



# Agrobiodiversity conservation on-farm: Nepal's contribution to a scientific basis for national policy recommendations

10 February 2002, Kathmandu, Nepal

**Devendra Gauchan, Bhuwon R. Sthapit and Devra I. Jarvis, editors**



Netherlands Ministry  
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## Acronyms

APO	Asia-Pacific-Oceania
ARS	Agriculture Research Station
CBD	Convention of Biological Diversity
CBO	Community-based Organisation
CBR	Community Biodiversity Register
DNA	Deoxyribonucleic Acid
DOA	Department of Agriculture
FAO	Food and Agricultural Organisation
FAOIU	FAO International Undertaking
FNA	Farmer Net Work Analysis
GEF	Global Environment Facility
GPA	Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture
HRS	Horticulture Research Station
I/NGO	International / Non-Governmental Organization
ICIMOD	International Centre for Integrated Mountain Development
IDP	Intensive Data Plot
IPGRI	International Plant Genetic Resources Institute
IPR	Intellectual Property Rights
IUCN	International Union for Conservation of Nature
LI-BIRD	Local Initiatives for Biodiversity Research and Development
LMDG	Local Multidisciplinary Group
MOAC	Ministry of Agriculture and Cooperatives
MOFSC	Ministry of Forest and Soil Conservation
MOPE	Ministry of Population and Environment
MV	Modern variety
NABC	National Agro Biodiversity Committee
NARC	Nepal Agricultural Research Council
NARS	National Agricultural Research Systems
NMDG	National Multidisciplinary Group
NPC	National Planning Commission
PGR	Plant Genetic Resource
PGRFA	Plant Genetic Resource for Food and Agriculture
PPB	Participatory Plant Breeding
PRO-PUBLIC	Forum for Protection of Public Interest
PVP	Plant Variety Protection (PVP)
R&D	Research and Development
SEAN	Seed Entrepreneurs' Association Nepal
TCC	Technical Co-ordination Committee
TRIPS	Trade Related Intellectual Property Rights Systems
UNDP	United Nation Development Program
WTO	World Trade Organization



## Introduction

Nepal's policy-makers are presently faced with implementing a myriad of national and international policy obligations that are relevant to the conservation, use and development of agricultural biodiversity. Rapid changes in the recent international policy scenario, the complexity of the emerging biodiversity policy issues, and the diversity of the stakeholders involved in the agrobiodiversity sector require good information by the policy-makers for the development of realistic policy relevant to the needs and goals of the Nepalese agro-economy. This proceedings is intended to provide a scientific basis for policy recommendation from information generated from empirical research activities carried out by the Nepal component of the global project "Strengthening the Scientific Basis of *In Situ* Conservation of Agricultural Biodiversity On-farm"<sup>1</sup> over the past 5 years (1997-2002).

The research findings and their implication for national policy presented here are based on the research done on keystone crops of national importance for local food security and livelihoods in the three representative ecological sites of Nepal. The crops are rice, barley, buckwheat, finger millet, taro, pigeon pea, sponge gourd and cucumber. The three ecological sites are Bara in Terai (lowland), Kaski in Mid-Hills and Jumla in the Mountain (high Hills). These sites are selected on the basis of the richness of agrobiodiversity, status of on-farm conservation by farmers and also interest and availability of collaborating institutions. The summarized major findings of the research and their implications for national policy were presented during the policy workshop held on 16 February 2002 in Kathmandu, Nepal on the following key themes of the *in situ* project: (1) conceptual basis and process to implement on-farm conservation research, (2) assessment of genetic diversity on-farm, (3) processes used to maintain crop genetic diversity on-farm, (4) who maintains genetic diversity on-farm, (5) factors influencing farmers' decision-making in the maintenance of genetic diversity, (6) benefits from conservation of crop genetic diversity on-farm in Nepal, and (7) key issues for policy consideration for agrobiodiversity conservation. The reflections of the workshop and the follow-up monitoring of the policy changes after workshop are presented in Annexe 1. Stakeholders and individuals who participated are listed in Annexe 2.

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<sup>1</sup> The project was implemented in 1997 and is run jointly by a national research institute (Nepal Agricultural Research Council, NARC) and an NGO (Local Initiative for Biodiversity Research and Development, LI-BIRD) in collaboration with the International Plant Genetic Resources Institute (IPGRI), Rome, Italy. The project strongly focuses on linking on-farm conservation with development activities. Value addition through market development, participatory plant breeding, community mobilization and policy changes has been the focus of the project since the very beginning. Institutional linkages, policy changes and local capacity-building are the tenets of the project approaches.

## The role of legislature, policy and agrobiodiversity management on-farm

*Susan Bragdon and Devra I. Jarvis*

The importance of conserving agrobiodiversity for future global food security lies in its potential to supply the needs of crop breeders and farmers for achieving sustainable agriculture. *In situ* conservation of agricultural biological diversity concerns the maintenance and management of diverse local crop varieties in farmers' fields or "on-farm". On-farm conservation conserves entire agroecosystems, including cultivated crops as well as their wild and weedy relatives that may be growing in nearby areas. This form of conservation allows for:

- the continuation of evolution and adaptation of crops to their environment
- the conservation of ecosystem services critical to the functioning of the earth's life support system
- the maintenance or improvement of farmers' control over and access to crop genetic resources
- the means to improve the livelihood of resource-poor farmers through the use of local crop resources

Recognizing these benefits, several major international conventions, statements and institutions—the Convention on Biological Diversity, the Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture (GPA) and the International Treaty for Plant Genetic Resources for Food and Agriculture—call for the conservation and sustainable use of agrobiodiversity. Among other things, each of these instruments recognizes: (1) the critical role of the local managers of genetic resources whether they are identified as farmers, indigenous and/or local communities, and (2) the need for national policies to be consistent and supportive of appropriate action at the local level.

The multifaceted nature of the conservation and sustainable use of agrobiodiversity presents challenges to policy analysis and formulation in support of on-farm maintenance of diversity. The importance of a "ground-up" approach to biodiversity policy-making is commonly noted in the literature. Yet a truly ground-up approach requires an understanding of the local management and decision-making processes and the factors affecting those processes. In response to this challenge, in 1995 IPGRI and its national partners launched a project "Strengthening the scientific basis of *in situ* conservation of agricultural biodiversity on farm" to increase our understanding of the:

1. Amount and distribution of genetic diversity maintained by farmers over time and space.
2. Processes used to maintain this diversity on-farm.
3. Identification of who is actually maintaining this diversity on-farm.
4. Factors that influence farmer decision-making to maintain diversity on farm.

As the proceedings to this meeting illustrate, IPGRI's on-farm project has created an infrastructure and body of knowledge that presents a unique opportunity for meaningful analysis of the effect of existing laws and policies on *in situ* agrobiodiversity and, more importantly, the identification of the necessary elements of a supportive legal and policy framework.

The global project is currently active in eight partner countries: Burkina Faso, Hungary, Mexico, Morocco, Nepal, Peru and Vietnam. At present there are institutional multidisciplinary implementing bodies at national and local levels in the participating countries. National frameworks that include government and non-government sectors have

been created and strengthened to implement *in situ* conservation on-farm. Farmers and communities have been identified to link into national/provincial PGR systems in all participating countries. As the meeting in Nepal demonstrates, the project has created an information base and infrastructure that provides the opportunity for a true understanding of the effect of law and policy and the elements necessary for a supportive legal framework.

Countries participating in the project are clearer on who is conserving and making decisions on the conservation and selection of local crop genetic diversity. Knowledge of the extent and distribution of diversity in six countries and 17 agroecological regions has been obtained as well as an understanding of the processes that farmers are using to maintain this diversity. Identification of limiting factors in the maintenance of crop diversity has been carried out in five of the participating countries. It is this that creates an invaluable opportunity to explore the meaningful development and reform of law and policy and for understanding the obstacles to this.

What the on-farm project has shown is there are already highly sophisticated and complex systems in place for the management of PGRFA. What we understand less well, however, is how these relate to and are affected by national policies and laws. Laws and regulations need to be closely matched to the physical, socioeconomic and cultural conditions of a particular site. The knowledge needed to establish such laws and regulations is that which is most in touch with this environment. Again, the on-farm project provides us with knowledge heretofore unavailable. Without such knowledge of law and policy—often catalyzed by obligations stemming from international treaties—successful human efforts to solve extremely complex problems may be inadvertently swept aside. In addition, commitment to the law is related to its perceived legitimacy and this corresponds to its relevance to the local situation where it applies. With the on-farm project, we are beginning to get a picture of the status quo (though this itself may be subject to rapid change due to external forces such as those brought to bear by globalization generally) from a scientific perspective. The on-farm project has assembled a range of data, information and interactive processes which can be built upon in developing a framework for legal and policy research, analysis and formulation.

As presented in this proceedings the project has identified some policy and legal factors—such as those influencing the seed supply system—that have an impact on on-farm maintenance of diversity. Each year farmers decide how much seed to plant and where that seed comes from. In addition to the seed selected and stored from their own crop, the farmers may obtain new seed from markets or other farmers. Many factors influence the seed supply system, such as the relative importance of the informal and formal seed supply systems, access to each, wealth, environmental factors, etc. Simply advocating for improvement of the seed supply system without greater understanding of these factors and also a means by which the impact of the policies promoting this strengthening over time is not useful. Improvement of the seed supply system, for example, could increase farmers' access to genetically diverse crop varieties at the same time that it decreases genetic diversity by decreasing differentiation among populations. Similarly, the structure, organization and performance of formal seed systems is controlled by various rules and regulations (e.g. seed certification, seed distribution regulations) that influence the type and quantity of seed that is supplied through formal channels. The impact of these rules and regulations, and their relation to the informal seed system in place, on *in situ* conservation on-farm needs to be understood with the effect of possible reforms monitored for impact.

As the information from Nepal shows, the role that law and policy plays or can potentially play in supporting farming systems maintaining crop diversity needs to be more fully investigated before recommendations can be made. Monitoring of impact is also critical. Another example is the legitimate and understandable call for legal and policy mechanisms aimed at adding economic value to on-farm conservation, which may improve the livelihoods of resource-poor farmers. The impact of such measures may be positive in

some aspects and negative in others. The measures might have a negative effect on diversity over time by valuing some local varieties over others. If the maintenance of diversity over time is a national objective (or directed by global international law), a means to bear the cost of such a choice will need also to be considered. If an option to add value to an on-farm crop population is proposed, it will be important to design a mechanism for monitoring its progress and impact.

The effect of specific policies on farmers' choices of varieties is not fully understood. For example, at first glance, a national policy subsidizing the use of modern varieties and related fertilizers might reduce the planting of landraces over large areas in certain high-yield environments. However, results from this workshop have shown that in some instances, for some income groups, the increased income from marketing of the improved varieties facilitated those farmers in continuing to maintain preferred varieties on a smaller land area. The changing nature of local systems and farmers' needs infers that policy analysis and formulation will need to allow for evaluation over time of the hypothesis upon which the policies and laws are based. Policy and legal responses must be monitored over time for their genetic, ecological and economic impacts on farming systems to see if they do indeed fulfil the goal of maintaining high levels of diversity on-farm, as well as achieving the benefits of supporting agroecosystem health and improving farmers' livelihoods in different contexts.

## Key issues for consideration in development of policy for PGRFA in Nepal

*Madhusudan Upadhyaya, Devendra Gauchan, Bimal Baniya, Anil Subedi and Bhuwon Sthapit*

### Introduction

Conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) plays a vital role in the Nepalese economy and food security since more than 80% of the population depends on agriculture for its livelihood. Despite the importance of agriculture and predominance of traditional farming systems, PGRFA so far has not been recognized as a priority issue and agenda item in the national plans and programmes. Understanding of key policy issues with appropriate R&D information and policy analysis will help decision-makers make the most informed choices that will have profound implications on ensuring food security and poverty reduction in Nepal.

International and national policies have important influences on the conservation of local crops and landraces. The important policies on PGRFA include economic policies (subsidies, market, credit), institutional policies (research, extension), regulatory framework and intellectual property rights (IPR), access and benefit-sharing, farmers'/community rights, biosafety and bioprospecting.

