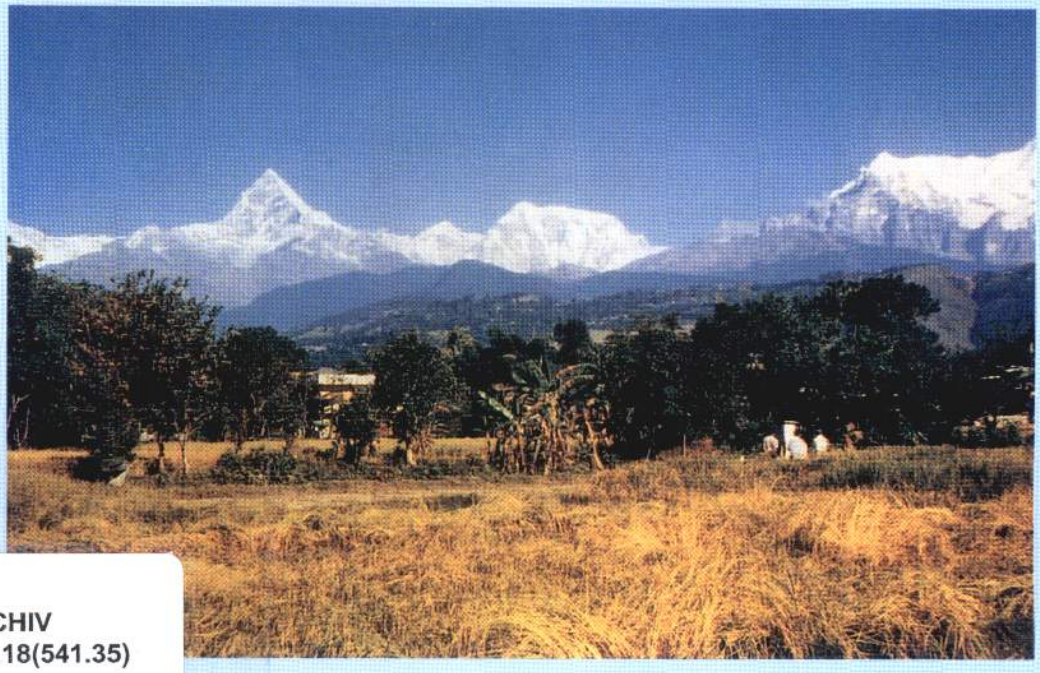
LI-BIRD Technical Paper No.: 2 ISSN 1561-1558

LI-BIRD

Inventory of Indigenous Rainfed and Aromatic Rice Landraces in Seti River Valley, Pokhara, Nepal

DK Rijal, KB Kadayat,
KD Joshi and BR Sthapit



Inventory of Indigenous Rainfed and Aromatic Rice Landraces in Seti River Valley, Pokhara, Nepal

DK Rijal, KB Kadayat,
KD Joshi and BR Sthapit

LI-BIRD Technical Paper No.: 2

LI-BIRD

Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
December 1998

Citation

Rijal, D.K., K.B. Kadayat, K.D. Joshi and B.R. Sthapit (1998). Inventory of Indigenous Rainfed and Aromatic Rice Landraces in Seti River Valley Pokhara, Nepal. *LI-BIRD Technical Paper No. 2.* Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal.

LI-BIRD Technical Paper No. 2

Published by

Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
P.O. Box – 324
Pokhara, Nepal
Telephone/Fax: 00977-61-26834
E-mail : libird@mos.com.np; libird@vishnu.ccsl.com.np
Internet: www.panasia.org.sg/nepalnet/libird

First Edition: December, 1998

Type setting at
LI-BIRD Publications Unit

This paper has been reviewed by Dr Ramanatha Rao and Dr Eero Nissila (IPGRI), Dr Anil Subedi and Mr R. B. Rana (LI-BIRD)

Financial support for this publication was granted by International Plant Genetic Resources Institute (IPGRI), Rome, Italy, through the Regional Office for Asia, the Pacific and Oceania (APO), Malaysia.

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 and learning about local genetic resources and knowledge as well as socio-cultural factors associated 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 contribute 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 report has focussed on local rainfed and aromatic rice landraces found in Seti River Valley of Pokhara, Nepal. The findings of the study have shown that farmers are growing a wide range of rice landraces for a number of socio-cultural, economic and environmental reasons. However, diversity in rice landraces is decreasing as new options are available or if efforts are geared towards new developmental interventions. This draws the attention that as the valuable genetic materials are gradually eroded, efforts are needed to conserve the existing ones thorough different breeding and non-breeding approaches for future utilization.

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.

Anil Subedi, PhD
Executive Director

December 1998

Acronyms and Abbreviations

FGD	Focus Group Discussion
IDRC	International Development Research Center
INGO	International Non-Governmental Organization
IRRI	International Rice Research Institute
LI-BIRD	Local Initiatives for Bio-diversity, Research and Development
NGO	Non-Governmental Organization
PRA	Participatory Rural Appraisal
SRV	Seti River Valley

Table of Contents

SUMMARY

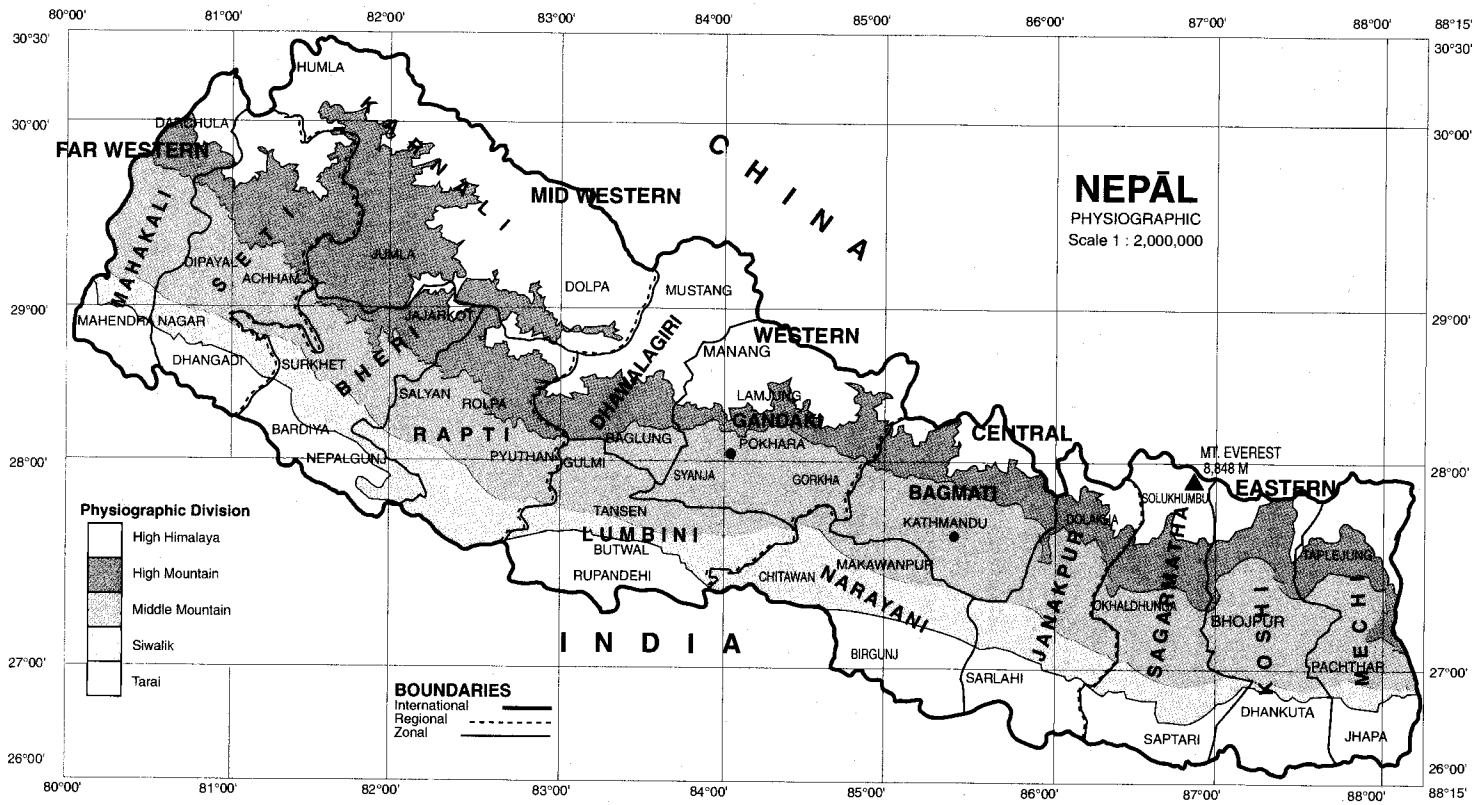
This paper describes the rice growing environments and status of indigenous rainfed and aromatic rice landraces in Pokhara Valley of Nepal. Rice is grown as staple and cash crop in the study area. More than 75 landraces have been reported by the farmers, of which only 11 are popular, area under 47 landraces is decreasing over the years while 17 have already been lost from the valley. Landraces diversity as recalled by farmers ranged from 5 to 24 over sites however, the number at present ranged from 4 to 16. Study revealed that farmers grow four types of rice; coarse (26), fine (13), fine aromatic (12) and coarse aromatic (2). A range of landraces are grown for different purposes such as home use (38), festivals (18), selling (14), guests (12), medicine (7) and for other uses such as preparing breakfast foods as *siraula, latte, bhujiya* (14). Farmers have identified landraces suitable for favorable (14), stressed (23) environment and for wider adaptation (12). Farmers consider a number of parameters to evaluate landraces and present study has documented 16 such criteria. Grain and straw yields are found to be the major criteria, however, farmers modify selection criteria depending upon the production objectives.

