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Dwindling diversity

– Attitudes and knowledge among different stakeholders about loss of agrobiodiversity in Nepal

Minskande mångfald – attityder och kunskap hos olika intressenter rörande förlust av agrobiodiversitet i Nepal

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My fascination with Nepal goes back a long time, all the way to that monsoon trek when I was 16 and first experienced the beauty, richness and warmth of this welcoming and quirky place.

The lush kitchen gardens of the Kathmandu valley, Ilam and Dhading inspired my choice to enter the field of horticulture. Therefore, I write these lines with a sense of gratitude towards the farmers of Nepal – especially those who kindly and without hesitation agreed to be interviewed for this study.

I would like to thank my supervisor Jonatan Leo for invaluable guidance, feedback and support.

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Stina Mortensen
Stångby, 7 January 2019

Abstract

Nepal's rich agrobiodiversity is rapidly decreasing, as local varieties of crops are replaced by imported hybrid or improved varieties. At the same time, in light of the increasingly apparent effects of climate change, the need for a broad genetic base in order to maintain the ability to adapt to new conditions is evident. In this study, the attitudes towards and knowledge of different crop types, agrobiodiversity loss and conservation among different stakeholders are examined. The results show that farmers' choices of crops are mainly motivated by yield and taste. Farmers are aware that local varieties are disappearing, but not about the possible long-term consequences of this loss. Conservation efforts need to take into account the economic reality of farmers and economic incentives to grow landraces should be strengthened. Continued support to community seed banks as a tool for conservation and awareness raising is indicated. As the role of landraces as a source of genetic diversity is not apparent to farmers in general, communication regarding conservation should focus on the perceived advantages of superior taste, increased food security, and potential economic benefits.

Sammanfattning

Nepals rika agrobiodiversitet minskar snabbt, då lokala sorter ersätts av importerade hybrider eller förädlade sorter. Samtidigt gör de alltmer uppenbara effekterna av klimatförändringar att behovet av en bred genetisk bas som verktyg för anpassning till nya förhållanden är stort. I denna studie undersöks attityder till och kunskap om olika sorters grödor, agrobiodiversitetsförlust och bevarandeåtgärder bland olika intressenter. Resultatet visar att odlarnas val av grödor främst motiveras av avkastning och smak. Odlare är medvetna om att lokala sorter försvinner, men inte om de möjliga långsiktiga konsekvenserna av detta. Bevarandeåtgärder måste ta hänsyn till odlarnas ekonomiska situation, och ekonomiska incitament för att välja lantraser bör stärkas. Fortsatt stöd till community seed banks som ett verktyg för bevarande och medvetandegörande är lämpligt. Då lantrasers roll som källa till genetisk diversitet inte är uppenbar för odlare i allmänhet bör kommunikation rörande bevarande fokusera på konkreta fördelar såsom överlägsen smak, ökad livsmedelstrygghet och potentiella ekonomiska fördelar.

Glossary and acronyms

Bikashe	Developed or improved (Nepali)

CBD	Convention on Biological Diversity
CIMMYT	International Maize and Wheat Improvement Centre
CSB	Community Seed Bank
IAAS	Institute of Agriculture and Animal Science
ICIMOD	International Centre for Integrated Mountain Development
IRRI	International Rice Research Institute
ITPGRFA	International Treaty on Plant Genetic Resource for Food and Agriculture
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
NAGRC	National Agriculture Genetic Resources Centre; the national gene bank
NARC	Nepal Agricultural Research Council
NGO	Non-Governmental Organization
PES	Payment for Environmental/Ecosystem Services

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1 Introduction

Nepal hosts a vast array of different agricultural systems and a diversity of crops to match. But the same topographical features that contribute to this richness in agrobiodiversity are also part of what makes the country vulnerable to the effects of climate change. The need for adaptation strategies is already evident, but the tool box of plant genetic resources, that could be used for diversification or plant breeding to meet the changing conditions, is rapidly being depleted as landraces and farmers' varieties are replaced by imported seeds.

1.1 Background

1.1.1 Agrobiodiversity: definition and significance

The concept of agrobiodiversity in a broad sense covers not only the planned diversity of crops and livestock (and their wild relatives), but also the associated diversity of interacting species such as pollinators, symbionts and biological control agents – plus competitors, pests, parasites and predators (Qualset, McGuire & Warburton 1995). In this study, focus is on crop diversity.

The importance of agrobiodiversity can be described in terms of *food security, ecosystem services, resilience* and *adaptability*.

The issue of *food security* is naturally centred around getting an adequate and stable yield. Complex ecosystems, with a high number of species or a high degree of intra-specific genetic diversity, often display a higher overall productivity than simpler systems (Frison, Cherfas & Hodgkin 2011). For instance, home gardens can achieve high productivity and make maximal use of existing resources by using many species that occupy different micro-niches. Greater diversity is also associated with increased resistance to pests and diseases, which in turn leads to increased yield and yield stability.

Ecosystem services are usually classified into four categories: provisioning, regulating, cultural and supporting services (FAO 2007). While biodiversity cannot be placed directly in any of these categories, it plays an elemental role in the provision of ecosystem services. For instance, agrobiodiversity is directly related to food production (a provisioning service), pollination (a regulating service) and the aesthetic value of a landscape (a cultural service). The ability of biodiversity to maintain ecosystem function and services has been emphasized by Rockström et al. (2009).