This paper is the outcome of the synthesis of *in situ* conservation research including review, survey and analysis of recent policy case study conducted on PGRFA in Nepal. The paper also presents the current policy scenario and gaps, and suggests key considerations for the development of appropriate PGRFA policy in the country.

### Preliminary findings of PGRFA policy case study

#### **Gaps in policies**

At the national level, conservation of agrobiodiversity has not received the same priority as forest biodiversity (Gauchan *et al.* 2000b). External and internal support for resource mobilization and national capacity-building have been constrained by the lack of recognition of PGRFA conservation as a priority issue in the national plans and policies. As a result, the country lacks overall national policy and action plans on conservation, protection, utilization, access to and equitable sharing of benefits arising from the use of PGRFA, particularly traditional crops and cultivars. Despite the importance of agriculture in farmer's livelihood, and in national and local food security, the level of awareness and knowledge on international and national policy development on PGRFA is low among many of the important stakeholders.

In the present (Ninth) Five Year Plan and the Agricultural Perspective Plan, the policies on credit, subsidy, research and extension including education systems, favoured the spread of modern technologies to boost agricultural production and productivity. However, these policies were not favourable to promotion of PGRFA. Seed regulatory framework and market forces also acted as disincentives for farmers to grow native minor crops and traditional cultivars on-farm (Gauchan *et al.* 2000a). This is evident in the gradual disappearance of farmers' varieties (landraces) and endogenous breeds from farming communities in favourable environments.

The existing Seed Act (1988), Seed Policy (2000) and recent Access and Benefit-Sharing legislation (draft) are chiefly sectoral policies and legislation which inadequately cover the overall policy dimensions of PGRFA including issues of farmers' rights for food security.

### **Major policy issues**

The policy-makers in Nepal are faced with implementing a myriad of national and international policy obligations that are relevant to the conservation, use and development of PGRFA. His Majesty's Government of Nepal is currently drafting the 10th National Five-Year Plan of national programmes, and Government Ministries are involved in formulating responsive policy and legislation related to biodiversity. Some of the major policy issues facing policy-makers and other stakeholders in Nepal are:

- Conservation, utilization and protection of genetic resources
- Access and benefit-sharing at the local, national and international levels
- Intellectual property rights (farmers/ rights, plant breeders' rights and *sui generis* rights)
- Biosafety and bioprospecting, including biopiracy.

### **Policy-formulation process**

Historically, the policy formulation process in Nepal remained in the government sector with no or limited participation of the private sector. Recently, however, there has been increased realization of the need for participation of civil societies in the policy-formulation process; this realization came about after His Majesty's Government opted to join the World Trade Organization (WTO). In addition, most of the institutions and stakeholders involved in the development of PGRFA priorities, action plans and policies are scattered in different ministries and institutes. They lack coordinated mechanisms and holistic action plans covering overall issues in the follow-up and implementation of both international PGRFA agreements and national priority issues.

### **Recent policy status**

A national commitment for the conservation and sustainable utilization of agrobiodiversity is exhibited by the fact that Nepal is a signatory of the Convention on Biological Diversity (CBD) 1992; the instrument of ratification was submitted on 23 November 1993 to the Secretary General of the United Nations and the international agreement into force on 21 February 1994, according to article 36 (3) of the convention. The Ministry of Forestry and Soil Conservation (MOFSC), Nepal is the focal point for implementing the CBD. It is in the process of finalizing a National Biodiversity strategy and implementing a Plan and National Biodiversity Trust Fund.

The Ministry of Agriculture and Cooperatives (MOAC), after a series of consultative meetings with the National Planning Commission and other stakeholders, established a National Agrobiodiversity Committee in 2000. With a view to conservation and utilization of agrobiodiversity, MOAC has organized a few meetings of the key decision-makers within the MOAC to include agrobiodiversity as a priority issues in the next Five Year Plan. The government of Nepal is now aware of the complexity of the PGRFA policy problems and issues and is willing to strengthen national capacity to build up efforts for increased competitiveness in the system.

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## Implementation of on-farm conservation in Nepal

*Bhuwon Sthapit and Devra Jarvis*

### Introduction

Agriculture has been identified as a priority sector in many Five Year Plans of Nepal and it will continue to be so in the forthcoming 10<sup>th</sup> Five Year Plan, as well as means of poverty alleviation and food security strategy. Genetic resources of animals and plants are some of the few resources available to resource-poor farmers to ensure sustainable production and improve livelihoods. In this context, conservation and utilization of agrobiodiversity, including traditional crops varieties and breeds, is both a national and global concern. It is the foundation upon which animal and plant breeding depends for the creation of new breeds and varieties and is, therefore, a critical aspect of food security.

Crop genetic diversity present in farming systems has been maintained through the combined action of natural and human selection. Crop diversity in agricultural systems, in addition to being affected by population structure (e.g. mutation rates, migration, population size, isolation, breeding systems and genetic drift) and natural selection from the surrounding environment (e.g. soil type, climate, disease, pests and competition), is affected by human selection and management. Crop genetic resources are passed from generation to generation of farmers and are subject to different natural and human selection pressures. Environmental, biological, cultural and socioeconomic factors influence a farmer's decision of whether to select or maintain a particular crop cultivar at any given time (Jarvis *et al.* 1998; Jarvis and Hodgkin 2000). In the process of planting, managing, selecting, roguing, harvesting and processing the farmers, in turn, make decisions on their crops that affect the genetic diversity of the crop populations. Over time a farmer may alter the genetic structure of a crop population by selecting for plants with preferred agromorphological or quality characteristics. Thus, crop landraces may be a product of farmer selection as well as farmer breeding (Riley 1996).

### Why *in situ* conservation?

For the last decades, agricultural scientists have responded to the threat of genetic erosion by developing a worldwide network of genebanks and botanical gardens for conserving the available useful genetic resources *ex situ* (Bommer 1991). Complementary to *ex situ* conservation, *in situ* conservation has the potential to (1) conserve the evolutionary processes of local adaptation of crops to their environments, (2) conserve diversity at all levels—the ecosystem, the species and the genetic diversity within species, (3) conserve ecosystem services critical to the functioning of the earth's life-support system, (4) improve the livelihoods for resource-poor farmers through economic and social development, (5) maintain or increase farmers' control over and access to crop genetic resources, (6) ensure farmers' efforts are an integral part of national PGR systems and involve farmers directly in developing options for adding benefits of local crop diversity, and (7) link farming community to genebank for conservation and utilization (Jarvis *et al.* 2000a).

Genebank facilities do not conserve farmer's traditional knowledge of crop selection, management and maintenance in the development of local cultivars. Nor can they ensure the continued access and use of these resources by farmers. At present, Nepal does not have a national genebank. On-farm conservation enables households with livelihoods based on biodiversity to meet 95% of their basic food and nutrition requirements.

The importance of conservation of agrobiodiversity for future of global food security lies in its potential to supply germplasm for the future needs of crop breeders and other users. In Nepal, rapid successes came in those programmes where traditional cultivars were used in crop improvement programmes. The continuing use of Nepalese landraces contributes to

stable food production and income, especially in marginal environments where impacts of modern varieties are limited or less effective. The concept of *in situ* conservation encompasses the effort by the scientific community to honour its debt to the legacy of farming peoples who created the biological basis of crop production.

### **What basic information is needed to understand *in situ* conservation?**

It is useful to identify what information is needed to support farmers and local communities in on-farm crop diversity conservation, management and use. Following are four basic research questions, which will provide a scientific basis for designing and planning effective on-farm conservation:

- what is the extent and distribution of the genetic diversity maintained by farmers over space and over time?
- what are the processes used to maintain the genetic diversity on-farm?
- who maintains genetic diversity within farming communities (men, women, young, old, rich, poor, certain ethnic groups)?
- what factors (market, non-market, social, environmental) influence farmer decisions on maintaining traditional varieties?

### **How do *in situ* conservation programmes provide benefits to a community?**

If crop genetic resources are going to be conserved on-farm, they must be part of farmers' productive (development) activities (Berg 1998). This means conservation must be put into a context of development (farmers' livelihood interest). A major challenge is to develop the framework of knowledge to determine where, when and how *in situ* conservation will be effective and to develop a broad guideline for research and practice in *in situ* conservation for national programmes.

The project, therefore, is concerned with how *in situ* conservation can be linked with genetic, socioeconomic and ecological benefits for livelihoods of people (Jarvis *et al.* 2000b). Benefits that accrue from such efforts could be both monetary and non-monetary. Answering the above-mentioned basic questions provides the knowledge needed to (1) support local seed systems, (2) improve participatory plant breeding programmes, (3) develop markets for traditional crops and cultivars, (4) promote appropriate curriculum development, (5) create methodologies for integrating locally adapted crop cultivars and farmer preferences into development and extension projects, and (6) advise on appropriate policies that support the management and use of crop diversity in agroecosystems (IPGRI 2001). Answers to these questions are also needed to develop methods for mainstreaming the use of local crop genetic resources into the agricultural development arena that aims for poverty alleviation and food security.

Effective management and conservation of genetic resources on-farm takes places where the resources are valued and used to meet the needs of local communities (Jarvis *et al.* 2000a). In order for local crop systems to be maintained by farmers, the genetic resources must have some value and/or be competitive with other options a farmer might have. Two options were used in adding benefits: the first, on adding benefits through participatory plant breeding, seed networks and grassroots strengthening, and the second, on adding benefits through public awareness, better processing, marketing, policy incentives and education in the formal sector (Jarvis *et al.* 1998).

The first option is to seek improved quality, disease resistance, high yield, better taste, longer storability and other preferred traits through breeding; seed networks and modified farming systems. The second option includes adding value to crop resources so that the demand for the material or some derived product may be increased. These diverse options

will emerge when community, researchers and developmental institutions are directly involved in monitoring local crop diversity using community biodiversity register and linking with crop improvement, seed and market networks for adding benefits on local resources.

### **The steps of effective implementation of on-farm conservation**

The following steps are identified that are essential for effective implementation of an on-farm conservation programme before “best practices” can be used for policy reforms (Sthapit *et al.* 2000):

- Locating ecosystem diversity, crops and community
- Creating an institutional framework and participatory planning process
- Community sensitization
- Locating diversity and custodians
- Monitoring diversity
- Characterizing, measuring and assessing local crop diversity
- Developing strategy for options of on-farm conservation of agrobiodiversity
- Mainstreaming information for development and policy reforms.

Understanding the scientific basis of on-farm conservation of crop genetic resources will allow an appreciation of the amount of genetic diversity maintained by a farming community and their genetic, sociocultural, economic and ecological values in order to formulate national research and development policies for poverty alleviation and food security.