The study indicated that landraces have not yet received proper attention for their promotion and conservation at local or national level. The potential danger of genetic erosion of those valuable resources could have far reaching consequences in future food security issue. Therefore, alternative options to tackle the problem have been suggested. Seeds of the landraces have been collected for their promotion and conservation.

***Key words**: Diversity, Environment, Aromatic rice, Landraces, Seti River Valley (SRV), Farmers*

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 Km^2. Nepal is divided into five physiographic regions viz. *Terai*, Siwalik, Middle Mountain, High Mountain and High Himalayas (Figure 1). Nepal is rich in genetic diversity of crop, vegetable, fruit, medicinal, ornamental and wild plant species because of diverse agro-ecological and extreme socioeconomic variations. Shrestha (1996) reported that Nepal covers about 0.1% of the world's land area whereas it houses over 2% of the world's natural flowering plants and 4% of the vertebrate species. This enormous biodiversity is quite significant for a small country like Nepal. It is estimated that more than 7000


NEPĀL
PHYSIOGRAPHIC
Scale 1 : 2,000,000
CHINA
INDIA
FAR WESTERN
MID WESTERN
WESTERN
CENTRAL
EASTERN
MAHAKALI
SETI
KARNALI
BHERI
RAPTI
DHAWALAGIRI
GANDAKI
LUMBINI
NARAYANI
BAGMATI
JANAKPUR
SAGARMATHA
KOSHI
MECHI
HUMLA
DARCHULA
DIPAYAL
ACHHAM
JUMLA
DOLPA
MUSTANG
MAHENDRA NAGAR
JAJARKOT
DHANGADI
SURKHET
MANANG
SALYAN
ROLPA
LAMJUNG
BARDIYA
BAGLUNG
POKHARA
NEPALGUNJ
PYUTHAN
GULMI
SYANJA
GORKHA
TANSEN
BUTWAL
KATHMANDU
RUPANDEHI
CHITAWAN
MAKAWANPUR
BIRGUNJ
SARLAHI
DOLAKHA
SOLUKHUMBU
MT. EVEREST
8,848 M
OKHALDHUNGA
BHOJPUR
TAPLEJUNG
PACHTHAR
DHANKUTA
SAPTARI
JHAPA
Physiographic Division
High Himalaya
High Mountain
Middle Mountain
Siwalik
Tarai
BOUNDARIES
International
Regional
Zonal
80°00'
81°00'
82°00'
83°00'
84°00'
85°00'
86°00'
87°00'
88°00'
88°15'
30°30'
30°00'
29°00'
28°00'
27°00'
26°00'

species of flowering plants are growing in the country and 79% of them have been collected, identified and preserved in the National Herbarium and Plant Laboratories, Godawari (NAA, 1995).

Nepal is rich in the diversity on both cultivated and wild relatives of rice. It is estimated that about 2000 different landraces[1] of rice exist in Nepal (Gupta *et al.*, 1996). This appreciable variation of landraces which are grown under both favorable and marginal environments have contributed to total food security. Rice is the most preferred food crop in Nepal, and is grown on 60% of the total cultivated land and contributes 52% of the total grain production of the country. It dominates the agricultural sector, engaging over 75% of the working population. Nepal produces nearly 3.5 million mt of rice from 1.4 million hectares of land (CBS, 1995).

In Nepal, four types of rice cultures are prevalent based on moisture regime; low land irrigated; low land partially irrigated/rainfed upland; and deep water. The replacement or erosion of low yielding crop varieties with high yielding modern ones is a common phenomenon for almost all the crops. However, quality rice varieties are more vulnerable to this process. Therefore, the dynamics of any crop needs to be understood prior to initiating any on-farm conservation and utilization programs.

Aromatic (*Basmati*) rice comprise of a group of rice varieties which emit aroma on cooking with excellent cooking and eating (softness) qualities. The aromatic rice is very popular in both domestic and international markets and fetches premium price. Giri and Shahi (1978) reported that Nepal used to export about 200 metric tons of fine quality aromatic rice per annum earning about 41million rupees at 1977 price. Nepal stopped exporting rice and there is an increasing evidence of importation of aromatic rices from India.

Partially irrigated/rainfed rice pre-dominates the rice production area in the country. This environment is prevalent in all the physiographic regions where a range of landraces are cultivated. Therefore, the environment is important in terms of production, varietal diversity and its magnitude.

Seti River Valley (SRV) has diverse and complex environments such as irrigated, water logged marshy land, partially irrigated/rainfed and upland. Moreover, source of irrigation water used in the area is also variable. Both the factors promote landraces

[1] Landraces are the local highly diverse crop varieties developed in traditional locally adapted agricultural systems by human and selected for long period of time (Glowka *et al;* 1994). Landraces are at least partly shaped by what may be referred to as the informal plant breeding and seed production and supply systems (Guarino, 1995)

diversity in the valley. Joshi *et al.;* (1997) reported that genetic erosion of low yielding but high quality scented rice is already taking place in Pokhara Valley and these landraces are not easily available to local farmers from *ex situ* conservation in International Rice Research Institute (IRRI) or Japan. Detail study of landraces as well as the indigenous knowledge base of the farmers, collection and promotion mechanism of aromatic and rainfed rice landraces is essential before these materials and associated information erode from the system. Therefore, there is a strong case to study the situation of rice genetic resources in the SRV.

An agreement was signed between Local Initiatives for Biodiversity, Research and Development (LI-BIRD) based in Pokhara, Nepal and International Development Research Center (IDRC), Canada for implementing one year study on "Inventory of Indigenous Rainfed and Aromatic Rice Landraces in Seti River Valley Pokhara, Nepal". The paper presents the findings of the study, and suggests ways forward.

OBJECTIVES OF THE PROJECT

- To identify the pockets with high varietal diversity and threatened landraces
- To document the diversity and value of rice genetic resources and indigenous knowledge associated with rice production systems at community level within the study area.
- To collect seeds of landraces for conservation and promotion purposes.

METHODOLOGY

An exploratory visit by a multidisciplinary team was conducted in the SRV to identify study sites. Sites were identified so as to fulfill the requirements as stated under objective above. Following the site selection, the study was conducted using PRA tools and techniques as follows:

- Interviews with the key informants as well as individual farmers using checklist.
- Focus Group Discussions (FGD) with farmers groups.
- Transect walk within and across the villages.

- Personal observation by the researchers in standing rice crop and collection of landraces seeds at maturity stage.
- Study of ethno-history and time line for some specific rice landraces.

Experience of LI-BIRD professionals in Western Nepal has been an added advantage to critically examine the issues raised during the discussion. Information collected from the field were scrutinized and entered onto computer and analyzed using SPSS software package.

Seeds of landraces were also collected during the study for future use.

Description of the study area

The main valley of Seti River; Pokhara is described as an ancient river terrace composed of calcareous, gravely, fluvial deposits. These deposits, the result of a glacial dam outburst flood which occurred more than 600 years ago, are different to most river deposits in the area and support a wide range of crops. SRV occupies an area of 625 km^2 with an annual rainfall of 3500 to 4500 mm. Summer is warm with high rainfall but winters are drier and cold. Mean air temperature from April to October is recorded above 20 ^{0}C.