Resilience in the face of adversity and *adaptability* to changing conditions go hand in hand. Jackson et al. (2010) call it sustainagility (the ability to adapt and meet needs in new ways under changing conditions) and link it to agrobiodiversity: ”Agrobiodiversity plays an important role in sustainagility, as it provides the biological sources (genes, species, and habitats) needed for adaptation and transformation to new production systems under unknown future environmental conditions.” (Jackson et al. 2010, p. 85)

Climate change is already presenting farmers with a range of challenges. Among them, droughts, floods, erratic rainfall and changing seasonal weather patterns are prominent (Mijatović et al. 2013). Biodiversity loss affects the ability of ecosystems to adapt to changing conditions, and thus increases their vulnerability to the effects of climate change (Rockström et al. 2009). The Himalayas are sensitive to the global changes taking place; temperatures are rising at a proportionately higher rate than the global average increase, monsoon timing is shifting, and precipitation patterns are changing (Xu et al. 2009).

The importance of species and varietal diversity becomes apparent when stress caused by climate change adversely affects land productivity. Using resistant or tolerant varieties is a mechanism of adaptation available to farmers, together with diversification of farming systems such as a higher diversity of crops and introduction of agro-forestry (Mijatović et al. 2013). Improvement of stress-tolerance through selection and breeding requires diversity as a source of stress-resistant and other desirable traits. Landraces, thanks to their adaptation to a wide variety of conditions through centuries of evolution, are a source of yield-enhancing and abiotic stress tolerant alleles (Dwivedi et al. 2016).

As many of the functions performed by various components of ecosystems are unknown, adopting a precautionary approach is often advocated. For example, according to the insurance hypothesis, heterogeneity of agricultural ecosystems can provide insurance value against environmental fluctuations in ways that are not necessarily detected by the kind of research that is typically conducted in the agricultural field (Jackson, Pascual & Hodgkin 2007).

1.1.2 Agrobiodiversity in Nepal

Nepal is rich in biodiversity, due to a wide variety of habitats in terms of climate, topography and ecological composition. It is situated between the Indo-Gangetic plain and the Himalayan mountain range (see Figure 1), with an elevation of between 60 and 8848 metres above sea level, within the 300 km north-south span of the country. Annual rainfall ranges from 165 mm in the semi-desert of the Trans-Himalaya to 5500 mm in the Pokhara valley in western Nepal (Government of Nepal 2014). Most of the rainfall occurs during the summer months of June–

September. Nepal is often described as consisting of three major zones: the Terai, which is the lowland area along the southern border with India; the hill region, with an altitude of 500–3000 m a.s.l.; and the mountain region. Many parts of the country are not accessible by road.

There are 282 endemic species of flowering plants in Nepal, the majority of which are found in the mountain zone (DPR 2013). Regarding agricultural species, the estimated number of crop landraces in Nepal is 30 000 (Joshi et al. 2017). There is a high genetic diversity in for example rice (*Oryza sativa*) (with more than 2 000 landraces), barley (*Hordeum vulgare*) and millet (*Eleucine coracana*) (Maskey 1996). Black gram (*Vigna mungo*), rice bean (*Vigna umbellata*), leaf mustard (*Brassica juncea*), common beans (*Phaseolus vulgaris*), cucumber (*Cucumis sativus*), gourd (various Cucurbitaceae), taro (*Colocasia esculenta*) etc are other crops that show a great genetic diversity here; Nepal is situated in a region believed to be the centre of diversity or origin of these species – i.e. the area where their distinctive properties developed (Zeven & Žukovskij 1975 see Paudel et al. 1998). The country is considered a secondary centre of diversity (with slightly less genetic diversity) for maize (*Zea mays*), buckwheat (*Fagopyrum esculentum*), pumpkin (*Cucurbita pepo*), sesame (*Sesamum indicum*) and cowpea (*Vigna unguiculata*).

Figure 1. Nepal is situated between India and China. Map source: http://www.freeworldmaps.net/asia/nepal/nepal-geography.jpg

The country is home to many different ethnic, religious and socio-cultural groups, each with their own preferences regarding food crops and culturally significant plants. More than 75 percent of the population depend on agriculture for their livelihood (MoAD 2017).

Traditional farming systems are assumed to play a major role in creating and conserving agrobiodiversity. Local adaptations to diverse physiographical and ecological conditions have led to the development of a vast array of both wild and cultivated species, and a range of different cropping systems (Maskey 1996). Agricultural systems vary between the agro-ecological zones: in the harsh climatic conditions of the mountains, agriculture is dominated by livestock farming and cultivation of mainly barley, buckwheat, millet and potatoes; in the hills, a wide variety of crops is grown, including maize, rice, different legumes and

vegetables; in the Terai, the major food producing area in the country, rice is the dominant cereal crop.

An agricultural system with great genetic diversity is the home garden, described by Sunwar et al. as “living gene banks and a reservoir of plant genetic resources” (Sunwar et al. 2006, p. 4212). In home gardens, new crops are tested, wild species domesticated, and underutilized species conserved (Shrestha et al. 2002). The traditional Nepalese home garden is an intensively cultivated area situated around the house, where a greater variety of crops – mainly vegetables, fruits, herbs and spices – is grown compared to other production domains of the household (Pandey 2015; Sunwar et al. 2006). 72% of households have home gardens (Gautam et al. 2005). Women are generally playing a major role in the management of home gardens and are highly influential in the choice of crops to be grown (Shrestha et al. 2002).