### **Strengthening local capacity to manage on-farm conservation strategies**

Figure 1 illustrates the processes by which a community develops its own on-farm conservation strategy that provides benefits to individuals, community, nation and international community. A number of participatory tools have been developed to implement on-farm conservation activities at the local level by a farming community:

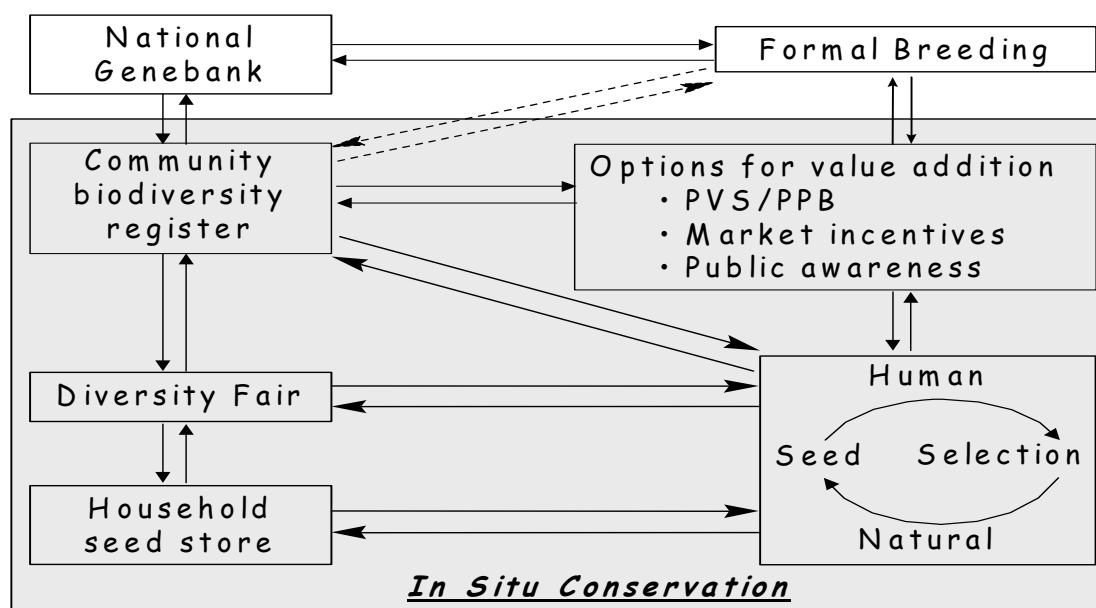
- *Local seed system*: Understanding local crop diversity, social networks of germplasm and knowledge flow, and storage methods; identifying technical gaps; strengthening the local seed system.
- *Diversity fair*: Local community can organize this fair for locating diversity and custodians, sensitizing community and policy-makers, and promoting access of information and materials.
- *Community biodiversity register*: Recording inventory of local crop diversity and associated local knowledge and monitoring the increase and decrease of number of landraces and modern varieties and their distribution pattern within households (by area) or between households within community.

Such activities will raise awareness on local crop diversity and increase the understanding of the value of local crop diversity. Diversity fair and Community Biodiversity Register are participatory methods that can strengthen local capacity to document taxonomic data and traditional knowledge on crop genetic resources (CGR) with the following specific objectives:

- create awareness and develop sense of community ownership on biodiversity
- locate unique, rare and culturally significant cultivars and their custodians
- enhance access to genetic materials and information on local crop diversity
- develop options for adding benefits and support biodiversity-based livelihoods
- build local capacity for monitoring diversity *in situ* and promote on-farm management of local crop diversity
- create awareness of and protect economically important biowealth against biopiracy.

A challenge of successful implementation of CBR will depend upon how the approach could provide direct benefits to the farming community. One direct benefit is that it may help to network key households, which maintain rare, unique and rich local crop diversity resulting in a network of seed stores to form a decentralized community seed bank.

It is important not only to focus on scientific understanding of the project but also to develop institutional capacity to run internally driven on-farm conservation programmes. The value of decentralized CBRs will be clearer when activities such as diversity kits, Participatory Variety Selection and Participatory Plant Breeding (Sthapit *et al.* 2000; Witcombe *et al.* 1996) are integrated into community-based informal seed management and exchange programmes. Participatory plant breeding and deployment of diversity kits will strengthen the capacity of farmers to search, select, maintain and exchange genetic resources for obtaining both genetic and socioeconomic benefits for farmers and society.



**Fig. 1.** Strengthening grassroots institutions and informal seed networks through participatory approaches such as diversity fair and CBR and linking with value addition options and *ex situ* conservation (Sthapit and Jarvis 1999).

All this requires greater collaboration between formal and informal sectors with more benefit-oriented activities. The promising results are emerging from all countries and many methods and approaches have been developed which have been as guidelines for on-farm conservation of agrobiodiversity (Jarvis *et al.* 2000a). These outputs must be evaluated and monitored in terms of effectiveness and sustainability of PGR conservation and utilization.

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## Assessment of local crop genetic diversity in Nepal

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### Introduction

Crop genetic diversity is one of the few resources available to resource-poor farmers to ensure sustainable production and a biodiversity-based livelihood. Genetic diversity can be measured at three levels: ecosystem, species and genetic. In the context of agricultural biodiversity, it is important to understand how diversity is measured at gene level. Genetic diversity is measured by richness, evenness and distinctiveness. Locating genetic diversity and measuring the amount and distribution of local crop diversity are important as diversity is not distributed evenly in any geographic region. The amount and distribution of local crop diversity on-farm is, however, associated with various social, economic, cultural, agroecological and genetic aspects. In order to understand the farmers' management of diversity and to measure its extent and distribution, various methods and markers were used ranging from participatory rural appraisal (PRA), baseline survey and diversity fairs to morphological variability, allelic richness, level of heterozygosity and polymorphism at DNA level in mandatory crops of the project across three *in situ* ecosites (Rijal *et al.* 1998, Paudel *et al.* 1998, Sherchand *et al.* 1998). The results are based upon eight traditional crops: rice, finger millet, buckwheat, barley, pigeon pea, taro, sponge gourd and cucumber.

### Findings

#### **Local crop diversity**

A considerable number of local crop cultivars of many crops continue to be maintained in different farming systems in Nepal (Rana *et al.* 2000abc). We found that farmers are generally consistent in naming and describing varieties. Farmers use a set of traits to describe a population and give names to characterize and describe these units of crop diversity. A farmer-named cultivar is thus the initial indicator of genetic diversity on-farm.

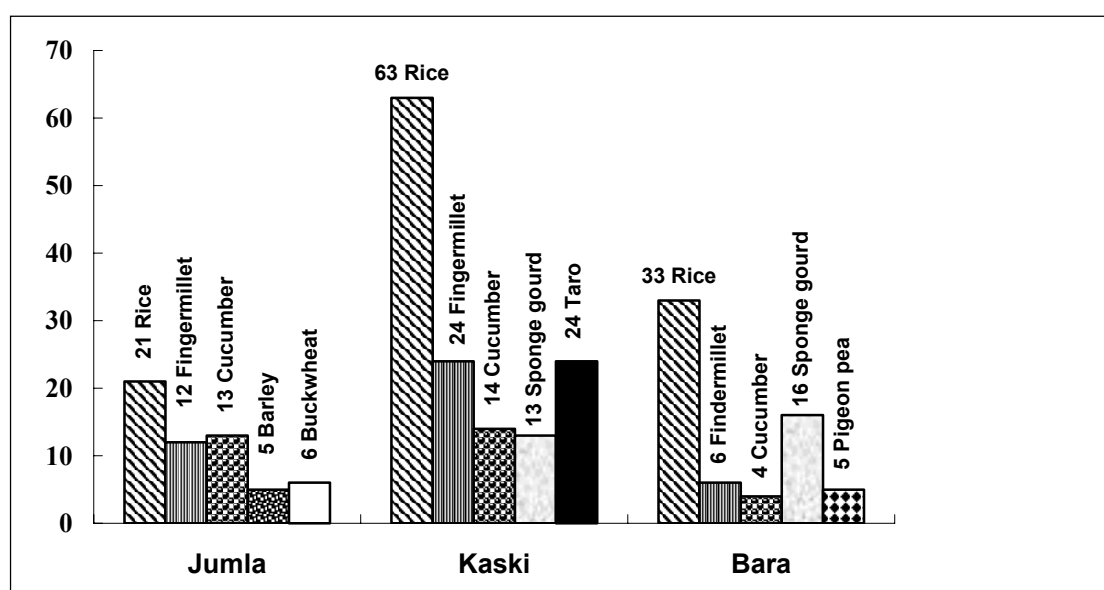
Figure 1 shows the amount of genetic diversity of rice, finger millet, cucumber, barley, buckwheat, sponge gourd, taro and pigeon pea in terms of the number of farmer units of diversity (FUD) and genetic distinctness (Rana *et al.* 2000abc). The middle hill ecosystem (Kaski: 600-1400 masl) is rich in numbers of rice, finger millet and taro cultivars. The Terai (Bara: 80-100 masl) is rich in sponge gourd diversity whereas the high hill (Jumla: 2240-3000 masl) is rich in barley and buckwheat diversity.

While most of the information has been collected on the number of cultivars, there are also results on the genetic variation found in three sites, using agromorphological traits, biochemical and molecular markers. In Kaski and Bara sites, genetic DNA marker data have substantially confirmed the richness of rice diversity, whereas in Jumla (a high-altitude site), limited differences in molecular genetic diversity were observed even though 21 rice cultivars were identified by farmers on the basis of agromorphological traits (Bajracharya *et al.* 2001abcd).

#### **Agromorphological diversity**

To validate the on-farm diversity on a scientific basis, the agromorphological characterization and evaluation of rice, taro, pigeon pea, sponge gourd, barley and buckwheat landraces was carried out in respective crop environments. A range of variation was observed in the morphological traits respective to the crops (Rijal *et al.* 2001; Baniya *et al.* 2001; Bajracharya *et al.* 2000; Gupta *et al.* 2001; Tiwari *et al.* 2001ab; Pandey *et al.* 2001ab; Yadav *et al.* 2001ab). Analysis of morphological traits revealed variation within the same-

named landraces and also between the different-named landraces. Barley varieties exhibited high intra- and interpopulation diversity and have potential for further improvement in terms of economic importance for the benefit of the farming communities.



**Fig. 1.** Comparative diversity of local landrace crops (measured as farmer's unit of diversity) in three ecosites (Rana *et al.* 2000 abc).

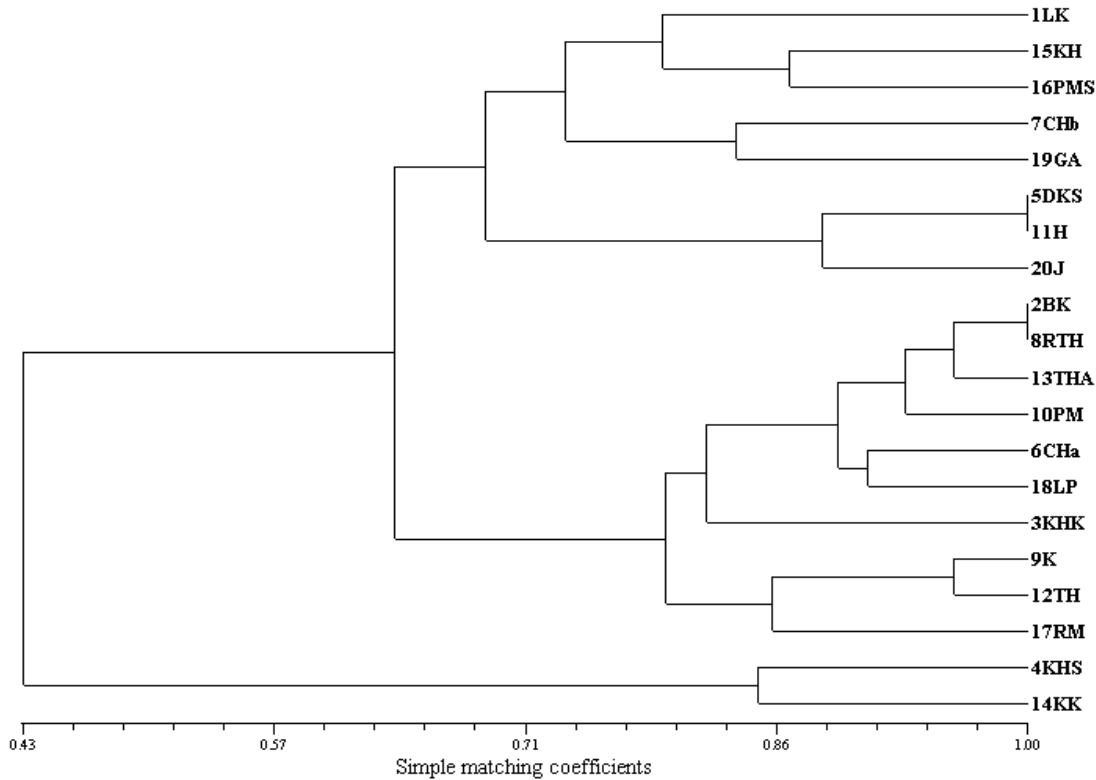
### ***Allozyme variability***

Examining variation at a number of polymorphic isozyme loci assessed genetic variation in taro, barley and bitter buckwheat landraces from Kaski and Jumla. The isozyme studies in barley, bitter buckwheat and taro revealed a considerable level of allelic variability among and within the landraces of these crops (Bajracharya *et al.* 2001abc). Statistical analysis of the isozyme data indicated the existence of gene diversity within and between populations and the total genetic diversity is due to an intrapopulation component of diversity in barley and buckwheat (Table 1). The variation could possibly be the result of farmers' management, particularly the seed exchange system, and the socioeconomic structure of the ecosite.