SRV areas are very much diverse in terms of farming systems, cropping practices, species richness, technology intervention specially on rice. Broadly, following factors were considered while selecting the study sites:

- Rice diversity and its production environments
- Availability of high quality rice landraces
- Reported genetic erosion
- Limited promotion of local high quality rice

Based on the above criteria, a total of 12 representative sites namely, Hyamja, Chaurasi Biruwa Phant, Armale Thulibesi Phant, Pamephant, Thula Khet, Arba Phant, Kundhar *P*hant, Kharane Phant, Bijaypur Phant, Rupatal Phant, Begnastal Besi Phant, Deepang-Maidi Phant , Shyang Khudi Phant and Majhthana were selected for the study purpose (Figure 2). Plates 1-3 present the glimpse of SRV, diversity in rice growing environments and rice landraces.

FINDINGS AND DISCUSSION

Status of rice landraces and varieties in SRV

Landraces in the study have been considered as described by Glowa *et al* (1994) and Guari -no (1996). For the purpose of this study, the situation of landraces is categorized as commonly and widely grown, those under threat and disappeared ones from the study area. Study findings showed that there were 75 landraces and 14 modern varieties grown by farmers over time (Appendix I). Out of 75 landraces only, 15% are most common and widely grown at present. About 62% of the them still exist but are under threat as the area coverage under these landraces across sites is decreasing whereas 23% have been reported to be lost/disappeared from the SRV over time (Figure 3).

Farmers are aware that the improved varieties are introduced through various sources including Government (Agriculture Development Offices) and Non-Governmental organizations (INGOs). The history for modern varieties is recorded. However, the written record for landraces is not traditionally maintained. The landraces have been grown since time immemorial but farmers could not exactly recall since when the

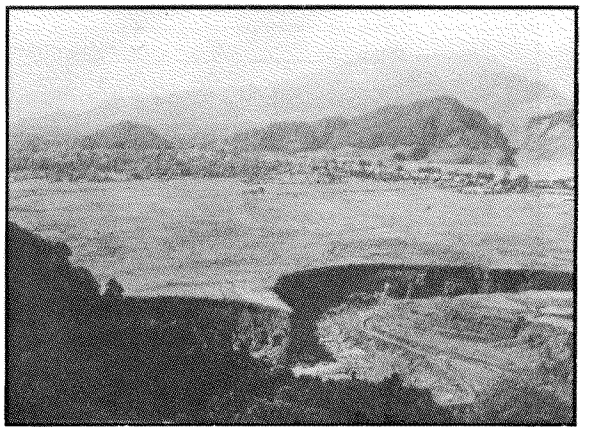


Plate 1: A glimpse of Seti River Valley, Pokhara.

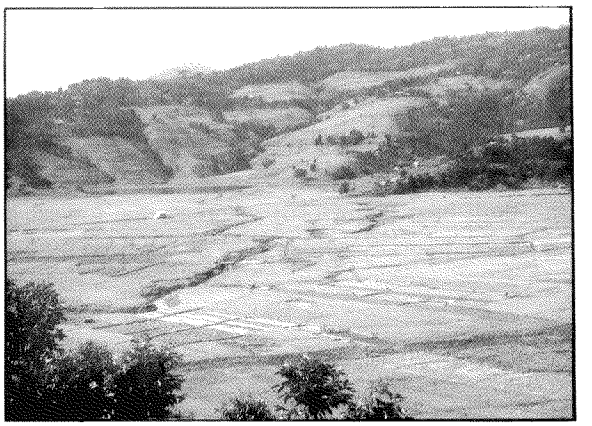


Plate 2: Diversity in maturity for indigenous rice landraces in Seti River Valley.

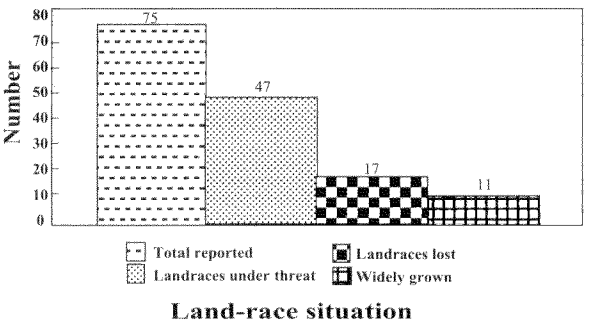


Figure 3 Stuation of Land-races in Seti River Valley.

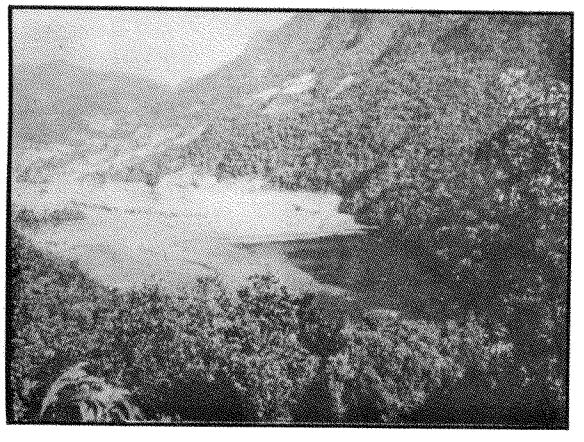
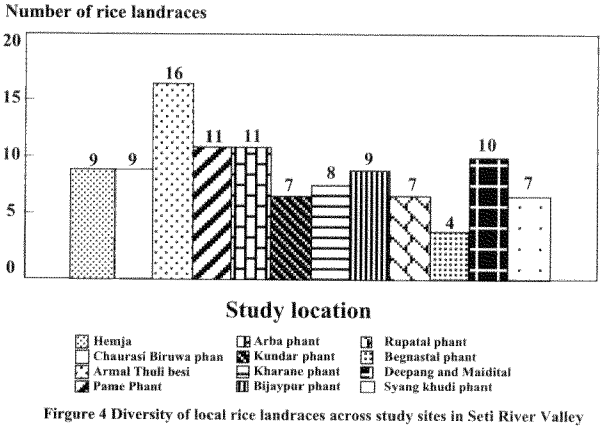


Plate 3: Lake environment; great diversity in growing condition and rice landraces.

landraces have been grown in the area. Farmers reported that most of the land-race are endemic to the area while a few landraces might have been introduced through relatives, visitors, neighbors and the people migrated from other places.

Rice diversity across study sites in SRV

Diversity analysis was done to understand and compare the landraces diversity across sites. Landraces situation across sites is presented in Appendix II. Highest varietal diversity was recorded at ArmaleThulibesi Phant followed by Pame Phant, Arba Phant and Deepang-Maidi Phant, whereas the lowest diversity was reported by farmers from Begnas area. The current landraces diversity is reported to be the highest from Armale thuli besi Phant (16) whereas, the lowest diversity is from Begnastal besi phant (4). Rice diversity across sites as reported by farmers is presented in Figure 4.



Firgure 4 Diversity of local rice landraces across study sites in Seti River Valley

Table 1 indicates that landraces are mostly grown for their quality traits. These landraces were still reported to have low yielding potential, more susceptible to insects attack and prone to lodging. However, popular landraces of one area do not exist on the other sites.

Coarser grain landraces e.g. *Tauli* is being replaced by other medium grain improved or local landraces. Rice diversity changes with farmers' needs and preferences which are influenced by local market, grain and straw yield.

Table 1: List of local landraces grown widely by farmers of the study sites in SRV

Rice	STUDY SITES											
Landraces	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Jethobudho	√	√	√	√	√	√	√	√			√	√
Gurdi	√	√		√	√	√	√	√			√	√
Aanadi		√	√	√	√	√		√	√	√		√
Panhele		√	√	√	√	√	√	√	√		√	
Gauria		√	√		√	√		√			√	√
Biramphool		√	√		√		√	√		√		
Ramani	√			√	√			√			√	√
Mansara	√							√	√		√	
Aanpjhutte			√		√			√				
Jerneli			√						√			√
Khalte kholo	√	√				√						
Total	5	7	7	5	8	6	4	9	4	2	6	6

Note: 1=Hyamja, 2= Chaurasi Biruwa phant, 3= Armale Thulibesi Phant, 4=Pamephant and thula khet, 5= Arba phant, 6= Kundhar phant, 7= Kharane phant, 8= Bijaypur phant, 9= Rupatal phant, 10=Begnastal Besi Phant, 11= Deepang and maidi phant and Shyang khudi phant, Majhthana

√Indicates where the respective landraces are grown

Table 2 indicates that a set of landraces have been reported just from one or two sites and areas under those landraces are dwindling. These set of landraces is termed as landraces "under threat" hereafter.

Farmers test, verify or evaluate new landraces to identify their suitability. Farmers discard landraces for different reasons. The reasons for disliking are presented in Appendices II and VII. Farmers' reasons for rejection of landraces were due to low yield potential along with the introduction of HYVs. Unlike locals, many improved varieties lack yield stability. However, no improved rices substitute local landraces for their special traits like aroma, grain and straw, and wider adaptation to local environment. For example, *Jethobudho, Panhele* and *Aanadi*, both fine as well as aromatic rices which fetch premium price in Pokhara *Bazaar*, can hardly be replaced by any improved varieties including Masuli (Joshi *et al.*, 1997).

