter. Summer vegetables are sown from February to June depending upon the altitude of the site. Lower the altitude earlier the sowing time of vegetables. Nursery raising is not practiced for pumpkin, sponge gourd, bitter gourd, beans, cowpeas and snake gourd. Farmers' experience is that the seedlings of these crops do not survive if transplanted, therefore, direct sowing of seeds in the field is practiced. These vegetables are available for consumption from July to October.

Winter vegetables are planted in September-October and become ready for harvest from October to February-March. Leafy vegetables such as broad leaf mustard, radish (leaf), mustard etc. become ready for harvest in a short time period after planting. The root vegetables are of medium duration to harvest from planting. Onion and garlic are long duration crop. However, they are also harvested in their early stages as fresh vegetables. Seedlings are raised and transplanted for cauliflower, cabbage, onion and broad leaf mustard whereas other vegetables are directly sown into the field.

The soil in home gardens is generally fertile due to heavy application of organic manure/compost. Though the exact quantity of organic manure applied in the field could not be calculated, it was estimated to be more than 50 ton/ha. The major part of the organic manure was derived from animal dung, usually decomposed in combination with other locally available materials such as leaf litter, crop by-products, twigs etc. The commercial farmers of Malepatan and Bharatpokhari sites also use poultry manure. Manure is usually applied at the time of land preparation and is broadcast evenly for the widely spaced crops such as cucumber, sponge gourd, bitter gourd etc. Some farmers cultivate broad leaf mustard on compost pit/heap. The crop usually does very good on compost pit due to the high fertility and high moisture availability on compost. Similar findings are also reported by Lohar *et al.* (1993) from other parts of the Western Hills of Nepal. The use of chemical fertilizers on vegetable crops for home gardening is not common. But the situation changes if farmers are growing vegetable landraces for commercial purpose. In fact, the level of compost application, chemical fertilizer application, irrigation and other management practices become intensive when traditional vegetables are grown for commercial purposes.

Vegetable landraces are also grown in association with cereals. Mixing cowpea, beans, soybean with maize are very common. A few vines of cucurbits are usually grown in or around the home yard. Small trees around the house are utilized to support the vines. Taro is also mixed cropped with maize.

Vegetables grown for home consumption are normally grown under rainfed condition. Nevertheless, water collected from the household use is used for irrigating such vegetables during the dry seasons. Mulching is a common practice for taro cultivation, which helps conserve moisture in the soil and smother weeds. Vegetable landraces grown commercially are irrigated during dry period of the year.

Farmers on pest and disease management aspect on vegetable landraces pay least attention. Yet the situation improves when the same vegetables are cultivated for marketing purpose. The use of wood ash on vegetable crops for disease and insect pests management is very common in both home garden and commercially grown plots. Satisfactory reduction in insect damage after wood ash dusting was reported at several places. Farmers believe that harvesting of vegetables in the morning when there is still dew on plants, is prohibited, because their belief was that doing so increases the incidence of aphids and other insect pests and also damages small fruits. It would be worthwhile to have a scientific investigation on indigenous knowledge base and beliefs of farmers on the subject of pest and disease management.

Seed maintenance and distribution systems for local vegetables

Over time a mechanism for the maintenance and distribution of vegetable seed have evolved at farm and community level. The traditional practice to save the seed of broad leaf mustard and radish is to keep a few plants especially for seed. Good looking, healthy and vigorously growing plants are kept for this purpose. In case of broad leaf mustard, no leaf is harvested from such plants and farmers reported deterioration on seed quality if leaves are harvested. In the past, each household in Khari Kuna and Dihi Gaun maintained the seed of a radish landraces, Seto Mula. But now only a few farmers (only about 3-4 households) produce seed of this variety locally, mainly because radish seed is now abundantly available in the market and most farmers buy the same from the nearby market.