Plant breeding and research is undertaken by various organizations in Nepal. Among those are the research stations and Agriculture Botany Division of NARC (Nepal Agricultural Research Council), the Department of Plant Breeding of IAAS (Institute of Agriculture and Animal Science) and LI-BIRD (Local Initiatives for Biodiversity, Research and Development) (Joshi 2017). The main focus since the first programmes started in the 1960s has been cereal crops (rice, wheat and maize), but breeding is also done on potato, oilseed crops, pulses and vegetables etc. International research organizations active in this field in Nepal are among others Bioversity International, IRRI (International Rice Research Institute), CIMMYT (International Maize and Wheat Improvement Centre) and ICIMOD (International Centre for Integrated Mountain Development).

1.1.3 Loss of diversity

Loss and fragmentation of natural habitats, due to pressure from human activities such as urban sprawl, road development and livestock grazing, is a threat to biodiversity in Nepal (Maskey 1996). The rapid and unplanned urbanisation is a threat to natural habitats and agricultural land, as large areas are being covered by buildings and roads. The increased outmigration to urban areas and overseas, caused by lack of employment, infrastructure and other amenities in rural areas, has also led to marginal agricultural lands being abandoned in recent years (Upreti & Upreti 2002; Government of Nepal 2014).

Nepal is experiencing a rapid loss of agrobiodiversity. It is estimated that 50 percent of the traditional varieties are no longer cultivated (Paudel, Joshi & Ghimire 2016). A survey conducted by Sunwar et al. (2006) among farmers in western Nepal revealed that the perceived causes behind loss of local and wild species are inaccessibility of seed/planting

material, deforestation, land fragmentation, difficulty to maintain planting material, introduction of new varieties and lack of market incentives for local varieties.

In general terms, many factors can contribute to the loss of crop diversity: social factors, for example farmers following the example of neighbours who adopt new varieties; political factors, for instance the tendency of development programs to focus on improved or hybrid varieties; natural factors such as disastrous droughts that lead to total destruction of local crops; and economic factors, that motivate farmers to switch to high-yielding modern varieties (Shrestha, Vernooy & Sthapit 2015). To this can be added a lack of awareness among farmers about current and future potential value of local varieties.

A major cause of agrobiodiversity loss in Nepal is the ongoing commercialization of agriculture (Upreti & Upreti 2002). Landraces, often grown for domestic consumption or specific purposes like medicine, festivals or religion, with a minimum of external inputs, cannot compete with newly introduced varieties in terms of yield. Integrated agricultural systems, with production of food, fuel, fibre, fodder and agro-forestry, are being replaced by monocultures and specialized farming. The local seed management systems – especially regarding vegetable seeds – is being replaced by a commercial seed sector, whereby genetic resources are lost as hybrids and improved varieties are introduced by multinational companies through local traders.

Road access, and the associated accessibility of markets for buying agricultural inputs and marketing crops, is a major factor in commercialization (Bhatta & Doppler 2016; Brown & Shrestha 2000). When a previously inaccessible area becomes more accessible, the result is an accelerated loss of biodiversity (Upreti & Upreti 2002). In remote areas, farmers are still saving seeds at household level whereas in more accessible areas this practice is disappearing, giving way to an increased dependence on the seeds available in the market.

Physical and market accessibility affect the type and intensity of threats to agrobiodiversity: urbanisation, commercialization and introduction of exotic species is more prominent in the Terai, while low awareness is more related to the mountain areas (Government of Nepal 2014).

Government organizations and NGOs are mainly focusing their development interventions and extension services on introducing improved varieties or exotic species, largely ignoring indigenous knowledge and practices (Sunwar et al. 2006; Upreti & Upreti 2002).

On 25 April 2015, an earthquake with a magnitude of 7.8 struck Nepal. Almost 9 000 people were killed, and the material damage was considerable. The earthquake also had a negative impact on agrobiodiversity in the affected districts: a rescue collection mission found that over 100 landraces were lost due to the earthquake and several others became

endangered, as storage structures were damaged and stored seeds buried, and as external agencies distributed improved and hybrid seeds as relief material (Gauchan, Joshi & Ghimire 2017). The building housing the national gene bank was also partially damaged, and the possibility of another earthquake of similar magnitude poses a potential threat to the collection of genetic resources kept on the premises (Paudel, Joshi & Ghimire 2016).

1.1.4 Conservation efforts

Ex situ conservation refers to maintenance of genetic resources in places like gene banks and botanical gardens, while *in situ* conservation is maintenance of genetic resources in natural habitats or on-farm – whether through the everyday activities of farmers or through the efforts of specific projects (Brush 2000). Conservation efforts have historically often focused on *ex situ* methods, but recognition of the importance of on-farm management of crop diversity is increasing as it contributes to preserving not only traditional crop varieties but also the knowledge system associated with them (Bioversity International 2012 see Sthapit 2013). Thanks to the dynamic nature of on-farm management, the processes of natural and conscious selection can continue (Brush 2000). Nowadays, *ex situ* and *in situ* are mainly seen as complementary approaches. Crop genetic resources are recognized to comprise not only the crop genotypes but also related species, agroecological relationships and human factors.

The importance of *in situ* conservation is also stressed by the Convention on Biological Diversity (CBD), negotiated in 1992 and ratified by Nepal (Brush 2000). In 2007 Nepal also ratified the International Treaty on Plant Genetic Resource for Food and Agriculture (ITPGRFA), and because of these international commitments the country is obligated to formulate laws and provisions to facilitate managing and sharing plant genetic resources (MoAD 2017). The CBD provides an international framework for biodiversity conservation, including equitable sharing of benefits; it also emphasizes the complementary relationship between *ex situ* and *in situ* conservation (de Boef 2000). While the CBD gives sovereignty over biological resources to nation states, the ITPGRFA aims to facilitate exchange of plant genetic resources and to protect farmers' rights (Bhatta, Joshi & Gauchan 2013; Vernooy et al. 2014).