Table 2: Landraces under threat by study sites in SRV

	STUDY SITES											
Landraces	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Kathe marsi	√		√									
Gudura	√			√								
Aanga	√											
Jadan	√			√								
Gorkhali			√									
Achhame masino		√				√						
Dudhe marsi		√										
Mananuri					√							
Jhinuwa					√							
Pakhe jhinuwa			√	√								
Seto gurdi			√									
Lamjunge			√									
Kali gurdi			√									
Bange jhinuwa			√									
Juwari			√									
Pakhe silange				√								
Kathe silange				√								
Gola				√								
Pokhreli jhinuwa				√								
Tunde					√							
Tulsi							√					
Samundra-phinj											√	
Madishe									√			
Masino									√			
Thulo madishe									√	√		
Sano madishe										√		
Jhinuwa												√
Naulo madishe										√		
Khure ramani											√	
Naltumme												√

Note: *Hyamja*, 2= Chaurasi Biruwa phant, 3= Armale Thulibesi Phant, 4=Pamephant and Thula Khet, 5= Arba Phant, 6= Kundhar Phant, 7= Kharane Phant, 8= Bijaypur Phant, 9= Rupatal Phant, 10=Begnastal Besi Phant, 11= Deepang and Maidi Phant and Shyang Khudi Phant, Majhthana

✓ *Indicates where the respective landraces are grown*

HYV's introduction in replacing landraces can not be overlooked. Farmers reported more than 14 introduced improved varieties being grown across the study sites. Varieties such as Mansuli, Radha 7, Khumal 4 and NR10163 are liked by farmers for

their desirable traits. As a result some of the landraces have been replaced. However, janaki, K39 and Radha 9 are likely to be discontinued for their less desirable traits such as low yield and narrow range of adaptation. Morevoer, Laxmi, an improved high yielding variety with good taste introduced several years ago in SRV was disliked by Begnas farmers for its threshing difficulty and short and low straw yield.

Influence of growing environment on rice landraces diversity

Discussions with farmers at different study sites revealed that apart from farmers' own preferences, growing environment plays a major role in determining landrace diversity (Figure 5).

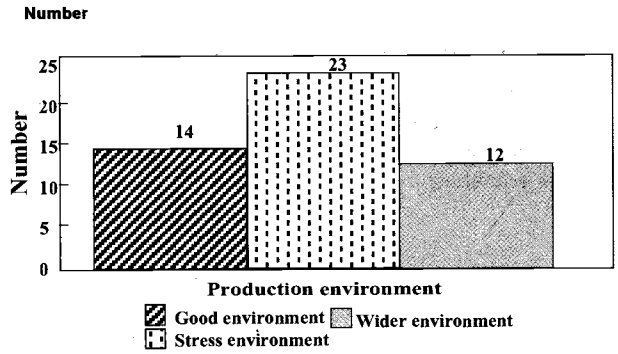


Figure 5 Suitability of landraces across environment.

Discussions with farmers on environments for Farm inventory of the local landraces indicated that land type, fertility, moisture regimes and source of irrigation water (cold and warm water) are the most important factors affecting varietal adaptation. For example, greater diversity was reported under stressed environment as against favorable environment, if the repetition of landraces is ignored (Table 3). Farmers' perception was that temperature of irrigation water also influences the varietal adaptation. *Jethobudho* which tolerates relatively more cooler water as compared to *Panhele* (which requires warmer temperature) therefore, is more popular in flat plains. Further more, some are affected due to changes in their habitats. The existence of *Samundraphinj* (grown in swampy land) is decreasing as its suitable habitat has decreased over time. A higher sterility is also observed when grown in other than its suitable habitat. It simply indicates that some landraces have been lost and some are under threat for one or other reason.

Irrespective of fertility status, there is a greater divesity under rainfed (28) against irrigated conditions (18). This indicates that moisture regime has greater influence in determining the varietal diversity of rice. Rice grown in upland conditions were found to be all local landraces suggesting that these are better adapted to stress environment. However, irrigation facility is improving for traditionally upland areas, as a result, farmers are looking for suitable varieties for irrigated conditions ultimately threatening the existence of rainfed rice landraces due to change in their habitats.

Table 3: Distribution of rice landraces as influenced by growing environment

Favorable environment[2]	Stress environment[3]	Wider adaptation
1. Aanadi	1. Aanga	1. Aanp jhutte
2. Bayarni	2. Andheri	2. Gauria
3. Jhinuwa	3. Bange jhinuwa	3. Gorkhali
4. Khalte kholo	4. Chhote	4. Gurdi
5. Ramani	5. Darmali	5. Jetho budho
6. Jerneli	6. Dudhe juwari	6. Manamuri
7. Kalo gurdi	7. Dudhe marshi	7. Mansara
8. Panhele	8. Germani	8. Marshi
9. Achame masino	9. Golaya	9. Pakhe jhinuwa
10. Samundra phinj	10. Golaya tauli	10. Sisuwa panhele
11. Gola	11. Gudura masino	11. Tauli
12. Silange phant	12. Jhauri	12. Thulo madishe
13. Jadan	13. Jhutte juwari	
14. Khasreni	14. Juwari	
	15. Kathe juwari	
	16. Kathe marashi	
	17. Koili	
	18. Lamjunge	
	19. Naltumme	
	20. Pakhe jerneli	
	21. Seto thakale	
	22. Silange pakhe	
	23. Thimaha	

Influence of socioeconomic factors on rice landraces diversity

Although varietal adaptation is determined by the environmental factors, socioeconomic factors influence household decision making process that determine the number and area coverage of different varieties.

Food security issue at household level and market opportunities also affect the type of variety to be grown. Regardless of the socioeconomic categories, *Jethobudho* and *Pahele* are extensively grown by the farmers specifically for selling purposes as both of them fetch premium price in the domestic market. It was interesting to note that even food deficit households grow high quality rices for selling purpose, and in return purchase medium quality cheaper rice from the market to meet their food requirement.

[2] Defined as irrigated fertile low land
[3] Defined as partially irrigated or rainfed with low fertility status

Since rice is native of the region, communities were found to be rich in utilization aspect of the rice landraces. The study documented six different types of utility including home consumption, selling, festival, guest, medicine and other uses (Figure 6). However, there are landraces which have multiple qualities in them and are more preferred over landraces with narrow range of traits. *Panhele, Jethobudho* and *Gurdi* for example, are widely grown as they are commonly used for almost all the purposes except for medicine. *Samundraphinj, Aanga* and *Koili* are mainly grown for home consumption. This strongly indicates that farmers grow different landraces for a range of objectives from cash earning to medicinal values.

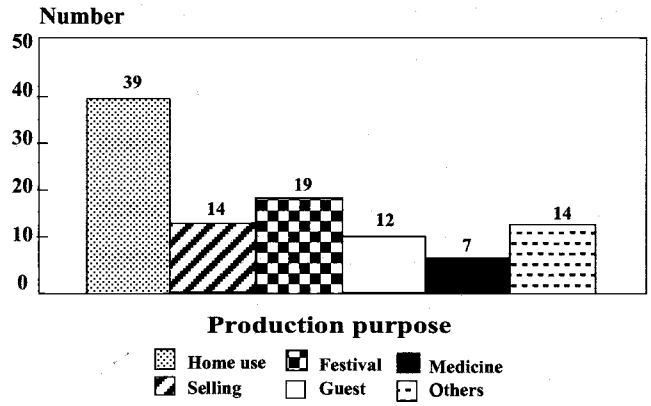


Figure 6 Farmers' reasons for growing local landraces in Seti River Valley.

In addition, farmers' needs and preferences are variable which also contribute to maintaining varietal diversity on-farm. Furthermore, study has indicated that farmers grow different landraces to serve specific requirements as indicated in Table 4.