Similarly, only one or two farmers reported to produce the seed of local broad leaf mustard, *Kalo Pate Rayo*, in Khari Kuna and Dihi Gaun. Since *Kalo Pate Rayo* is a late bolter, seed production takes a long duration. Therefore, farmers in the village purchase seed of this landrace from farmers of another village, Armala Kot (a village at higher altitude than Khari Kuna and Dihi Gaun). In the past, Armala Kot farmers used to come to Khari Kuna and Dihi Gaun for exchanging seeds of broad leaf

mustard and radish with rice since rice was in short supply at high altitude. However, the tradition is now eroding due to two reasons: firstly, easy availability of seed in the market for cash; and secondly, increased off-farm income, farmers could buy rice from the market.

In case of cucurbits such as sponge gourd, snake gourd, bitter melon etc. farmers keep a few early fruits for seed purpose. Farmers mentioned that the early fruits look healthy and large and mature earlier than others. Early fruits tend to self pollinate due to small vine size, only few female flowers, and a large male flowers and hence breed true to the type.

Farmers adopt different approaches to get seeds for their home garden. For example, they use the seeds produced by themselves. If they do not have sufficient quantity of seed then they get it from neighbors. Seed may be acquired through exchange, barter, free of cost or for cash or kind. Seeds are exchanged between villages far apart from each other through family ties and friendship. Seeds also make their way to different households in the form of gift. Social and family relations play a significant role in this kind of seed flow system. Case studies on adoption and diffusion of *Chaita* rice in the western hills of Nepal (Joshi, *et al.*, 1997) and high altitude rice have proved that family ties (married daughters) have important role in the diffusion of innovation to distant places (Sthapit, *et al.*, 1997; Shrestha, 1996).

Women farmers are responsible for and playing a lead role in maintaining or arranging seed of vegetable crops for the home gardens. Mostly women do planting, after care of the crop, harvesting and cook food including vegetables for the family. Thus it is clear that home garden, local vegetable diversity and women are linked very closely. On an average, the role of Nepalese men and women in crop and seed selection ranged from 40-48% and 52-60%, respectively (Shrestha, 1996). Women have traditionally been the users and managers of crop germplasms and their diversity. The study found that women have significant role in properly maintaining home garden, taking decision on the choice of varieties and saving seeds for next year planting. This indicates that involvement of women in vegetable diversity management through participatory approaches is essential to achieve desired result.

Endangered and lost landraces on selected vegetables in the study area

Farmers were asked to provide name and number of crops/cultivars lost or endangered and the possible reasons for the same (Appendix II). The list is based on the farmers' recall of the cultivars from the past. Since the list of lost landraces is generated based on recollection the list cannot be complete for the area. Mainly elderly people in the village were interviewed for the obvious reason that they have more than younger ones. Few elderly farmers, for example, reported the loss of

cucumber landraces from Malepatan area, nevertheless, they were unable to tell the name and number of lost landraces.

In Malepatan, Bharatpokhari and Arghaun farmers are increasingly growing pumpkin for green shoots rather than for fruits. The reasons given for this change was that harvesting green shoot and selling them in market provides a quick return to the producers. Pumpkin cultivation for fruits requires large area and takes long duration for harvesting fruits. For seed purpose, farmers spare a few fruits at the corner of their farm. Whether this practice will maintain the varietal diversity at present level is a matter of further study.

Farmers at all sites agreed that crops such as sponge gourd, snake gourd and bitter gourd will never disappear from the village, though the amount of diversity may decrease. The reason for such an expression is the importance of such vegetables in the diet of local people and the deep-rooted traditional food culture.

No one can deny that urbanization and access to market have been found to play a pivotal role in accelerating the loss of vegetable landraces diversity. Commercialization of vegetables also equally contribute to varietal erosion, but if vegetable landraces are commercialized the process may conserve genetic materials on-farm; as observed in sponge gourd, bitter gourd, snake gourd and pumpkin at Malepatan and Bharatpokhari (Table 2). This argument needs to be further strengthened with case studies from commercial vegetable growing areas, which might provide insights into the situation on genetic conservation of landraces through market incentives.

VEGETABLE GERMPLASM COLLECTION

One of the objectives of the project was to collect vegetable germplasms and provide them to the national plant genetic resources (PGR) unit at Khumaltar, Kathmandu for evaluation and their utilization in breeding programs. Therefore, every effort was made to collect vegetable landraces from the different areas visited (Table 4).