In 2014, the National Biodiversity Strategy and Action Plan (NBSAP) was formulated, to provide a framework for the management of Nepal's biodiversity (GoN/MoFSC 2014). The plan includes a long-term (35 years) vision, and short-term (up to 2020) strategies and priorities. With regard to agrobiodiversity, some of the strategies included in the plan are strengthening community-based management of agricultural genetic resources, strengthening *ex situ* conservation, enhancing public awareness, and promoting indigenous traditional

knowledge and practices. Also included in the NBSAP are strategies relating to closing policy and legislative gaps, institutional strengthening and adaptation to climate change.

Collection of indigenous plant genetic resources in Nepal began in 1940, on the initiative of the government (Genebank 2016). In 1972, the Vegetable Development Division was established, with focus on collecting landraces. The Plant Genetic Resource Section in the Agriculture Botany Division of NARC was initiated in 1984, and in 1986, a medium-term storage facility was established.

The National Agriculture Genetic Resources Centre (NAGRC), or national gene bank, was founded in 2010 for the purpose of conservation and sustainable use of agricultural genetic resources, and to meet the obligations of CBD and ITPGRFA (Bhatta, Joshi & Gauchan 2013). The gene bank applies complementary strategies: *ex situ* conservation in the gene bank and field gene bank, *in situ* conservation of wild species, and on-farm conservation of local crop varieties.

NAGRC is supporting on-farm conservation of landraces by establishing and providing technical support to community seed banks (see below) (Paudel, Joshi & Ghimire 2016). The *ex situ* conservation facilities consist of long- and medium-term storage rooms, in-vitro cultural lab and tissue bank, and field gene banks for species with recalcitrant seed types and for vegetatively propagated species.

As of November 2018, the national gene bank held more than 11 300 accessions of around 140 crop species, plus 40 wild relatives/wild edible plants; 99% of the accessions consist of landraces (K.H. Ghimire, personal communication, November 27, 2018).

Outside the country, Nepalese crop accessions are kept in for example the World Seed Vault in Korea, in eleven gene banks of CGIAR (formerly the Consultative Group for International Agricultural Research, a global partnership of organizations working in the field of food security), and in 21 countries – among them USA, Japan and Sweden (Joshi et al. 2017).

There are several practices that can be applied to strengthen conservation on the local level (Subedi 2016). Diversity fairs, where farmers collect and display plant parts, seeds, local foods etc, can serve as a venue for exchange of seeds/planting materials, increase awareness about the value of biodiversity, facilitate sharing of knowledge and gathering of information about diversity. A community biodiversity register, in which local genetic resources are documented, serves to monitor and keep inventory of local knowledge and biodiversity.

A tool for on-farm and *in situ* conservation, used to a relatively high degree in Nepal, is the community seed bank (CSB). CSBs are normally small-scale local institutions that store seeds on a short-term basis, in contrast to the longer-term conservation that is the goal of national

gene banks. The origins of community seed banks lie in the 1980s, when NGOs started establishing community gene or seed banks in the Global South in order to conserve local and/or rare varieties that were being lost due to societal forces or natural disasters (Vernooy 2013). Although conservation was the main object in the beginning, CSBs have evolved to fulfil a range of roles, such as:

- Conservation of local varieties
- Restoration of lost varieties
- Crisis responsiveness
- Secure seed storage
- Improved accessibility of seeds at the local level
- Facilitation of seed swaps
- Provision of seeds at a lower cost than the commercial sector
- Knowledge sharing
- Seed multiplication
- Participatory plant breeding
- Income generation through sale of seeds
- Providing a link between *ex situ* and *in situ* conservation

CSBs promote conservation through on-farm use of local varieties, but most CSBs also include a community-level short-term seed storage facility (Shrestha, Vernooy & Sthapit 2015). Seeds are made available to farmers on a cash or loan basis or free of charge, and often also through promotion of informal seed exchange through seed or diversity fairs etc.

The first CSB in Nepal was established in 1994 in Dalchoki by USC Canada-Nepal, when they started collecting and storing seeds of local varieties in response to farmers' reports that they had no access to local seeds (Joshi 2013). Since then, over a hundred CSBs have been established (115 as of 2013). Most are supported and initiated by NGOs, notably Oxfam Nepal and LI-BIRD, but government agencies such as the Department of Agriculture, NARC and NAGRC have lately started to promote CSBs (Maharjan & Maharjan 2018). Many CSBs focus on conservation of local and rare seeds, but management and accessibility of improved varieties is also a priority for many. However, some CSBs are now facing problems due to withdrawal of support from NGOs (Paudel, Joshi & Ghimire 2016), which raises the issue of the sustainability of the seed banks.

Successful examples of CSBs in western Nepal have been shown to contribute to sustainable livelihoods in rural communities, by improving access to seeds, strengthening local seed exchange systems and reducing dependency on outside sources (Maharjan, Gurung

& Sthapit 2011). The CSBs have also been successful in conserving local genetic resources and raising farmers' awareness of the value of landraces in adaptation to climate change.

An approach to generate income for the CSB and to improve the economic situation of its members, developed in connection with a LI-BIRD-supported CSB in Kachorwa in Nepal and now practiced in other places and countries, is the community biodiversity management fund, where members can receive small loans for income-generating activities (Shrestha & Sthapit 2015; Vernooy et al. 2014). The fund charges a relatively low interest, and members commit to growing at least one rare variety conserved in the CSB.