**Table 1.** Summary of diversity data of isozyme traits in barley landraces, 1999

Landrace	Frequency of alleles/locus (A)	Frequency of alleles / polymorphic locus (Ap)	Percentage of polymorphic loci at 95% (P)	Heterozygosity (H)
Chawali	1.39	2.05	35.21	0.1525
Bhuwali	1.36	2.01	33.02	0.1464
Lekali	1.34	1.72	29.43	0.1282
Pawai	1.13	2.00	25.00	0.1105
Bonus (Check)	1.00	0.00	0.00	0.0000
Mean	1.38	2.01	34.22	0.1490
SD ( $\pm$ )	0.22	0.48	18.27	0.0824
Number	198	198	198	198

Isozymic profiling of UPGMA cluster analyses of the isozyme data in taro indicated the genetic relationships among the different-named landraces (Fig. 2). These cultivars were identifiable with individual zymotype with considerable genetic variation among them but with no correlation with described morphotypes.



**Fig. 2.** Dendrogram of 20 taro landraces, generated by UPGMA cluster analysis based on simple matching coefficients using 24 isozyme alleles detected with 6 enzyme systems ( $r=0.87$ ;  $p<0.001$ ).

### **Molecular (DNA polymorphism) diversity**

Microsatellite diversity in 39 microsatellite loci of rice (*Oryza sativa* L.) landraces was examined in 69 accessions from three ecosites representing a range of agroecological conditions and rice-growing environments. A set of samples from each ecosite comprised 10 different-named landraces with diverse phenotypes and reflected a high ethnobotanical diversity.

The study showed that the amount of diversity at microsatellite loci varied among landraces specific to agroecozones. Jumla (high altitude with cold environment) had a relatively a low level of diversity with a narrow genetic base (Bajracharya *et al.* 2001a). Despite the ethnobotanical diversity in names and phenotypes, the lack of variation in molecular data suggests that rice landraces from Jumla are closely related and could have originated from a similar source. However, the level of genetic diversity in the groups of landraces from Kaski and Bara was high and unique specific to agroecosystems and consistently reflected ethno botanical diversity in names and phenotypes (Table 2).

**Table 2.** Comparison of rice genetic diversity at molecular level, 2000-2001

Parameters	Jumla	Kaski	Bara
	(2000-3000 m)	(600-1400 m)	(100-150 m)
Landraces (FUDs)	10	10	10
Total accessions	21	24	25
Markers analyzed	39	39	39
Total alleles	43	89	90
Alleles/locus	1.10	2.28	2.31
Total polymorphic alleles	4	85	85
Polymorphic alleles/locus	2.00	2.43	2.50
% of polymorphic alleles (PPA)	9.30	95.51	94.44
% of polymorphic markers (PPL)	5.13	89.74	87.18
Similarity index mean	0.8889	0.4836	0.5002

Methods to characterize and measure the extent and distribution of diversity were developed based on the average area and number of households growing each landrace (Sthapit *et al.* 2000). The method classified the existing crop diversity into two groups at variety level: (1) common vs. rare, and (2) widespread vs. localized.

Table 3 shows the pattern of distribution of genetic diversity of rice landraces in Kaski relative to the local social and cultural values of named landraces. Landraces were thus distributed in groups of large and small areas and many and few households to suit different cultural and ethnic preferences. Depending upon the socioeconomic context and natural circumstances, the individual households were found to maintain 1-4 landraces on average.

**Table 3.** Extent and distribution of rice diversity in Kaski ecosite at community level

Area	Number of households	
	Many (>11)	Few (<11)
Large (>1.2 ha)	Ekle, Madhise, Mansara, Kathe Gurdi, Jetho Budho, Pahenle, Jhinuwa ghaiya, Thulo Gurdi	Sano Madhise, Gurdi
Small (<1.2 ha)	Seto Anadi, Jarneli, Bayarni, Anga, Rato Anadi.	Lahare Gurdi, Thulo Madhise, Sano Gurdi, Kalo Gurdi, Naulo Madhise, Jhauri, Ghaiya, Jire ghaiya, Seto ghaiya, Tunde, Rato Ghaiya, Seto Gurdi, Bicharo Ghaiya, Gurdi ghaiya, Manamuri, Pakhe Jernali, Gauriya, Kaude, Naltumme, Ramani, Basmati, Jhyle Rato Ghaiya, Mala, Kaude, Anadi, Biramphool, Dhabe Jernali, Jhinuwa, Kalo Jhinuwa, Lahare ghaiya, Kunchali ghaiya, Lame, Kanjira Ghaiya, Katuse Ghaiya, Masino Ghaiya, Masino Jhinuwa, Seto Jhinuwa, Tunde, Jhinuwa, Barmali, Chhobo Jhinuwa Basmati, Junge Bayarni, Kalo Bayarni, Rate, Pakhe Ramani, Thapachini, Seto Bayarni, Kalo Tunde Jhinuwa

## Policy implication

### Policy for diversity deployment

In Jumla valley, low genetic diversity was found in populations of *Jumli marshi* rice with a very narrow genetic base resulting in frequent breakdown due to blast disease. However, this population has a unique ability for chilling tolerance. Crop genetic resistance to disease can also be enhanced by policies that encourage (1) cultivation of diverse varieties with different genetic mechanisms for combating a pest, (2) cultivation of specific varieties that

contain multiple genetic mechanisms for resistance, or (3) continual deployment of varieties in farmers' fields by participatory plant breeding (PPB) products that carry new genetic sources of resistance.

### **Policies promoting participatory plant breeding**

The project has developed a few good participatory practices to understand the extent and distribution of local crop diversity and the processes by which farmers maintain their diversity *in situ*. PPB is considered a strategy to strengthen the process of on-farm conservation by encouraging farmers to continue to search, select and manage local crop populations. Landrace traits such as the valued cold tolerance in *Jumli Marshi*, the adaptive traits of *Mansara* or the good eating quality of *Jetho Budho* could be exploited through participatory plant breeding.

### **Cataloguing of specific and unique diversity**

The project has now developed institutional capacity at NARC to measure and characterize genetic resources at the DNA marker level. This is the first such facility developed in Nepal, which should be efficiently used to catalogue the most valued and unique genetic diversity in the country.

### **Need for *ex situ* collection facilities**

Landraces grown by a limited number of households are in danger of being lost from the habitat. The number of farmer-named cultivars is not only a reliable indicator of richness. In three sites, 54-76% of total rice diversity falls into rare groups. These landraces are grown by few a households and thus the Government should give priority to establishing an *ex situ* facility to conserve such rare and valuable genetic resources before they are lost from the fields. Also, participatory methods should be developed to allow utilization of these resources by researchers and development agencies.

### **Blending traditional knowledge**

Traditional ethnobotanical knowledge is a main source of understanding diverse local uses and traditional management practices of crop diversity *in situ*. Such understanding can be created by using participatory methods such as diversity fairs. Such tools can also be used to locate the areas with rich diversity for several economically important crops and recognize them for on-farm conservation.

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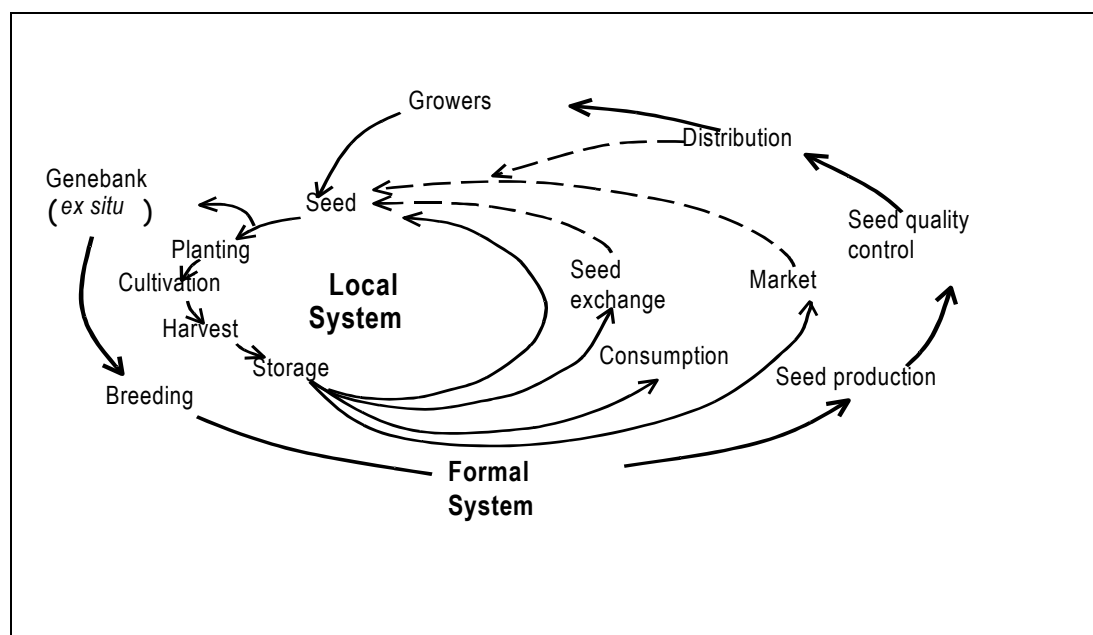
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What are the processes used to maintain genetic diversity on-farm?

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## Introduction

Crop genetic diversity of a given farming system is maintained through the combined action of natural and human-managed processes. Natural processes (environmental, biological) and human-managed (socioeconomic) factors influence a farmer's decision of whether to select or maintain a particular crop cultivar at any given time (Jarvis and Hodgkin 2000). Formal and informal human-managed processes are responsible for conserving, increasing or decreasing and modifying the genetic diversity on-farm. Figure 1 presents formal and informal human-managed processes in crop seed management. In the process of planting, managing, selecting, rogueing, harvesting and processing the farmers make decisions about their crops that affect the genetic diversity of the crop population. The way farmers select seed, store and exchange with their social networks influences the local seed management system. Over time a farmer may alter the genetic structure of the crop population by selecting for plants with preferred agromorphological or quality characters (Jarvis and Hodgkin 2000). This study tried to understand the human-managed processes of the informal local seed supply systems of rice, finger millet and taro crops in the three ecosites of the *in situ* project, Nepal.



**Fig. 1.** Formal and informal human-managed processes in crop seed management (source: adapted from Almekinders and deBoef 2000).

## Findings

Farmers in the three ecosites (Jumla, Kaski and Bara) manage local crop diversity through planting, cultivation, seed selection, harvesting and storing the crop seeds. These processes influence the geneflow and change the genetic constituent of a given crop. Two seed systems are broadly recognized—informal and formal systems. Both systems of seed supply were observed in the target crops. However, the informal or farmers' local seed supply system was

the predominant one. The informal system is characterized by farmers' producing and preserving their own seeds for subsequent planting, at times often exchanging with other farmers and or /in the form of gifts, with very little use of monetary transactions (Joshi 2000; Sthapit and Shah 2001). In the informal seed supply system, retention of the farmer's own seed and exchange with neighbours are prominent practices.

Tables 1 and 2 present farmers' management of local rice seed supply systems in different ecosites. A large percentage of cultivated area is planted with seed saved from the informal seed supply system; this ranges from 96 to 100% in Bara, Kaski and Jumla. This indicates that informal seed sources are a key element in rural livelihoods. Use of seeds from relatives is comparatively low and few farmers received seed of new varieties from research and development organizations.

**Table 1.** Farmers' management of local rice seed supply systems in the three ecosites

Source	Jumla	Kaski	Bara
Informal system (%)	100	98	96
Own retention	79	44	32
Neighbours	11	46	40
Relative	8	8	8
Others	2	–	14
Formal system (%)	–	2	4
Total	100	100	100

Source: Baniya *et al.* (2001a).