The other objective of collecting seeds was that choice of varieties through participatory variety selection approaches could offer opportunities for selection and varietal exchange between communities. This could be cost effective means to reintroduce some of the landraces in the project area. Materials that have been lost or endangered are given back to farming community (through careful seed from gene bank or collected from nearby areas) to plant and to carry out simple mass selection to improve their characteristics. LI-BIRD has vision to carry out programmes that support introduction of diversity and seed of choice through strengthening skill of seed selection and conservation. This can be implemented by supplying packets of

multiple vegetable seed of local origin through farmers group, extension agent and seed retailers.

Table 4: List of collected local vegetable landraces

Sn	Species	Scientific Names	Seed sample
1	Sponge gourd	<i>Luffa cylindrica</i>	12
2	Tomato	<i>Lycopersicon esculentum</i>	6
3	Cucumber	<i>Cucumis sativus</i>	3
4	Bitter gourd	<i>Momordica charantia</i>	6
5	Snake gourd	<i>Trichosanthes anguina</i>	2
6	Balsom gourd	<i>Cyclanthera pedata</i>	4
7	Bottle gourd	<i>Lagenaria siceraria</i>	3
8	Ash gourd	<i>Banincasa hispida</i>	1
9	Pumpkin	<i>Cucurbita pepo</i>	2

WAYS FORWARD

Future activities are guided by the findings of the present study. It is apparent from the study that vegetable landraces and the knowledge base of the communities are eroding. But the rate of erosion appears to be higher in urbanized and commercialized areas where off-farm opportunities are higher as compared to inaccessible areas. This is a natural phenomenon associated with urbanization and development process. The study also indicated that management level improves considerably when vegetables/landraces are cultivated for commercial purpose. This gives a strong indication that vegetable germplasms might be conserved effectively on-farm provided market incentive drive farmers to commercialize. Eliminating undesired traits through genetic recombination (Participatory Plant Breeding) can also contribute in the process. In a nutshell, both research and promotion activities could lead to landraces conservation on-farm. Any single strategy for conservation will not work, thus multiple strategy might be required even for conserving genetic diversity contained in single landrace. Therefore, some of the future activities in this regard could include the following aspects:

Market promotion for vegetable landraces

It can be argued that in the absence of other feasible options to conserve landraces, market promotion for local varieties with reasonable yield and other preferred traits could provide incentives to the growers for maintaining them on-farm. Exploration of ways and means to sensitize consumers to develop preference for local vegetables could be the first step forward. One of the effective ways of promoting vegetable

landraces would be to work jointly with local hotels and restaurants by blending indigenous culinary knowledge while developing seasonal menus. Simultaneously identifying markets, marketing channels, marketing mechanisms for these products at local, regional and national level will ultimately facilitate in expanding and strengthening opportunities for such produce.

Exploring possibilities for the value addition to local vegetables viz: inclusion of local vegetable dishes in tourist meals, such as *Karkolo* (green stems of taro), *Pharsi Ko Munta* (tender shoots of pumpkin) etc., processing of some local vegetables for the preparation of both pickles and *petha* (sweets) from ash gourd. Value addition of vegetable landraces can be taken up as cottage industry thereby generating employment opportunity and cash generation at village level. Involving women in this activity would be advantageous since the nature of the work requires less physical strength and can be performed at any time within the house. Moreover, women already have expertise in food processing, and this will add to their knowledge and skills, at the same time, will give access and control over cash.

Awareness creation

Creating awareness on genetic resources wealth and need for conservation at different levels: community, Government Organizations (GOs)/Non-government Organizations (NGOs), entrepreneurs and consumers. It is essential to demonstrate the linkage between conservation and the benefits accruing thereafter. Experiences have shown that farmers actively participate in activities where they see clear benefits from their involvement. However, community members are yet to see the benefits associated with conservation of biodiversity and their utilization aspect. In this context, activities should be focused to generate awareness at all the levels that are directly or indirectly involved in the use and conservation of biodiversity. This could be effectively done through mass media, talk programs in schools, colleges and other institutions for variety of audiences. Agriculture fairs and demonstrations organized in the area also provide a forum where information on vegetables/landraces and their end products could be effectively disseminated to the public.