Women often take an active role in CSBs, in selecting and conserving seeds, and participating in informal seed exchange networks sharing landraces grown in their home gardens (Vernooy et al. 2014; Maharjan, Gurung & Sthapit 2011).

1.2 Objectives

Farmers' attitudes are crucial for conservation of agrobiodiversity (Jackson et al. 2010). The purpose of this study is to investigate attitudes towards and awareness of the loss of agrobiodiversity in Nepal, among farmers (both commercial farmers and home garden owners) and representatives of authorities. This is based on the assumption that attitudes reflect the value put on an object or phenomenon, and that they therefore can build a motivation to act – in this case, to act in order to conserve agrobiodiversity. Knowledge is another precondition for action. Understanding of differences in attitudes and knowledge between groups is thus valuable in the formulation and communication of strategies for *in situ* agrobiodiversity conservation. The choice to interview farmers is based on their role as key actors in on-farm conservation.

1.3 Research questions

What are the attitudes towards and knowledge about agrobiodiversity loss and conservation among commercial farmers, home garden farmers and representatives of concerned authorities? How do attitudes differ between the groups?

2 Material and methods

The study was conducted in the form of semi structured interviews. Before the interviews took place, an interview guide (Appendix 1) was formulated. This guide consisted of a number of suggested questions under different themes, intended as a support to the interviewer rather than as a strict script to be used during the interviews.

As the object of the study, specified in the research question, is to investigate attitudes towards and knowledge about agrobiodiversity loss and conservation, the aim of the interviews was to gain insight into the following areas:

- The respondents' knowledge
    - of differences between different types of crops
    - that agrobiodiversity is declining
    - of the possible consequences of biodiversity loss.
- The respondents' attitudes
    - towards traditional varieties vs. new
    - towards conservation
    - regarding the value they put on different crops.

The interviews opened with questions about different types of crops (for example the perceived differences between local and improved varieties, and the individual farmer's criteria for choice of crops). In the case of the farmers, a discussion about the crops they are currently growing became a natural starting point for the interviews. From there, questions moved towards the respondents' perceptions of agrobiodiversity loss. This led to the issue of conservation.

The respondents were selected to represent different categories of farmers plus a representative of a government authority. Three commercial vegetable farmers and three home garden farmers were selected, based on suggestions from several people knowledgeable in farming practices in the local community. The exception is one of the commercial farmers, who occupies a neighbouring field to the first commercial farmer being interviewed and was approached spontaneously. The national gene bank (NAGRC) was contacted via email, and a senior official offered to take part in an interview.

The commercial farmers are all male, active in the Bode area on the banks of Manahara river, on the eastern outskirts of Kathmandu: RP, age 38, DKB, age 43 and RKA, age 45, who also owns and runs a seed retail business.

All three home garden farmers live in Aryalgaon, an eastern suburb of Kathmandu. Two of them are women (SN, age 73, and SA, age 50), cultivating gardens that have been family property since generations; the third (SD, age 60) is male. His kitchen garden is situated on rented land where his family has resided for the past two years. He migrated to Kathmandu from the nearby rural district of Sindhupalchowk 30 years ago and has been growing vegetables sporadically since then.

The six farmers represent their own personal views. In the case of the gene bank official, it is difficult to separate between his personal and professional attitudes and he is therefore seen as a representative of the official attitude.

As most respondents had little or no knowledge of English, interviews were for the major part conducted through an interpreter, a native speaker of Nepali. The exception being the gene bank official, with whom the interview could be conducted in English. The interviews were recorded. For practical reasons – the researcher having insufficient knowledge of the Nepali language – the interviews were not transcribed in full. When necessary, the interpreter was consulted to clarify points in the recorded material or to verify the correctness of quotes.

Before each interview, the respondent was informed of the objective of the study. Recording started only after permission was granted by the respondent and he/she had been informed that the recording of the interview would not be made public.

The data was analysed by structuring the respondents' statements thematically. The themes largely reflect the framework of the interviews (see Appendix 1), where questions about different types of crops were followed by a discussion about agrobiodiversity loss and lastly conservation. As themes and trends emerged, the structure of the text was adjusted to reflect these.

The following headings were used:

- Different types of seeds (Characterization of crops, Perception of different types of crops and Criteria for choice of crops).
- Changing patterns of agrobiodiversity (Perceptions of a changing pattern, Loss of local varieties and Attitudes to the possible consequences of agrobiodiversity loss)
- Conservation

Under each heading, the respondents' awareness/knowledge and opinions/attitudes were compiled as it was deemed difficult to separate the two.

For background information, relevant literature was found and accessed mainly through Web of Science and Google Scholar.

2.1 Delimitations

All interviews were conducted in Kathmandu and its immediate surroundings. Due to time constraints, the number of respondents was limited to seven. The focus of the interviews was cultivation of vegetables, while cereals and other agricultural crops were not specifically covered. Comparisons with other countries also lie beyond the scope of this study.

3 Results

Most of the interviewed farmers cultivate a mix of local, improved and hybrid varieties, with the exception of one of the home garden owners who uses exclusively local seeds. All have been growing vegetables for many years and have experience of a time when only local seeds were used.