The most common way to manage seed is by exchanging seed with seed or food grain (Table 2). Again, gifts and purchases from different sources also were significant. Similar results were found in finger millet (Baniya *et al.* 2001b). In Bara, which is near research stations, about 10% of farmers received rice seed in the form of demonstrations and minikits. This process enhances the seed flow from one place to another.

**Table 2.** Farmers' sources of rice seed management in Kaski and Bara ecosites, 2000

Process of seed management (%)	Kaski	Bara
Exchange	54	64
Gift	30	17
Purchase	16	9
Others	0	10
Total	100	100

Source: Baniya *et al.* (2001b).

Farmers have the practice of changing the seed lots at certain periods. For example in Kaski, 64% of the farmers replace taro planting materials every 3 years (Baniya *et al.* 2001c). Most of the farmers follow seed selection before and after harvesting the crop. Some farmers designate a certain patch of land for seed production and use that area as a seed source. Field and plant selections are based on a fixed set of criteria, which vary from crop to crop and farmer to farmer. Mostly farmers keep seed in local containers and structures made with locally available materials. Farmers are very careful to store seed in safe places to maintain high seed quality. Types of storage structure vary with the amount of seed to be stored, its unique value and the local ethnic culture. In addition to seed selection and seed storage, farmers practise many other regular processes to grow a given crop. Few farmers reported that they rogue off-types and maintain isolation distances for preventing mechanical mixing with other grains.

**Seeds: policy implications**

*Relative importance of formal and informal seed systems:* In rural areas, rice-based livelihoods are dependent upon farmers' own seed sources. This holds true in the case of other biodiversity as well. Identifying strengths and weaknesses of farmer's seed systems and providing incentives to strengthen informal seed supply systems needs priority attention as it could serve to promote conservation of local cultivars and to supply farmer seed demand.

*Policy and legislative provision for production and distribution of seed of landrace:* Results showed that many local varieties are conserved for quality traits demanded by the market whereas some local cultivars are competitive with modern cultivars in certain niches. Seed regulatory reforms for production, promotion and marketing of competitive or valued local varieties through formal channels also need attention.

*Develop a framework for benefit-sharing mechanism for unique landraces:* Since exchange of local crop diversity is a key process in managing large amounts of genetic diversity, good practices such as biodiversity fairs and diversity kit distributions can be mainstreamed into the regular government programme to promote benefit-sharing among farming communities. Marketing unique local varieties in branded local names and recognition of seed production by a custodian community may be considered as options for benefit-sharing mechanisms.

*Inclusion of landraces seed in agricultural extension and development projects:* Methods need to be created to integrate seeds of landraces and locally adapted crop cultivars and farmers' preferences into agricultural extension programmes and development project works. This will help in promoting locally adapted crop cultivars and landraces.

*Strengthen and improve the weaknesses in the local farmers' seed systems:* Feasible modern techniques of seed production and storage systems need to be introduced to promote quality seeds in the farmer's seed systems. Communities need to be supported to establish seed networks or seed banks at the local level to enhance easy access and availability.

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## Who maintains genetic diversity and how? Policy implications for agrobiodiversity management

*Anil Subedi, Pashupati Chaudhary, Bimal Baniya, Ram Rana, Radha Krishna Tiwari, Deepak Rijal, Devra Jarvis and Bhuwon Sthapit*

### Introduction

Analyses of farmers' networks were carried out at Kaski (Begnash) and Bara (Kachorwa) ecocites of the *in situ* crop conservation project in Nepal to explore and examine who maintains genetic diversity in the community and how genetic diversity is maintained by such farmers. The study employed a sociometric survey using the snowball-sampling technique. A summary of findings and discussion of their policy implications is presented here.

### Findings

#### ***Who maintains genetic diversity on-farm?***

The study found that certain farmers maintain a relatively larger amount of crop diversity than other members of the community. Such farmers are considered to be the "nodal farmers" of the community (Subedi *et al.* 2001). They grow higher numbers of cultivars including important and rare landraces. They constantly look for new cultivars for their variable farm environments, and play an important role in the flow of genetic materials within and outside their community. They are also perceived to be more knowledgeable farmers in matters related to seed and production environments, and are the "diversity-minded" farmers in the community. However, they belong mainly to the resource-endowed farmers having larger landholdings with higher number of land parcels and livestock (Rana *et al.* 1999). Resource-endowed farmers have a higher education level and more frequent/regular participation in the local market (Gauchan *et al.* 2001). Some nodal farmers are women. These nodal farmers are spatially distributed within the community settlements.

#### ***How is genetic diversity maintained on-farm?***

The study on the seed systems has empirically revealed that farmers basically depend on their own informal (farmer) system of seed supply (Baniya *et al.* 2000, 2001) not only in the situation when seed loss occurs through a random event of natural calamity such as hail in a specific locality but also in normal situations every crop season. This informal system plays an important role in the maintenance of the varietal diversity on-farm. Seed flow occurs basically through farmers' social networks (Subedi *et al.* 2001), the main means of seed flow being: exchange (60-63%) on a barter basis (bartering either grain for seed or seed for seed but of different cultivars), gift (20-25%), borrowing of either seed or seedlings (10-12%), while a small proportion (<5%) of seed flow occurs through purchase from within or outside the community. Seed flows occur because of: a shortage or need to replace poor-quality seed retained at household level, interest in growing better cultivars as observed in other farmers' fields, interest in testing new cultivars, looking for suitable cultivars to replace the existing one for a specific land parcel, etc. Nodal farmers play an important role in these seed flows through social networks. They give seed to other farmers within and outside the community and are thus the source of seed. They also bring in materials from other farmers within and outside the community. These farmers are creating a dynamic process of delivering diversity on-farm through the germplasm flows. They are also active in selecting seed and testing diverse crop populations. Nodal farmers tend to address the diversity need of the poorer categories of farmers; poor farmers have been found to go to them to obtain seed. In this process of material flow, it was also reported that non-material (knowledge) information like valued traits of the materials, adaptive conditions, management practices or how they would perform in different conditions as well as their uses associated with the genetic materials also

flows. This indicates that nodal farmers play an important role in dissemination of knowledge-based information as well.

### **Policy implications**

The network approach is still evolving. Further study on the stability of the networks over time and identification of nodal farmers for different crops is needed. Input of participatory plant breeding (PPB) with nodal farmers needs to be studied. The implications of this farmers' network study on the national policy are outlined below.

### **Diversity deployment/extension and training**

Nodal farmers can be involved in enhancing farmer-to-farmer dissemination of genetic materials. They can be effectively involved as resource persons for farmer-to-farmer training and source of information on local crop diversity. Their expertise and knowledge can be effectively utilized in the development of training and extension materials on local cultivars and their associated knowledge; and can also be involved in public awareness on agrobiodiversity.

### **Participatory plant breeding (PPB)**

Expertise of the nodal farmers in selection and maintenance of genetic materials can be effectively used in PPB, and capacity-building of nodal farmers in participatory plant breeding may enhance diversity in a large scale of crops.

### **Strengthening on-farm conservation of crop diversity**

A network of nodal farmers can act as conservation farmers and their farms can be used as a "Field Genebank". They can very effectively be involved in community biodiversity registers (CBR) and linked to development opportunities.

### **Strengthening seed supply**

Access to local seed is often reported as a constraint for production. Nodal farmers can be involved in seed production of landraces and distribution thereby strengthening informal seed systems. At the community level, a network of nodal farmers can be a sustainable way of managing local-level seed production and distribution.

### **Methodological approach**

Network analysis is an effective methodological tool to trace the flow of genetic materials and associated knowledge along with the identification of nodal farmers. This method can be effectively adopted and employed in biodiversity conservation and utilization as well as in other research and development purposes.

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## Factors influencing farmers' decisions on management of local diversity on-farm and their policy implications

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### Introduction

Farmers make decisions on how many and which varieties of a crop to grow and on what proportion of their land. A farmer's management of these varieties on his or her farm is determined by the farmers' understanding of agroecology of the region, socioeconomic and cultural setting, economic/market forces, and current government policies. Within the project, efforts have been made through interdisciplinary research work to understand farmers' decision-making processes regarding management of plant genetic resources on-farm for developing future strategies for agrobiodiversity conservation and utilization. This paper first outlines the summary of the key findings of the *in situ* project and then briefly highlights its implications for national policy in the subsequent sections.

### Findings

#### Agroecology

Agroecology is the major determinant of the species/varieties adaptation in a certain location. Ecogeographic and baseline surveys conducted in three different ecosites—namely Bara (terai), Kaski (mid-hills) and Jumla (high-hills)—revealed that high diversity at the varietal level was positively associated with diverse ecosystems within the ecosite (Table 1). Certain species/varieties were found to be adapted to specific habitats (*Jumli Marshi*—cold-tolerant rice in Jumla, aromatic sponge gourd in Jamal Kuna, Begnas). Some landraces of rice (*Thulo/Sano Madhise* in Begnas ecosite; *Lalka Basmati* in Kachorwa ecosite) were as competitive as modern varieties (*Mansuli* or *Sabetri*) in specific domains, whereas in marginal growing environments they (*Mansara* and *Kathe Gurdi* in Begnas; *Bhati* in Kachorwa) were the only options available to farmers (Table 2). The studies also concluded that high diversity existed in mid-hills, and unique diversity was present in high-hills. Not all production systems have the same amount of diversity or the same reliance on traditional varieties.

At the isolated high-altitude site of Jumla only traditional cultivars of rice are grown whereas at Bara, on the fertile plains of Nepal, only about 17% of the rice cultivated area is occupied by local varieties and the rest of the area is occupied by modern varieties (Fig. 1). Local varieties are required at Jumla because of the difficult and extreme production conditions while at Bara, traditional cultivars continue to be used where they can fulfill special needs or are adapted to local niches (Table 2).

**Table 1.** Number of rice and finger millet varieties grown across ecosites

Ecosites	Elev. (m asl)	Rainfall (mm)	No. of varieties		No. of landraces		No. of modern varieties	
			Rice	F/Millet	Rice	F/Millet	Rice	F/Millet
Kachorwa, Bara	84	1515	53 (38.4)*	5 (12.2)	33 (29.2)	5 (12.2)	20 (80.0)	0
Begnas, Kaski	668-1206	3979	68 (49.3)	24 (58.5)	63 (55.8)	24 (58.5)	5 (20.0)	0
Talium, Jumla	2240-3000	866	17 (12.3)	12 (29.3)	17 (15.0)	12 (29.3)	0	0
Total			138	41	113	41	25	0

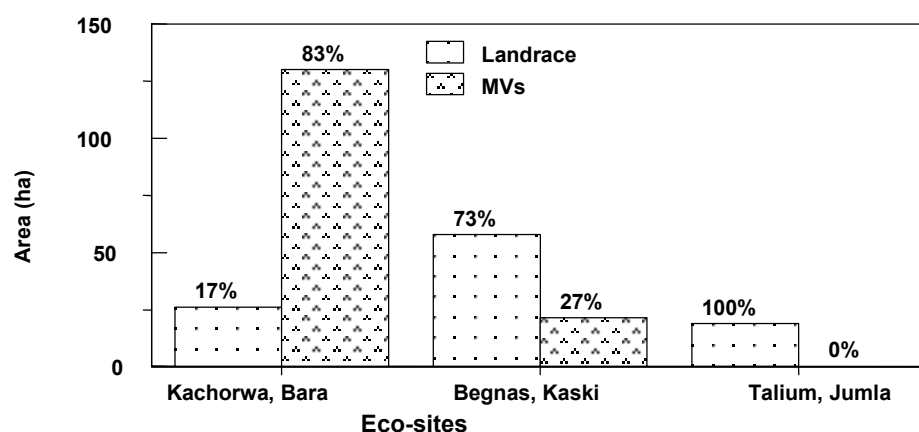
\* Figures in parenthesis indicate column percentages.

Sources: Poudyal *et al.* 1998; Rijal *et al.* 1998; Sherchand *et al.* 1998; Rana *et al.* 2000a,b,c.