Participatory variety selection (PVS): Seed of choice programme

Results from Nepal and India have clearly indicated that Participatory Variety Selection (PVS) in cereal crops is quite successful in providing a basket of varietal choice to farming communities to choose from. This leads to adoption of different varieties by different farmers resulting in varietal diversity at household and community level (Joshi, *et al.*, 1997; Sthapit, *et al.*, 1996 and Joshi and Witcombe, 1996). Similar approach could be applied in case of local vegetables/landraces. So far the success stories have been reported in case of self-pollinated crops, i.e. cereals

and beans. PVS in open-pollinated vegetable crops will be a new experience and the methodological issues arising while implementing the project will be helpful in setting future guidelines for research in this field. Therefore, PVS program with collected germplasms could be planned and implemented. This program provides three distinct advantages: providing direct benefits to farmers; conserving genetic resources on-farm and developing methodological approaches related to open-pollinated crops.

Case studies

Commercialization, in general, results in the erosion of varietal diversity. However, the present study has indicated that varietal diversity could be maintained on-farm provided the market opportunity exists. Furthermore, farmers at commercial and semi-commercial study sites were found to use better management practices for those landraces for which market exists. This also favors the promotion of existing varietal diversity. However, the finding needs further validation with more in-depth study in wider geographical settings.

Documenting and understanding farmers' logic and belief on indigenous plant protection measures demand immediate attention from scientific community. This aspect becomes even more important in pocket areas where commercialized agriculture is practiced with abusive use of pesticides.

Another important aspect for consideration is improvement on agronomic practices for better returns from landraces. Agronomic research is seldom conducted on landraces to improve their overall return. Therefore, it represents an important but unexplored avenue with the potential to deliver much in the conservation of landraces through utilization.

Endangered landraces

Farmers from different study locations have reported several landraces to be endangered. However, it is essential to understand the reasons and the value of those PGR before they become extinct from the ecosystem. Those germplasms may have potential value either as donor parent or a commercial variety. Therefore, their actual value needs to be assessed. Direct observation on-farm and participatory evaluation of such landraces would provide a basis for rejuvenation, commercialization and source for future breeding. However, use of molecular techniques would be necessary at some point to identify rare genetic traits.

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APPENDIX I: Characteristics of some local vegetable landraces grown in the study area.

Vegetable species/ landraces	Important characteristics	Site(s) where reported
Rayo Kalo Pate Rayo	Entire leaf margin, large leaf, dark green leaf color (thus, Kalo Pate = Black leaf), seeding in September – January, harvest from October-April, tastier than modern varieties.	Khari Kuna, Dihi Gaun
Radish Seto Mula	White root, taste same as improved varieties, low infestation of diseases and insect-pests, drought tolerant.	Khari Kuna, Dihi Gaun
Dolichos Bean Rato Seto Kalo	Prevalent landrace, pinkish pods (hence Rato=Red), very tasty, large vine. Less prevalent than Rato, less tasty than Rato, white pods (hence Seto=white) dense pod setting, large vine. Rare landraces, dark green pod (hence Kalo=black).	Khari Kuna, Dihi Gaon, Khudi, Bharat Pokhari Khari Kuna, Dihi Gaon, Khudi, Bharat Pokhari Khari Kuna, Dihi Gaon
Sponge gourd Hariyo Lamo	Long fruits (about 50 cm long), dark green color, sparse bearing, becomes fibrous early, very tasty, tender fruits, sweet taste.	Khari Kuna, Dihi Gaon, Malepatan, Bharat Pokhari, Khudi, Arghaun.
Hariyo Chhoto	Short fruits (about 30 cm long), dark green fruit color, dense bearing, early fruiting, late to get fibrous, very tasty and tender.	Khari Kuna, Dihi Gaon, Bharat Pokhari, Khudi, Arghaun.
Seto Lamo	Long fruits (about 50 cm long), white or light green fruit color, sparse bearing, becomes fibrous early, average taste, hard fruit surface.	Khari Kuna, Dihi Gaon, Khudi, Arghaun, Bharat Pokhari
Seto Chhoto	Short fruits (about 30 cm), white or light green fruit colour, heavy bearing, less tasty, hard fruit surface, becomes fibrous late.	Khari Kuna, Dihi Gaon, Khudi, Bharat Pokhari, Arghaun
Snake gourd		
Short white (Seto Chhoto)	Fruits short (about 40 cm) and white in color, tasty, preferred by consumers, good bearer	Malepatan, Dihi Gaun, Bharat Pokhari, Khudi, Arghaun
Lamo Seto (Long White)	Fruits long (about 60-70 cm) and white color, less tasty than short white, good bearer, limited consumer preference.	Malepatan, Dihi Gaun, Bharat Pokhari, Khudi, Arghaun
Chhoto Hariyo	Fruits short, fruit color green with white stripes along the length, less tasty than white landraces, good bearer, limited consumer preference.	Malepatan, Dihi Gaun, Bharat Pokhari, Khudi, Arghaun
Lamo Hariyo (Long Green)	Fruits long (some times >100 cm), fruit color green with white vertical stripes, good bearer, less tasty than white landraces, limited consumer preference	Malepatan, Dihi Gaon, Bharat Pokhari
Bitter gourd		
Lamo Seto (Long white)	Long (about 25 cm) and white fruit, less bitter, sparse bearer.	Malepatan, Dihi Gaon, Khari Kuna