Table 4: Varietal diversity as influenced by socioeconomic factors

Home use	Selling	Festival	Guest	Medicine	Others[4]
Jetho budho	Jetho budho	Jetho budho	Jetho budho	Aanadi	Aanadi
Gurdi	Panheli	Panheli	Panheli	Andheri	Jethobudho
Gauria	Gauria	Gauria	Ramani	Aanadi rato	Jerneli
Panhele	Ramani	Biramphool	Biramphool	Bayarni	Silange pakhe
Mansara	Biramphool	Achhame masino	Gauria	Panheli	Panheli
Biramphool	Achhame masino	Ramani	Gurdi	Ramni	Gauria
Ramani	Jhinuwa	Jhinuwa	Achame masino	Aanpjhutte	Madishe
Tauli chinia	Bayarni	Bayarni	Jhinuwa		Andheri
Khalte kholo	Aanadi	Gurdi	Bayarni		Gudura masino
Aanp jhutte	Khalte kholo	Khalte kholo	Masino		Gurdi
Jadan	Pakhe jhinuwa	Mansara	Kathe marsi		Jadan
Jhutte juwari	Mansara	Masino	Bayarni jhinuwa		Juwari
Aanadi	Gurdi	Pakhe jhinuwa			Khalte kholo
Gurdi kalo	Chhote	Tauli			Tauli chinia
Gurdi seto		Juwari			
Thimaha		Jhauri			
Tunde		Jerneli			
Pakhe jhinuwa		Bayarni jhinuwa			
Kathe marsi					
Juwari					
Jerneli					
Gorkhali					
Achhame masino					
Aanga					
Andheri					
Bayarni					
Gudura masino					
Jhauri					
Lamjunge					
Silange phante					
Seto thakale					
Samundraphinj					
Naltumme					
Koili					
Kathe juwari					
Dudhe juwari					
Budho thakale					
Chhote					

FARMERS INDIGENOUS KNOWLEDGE ASSOCIATED WITH RICE LANDRACES IN SRV

In the subsistence agriculture it is equally important to understand the farmers' cultivation practices associated with any specific crops. This study tried to document

[4] For making beaten rice (*Chiura*), puffed rice (*Bhujia*) and other special preparations (*Latte, Siroula*) and for physical workers i.e. different types of preparations.

the major practices employed for rice, categorization of landraces, utility of landraces developed by the communities over time and farmers' selection parameters for the rice crop.

Farmers' categorization of landraces by grain type and aroma

The study found that farmers categorize landraces on the basis of grain type and aroma into four distinct groups these are: coarse grain, fine grain, fine aromatic and coarse aromatic[5]. Results indicated that 48% of the total landraces were coarse type, 24% fine type, 23% fine aromatic while only 5% landraces had coarse with aromatic properties (Appendix 3, Figure 7). The subsistence farmers in particular who grow rice in both the seasons, select and grow coarse grain landraces for home consumption, that last relatively longer (*Aadilo*). However, fine aromatic rices are common among well-to-do farmers. A progressive farmer, *Zamdar Baa*, from Begnas reported that rice produced from early season (medium coarse grain types) is enough for home consumption. And the main season rices is sold that give higher economic return. This indicates that rice landraces differ according to the farmers' need and choices for which they have been growing.

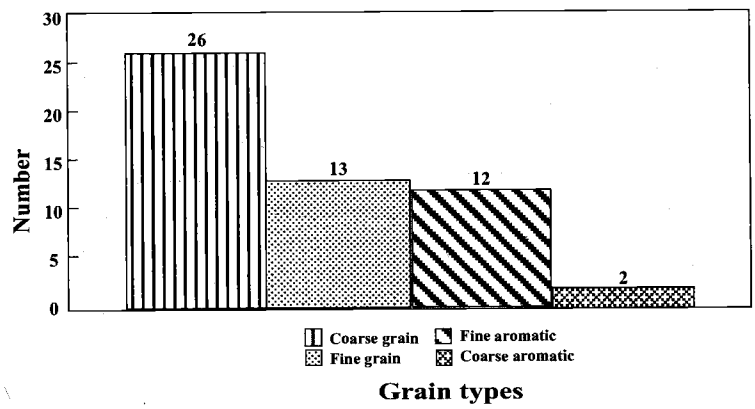


Figure 7 Landraces categories by grain characteristics.

Farmers perceive that the rice aroma is a relative term. It was interesting to note that one can realize aroma when aromatic rice is consumed for the first time. However, the degree of aroma decreases if consumed the same rice on a regular basis. Farmers expressed that the aroma decreases when an aromatic rice is grown with the application of chemical fertilisers.The application of home made compost is a must if the real aromatic rice is to be produced. Aroma in recently harvested rice is higher over old stock, and the degree of aroma decreases with storage over time. Aroma is

[5] Unlike IRRI's definition, fine grain in Nepalese context refers to small grains that expand and become soft on cooking.

also dependent upon how the rice is milled. Aroma of rice milled with local *Dhiki*[6] is higher as compared to milled in a rice huller.

Farmers at Begnas reported that fine and aromatic rices are prone to many risk factors such as insect, disease and environmental stresses over coarse and non-aromatic rices. Farmers experience shows that the quality of rice is superior when grown in irrigated low land as compared to swampy lands. Rice grown with water from natural spring have more softness than grown with Seti River water. This shows that rice quality is determined by many factors including management.

Farmers' selection parameters and their implication for rice diversity

Farmers use a number of parameters while assessing rice varieties. Farmers viewed that the adaptation of a cultivar in local environment is a must. A range of landraces were tested by farmers over time and many of them have been discarded for one or the other reasons. It was also learnt that landraces replacement was also taking place in the study area. Analysis of parameters that influence the disliking of landraces, it revealed that low grain yield was the major one (Appendix 6, Figure 8). Other important parameters include straw, problem of sterility, taste and lodging. Introduction of HYVs with desirable traits have also replaced some of the landraces with low yield and other inferior traits (Appendix 7). This is the reason why there is a wide diversity of landraces in the valley.

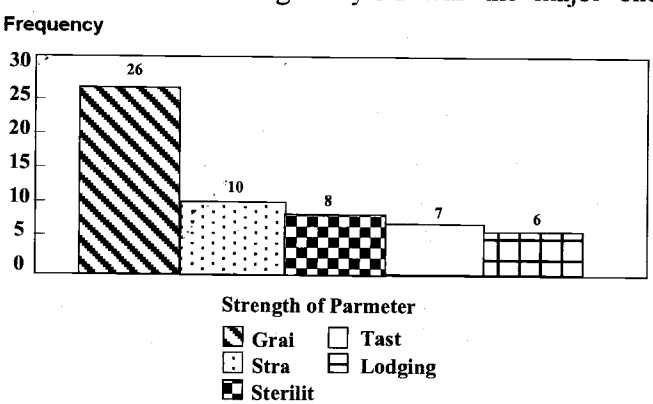


Figure 8 Strength of selection parameters in rice varieties

Selection parameters obtained from different sites were further verified with Begnas farmers in order to establish relative ratings. Farmers, in general, agreed that landraces are selected for their relative advantages and they were of the opinion that it is almost impossible to have single landrace that fulfils their needs. The selection criteria as ranked by Begnas farmers are as follows:

[6] Locally made rice poundering equipment made of either wood or stone.

1) biological yield (grain and straw),
2) market price
3) Insect, pest and diseases
4) postharvest traits (shattering, milling, taste, threshing etc.)
5) adaptation

The above evidence shows that farmers' selection parameters have direct bearing on the extent of varietal diversity. Farmers selection criteria in SRV have largely enhanced rice diversity even though a few landraces have been discontinued by the farmers with the availability of better options.

Crop husbandry practices and farm innovations for landraces

Rice in SRV is grown in rice-wheat, rice-potato, rice-vegetables or rice-fallow systems. In most cases rice is grown on residual fertility. However, top dressing with urea is also practised. During the study it was found that farmers explore a number of alternative innovations to maximise the farm production. A progressive farmer of Begnas, locally known as *Zamdar baa* had a piece of low land where rice did not grow well. To renovate this land, he tried several methods such as *Titepati* (*Artemisia vulgaris*), batteries and agricultural lime and found that the use of *Titepati* was most effective. Similarly, farmers have been trying different landraces in *Dhab*[7] area where no other landraces are adapted so far. However, they were unaware of *Samundraphinj*, a suitable landrace for swampy and submerged conditions although the landrace is being grown by a few other farmers nearby. This has raised an important issue of information gap among the farming communities and there is a need for outside intervention to mitigate such issues.

SIGNIFICANCE OF RICE DIVERSITY AS PERCEIVED BY FARMERS

The issue of importance of rice diversity for present and future use was discussed with the local community. Farmers have not really thought of how landraces should be utilized and conserved for future generation. Farmers believe that varieties should be changed after certain period of time but should not be lost for ever. Farmers were found aware of the importance of local practices and knowledge which are more useful and needs continuation for the longer term. But, they admitted that these practices/techniques are under threat and are likely to be replaced by so-called improved ones. However, they were more interested to resolve existing problems rather than conserving for the future. Similarly, no landraces are grown for their conservation

[7]Swampy and submerged low land

point of view but those landraces that meet farmers' requirements get automatically conserved in the system. More over, it was argued that landraces conservation on-farm is difficult if not impossible, provided a well-defined mechanism is developed.