The commercial farmers grow mainly various leaf vegetables, carrots (*Daucus carota sativus*), radish (*Raphanus sativus*), coriander (*Coriandrum sativum*), onion (*Allium cepa*), garlic (*Allium sativum*) and leeks (*Allium porrum*); also mentioned were cabbage (varieties of *Brassica oleracea*), cauliflower (*Brassica oleracea* var. *botrytis*), chili (genus: *Capsicum*) and lettuce (*Lactuca sativa*). The home garden farmers cultivate a wider variety of vegetables, adding to the list maize (*Zea mays*), taro (*Colocasia esculenta*), chayote (*Sechium edule*), sponge gourd (*Luffa aegyptiaca*), bitter gourd (*Momordica charantia*), cucumber (*Cucumis sativus*), pumpkin (*Cucurbita pepo*), tomato (*Solanum lycopersicum*), eggplant (*Solanum melongena*), ginger (*Zingiber officinale*), different species of peas and beans (family: *Fabaceae*) etc.

3.1 Local, improved, hybrid – different types of seeds

3.1.1 Characterization of crops

The farmers are aware that there are different types of seeds. Generally, they often spoke of different crops as belonging to one of two groups: on the one hand local and on the other hand either ‘bikashe’ (improved) or hybrid. The terms local and Nepali were used interchangeably.

A few local vegetables were identified by their geographical origin, for example ‘Marpha rayo’ (broad leaf mustard, *Brassica juncea*, from the village of Marpha).

The home garden farmers were more prone to use the term ‘bikashe’. In some instances, it was obvious that the respondent did not know whether the crop being mentioned was a hybrid or merely improved.

The commercial farmers tended to be more specific regarding the origin of the seeds, referring to them as for example Indian, Chinese or Korean. They appear to have a good understanding of the difference between hybrid and other seeds, in the respect that they are aware that they cannot save seeds from the hybrids.

The NAGRC official distinguished between landraces/farmers’ varieties, domestic and foreign improved varieties, and domestic and foreign hybrids.

3.1.2 Old versus new – perception of different types of crops

When respondents were asked to describe the differences between local and improved/hybrid varieties, the most frequent arguments for local varieties were better taste and storability, while the major arguments for improved/hybrid varieties were higher yield and longer growing season. The findings are summarized in Table 1.

The respondents unanimously praised local varieties as having a superior taste, in comparison with improved and hybrid varieties. One of the commercial farmers, RP, mentioned that imported varieties of radish have a milder, more pleasant taste than the local kind, but apart from this exception this respondent was also of the opinion that local varieties in general are ’dherai mitho’ (very tasty).

Especially regarding different kinds of leaf vegetables, such as spinach (*Spinacea oleracea*) and cress (*Lepidium sativum*), local types were said to taste better. But also cereals such as maize and rice were mentioned. Home garden farmer SN remembered: ”Earlier we had different types of local rice. They were very good, sweet and soft like cotton. You didn’t need any curry with them.” She contrasts this with the nice-looking but not very tasty new varieties. Another home garden farmer, SA, gave the example of ’pharsi ko munta’ (shoots of pumpkin/squash, used as a leaf vegetable during the rainy season), describing how the hybrid varieties look very fresh and healthy but are devoid of taste whereas the local kind tastes very good.

The main characteristic speaking in favour of improved or hybrid seeds, mentioned by all respondents, is their potential to produce a higher yield. SA exemplified this point with an account of the rice harvested by a fellow villager: this villager’s field had yielded 12 muri (muri is a unit of capacity corresponding to approximately 90 litres) of hybrid rice, instead of the 3 muri that, in SA’s opinion, could have been produced in the same field using a local variety. Her neighbour SN said, referring to the situation some years back: ”The bikashe

radish we grew in our field, they were so big. I used to sell them for five Rupees per piece, even in those days."

Table 1: Properties mentioned by respondents as arguments in favour of different crop types, when comparing local with improved/hybrid varieties. Each "x" represents one respondent mentioning the property.

	Property/quality	**Commercial farmers (3)**	**Home garden farmers (3)**	**Official (1)**
Local	Taste	xxx	xxx	x
	Storability	x	xxx	
	Pest resistance		x	x
	Abiotic stress resistance		x	x
	Cheaper seeds	xx		
	Ability to save seeds	xx		
	Higher profit per unit	x		x
	Broad genetic base			x
	Self-sufficiency/ independence	xx		x
Improved/hybrid	Yield	xxx	xxx	x
	Appearance	x	xx	
	Growing season	xxx	x	
	Cleaner seeds, higher germination percentage	x		

Cleaner seeds, with a higher germination percentage, was mentioned by the farmer/seed retailer RKA as a virtue of hybrid varieties. On the other hand, the commercial farmers pointed out that imported or hybrid seeds are more expensive. The fact that they can save seeds from local varieties was mentioned as a potential advantage of those crops.

The commercial farmers all stressed that local/domestic varieties, mainly of leaf vegetables, have a limited growing season, whereas imported seeds offer a spectrum of cultivars that can be grown during different times of the year. Home garden farmer SN mentioned that hybrid/improved varieties allow her to harvest different kinds of beans later in the year than she could do when only local cultivars were available.

Improved and hybrid varieties were described by one commercial and two home garden farmers as being more even and pleasant in appearance than local equivalents.

There is a perceived difference in post-harvest performance. Especially the home garden farmers pointed to this, saying that for example local maize and potato can be stored longer than hybrid or improved varieties, without problems with insect infestations. One of the commercial farmers, RP, said that local radish can be dried and preserved for future use if there is a surplus, while the imported kind is not suitable for that.