**Table 2.** Adaptation of varieties across specific domains at Kachorwa ecosite, Bara

Domains	Soil type	Productivity	Varieties
Ucha (upland <i>khet</i> )	Balaute (Sandy)	III	Mutmur, Sotwa, Soka, Saro... No modern varieties found in this domain
Samtal (flat land, good drainage)	Domat (Loam)	I	Nakhi Saro, Bhadiya Basmati, Sathi, Saro... China-4, Sabetri, Jiri... (Modern varieties)
Nicha (flat land, poor drainage)	Matiyar (Clay)	II	Basmati, Lajhi, Karma, Batsar... Masula, Sabetri, Nat Masula... (Modern varieties)
Pokhari (wet land, deep water rice area)	Matiyar (Clay)	IV	Bhati, Meghraj, Silhaut No modern varieties found in this domain

(Source: Chaudhary 2000).

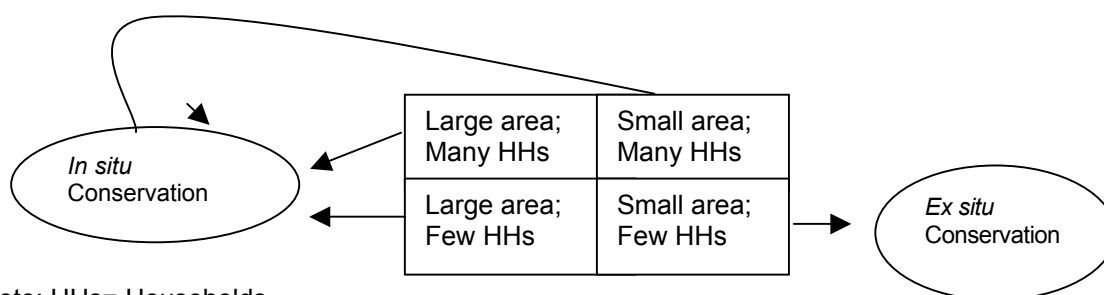


**Fig. 1.** Contribution of rice landraces in food security situation across ecosites (Rana *et al.* 2000a,b,c).

### **Economic/market facts**

Findings from market surveys, price monitoring at specific market outlets and baseline surveys indicated that many households grew rice landraces (*Jetho Budho*—30 HHs, 3.21 ha and *Pahele*—23 HHs, 3.22 ha in Begnas; *Basmati*—33 HHs, 4.4 ha in Kachorwa) with economically valued traits (aroma, fine type with soft texture after cooking) in large areas. Conversely, landraces (e.g. *Battisara* and *Thapachini*—Begnas; *Khera* and *Madhumala* - Kachorwa) with less economic value were less likely to be maintained by farmers' on-farm (Fig. 2).

The probability that farmers grow landraces only, modern variety only or both is associated with the farmers' participation in market. Farmers who participate in the market are more likely to grow landraces and modern varieties simultaneously (Gauchan *et al.* 2001b). Market-driven landraces were more uniform and many households tend to grow in large areas. Landraces favoured by market would have the least cost of conservation on-farm (Gauchan 2000). From a conservation point of view, landraces grown in small areas by a limited number of households are better conserved through *ex situ* means than *in situ*.



Note: HHs= Households

**Fig. 2.** Different conservation strategy depending upon extent and distribution of landraces.

### Sociocultural factors

Socioeconomic surveys, intensive data plots technique and knowledge acquisition methods were employed to generate information on this aspect. Richer households grow more varieties of different crops than poorer households (Rana *et al.* 2000a,b,c). Management of landraces at household level was influenced by socioeconomic factors such as wealth category, education status of decision-makers, land holding, land parcels, livestock number and market participation (Table 3).

The study concluded that resource-poor rather than resource-endowed households are more dependent on landraces for food security in marginal than in better-off environments. The area planted to rice landraces was greater in Kaski and Jumla, the marginal areas, than in Bara (Fig. 1). Culturally valued landraces were grown by many households but in small areas, e.g. *Anadi* (99 HHs, 0.02 ha) in Kaski and *Sathi* (8 HHs, 0.15 ha) in Bara. Unique rice varieties are also maintained by farmers, for example *Anga* for medicinal value and *Sathi* for rituals. Communities maintains diverse varieties within a crop to meet their multiple needs and uses. Landraces having multiple uses have better chances of survival on-farm, e.g. *Hattipau pidalu* (taro) in Begnas.

**Table 3.** Socioeconomic parameters and landraces at household level in the ecosites

Parameters	Wealth status			Remarks
	Rich	Medium	Poor	
Wealth status	1.0556	1.6064	2.34.4	1=rich, 2=medium, 3=poor
Education status	2.5000	2.2128	1.6596	1=illiterate, 2=primary, 3=secondary and above
Total Khet area	18.5778	11.6702	2.7399	Area in local unit (ropani)
Khet parcels	6.1111	4.3617	1.6064	–
Livestock number	8.8889	9.7128	3.9255	–
No. of landraces	5.1111	3.9787	1.5213	–

(Source: Rana *et al.* 2000a,b,c.)

### Policy

Policy factors play an important role in influencing farmers' decision to choose and maintain local crop diversity. Policy studies within the *in situ* project are carried out to understand the policy factor influencing positive and negative impact in local crop diversity and to strengthen national capacity for policy analysis on PGR issues. Analysis of agricultural policy, including the Agricultural Perspective Plan (APP), suggested that agricultural research, extension,

support services and education systems were directed toward modern varieties. In practice access to credit, inputs and subsidies were primarily provided to modern varieties (Gauchan *et al.* 2001a,b; Sapkota *et al.* 2001). Seed regulatory framework and market forces acted as disincentive for farmers to grow landraces on-farm (Gauchan *et al.* 2001a).

### **Policy implications**

#### **Diverse germplasm required for diverse environments in Nepalese agroecological setting:**

Adaptation or competitiveness of varieties is limited to specific domains/environment, thus niche-based variety development (broad genetic base) and promotion should be encouraged.

**Market promotion of landraces with economically and culturally valued traits:** Better market linkages are needed for landraces with economically valued traits, and public awareness on importance of conservation of cultural diversity for agrobiodiversity maintenance on-farm should be increased. These activities would stipulate the demand of landraces and consequently farmers could derive economic benefits by growing them.

#### **Ex situ collection and conservation of rare landraces:**

Landraces grown by a limited number of households are in danger of being lost from the system. These genetic materials need to be collected and conserved *ex situ* for future use. Hence, there is a need for an integrated conservation approach (*in situ* and *ex situ* conservation) as a basic requirement for long-term development of agriculture in Nepal, and specifically to address food security, poverty alleviation and equity issues.

#### **Utilization of unique landraces in breeding programmes:**

In Nepal, plant breeding programmes that use traditional and locally adopted cultivars are more successful than others. Priority should be given by research systems (commodity programmes) to utilize locally adapted diverse landraces while breeding farmer-acceptable varieties for diverse environments.

#### **Repatriation of promising landraces through extension networks:**

Evaluation and introduction of promising landraces in domains (marginal growing environments) where landraces could compete 'best fit' with modern varieties could be effected through agricultural extension networks. The availability of seed of traditional cultivars is still a constraint.

#### **Mitigation of policy hindrances for landraces conservation and utilization:**

Research, extension, credit, subsidies and seed regulations need to be reformulated so that farmers' access to quality seed of promising landraces can be improved.

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## Benefits from on-farm conservation of crop diversity: experience of Nepal's *in situ* agrobiodiversity conservation project

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### Introduction

In Nepal, on-farm management of crop genetic resources plays a vital role in the Nepalese economy and food security since more than 80% of the population depends on agriculture for a livelihood. On-farm management provides an option for future crop improvement and sustainable agriculture development. Sustainable on-farm conservation is possible only when farming communities and the nation perceive benefits in terms of genetic, economic, social and ecological aspects. These benefits accrue at private (farmer) and public (society) levels (Smale *et al.* 2001) and in different hierarchies (e.g. local, national and global). Benefits can be monetary as well as non-monetary. Important non-monetary benefits include access to more germplasm and materials as well as training opportunities, new technologies and information arising from the use of exchanged material (Raymond and Fowler 2001).

Nepal's IPGRI-supported project on *in situ* conservation of agrobiodiversity on-farm has made efforts to generate information on local crop diversity to enhance benefits in a given social, economic and ecological context. The project experience has shown that adding benefits on local crops and cultivars is one of the practical ways to enhance on-farm conservation by individual farmers and farming communities. The details of each of these strategies for value addition, their field applications in on-farm conservation research and benefits enhancing activities are described elsewhere (see Joshi *et al.* 2000; Sthapit *et al.* 2000; Gauchan *et al.* 2000, 2001; Rijal *et al.* 2000, 2001). The main strategies employed for enhancing benefits to local crop diversity used by the project are two-fold: (1) make local crop diversity competitive to the options available, and (2) increase demand for local genetic resources.

This paper presents the perceived benefits of on-farm conservation research activities of Nepal and its implications for national policy. The approach used to assess the underlined benefits of the project is based on the review, participatory field study, and direct field observation and monitoring of the project activities carried over the last 5 years.

### Findings

#### ***Economic and social benefits to farming community***

Farming communities in the project ecosites have received direct economic and social benefits from cultivation of diverse crops and cultivars. The important ones are listed below.

#### **Income generated through value addition and market linkage**

Value addition and linking a product of local crop diversity with a market increased the area of production of local crops and enhanced economic benefits to farming communities. For instance, Pratighya Cooperatives of Begnas Ecosite in Kaski has been linked to Shital Agro-Enterprise, supermarkets, hotels, and popular local food culture and ecotourism outlets in Pokhara. Local taro products (*Maseura*, *Tandre*, *Koreso*) are marketed through better processing, packaging and nutrition analysis. The cooperative has benefited from such linkages and earned Rs175,000 (US\$2350) in 3 years. The area of rice landrace (*Anadi* in Kaski) and taro (*Pindalu*, *Karkalo*) is increasing by such market linkage and value addition.

#### **Enhancing the value of local diversity through public awareness**

Creating community awareness on the value of indigenous products and local crop diversity through diversity fairs, Rural Roadside Drama, Rural poetry journey (*Kabita Yatra*) and a local radio agricultural programme ("*LI-BIRD ko Chautari*") has helped in on-farm

conservation of the local crop varieties. It has also increased exchange of local seed materials and information among farming communities. Local communities, the public and visitors in the project ecosites have been sensitized to nutritional, quality and cultural values of local varieties and food culture such as aromatic sponge gourd (*Basaune ghiraula*); easily cooked, tasty and protein-rich *panchmukhe* taro; low acidity of *Dudhe karkalo*, etc.

### **Building local capacity of farming communities and CBOs**

Farming communities and community-based organizations (CBOs) are empowered through increased ownership of community genetic resources, maintenance of community biodiversity registers (CBR), diversity fairs and diversity blocks. Initiation of participatory plant breeding (PPB) activities in rice and enhanced local social networks in seed systems have further enhanced farmers' local technical capacity in maintaining local crop diversity. Enhancement of technical skills of farmers and CBOs in decentralized decision-making and project management has been accomplished through short training and exposure visits of CBO representatives, e.g. Pratigya Cooperative, Environment and Development Club (DEPC) in Kaski, and Saving and Credit women groups in Bara including several local farmers' groups in the project ecosites.

### **Genetic benefits to farming communities**

Developing participatory plant breeding (PPB), seed selection and management programmes including other innovative tools such as CBR, diversity fairs and diversity kits has created improved access to genetic materials. In addition these have directly added genetic value to the local crops by overcoming some key constraints, presented below.

#### **Improved access to unique and valued landraces**

The innovative tools such as diversity fairs, diversity kits and CBR have been used to locate unique and valued diversity. They are also good practices to enhance access to genetic materials by the local community. For example the flow and use of unique and local valued genetic material such as aromatic sponge gourd seed, rice (*Anadi*, *Jethobudho*, *Basmati*) and taro (*Panchmukhe*) planting materials have increased over the years in the communities across the ecosites.