GERMPLASM COLLECTION

One of the objectives of the study was to collect germplasm of landraces for their promotion and conservation purposes. Seeds of 75 rice landraces from various sites within SRV were collected at the time of harvest. The inventory of these landraces with the name and address are recorded. The germplasm could be utilized for different purposes. For example, inclusion in breeding program, re-introduction to specific growing environment, participatory variety selection and also for *ex-citu* conservation.

CONCLUSION

The study has documented very interesting and important findings regarding the status of rainfed and aromatic rice landraces. There is a great wealth of rice diversity in SRV. Diversity of landraces is basically maintained by farmers to suit their growing environments as well as to meet their multiple usage. To find perfect landraces that suit local environment as well as fulfill farmers' needs is very difficult therefore, farmers test and evaluate them to identify suitable landraces. As a result farmers have identified many landraces suitable for specific or general purposes as they required. This has ultimately helped conserve landraces on-farm.

Study revealed a wealth of indigenous knowledge associated with rice production and their utilization in SRV. It was found that the socioeconomic factors such as food sufficiency level, market opportunity and rice utilities have influence on household decision for maintaining rice landraces. The fine and aromatic rices are primarily grown for cash income as they fetch premium price in the domestic market. The demand for quality rice in Pokhara Valley and elsewhere in the country is increasing. Likewise, medium to coarse grain types are largely grown for home consumption. In this context, the Rice Research Program should take into account these information while setting breeding strategies.

AREAS FOR FUTURE WORK

- Results suggest that many landraces are under threat and are likely to disappear from the Pokhara Valley. Therefore, the conservation of these landraces specially that are under threat is urgently needed. To promote and conserve these landraces on-farm, a strong and wider networking is required among the concerned institutions at local, regional, national and international levels.

- A number of landraces have been reported to be under threat due to changes in their habitats, introduction of high yielding improved varieties and changes in farmers' priorities over time. Possible ways to address this issue would be to locate similar habitats elsewhere in the country and explore the possibilities of rejuvenating such landraces through introduction. Similarly, monitoring of farmers' priorities and consumers' preferences periodically would probably serve the basis for promoting particular landrace.

- In general, most landraces as reported threatened by the farmers, have good quality traits but lack high production potential. So far no systematic studies have been done to understand their desirable as well as undesirable traits. The first step towards conserving these landraces is their collection, participatory evaluation and identification of farmers' preferred traits. The only way to conserve valuable genetic resources on-farm is to initiate the participatory plant breeding.

- Conservation through market promotion is one of the most attractive options for involving farming communities into on-farm management of agrobiodiversity. Many rice landraces grown in SRV have been found very good source of cash income. Market network is already established for few popular landraces (e.g. *Panhele, Jethobudho*) but is limited to a few major cities. Similarly, there are number of other landraces which also have better quality traits but their potentialities are yet to be exploited. Basically, there are two important issues. Firstly, expanding market for landraces which have already established network and secondly, the promotion of potential landraces in the market that offer better choices to the consumers.

ACKNOWLEDGMENTS

This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada. Farmers of the Seti River Valley who generously provided information, helped in the study and provided seeds of the landraces are duly acknowledged. We are thankful to Drs Ramanatha Rao and Eero Nissila of IPGRI, Dr Anil Subedi and Mr Ram B. Rana of LI-BIRD for their critical comments and suggestions on earlier this paper. We thank Ramesh Shrestha of LI-BIRD for his support.

REFERENCES

CBS (1995). *Central Bureau of Statistics*, National Planning Commission Secretariat, HMG/ Nepal.

Giri, T.P. and Shahi, B.B. (1978). *Performance of Aromatic Rice Varieties in Nepal.* Proceeding of the 5th Rice Improvement Workshop 1977, NRIP, 27 February - 2 Mar 1978. Parwanipur, Bara, Nepal.

Glowka, L., Burhenne-Guilmin, F., Synge, H., McNeely, J.A. and Gundling L. (1994). A Guide to the convention on Biological Diversity. IUCN Gland and Cambridge. xii+161 pp.

Guari, L. (1995). Secondary sources on cultures and indigenous knowledge systems. In collecting Plant Genetic Diversity, Technical Guidelines. (Eds Luigi Guarino, V. Ramnath Rao and Robert, Reid). IPGRI, FAO, UNEP, IUCN, CAB International. pp 195-228.

Gupta, S.R., Upadhyay, M.P. and Katsumoto, T. (1996). Status of Plant Genetic Resources in Nepal. Paper presented at the 19th Summer Crops Workshop, held at National Rice Research Programme, Parwanipur, Bara, Nepal from 27-29 February, 1996.

Joshi, K.D., Subedi, M., Kadayat, K.B. and Sthapit, B.R. (1996). *Genetic Diversity and Erosion in Indigenous Arable Crops and Green Manuring Species in the Mountains of Nepal: Some Conservation Issues.* Paper Prepared for Managing Agricultural Biodiversity for Sustainable Mountain Agriculture: Issues and Experiences, Organised by LI-BIRD/ICIMOD/IPGRI at Urban Development Training Centre, Pokhara, Nepal, 15-16 March 1996.

Joshi, K.D., Sthapit, B.R., Vaidya. A., Kadayat, K.B., Tuladhar, J.K., Subedi, K.D. and Lohar, D.P. (1997). Report on Aromatic Rice Survey and RRA in Pokhara Valley of Nepal: Issues for Rice Research, *LARC Working paper no. 95*, Lumle Agricultural Research Centre, Kaski, Nepal.

NAA (1995). *Plant Genetic Resources Profile Study.* Nepal Agricultural Association, Kathmandu, Nepal

Sarkar, M.P., Sarkar, N.D., Dutt, J., Bramhacharya, R.L (1992). *A method to Synthesize the Aroma of Certain Varieties of Fragrant Indian rice.* IRRN, 17 (5):9.

Shrestha, T.B. (1996). *Biodiversity Conservation - a Key to Sustainable Human Development in Nepal*, IUCN, Kathmandu, Nepal.

Upadhyay, M.P. and Sthapit, B.R. (1995). *Plant Genetic Resource Conservation Programmes in Nepal: Some Proposals for Scientific Basis of In Situ Conservation of Agrobiodiversity.* Paper Presented at the Participants' Conference on *In Situ* Conservation of Agricultural Biodiversity, IPGRI Rome from 17-19 July 1995.

APPENDIX 1. Situation of landraces as reported by farmers in SRV

Widely grown landraces	Landraces under threat	Landraces lost over time
1. Jethobudho	1. Pakhe jhinuwa	1. Thimaha
2. Gurdi	2. Basaune jhinuwa	2. Tauli
3. Aanadi	3. Bayarni	3. Darmali
4. Panhele	4. Panhele jhinuwa	4. Germani
5. Gauria	5. Marshi	5. Koili
6. Biramphool	6. Gudura	6. Budho thakale
7. Ramani	7. Bardani	7. Ghote
8. Mansara	8. Batti sara	8. Salidhan
9. Aanpjhutte	9. Pokhreli jhinuwa	9. Jhauri
10. Jerneli	10. Pagate jhinuwa	10. Thapachinia
11. Khaltekholo	11. Phante silange	11. Bhamgere
	12. Jhinuwa	12. Ramsali
	13. Seto jadan	13. Dhabe gauria
	14. Aachame	14. Rato jhauri
	15. Andheri panhelo	15. Phalyankote
	16. Kathe marshi	16. Zyagdikhola
	17. Kalo gurdi	17. Ekale pakhe
	18. Rato aanddi	
	19. Achhame masino	
	20. Sano madishe	
	21. Naltumme	
	22. Samundraphinj	
	23. Gauria ramani	
	24. Gaudi khola	
	25. Anadi seto	
	26. Ekle	
	27. Madishe	
	28. Chuta	
	29. Naulo madishe	
	30. Bagarni	
	31. Anadi	
	32. Aanga	
	33. Gorkhali	
	34. Dudhe marshi	
	35. Manamuri	
	36. Seto gurdi	
	37. Lamjunge	
	38. Bange jhinuwa	
	39. Juwari	
	40. Pakhe silange	
	41. Kathe silange	
	42. Gola	
	43. Tunde	
	44. Tulsi	
	45. Masino	
	46. Thulo madishe	
	47. Khure ramani	

APPENDIX 2. Situation of landraces as reported by a number of key informant farmers by site in SRV