One home garden farmer, SA, also finds the local crops more resistant to pests in the field. On the other hand, commercial farmer RP was of the opinion that there is no difference in resistance between crop types, rather that the season determines with winter crops being sturdier and more resilient in comparison with crops grown in the summer. SA also mentioned that hybrids have a lower tolerance to unfavourable abiotic conditions, for example due to erratic rainfall. Under those circumstances, the local maize will still give something while the hybrid will either die or give no harvest.

The gene bank official constitutes a special case, being the only respondent to emphasize the potential value of landraces as a genetic resource for plant breeding purposes. He also pointed out the wide adaptability of landraces, and their ability to provide at least something, even under poor conditions. This was contrasted with the inability of improved varieties to tolerate a broad range of adverse conditions, being in danger of getting completely wiped out by a disease or insect. Apart from this, he joined the other respondents in pointing out taste and yield as the chief arguments for local and improved varieties, respectively.

3.1.3 Criteria for choice of crops

The main criteria stated by the farmers for choosing particular crops were taste, yield, availability and market demand. Leaf vegetables and garlic were most frequently mentioned among crops where local seeds or planting material are used.

The commercial farmers were motivated greatly by market demand. Local varieties of leaf vegetables, such as cress and spinach, are popular among consumers – ”people love them”, according to RP. However, they have a limited growing season and cannot be cultivated during the rainy season. To meet the market demand for leafy greens, the commercial farmers grow Chinese leaf vegetables that tolerate the heavy summer rain. According to RP, big hotels specifically order Korean radish rather than local.

When asked why they don’t choose crops that are traditionally grown in the summer, notably different species of Cucurbitaceae and Fabaceae, the commercial farmers quoted practical reasons such as the need for special equipment (e.g. tunnels), and lack of experience and/or knowledge. It is seen as easier to just grow leaf vegetables. DKB gave the explanation

that with the traditional crops, there will be gaps between cultures, while with imported varieties the use of the land can be maximized.

DKB stated that for crops with seeds that can easily be saved and preserved, he uses local varieties. This is the case with cress, spinach and broad leaf mustard. Others are bought from outside. He mentioned carrots as an example of a species where seed saving is difficult and related a personal experience of trying to save seeds from a hybrid carrot, which resulted in an uneven, unsellable product.

Seed retailer RKA receives samples from importers/wholesalers and is able to try them before deciding whether to sell them or not.

Home garden farmer SN's choice was guided partly by availability – as local maize is not available, she uses bikashe. Conversely, she now grows a local cultivar of potato, as she couldn't find the bikashe type previously used. She saves seeds of 'simi' (a variety of bean, *Fabaceae*), but buys other seeds, relying on information and recommendations provided by the shop keepers.

Another home garden farmer, SA, expressed a preference for hybrid varieties because of their high productivity and nice appearance. For example, she grows high-yielding hybrid maize as fodder for her cows. On the other hand, she grows local varieties of maize for the family's consumption, because of their superior taste.

The only grower using solely local seeds, SD, motivated this choice by saying that this is what he is used to and feels confident with. He gets some of his seeds from his home village, where he still has a network of friends and family that share their own saved seeds with him free of cost. Whenever he buys seeds from the government seed shop, he always asks for local varieties, that he sees as familiar and reliable. As he is a construction worker, being away from home most days, he feels that he doesn't have time to nurse unknown crops.

3.2 Changing patterns of agrobiodiversity

3.2.1 What is being cultivated: perceptions of a changing pattern

When faced with an open question regarding how the composition of crops that are cultivated in the country has changed in recent years, the advent of new/improved/hybrid varieties was mentioned by most respondents. "A lot of new varieties have come, but I never bother about them. But others are using them, so they must be good in some way. […] Now everything is bikashe. Everyone wants more production", said SD. Also SA mentioned how the desire to produce a high yield makes people prefer hybrid.

Several of the respondents were of the opinion that there is a wider choice of seeds available now than in the past. SN expressed that earlier there was not much variety, “maybe we didn’t have time to look for alternatives”. She relates how they used to follow the same crop rotation as everyone else in their fields, growing one thing at the time using their own seeds. In her opinion, the number of options is bigger now when she can buy seeds and fertilizer from outside.

The gene bank official pointed to the fact that development organizations, policy makers and extension workers all give priority to improved varieties, while farmers’ level of awareness about the issue is low.

3.2.2 Loss of local varieties

While only two respondents (DKB and the gene bank official) spontaneously voiced the opinion that local seeds are disappearing, when presented with the statement that research shows that many local varieties are no longer available, all respondents agreed that this is the case. It is a pity, deemed seed retailer RKA, giving the example of local onion which now is almost gone from the area. And observing, regarding the qualities that are lost: ”The local cress, spinach and garlic – if it is planted in that field you can smell it from here.”

Commercial farmer RP mentioned that local coriander is disappearing. His opinion is that the main reason behind the loss of local varieties is that it is easier to buy seeds from outside than saving seeds, which is a long process, requiring knowledge and a lot of work.

”Bikashe gives a higher yield but it is tasteless”, said home garden farmer SA with a laugh when asked how she feels about the development.

Home garden owner SD predicted that hybrid varieties will replace all local crops, suggesting that the soil has been contaminated by chemical fertilizers and that hybrids may be more compatible with those conditions.

The NAGRC official stated that the loss of diversity is accelerating, with the loss clearly evident in urban and peri-urban areas while in remote areas there is still a greater – but shrinking – diversity. He gave a personal example: ”My parents are also farmers, and in my childhood, just around 30 years ago, in my small village with 30 to 40 households, at that time we could find at least 40 to 50 varieties of rice. But now we can hardly find eight, ten varieties. Mostly they are growing hybrids, a few improved varieties, and very few landraces, one or two.”