Vegetable species/ landraces	Important characteristics	Site(s) where reported
Chhoto Seto (Short white)	Short (about 10 cm) and white fruits, tasty, less bitter, good bearer	Malepatan, Dihi Gaon, Khari Kuna, Bharat Pokhari, Khudi, Arghaun.
Lamo Hariyo (Long Greens)	Long and green fruit, bitter, good bearer	Malepatan, Khari Kuna
Chhoto Hariyo (Short Green)	Short and green fruit, tasty, very bitter, good bearer	Malepatan, Khari Kuna, Dihi Gaon, Bharat pokhari, khudi, Arghaun
Seto Madhyam (White Medium)	Short and green fruit, tasty, very bitter, good bearer medium fruit length (about 20 cm) and white fruit color, large and high ridges on the fruit surface, good bearer, high demand in the market	Malepatan
Pumpkin		
Lamo Hariyo (Long Green)	Fruit cylindrical, unripe fruit color green, sparse bearer, late	Malepatan, Dihi Gaon, Khari Kuna, Bharat Pokhari
Thulo Golo (Large Round)	Large and round fruits, ripe fruit color green, heavy bearer, tastier than Lamo Hariyo	Malepatan, Dihi Gaon, Khari Kuna, Bharat pokhari
Sano Golo (Small round)	Fruits round but smaller than Thulo Golo, unripe fruit color green.	Dihi Gaon
Cucumber Malepatan Local	Long cylindrical yellowish green fruits, fruit curvature frequency less than Bhaktapur Local, long productive life, slightly late to bear fruits, large vine, locally very popular	Malepatan
Brinjal		
Kalo Chhoto (Black short)	Black fruits, short in length, very tasty, perennial, good bear	Bharat pokhari
Lurki	Long but slender fruits, dark purple color, good bearer, early bearer, very popular, said to be tolerant to wilt.	Malepatan