	Landraces situation			
Study site	**Presently grown**	**Threatened**	**lost**	**Reasons to disappear**
Hemja (9)	Ramani Kathemarsi Jethobudho Khaltekholo Gurdi Aanga	Jadan Mansara Gudura	Gorkhali Thimaha Panhele	• Introduction of HYVs • Land converted into Khet • Non-lodging var eg. Radha 7 • Unlike locals HYVs adapted well even under shade and swampy areas
Chaurasi biruwa phant (9)	Panhele Khalte kholo Jethobudho Gauria Aachame masino Aanadi	Biramphool Gurdi Dudhe marsi	Manamuri Mansara Aanpjhutte Jerneli Bayarni Jhinuwa Pakhe jhinuwa Tauli	• Low grain and straw yields • Introduction of HYVs • Irrigation facility improved • Shattering problem • Early maturity • Poor taste • Lodging problem
Armale Thulibesi phant (16)	Kathe marsi Jerneli Aanpjhutte Mansuli Gauria Panhele Jethobudho Aanadi Seto gurdi Gorkhali Biramphool Lamjunge Kali gurdi Bange jhinuwa Juwari Pakhe jhinuwa	Not reported	Mansara Dudhe marsi Darmali Aanga Thimaha Marsi	• Low grain and straw yields • Low milling ratio • Short plant and panicle and more tillering • Poor taste • Introduction of HYVs • Late maturity • Low market price of locals
Pame phant and thula khet (11)	Jethobudho Jadan Pakhe silange Ramani Gudura Kathe silange Aanadi Gola Pokhreli jhinuwa	Gurdi Pakhe jhinuwa	Germani Thimaha Koili Budho thakale Panhele	• Low grain and straw yield • Over vegetative growth • Low market price • Threshing difficulty • Poor taste
Aarba phant (11)	Jetho budho Aanpjhutte Ramani Manamuri Tunde gauria Jhinuwa Aanadi	Gurdi Panhele Biramphool	Ghote Mansara Aanga Thimaha Salidhan	• Low grain and straw yields • Low market price • Poor taste • Late maturity • Introduction of HYV with better traits
Kundahar phant (7)	Jethobudho Khaltekholo Achhame masino Gauria	Gurdi	Mansara Manamuri Biramphool Gorkhali	• Low grain and straw yield • Irrigation facility improved • Low market price

Study site	Landraces situation			
	Presently grown	Threatened	lost	Reasons to disappear
	Panhele Aanadi		Tauli Jhauri Aanga Thimaha Thapachinia Jerneli	• Introduction of better HYVs
Kharane phant (8)	Jethobudho+gauria Jethobudho Panhele Gurdi	Tulsi Biramphool Mansara+tulsi Bhangere+mansara	Mansara Gurdi Jhauri Tauli Ramsili Samundraphinj	• Low yield(Tulsi, S. phinj • Coarse grain (Bhagere) • Non-scent (Jhauri) • Low straw yield • Irrigation facility improved
Bijaypur phant (9)	Aanpjhutte Gurdi Mansara Gauria Jethobudho Ramani Panhele Aanadi	Biramphool	Not reported	Not reported
Rupatal phant (Sishuwa) (7)	Madise Panhele Aanadi Masino Mansara Thulo madise	Jerneli	Ramsali Bayarni Sano madise Tauli Manamuri Gurdi Dhabe gauria Rato jhauri Phalyankote Jhinuwa Zyaudikhole	• Introduction of early maturing HYVs • Low yield than HYVs • Economically less profitable • Low market price • Late maturity
Begnastal besi phant (4)	Naulo madise Thulo madise Sano madise Aanadi	Not reported	Madese Gauria Ekle pakhe Gurdi Jethobudho	• Low yield • Tall and lodging • Over vegetative growth • Introduction of beter HYVs • Late maturity of local vars
Deepang and Maidi phant (Shibuwa) (10)	Panhele Jethobudho Biramphool Gurdi Mansara Khure ramani Gauria Ramani	Samundra phinj	Tauli Jhauri Aanga Thimaha	• Low yield • Low straw yield • Irrigation facility improved • Poor taste • Low market price
Syang khudi phant (Majh thana) (7)	Jethobudho Ramani Aanadi Jerneli Gauria Gurdi Jhinuwa Naltumme	Not reported	Masise	• Low yield potential and less responsive to improved conditions

Note: Numbers in parenthesis in site column indicate the rice diversity at present

APPENDIX 3. Landraces category for their culinary traits in SRV

Coarse grain	Fine grain	Fine aromatic	Coarse aromatic
1. Aanga	1. Andheri	1. Aachame masino	1. Dudhe marsi
2. Aanpjhutte	2. Chhote	2. Bayarni	2. Pakhe jhinuwa
3. Anadi rato	3. Gola	3. Biramphool	
4. Bange jhinuwa	4. Gudura masino	4. Gauria	
5. Budho thakale	5. Gurdi	5. Gurdi kalo	
6. Darmali	6. Jerneli	6. Gurdi seto	
7. Dudhe juwari	7. Khusremni	7. Jetho budho	
8. Golaya tauli	8. Lamjunge	8. Khalte kholo	
9. Gorkhali	9. Manamuri	9. Mansara	
10. Anadi	10. Panheli masino	10. Masino	
11. Jadan	11. Samundraphinj	11. Panheli	
12. Germani	12. Tunde	12. Sisuwa panheli	
13. Pakhe jerneli	13. Marsi		
14. JhauriJhutte juwari			
15. Juwari			
16. Jhinuwa			
17. Kathe marsi			
18. Kathe juwari			
19. Naltumme			
20. Naulo madishe			
21. Sali dhan			
22. Seto thakale			
23. Silange pakhe			
24. Thimaha			
25. Tauli			
26. Thulo masishe			

Appendix 4. Farmers' purpose of landraces production in SRV

Landraces	Home use (1)	Selling (2)	Festival (3)	Guest (4)	Medicine (5)	Others (6)	Total score out of 6
Jetho budho	1	1	1	1	0	1	5
Gurdi	1	1	1	1	0	1	5
Gauria	1	1	1	1	0	1	5
Panheli	1	1	1	1	1	1	6
Mansara	1	1	1	0	0	0	3
Biramphool	1	1	1	1	0	0	4
Ramani	1	1	1	1	1	0	5
Tauli chinia	1	0	0	0	0	1	2
Khalte kholo	1	1	1	0	0	1	4
Aanp jhutte	1	0	0	0	1	0	2
Jadan	1	0	0	0	0	1	2
Jhutte juwari	1	0	0	0	0	0	1
Aanadi	1	1	0	0	1	1	4
Gurdi kalo	1	0	0	0	0	0	1
Gurdi seto	1	0	0	0	0	0	1
Thimaha	1	0	0	0	0	0	1
Tunde	1	0	0	0	0	0	1
Pakhe jhinuwa	1	1	1	0	0	0	3
Kathe marsi	1	0	0	1	0	0	2
Juwari	1	0	1	0	0	1	3
Jerneli	1	0	1	0	0	1	3
Gorkhali	1	0	0	0	0	0	1
Achhame masino	1	1	1	1	0	0	4
Aanga	1	0	0	0	0	0	1
Andheri	1	0	0	0	1	1	3
Bayarni	1	1	1	1	1	0	5
Gudura masino	1	0	0	0	0	1	2
Jhauri	1	0	1	0	0	0	2
Lamjunge	1	0	0	0	0	0	1
Silange phante	1	0	0	0	0	0	1
Seto thakale	1	0	0	0	0	0	1
Samundraphinj	1	0	0	0	0	0	1
Naltumme	1	0	0	0	0	0	1
Koili	1	0	0	0	0	0	1
Kathe juwari	1	0	0	0	0	0	1
Dudhe juwari	1	0	0	0	0	0	1
Budho thakale	1	0	0	0	0	0	1
Chhote	1	1	0	0	0	0	2
Jhinuwa	0	1	1	1	0	0	3
Masino	0	0	1	1	0	0	2
Tauli	0	0	1	0	0	0	1
Bayarni jhinuwa	0	0	1	1	0	0	2
Anadi rato	0	0	0	0	1	0	1
Silange pakhe	0	0	0	0	0	1	1
Madishe	0	0	0	0	0	1	1

Note: 1 and 0 stand for yes and no answers

Appendix 5. Distribution of rice landraces under different fertility and moisture regimes in SRV