#### **Genetic enhancement in high-quality landraces**

Enhancement of desired genetic value of locally valued landraces through selection has been initiated in aromatic rice, e.g. *Jethobudho*, *Kariakamod*, *Lalka Basmati* in Kaski and Begnas ecosites. This has increased the access and maintenance of farmer-valued high-quality local landraces.

#### **Improvement of landraces through participatory plant breeding (PPB)**

Participatory plant breeding activities in local rice landraces have been initiated with the active participation of farmers to make them competitive with the modern varieties and to enhance the access to diverse genetic materials in the farming communities. Farmers have been involved right from setting breeding goals to management of these genetic resources in their own crop fields. In this process, a farmer variety is used as one parent. Work is ongoing in more than 6-7 crosses of rice varieties in Kaski and Bara ecosites of which *Mansara* × *Khumal-4*, *Lajhi* × IR 161-2, *Pusa basmati* × *Jethobudho* are showing promising results on-farm.

### **Ecological benefits to farming community and society**

Cultivation of diverse traditional crops and local landraces has allowed limited use of chemical inputs and reduced the vulnerability of agroecosystems to pests and other environmental stresses. On-farm conservation linked to low-input or organic farming will be able to conserve sustainable agricultural practices through improved agroecosystem health

and stability (Jarvis 1999). Some of the ecological benefits perceived are reduction in harmful chemical use in the food chain through local diversity as outlined below:

- Better adapted crops and varieties which demand low external inputs have been used to reduce pesticides and fertilizers. Examples include local rice landraces (*Mansara*, *Anga*) and some local crop species such as buckwheat, barley, pigeonpea.
- Local crop diversity is also used for organic farming and integrated pest management (IPM) technique in Kaski ecosite (e.g. Surya Adhikari's permaculture farm).
- Local organic products are linked to niche markets. The important example is *Gunilo-Shital* agroproducts which uses local organic products (e.g. taro) from the Begnas site. It is being linked to ecotourism in Pokhara and other places.

### **Overall perceived benefits to Nepal**

The work in project ecosites has given a knowledge base and modalities to scale-up agrobiodiversity conservation in other parts of the country. The project has initiated:

- work in building and strengthening local and national technical capacity in agrobiodiversity documentation, conservation and utilization.
- creation of knowledge base and information on unique and valued local genetic diversity for future crop improvement
- documentation of farmers' indigenous knowledge and local diversity to protect from biopiracy
- development and identification of innovative tools for on-farm agrobiodiversity conservation, e.g. diversity fairs, diversity kits, diversity blocks, community biodiversity registers, participatory plant breeding, Farmer Network Analysis (FNA) etc.
- awareness creation (e.g. local radio programme in Kaski) and development of market networks, including initiation of export of local products to Hongkong and Brunei
- increased utilization of local landraces in national crop breeding programmes, e.g. *Jumli Marshi*, *Lajhi*, *Mansara*, *Jethobudho* and *Lalka Basmati* rice
- institutionalization of PPB in national research systems (recognition and endorsement of PPB methods in national crop breeding systems)
- scaling up on-farm conservation as a method of development strategy in government agencies
- local and national capacity-building through human resources and development of modern molecular laboratory facilities for genetic characterization and analysis.

### **Contribution of Nepal project to global community**

The project work has contributed substantially to enhancing global knowledge on when, where and how *in situ* conservation on-farm can be successful. Substantial progress has been made in the following aspects.

The project has developed innovative methods, tools and good practices of on-farm conservation which have been increasingly adopted in other *in situ* projects at the global level, e.g. diversity fairs, CBR, PPB, FNA, etc.

Nepal's use of PPB as a strategy for on-farm conservation has been recognized and utilized by the global *in situ* conservation project.

The partnership research approach (e.g. NARS with NGOs and CBOs) and institutional framework (e.g. TCC, NMDG, LMDG, CBOs, farmers' groups) for decentralized decision-making used by Nepal project is unique.

### **Implications for national policy**

Despite the need of future in-depth empirical assessment and measurement of the impact of the benefit-enhancement options on genetic diversity, ecosystem health and human

well-being at different hierarchical levels, the experience of Nepal's on-farm conservation project has provided evidence that adding benefits and intervention strategy has the following implications for the national policy.

### **Market development**

Policy targeted to market development of local crops and landraces enhances on-farm conservation and provides direct economic, social, genetic and ecological benefits to farming communities. On-farm conservation linked to niche markets for organic and nutritional products can exploit comparative advantages of local products including other sectors of the economy.

### **Access and benefit-sharing**

Innovative approaches such as participatory plant breeding, community biodiversity register and diversity fair can be used as the R&D strategies for enhancing farmers' access to genetic resources, providing and sharing benefits to communities and sustaining on-farm conservation.

### **Ecological agriculture**

Policy linked to on-farm conservation can be linked to a broader environmental policy of maintaining ecosystem and human health and sustainable agriculture. It also enhances promotion of ecological agriculture and ecotourism.

### **Benefits to global community**

The information generated and valuable genetic resources conserved on-farm provide benefits not only to individual farmers and local communities but also to broader society at the national and global levels and to humankind as a whole.

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## Conclusions and impact

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### **Key policy considerations for PGRFA conservation**

A predominance of farming communities in rural areas and dependence of the economy on diversified agriculture require formulation of economic development policies, legislation, rules and regulation that favour conservation of genetic diversity and protect the interests of farming communities and the nation. The policies should also help improve livelihood of the farming communities and make them competitive in the global scenario. This necessitates an umbrella policy on PGRFA in the country for the sustainable conservation and use of diverse crop genetic resources.

The specific findings of the *in situ* projects and policy case study including specific policy considerations for the conservation of PGRFA are briefly outlined in Table 1.

After the policy workshop on 16 February 2002, follow-up monitoring was undertaken by the *in situ* policy research team to document the policy initiatives /actions undertaken by the relevant policy-makers. Through the process of policy workshop and the policy case study it was possible to make some of the high-level key officials of the government and policy-makers aware of the importance of agrobiodiversity conservation in Nepal. The policy workshop provided an additional opportunity to develop links among important stakeholders in the country. It also helped stimulate the activities of the National Agrobiodiversity Committee (NABC) to coordinate and consult stakeholders in the policy dialogue and policy formulation process in agrobiodiversity issues in Nepal. Some of the recent policy initiatives and the activities undertaken by the concerned policy-makers and stakeholders after the policy workshop are presented in the Table 2.

In addition to these recent policy initiatives that came out of this meeting, the NABC visited Kaski and Mustang districts and initiated stakeholder consultation meetings in the process of developing policy guidelines and initiate agrobiodiversity conservation activities. Moreover, *In Situ* Project Nepal's presentation of its key research findings further stimulated key decision-makers in the MOAC and the NARC to coordinate and take a lead in organizing consultation meetings on agrobiodiversity conservation issues, specifically on the inclusion of an agrobiodiversity component as a priority sector in the 10th National Plan (2002-2007).

The outcome of the meeting is also seen in the progress made in the process of enlisting agrobiodiversity as the priority sector in the 10th National Plan (2002-2007) and developing appropriate linkages and coordination mechanisms among important stakeholders, particularly with I/NGO sectors in Nepal. The meeting also led to increased understanding and level of awareness on agrobiodiversity issues; this has been observed among the government sectors, particularly in the MOAC, resulting in new action plans and consultation meetings organized in close collaboration between public and I/NGO private sectors.

**Table 1.** Key findings and policy consideration in crop genetic resources conservation

<b>Key findings</b>	<b>Policy consideration</b>
1a. Landraces are adapted in marginal/niche-specific environments	Include conservation and utilization of agrobiodiversity as the priority sector in the 10th Five-Year Plan Develop a National Policy on Agrobiodiversity Recognize and reward the farming communities for their contributions through appropriate Farmers Rights
1b. Diversity still maintained by the traditional farmers with their traditional knowledge, skills and techniques (KST)	
1c. Landraces contribute to food security and poverty reduction in high and mid-hills and in marginal areas of Terai	
2a. Genetic diversity in the form of landraces/farmers' varieties is gradually disappearing	Establish a national genebank facility to conserve endangered landraces Enhance national capacity in characterization and utilization by strengthening biotechnological facilities Promote public awareness and value-addition activities Develop curriculum and courses on agrobiodiversity conservation in schools, colleges, universities and extension training
2b. About 57-76% of existing landraces are threatened. Higher rate of extinction is of great concern	
2c. Valuable and unique value of local diversity has been identified	
3a. Increased access to landraces increased their area of production	Include landraces package in the extension demonstration and promotion campaign Promote local products and crop diversity through economic and agricultural policy Promote linkage with market outlets
3b. Linking with market for local crop diversity increased the area of production and enhanced economic benefits to farming communities	
4. Participatory plant breeding (PPB) and genetic enhancement of landraces indicated the plausible potential of local crop diversity in increasing production capability, quality and farmers' welfare	Promote landrace enhancement and PPB in national research policy Integrate PPB into national plant breeding programmes to select, and maintain local crop diversity
5. Community Biodiversity Register (CBR) has increased access and ownership of genetic resources, and has assisted in monitoring of genetic diversity over time	Scale-up CBR as a national campaign to list and monitor valuable genetic resources in line with national needs and international commitments to protect the interests of farming communities
6. Created community awareness on local indigenous products and local diversity with various participatory methods	Institutionalize activities like diversity fairs in national agricultural extension programmes
7a. Informal seed supply predominates in the national production systems	Strengthen and support informal seed supply systems through national policies Support farmers' social network and increase the capability of nodal farmers through extension programmes Reform seed regulatory framework to ensure it recognizes and promotes the local seed source
7b. Farmers' networks and the nodal farmers play key role in maintaining local crop diversity	

**Table 2.** New policy initiatives undertaken after policy meeting (16 February 2002)

<b>Date and Venue</b>	<b>Policy Actions Undertaken</b>	<b>Outcomes of the meeting</b>
28 Feb 2002	Discussion on inclusions of Agrobiodiversity as a priority issue in the 10th National Development Plan (2002-2007). The meeting was coordinated and chaired by Joint Secretary Planning, Ministry of Agriculture	The meeting was attended by key decision-makers of Agricultural Ministry and its R & D institutions Meeting agreed to include conservation of agrobiodiversity as a priority sector in the 10th plan and a subcommittee was formed to review, revise, reword and integrate appropriate statement in the 10th Plan
5 March 2002	Meeting on community biodiversity registration to develop and discuss development of CBR formats. The meeting was organized by the MOFSC	The meeting was attended by stakeholders from MOFSC, MOAC, NARC, I/NGO (LI-BIRD, Action Aid) The meeting agreed to initiate CBR process with the modification of available format as the pilot basis
10-12 April 2002	Field implementation and orientation training of community biodiversity register (CBR) to field staff, relevant stakeholders and farmers in Kaski. The training was coordinated by MOFSC with <i>In Situ</i> Project, Nepal	The training was successfully completed in association with In Situ Project and LI-BIRD, Nepal and local stakeholders in Kaski Field implementation of CBR process initiated as a pilot basis in Chaur (Begnas) and Maramche villages in Kaski district, Western Nepal
4-5 May 2002	Consultation Meeting for Intellectual Property Rights (IPR) and Farmers Rights. The meeting was organized by Action Aid, Nepal in cooperation of NARC	Meeting was held successfully with the support of MOAC and the other important stakeholders and of some international experts from Asia The meeting agreed that Nepal needs to have appropriate farmers' rights legislation suited to the needs of the country

## Annexe 1. Reflections on the policy workshop

A half-day policy workshop was organized on 16 February 2002 at Hotel Yak and Yeti in Kathmandu to share the results of ongoing research and development activities of the *in situ* conservation project with the key stakeholders and policy-makers in Nepal. There were 47 participants representing different government ministries, research and development institutions, and international and national NGO representatives. Key decision-makers from Ministry of Agriculture, Ministry of Forestry and Soil Conservation, National Planning Commission and Nepal Agricultural Research Council made presentations at the workshop. Director General of IPGRI, Rome and Regional Director-APO-Malaysia were the special guests of the workshop and provided their valuable guidelines and inputs for the meeting. All the participants appreciated the work done by the Nepal component of the *in situ* conservation project team and the scientific presentations of the major results of the project with their important policy implications. It was expressed that within a short period of time, this seminar was able to share major results of the project including their important policy implications. A display in the seminar hall supported the results of the project. Some of the important reflections expressed during the workshop by the key decision-makers are outlined below.