Appendix II: Endangered and lost local vegetables/landraces in the study area

Crop Variety	Present status	Site(s)	Reasons
Cucumber Many landraces	lost	Malepatan	<ul style="list-style-type: none"> commercialization (easy access to new land) difficulty of maintaining seed
Pumpkin Golo Seto (Round White) other landraces	lost endangered	Malepatan Malepatan, Bharat-Pokhari, Arghaun	<ul style="list-style-type: none"> commercialization large area required to maintain crop increased tendency towards pumpkin cultivation for green shoots
Balsam gourd (<i>Cylanthra pedata</i>)	lost	Malepatan	<ul style="list-style-type: none"> low yield late bearing
Ash gourd (<i>Benincasa hispida</i>)	lost	Malepatan, Bharat Pokhari	<ul style="list-style-type: none"> commercialization market opportunity late bearing
Bitter gourd Chhoto Hariyo (Short Green) Chhoto Seto (Short White)	endangered	Bharatpokhari	<ul style="list-style-type: none"> low yield commercialization of tomato
Chilli Many landraces Lamo (long) Long fruit	endangered lost	Bharatpokhari Dihi Gaon	<ul style="list-style-type: none"> easy availability of chilli in market lack of interest
Brinjal Kalo Chhoto (Black Short)	endangered	Bharatpokhari	<ul style="list-style-type: none"> easy availability of other vegetables lack of interest
Tomato A landrace	endangered	Bharatpokhari	<ul style="list-style-type: none"> commercialization of tomato availability of superior varieties
Broad Leaf Mustard Kalo Pate Rayo	endangered	Khari Kuna, Dihi Gaon	<ul style="list-style-type: none"> availability of improved seed in market increased frequency of hailstone
Radish Seto Mula (White)	endangered	Khari Kuna, Dihi Gaon	<ul style="list-style-type: none"> availability of improved seed in market increased frequency of hailstone decreasing trend to save seed



Some Indigenous Vegetables
in Seti River Valley,
Pokhara, Nepal



Seto Lamo Sanke Gourd



Hariyo Lamo Sponge Gourd



Hariyo Chhoto Sponge Gourd



Pokhara Lurki, Brinjal

Some Indigenous Vegetables
in Seti River Valley,
Pokhara, Nepal



Hariyo Lamo Bitter Gourd



Seto Chhoto Bitter Gourd



Seto Lamo Bitter Gourd



Malepatan Local - Cucumber

LOCAL INITIATIVES FOR BIODIVERSITY, RESEARCH AND DEVELOPMENT (LI-BIRD)

INTRODUCTION

Local Initiatives for Biodiversity, Research and Development (LI-BIRD) is a non governmental organisation (NGO) established in October 1995. It is committed to capitalise on local initiatives for sustainable management of renewable natural resources and improve livelihood of people in Nepal. LI-BIRD strives to develop and maintain active links with local, national and international institutions in achieving its objectives. Governed by Executive Board and managed by executive Director, LI-BIRD has a team of well experienced and competent professional and support staff of various disciplines namely, natural resource management, biodiversity, in-situ conservation, communication, extension, marketing, gender, socio-economics, social anthropology, environment, livelihood strategy analysis, GIS etc. Currently, LI-BIRD has a total of 58 staff working in its various projects.

OBJECTIVES

- To capitalise on local initiatives in the conservation and utilisation of biodiversity for sustainable development through participatory research and development programmes.
- To improve the quality of life of the resource poor through income generating activities and increased food security with an emphasis on equity, gender and environmental issues.
- To create awareness, influence policy interventions and strengthen networking on the conservation and utilisation of biodiversity in Nepal.
- To provide training and professional services to the actors and involved in the area of biodiversity, research and development.
- To engage in social and welfare services of the socially and economically disadvantaged members of the community.

FOCUS AREAS

In pursuit of its objectives, LI-BIRD:

- conducts action, system-oriented and policy research;
- implements demonstrative and income generating development activities;
- offers training for professionals/practitioners and farmers;
- provides support services, including consultancy;
- engages in Social Welfare Services for socio-economically disadvantaged individuals; and
- advocates on the policy issues related to biodiversity, and participatory research and development.

COLLABORATIONS

Since its inception, LI-BIRD has completed 11 projects, and is, currently, undertaking 15 research and development projects in 16 hill and terai districts of Nepal. These projects are supported by DFID/UK; IPGRI/Rome; SWP PRGA/CIAT; DANIDA, GARDP-II/EU; CARE/Nepal, PLAN International/Nepal; and IDRC Regional Office/India and are implemented in partnership and collaboration with farming communities; CBOs; NARC; DOAD; CARE Mahotari and Syangja; PLAN International Morang; PSP/NRSP, UK; CAZS; School of Agricultural and Forest Sciences; University of Wales, UK; Institute of Terrestrial Ecology, UK; and IPGRI, Rome. LI-BIRD is constantly looking for further collaboration with institutions of similar interests.