	Good fertility versus moisture regime			Poor fertility versus moisture regime	
Landraces	Irrigated	P. Irrigated/ Rainfed	Swampy/ lowland	Upland/ rainfed	Tari
1. Aachame masino	1	1	1	0	0
2. Aanadi	1	1	1	1	0
3. Aanga	0	0	0	1	1
4. Aanp jhutte	1	1	1	1	1
5. Andheri	0	1	0	1	1
6. Bange jhinuwa	0	0	1	1	0
7. Bayarni	1	1	1	1	0
8. Chhote	0	1	0	0	0
9. Darmali	0	0	0	0	1
10. Dudhe juwari	0	0	0	1	0
11. Dudhe marsi	0	1	0	1	1
12. Gauria	1	1	1	1	0
13. Germani	0	0	0	1	0
14. Gola	1	0	0	0	0
15. Golaya	0	0	0	0	1
16. Golaya tauli	0	0	0	0	1
17. Gorkhali	1	0	1	1	0
18. Gudura masino	0	0	0	1	0
19. Gurdi	1	1	1	1	1
20. Jadan	1	0	0	1	0
21. Jerneli	1	1	0	1	0
22. Jethobudho	1	1	1	1	1
23. Jhauri	0	1	0	1	1
24. Jhinuwa	1	0	1	1	0
25. Jhutte juwari	0	0	0	1	1
26. Juwari	0	0	0	1	1
27. Kalo gurdi	1	1	1	0	0
28. Kathe juwari	0	0	0	1	0
29. Kathe marshi	0	0	0	0	1
30. Khalte kholo	1	1	1	0	0
31. Khsreni	0	0	1	0	0
32. Koili	0	0	0	1	0
33. Lamjunge	0	1	1	1	0
34. Manamuri	1	1	0	1	1
35. Mansara	0	1	1	1	1
36. Marshi	0	0	0	1	1
37. Naltumme	0	0	0	1	0
38. Pakhe jerneli	0	0	0	0	1
39. Pakhe jhinuwa	0	1	1	1	1
40. Panhele	0	1	1	0	0
41. Ramani	1	1	1	0	0
42. Samundra phinj	0	0	1	0	0
43. Seto thakale	0	1	0	0	0
44. Silange pakhe	0	1	0	0	1
45. Silange phant	0	0	1	0	0
46. Sisuwali -pahele	0	0	1	0	1
47. Tauli	1	0	1	0	1
48. Thimaha	0	0	0	0	1
49. Thulo madishe	1	0	0	0	1

Note: 1 and 0 in above table indicate yes and no, respectively.

Appendix 6. Farmers' basis for landraces assessment in SRV

Farmers' reason	TVR/D[8]	Landraces disliked
1. Low grain yield	26	Thapachini, Mansara, Samundraphinj, Manamuri, Madise, Zyagdi khola, Thulo madise, Kalyankote, Ramsali, Gurdi, Biramphool, Taichung, Aanpjhutte, Jadan, Koili, Tauli, Jhinuwa, Jhauri, Ramani, Aanga, Thimaha, Germani, Chote, Bayarni jhinuwa, Juwari Gudura
2. Poor taste	7	Jerneli, Manamuri, Tauli, Jhauri, Germani, Thimaha, Mansara
3. Low market price	4	Gurdi, Gauria, Aanpjhutte, Budhothakale
4. Poor grain type	5	Jhauri, Aanga, Thimaha, Gorkhali and Thapachinia
5. Coarse grain	3	Ramsali, Sano madise, Tauli
6. Tall & over growth	3	Madise, Tauli, Masuli
7. Lodging	6	Madise, Gauria, Manamuri, Tauli, Biramphool, Gudura
9. Sterility	8	Tauli, Mansara, Pakhe jhinuwa, Jhauri, Juwari, Dudhe marsi, Aanga, Gorkhali
10. Maturity	4	Jhauri, Pakhe jhinuwa, Tauli and Juwari (Early and Gauria (Late)
11. High shattering	5	Manamuri, Jadan, Jethobudho, Mansara, Aanpjhutte
12. Poor straw quality	10	Taichung, Aanpjhutte, Mansara, Manamuri, Gorkhali, Tauli, Jhauri, Thimaha, Pakhe jhinuwa, Chhote
13. Low milling	3	Jarneli, Mansara, Gajale marsi
14. Insect problem	2	Mansara and Biramphool
1. Expansion when cooked	1	Mansara
2. Introduction of HYVs	6	Gurdi, Aanpjhutte, Gorkhali, Mansara, Tauli and Manamuri
17. Suitable for specified environment	1	Samundraphinj

[8] Total number of varieties rejected or discontinued

Appendix 7. Household's response for increasing rate of replacement of local landraces in SRV

	Landraces as reported by farmers		
Landraces	**Reasons for replacement**	**Landraces threatened**	**Reasons to be threatened**
Gurdi	a. HYVs introduced	Biramphool	a. Low yield
	b. Low market price		b. Low market price
	c. Low yield		c. Late maturity
Aanpjhutte	a. HYVs introduced		d. Lodging
	b. Low market price		e. Stem borer attack
	c. Low yield		f. *Kam Aadilo*
	d. Short straw	Khaltekhole	a. Sterility
	e. Shattering		b. Poor taste
			c. *Kam Aadilo*
Thapachinia	a. Low yield	Tulsi	a. Low yield
	b. Short plant		
Gorkhali	a. HYVs introduced	Jarneli	a. Over vegetative growth
	b. Short straw		b. Low yield
	c. red grain		
	d. Sterility		
Mansara	a. HYVs introduced		
	b. Low straw yield		
	c. Sterm borer attack	Jadan	a. Unsrynchonous maturity
	d. Poor taste		b. Poor tillering
	e. Short straw		c. Sterm borer attack
	f. Late maturity		d. HYVs introduced
	g. Low milling	Lamjunge	a. Moth in store grain
	h. Shattering		b. Insect/disease attack
	I. No rice expansion when cooked	Bayarni	a. Low yield
Samundra phinj	a. Low yield	Andheri	a. Low yield
Jhauri (Tauli)	a. Low market price	Mansuli	a. Over vegetative growth
	b. Red rice grain	Kalo gurdi	a. Low yield
	c. Poor taste	Janaki	a. Low milling
	d. Early maturity		b. Short plant height
	e. Short straw	Mansara	a. Low yield
	f. Sterility		b. Shattering
	g. HYVs introduced		c. Short straw
Ramsali (S. Madise)	a. Coarse grain		d. Late maturity
Manamuri	a. Low yield	Panhele	a. Insect/disease attack
	b. Lodging		b. low yield
	c. Shattering	Gurdi	a. Low grain yield
	d. Poor taste		b. Low straw yield
	e. Short straw		c. Poor taste
	f. HYVs introduced		d. Low market price
Zyagdikhola	a. Low yield		e. Stem borer attack
Kalyadkhote	a. Low yield	Juwari	a. Low grain yield
Madishe	a. Low yield		b. Low straw yield
	b. Over vegetative growth	Manamuri	a. Low grain yield
	c. Too tall		b. Short straw

Landraces	Landraces as reported by farmers		
	Reasons for replacement	Landraces threatened	Reasons to be threatened
	d. lodging	Pakhe Jhinuwa	a. Poor taste
Gauria	a. Lodging	Marsi	a. Low grain yield
	b. Low market price		b. Lodging
	c. Late maturity	Bange jhinuwa	a. Low milling
		Kathe marsi	a. Low yield lodging
Biramphool	a. Low yield	Dudhe marsi	a. Stem borer attack
	b. Lodging		b. Lodging
	c. Stem borer attack	Jetho budho	a. Poor taste
Tauli	a. Too tall		b. HYVs introduced
	b. Over vegetative growth		
	c. Short straw	Gudure	a. Low yield
	d. Low yield	Andheri marsi	a. Lodging
	e. Less suitable for rainfed		
	f. Poor taste		
	g. Sterility		
	h. Coarse grain		
	i. Early maturity		
Jadan	a. Low yield		
	b. HYVs introduced		
Koili	a. Low yield		
Budhothakale	a. Low market price		
Panhele	a. HYVs introduced\		
Jhinuwa	a. Low yield		
Jarneli	a. Low milling		
	b. Poor taste		
Marsi	a. HYVs introduced		
Ramani	a. Low yield		
Aanga	a. Low yield		
	b. Red grain		
	c. Unsuitable for rainfed		
	d. HYVs introduced		
Thimaha	a. Low yield		
	b. Poor taste		
	c. Red grain		
	d. Low straw yield		
Germani	a. Low yield		
	b. Poor taste		
	c. Low straw yield		
Ghote	a. Low grain yield		
	b. Low straw yield		
Salidhan	a. HYVs introduced		
Bayarni (Jhinuwa)	a. Low yield		
Pakhe jhinuwa	a. Sterility		
	b. Early maturity		
	c. HYVs introduced		
Juwari	Low yield		
	b. Early maturity		
Gudura	a. Low yield		

	Landraces as reported by farmers		
Landraces	**Reasons for replacement**	**Landraces threatened**	**Reasons to be threatened**
	b. Lodging		
Dudhe marsi	a. Sterility		
Phalame	a. HYVs introduced		

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.