1. Mr Raghunath P. Sapkota, Executive Director, Nepal Agricultural Research Council (NARC): As a welcome address to the policy meeting Mr Sapkota expressed that *in situ* conservation of agrobiodiversity in Nepal recently has generated more energy among scientists, planners and policy-makers. The project has successfully demonstrated that partnership produces better outputs if we maintain transparency in the work and document information in a team spirit and publish achievements jointly. The project work is directed toward enhancing the level of benefits to farming communities through scientific advances, and to linking conservation strategies with markets. National research and development systems may have to orient their approaches to promote agrobiodiversity to meet the aspirations of the present and future generations of the Nepalese people.
2. Mr Harishankar Tripathy, Honourable Member, National Planning Commission (Agriculture and Forestry Sector), His Majesty's Government of Nepal: As a chief guest, Mr Tripathi said that poverty alleviation will remain the main thrust of the Tenth Five-Year Plan and agrobiodiversity will certainly receive priority as a basic natural resource base for agricultural development. He emphasized that richness in agrobiodiversity should be translated into benefits for Nepalese farmers and the community. The interests of the community are protected for sustained conservation of agrobiodiversity through their involvement and empowerment. In today's changing world, Intellectual Property Rights, Plant Breeders' Rights and Farmers' Rights have to be harmonised through development of appropriate policy and legislative measures. We are in the process of developing national policies on these issues to meet our needs. We will do our best to support the outcomes of this meeting.
3. Mr R.L. Kayastha, Secretary of Ministry of Agriculture and Cooperatives (MOAC): As chairperson of the policy meeting, Mr Kaya highlighted the importance of agrobiodiversity conservation to ensuring local and national food security in Nepal. He reflected his commitments to include agrobiodiversity conservation issues in the forthcoming 10th National Development Plan. He added that the microlevel field research findings of the *in situ* agrobiodiversity project on the conservation of local crop diversity are very noteworthy. The outcome of today's meeting and the key policy finding presented today by the project team has to be translated into ensuring food

security and alleviating poverty in Nepal. We will certainly initiate the process to include agrobiodiversity as a priority sector in the upcoming Tenth Five-Year national plan, which will be implemented in the next fiscal year. Similarly, the complementarities between the long-term Agricultural Perspective Plan (APP) and utilization of agrobiodiversity have to be worked out.

4. Dr Udaya Raj Sharma, Joint Secretary, Ministry of Forestry and Soil Conservation (MOFSC): As a focal point for CBD and biodiversity sector in Nepal, he informed that we are in the process of finalization of a Nepal Biodiversity Strategy (NBS), access and benefit-sharing legislation, biodiversity trust fund and National Biodiversity Implementation Plan. NBS provides an institutional mechanism to coordinate, prioritize programmes and activities, seek donor support, and involve stakeholders in the process of planning and implementation for biodiversity conservation activities among private and civic society sectors in Nepal. He highlighted the commitments of MOFSC to enhance linkage with the *in situ* project and MOAC for addressing the agrobiodiversity part in the upcoming policy documents. He appreciated the institutional framework of the *in situ* project which has increased the effective participation of farmers in planning agrobiodiversity conservation activities and also recognized the good work of the *in situ* project in initiating the process of developing Community Biodiversity Registers in Nepal.
5. Mr Narayan Regmi, Joint Secretary and Spokesman, MOAC: Mr Regmi as a secretary (focal point) for National Agrobiodiversity Committee (NABC), Nepal emphasized the inclusion of agrobiodiversity conservation in the 10th National Development Plan for the sustainable development of the country. He appreciated the contribution of the *in situ* project in highlighting agrobiodiversity conservation activities through linking conservation with market. The lessons from *in situ* conservation research have to be utilized and integrated in the upcoming 10th National Development Plan. This is the best time for the national planning commission to think of using agrobiodiversity for sustainable development in the country.
6. Mr Ashewor Jha, Joint Secretary and Chief, Women Farmer Development Division (WFDD), MOAC: Mr Jha, an extensionist and former Director General of Department of Agriculture, reflected that the *in situ* project findings presented in the workshop have stimulated us to rethink our agriculture development plan and policy. Past approach of development has been basically focused on modern varieties (MVs) where adoption of MVs has been an indicator of success. As a result local crop cultivars with unique traits have been lost. Now is the time to rethink about the inclusion of local varieties in the formal channel of agricultural development process.
7. Mr Ganesh KC, Joint Secretary and Chief Planning Division, MOAC: Mr Ganesh KC, a key person in the Ministry of Agriculture and Cooperatives, informed the workshop participants that Nepal is soon going to be a signatory of the Revised FAO International Undertaking for Plant Genetic Resource for Food and Agriculture which was approved 3 November 2001 in FAO, Rome. This is also a good indicator of our continued support of agrobiodiversity conservation. He believes that the recommendation of today's meeting will be implemented by the government.
8. Mr Gyan Prasad Sharma, Under Secretary, National Planning Commission: Mr Sharma a key official involved in the planning and development of policy in Agricultural and Forestry Sector at the National Planning Commission, highlighted the inclusion of the overall biodiversity sector in the approach paper of the 10th National Development Plan.

Both Agriculture and Forestry sectors should see biodiversity conservation as a joint activity. National Planning Commission (NPC) is committed to including a agrobiodiversity conservation chapter in the National Plan.

9. Dr Eklabya Sharma, Head of Farming Systems Division, International Center for Integrated Mountain Development (ICIMOD): Dr Sharma appreciated the work of the *in situ* conservation project and the sharing of results of the research activities. He shared his experience from ICIMOD in working with the mountain communities/farmers. He expressed his concern that an appropriate strategy is needed for on-farm agrobiodiversity conservation in maintaining local diversity in the situation of changing pattern of cropping with the promotion of cash crops in the mountains.
  
10. Dr Geoff Hawtin, Director General, IPGRI, Rome: As a special guest of the policy workshop, Dr Hawtin said that *in situ* conservation is one of the best ways of conserving the traditional genes in farmers' fields and now the governments of the globe should give priority to preserving traditional landraces and linking with market opportunities. Community biodiversity registration initiated by the project is a good initiative to provide benefits to farming communities and the nation. It recognizes ownership of genetic resources not only by the local community but also the sovereignty of the national government. He believes that the experiences and findings of the Nepal *in situ* project have given some guidelines for appropriate national policy development in Nepal. One project experience is that conservation of genetic materials through use is important, not just conservation *per se*. He also believes that ratification of the revised FAO International Undertaking by Nepal will provide impetus for agrobiodiversity conservation. This type of multilateral agreement has given opportunity for flow of genetic materials to enhance global and regional food security, which is not possible through bilateral arrangements. The CBD (1992) is a major international policy that recognizes national sovereignty of genetic resources and provides policy options for sustainable conservation, utilization and equitable sharing of the benefits to a nation and the community. It has also a mechanism for technical support to developing countries in building their capacity in biodiversity conservation.

## Annexe 2. Meeting participants

Name	Designation and address
Mr HS Tripathi	Honorary member, National Planning Commission
Mr GP Sharma	Under Secretary, National Planning Commission
Mr RL Kaye Stha	Secretary of MOAC & Chairperson of NABC
Mr Ganesh KC	Joint Secretary, Planning, MOAC
Mr A Jha	Joint Secretary, Women Development Division, MOAC
Mr N Regmi	Joint Secretary MOAC & Member Secretary, NABC
Mr RB Shrestha	Environmental Unit, MOAC
Dr UR Sharma	Joint Secretary, Environmental Division, MOFSC
Mr D Parajuli	Joint Secretary, MOFSC
Mr RP Sapkota	Executive Director, NARC
Mr DS Pathic	Director, Crops and Horticulture, NARC
Dr G Hawtin	Director General, IPGRI
Dr P Sajise	Regional Director, IPGRI-APO
Mr SB Pandey	Director, Planning, NARC
Mr NP Shrestha	Director, Livestock, NARC
Mr BMS Basnet	Chief, CPDD, NARC
Dr HP Bimb	Bio-technologist, NARC
Mr BR Kaini	Director General, Department of Agriculture, MOAC
Mr BK Baniya	Chief, ABD, <i>In Situ</i> Conservation Project, Nepal
Dr A Subedi	Executive Director, LI-BIRD
Dr MP Upadhyaya	National Project Coordinator, <i>In Situ</i> Project, Nepal
Dr M Joshi	Thematic leader, <i>In Situ</i> Project, NARC, Nepal
Mr KP Shrestha	Plant breeder, <i>In Situ</i> Project, NARC, Nepal
Mr A Mudwari	Senior scientist, <i>In Situ</i> Project, NARC, Nepal
Mrs J Bajracharya	Crop biologist, PhD Student, <i>In Situ</i> Project, NARC
Mr RB Rana	Socioeconomist, PhD student, <i>In Situ</i> Project LI-BIRD
Mr D Gauchan	Economist, PhD student, <i>In Situ</i> Project, NARC
Mr S Gyaweli	Plant Breeder, LI-BIRD, <i>In Situ</i> Project LI-BIRD
Mr P Chaudhary	Site Officer, <i>In situ</i> Project, Bara, LI-BIRD
Mr ML Vaidya	Site coordinator, JUMLA, <i>In Situ</i> Project, NARC
Mr KP Baral	Site coordinator, KASKI, <i>In Situ</i> Project LI-BIRD
Dr BR Sthapit	Scientist, IPGRI-APO
Dr KD Joshi	Adjunct Scientist, ASP/DFID-CIMMYT-Nepal
Dr V Singh	Programme Officer, UNDP /GEF,
Dr E Sharma	Chief, Farming System Division, ICIMOD,
Dr B Thapa	Asst. Country Director, CARE- Nepal
Mr S Bhandari	Environmental Lawyer, IUCN
Mr GK Sedhai	FRP Coordinator, PRO-Public
Ms Y Ghale	Coordinator Food Rights Campaign, Action AID- Nepal
Dr Hari Bahadur. K C	Technical Officer, ABD

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Mr K Aryal	Field Officer, LI-BIRD
Mr YR Pandey	Horticulturist, HRS, Jumla
Mr BH Adhikari	Horticulturist and Chief, HRS, Malepatan, Pokhara
Mr R Gautam	Program Officer, LI-BIRD, Kaski
Mr RK Tiwari	Site Officer, Kaski, <i>In situ</i> Project, NARC
Mr PR Tiwari	Site Officer, Jumla, <i>In situ</i> Project, LI-BIRD
Mr SK Shrestha	Administrative Officer, <i>In situ</i> Project, NARC

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## Annexe 3. Press coverage in Nepal national news media

<b>Newspaper</b>	<b>Headline</b>
Adarsha Samaj	IPGRI's scientist in Begnas
Kantipur	Rome's biodiversity expert team in Begnas
Gorkhapatra	Need for conservation of traditional crops
Nepal Samacharpatra	Poor preparation of bio wealth rich country
	Possibility of losing IPR
Spacetime	Nepal needs genebank for agrobiodiversity
Rajdhani	Nepal can compete in international trade with biodiversity conservation
The Himalayan Times	Conservation of agrobiodiversity
The Himalayan Times	Well defined biodiversity policy needed
Space Time Today	Need to explore and utilize agrobiodiversity
Adarsha samaj	Emphasis on conserving landraces
Kathmandu Post	IPGRI Chief arrives Today
Kathmandu Post	Call to preserve agrobiodiversity
Kathmandu Post	Green Revolution: Scientific Vs traditional farming
The Rising Nepal	Nepal's Entry to WTO: Time to review policy changes
The Himalayan Times	Wild rice species facing extinction, says experts
The Himalayan Times	Lack of conservation efforts leading rapid genetic erosion of agrobiodiversity
Kantipur	Demand for separate programme for biodiversity development
Adarsha samaj	In the context of biodiversity conservation, concept of community seed bank: process and challenges
Kantipur	Variability within <i>Jetho budho</i> rice

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