He also shared information on how the 7.8 magnitude earthquake that struck central parts of Nepal on April 25, 2015 has sped up the loss of diversity. Many seeds were buried in collapsed buildings, and different NGOs involved in relief work promoted improved seeds in

remote areas without proper assessment of need and consequences. As a result, local seeds were lost.

3.2.3 Consequences of agrobiodiversity loss

The commercial farmers all expressed opinions on the possible consequences of agrobiodiversity loss, while the home garden farmers did not appear to have considered the question. ”We cannot live without eating, so whatever they produce, we have to eat”, said SD. ”I am compelled to eat the bikashe now”, said SN, while the third home garden farmer, SA, simply stated that no local varieties will remain and that they will not be able to find the seeds that they used to grow before.

Seed retailer/farmer RKA highlighted the economic consequences for farmers. The price of improved and hybrid seeds is much higher than that of local equivalents. He gave two examples: one crop where local seeds cost 100 Nepali Rupees for 100 g while the hybrid seeds cost 65 Rupees for only 5 g, and one crop where local seed for a one ropani field (508.72 m^2) costs 400 Rupees but hybrid seed costs 4500 Rupees.

RKA was alone in mentioning the consequences on farmers’ health of the increased use of pesticides and other agrochemical products associated with switching to hybrid varieties. He pointed to the nearby district of Kavre Panchkal where there is a big production of tomato, using a lot of pesticides. ”In Panchkal, in each farmer’s house there is one case of cancer”, according to RKA.

Commercial farmers RP and DKB mentioned the issue of being in control, and that relying on imported seeds means being dependent on others. RP also mentioned that importing seeds means that the money goes to other countries.

The subject of self-sufficiency was also raised by the NAGRC official, who believes that Nepal needs to develop a strong hybrid breeding program to be able to replace some of the import with domestic alternatives. In the current situation, he said, ”if the foreign seeds will stop coming to Nepal, farmers will really have a problem. They will not have their own seed to grow”. He emphasized the danger of losing the broad genetic base of landraces, in the face of climate change and the likely events of for example severe droughts and erratic rainfall. The improved varieties do not provide the necessary diversity to cope with the changing conditions. ”At that time, they will realize the importance of landraces, but it will be too late”, he said.

3.3 Conservation

All three commercial farmers believe that conservation is only possible if the government assumes a leading role. Their general opinion is that the agricultural sector is neglected by the authorities, and that farmers lack facilities and knowledge to do something about the loss of local varieties.

RP claimed that he tries to preserve the local varieties, because of their taste. ”It should be from Nepal”, he said. DKB agreed that it would be nice to have local varieties.

RKA believes that a totally different pattern of farming is needed if local varieties are to survive. He pointed to the excessive use of pesticides and chemical fertilizers, associated with the cultivation of hybrid varieties, that he believes have contaminated the soil. In his opinion, the government needs to focus on organic farming practices, and promote studies of how the damage that has been done can be remedied.

One of the home garden farmers, SA, also believes that something might be done to stop the development only if the central authorities take a lead, as farmers are mainly focused on profit and don’t consider the consequences. In her opinion, it is not clear whether stopping the development is desirable, as there are both positive and negative aspects of both local and hybrid crops. She gave the example of hybrid rice which has shorter stalks, giving a more secure production, while local rice grows tall and is more sensitive to wind. In this way, she uses a food security argument in favour of hybrid rice – interestingly, she used the same type of argument in favour of local varieties when referring to their resistance to biotic and abiotic stress (see section 3.1.2).

The other home garden farmers were of the opinion that the development cannot be halted. SD predicted that he may also be forced to use the new varieties, and SN said that since everyone is using bikashe, how can it be stopped? She also questioned the value of conservation. Based on their high productivity and wide seasonal range, in her opinion ”bikashe is OK, it produces a lot”.

The NAGRC official emphasized the need for awareness raising – among farmers, consumers and policy makers. The NAGRC are working to convince policy makers to develop incentives to farmers growing a big number of landraces.

Regarding consumers, according to the gene bank official the NAGRC are trying to promote geographical indicators to influence the market so that the farmers can get a better price for their produce. He stated that farmers can get a comparatively higher price for landraces, and if consumers’ awareness of the superior taste and quality of landraces

compared to imported varieties can be raised, this can be boosted further. Commercial farmer RP also said that they are paid more for local leaf vegetables, as the demand is constant, and the market price doesn't go up and down as much as for the new types.

For successful conservation, the gene bank official described a mixed strategy. As improved seeds have a higher yield potential, he agrees that individual farmers cannot realistically be expected to abandon them completely. In his words: "We don't say: don't grow improved varieties […] but: don't lose the local varieties, we say like that." Some varieties can be grown by the farmer, some can be preserved by a joint effort in the local community (for example in the form of a community seed bank, CSB), some can be brought to the gene bank for safe storage until such a time as they can be repatriated to the village. He described the gene bank as a great strength in the conservation efforts, emphasizing that it is not meant to function as a museum but rather to be a source for distribution of genetic material to different stakeholders. He also highlighted the potential of CSBs to contribute to both conservation and food security. The activities of the CSBs contribute to raising awareness, and also to farmers' independence as they are able to produce seeds at the local level.

4 Discussion

The results of this study show that farmers' choices of crops are mainly motivated by yield and taste. Farmers are aware that local varieties are disappearing, but not about the possible long-term consequences of this loss.

Perceptions about and attitudes to different seed types can be seen as tools to be used in communicating the value of conserving plant genetic resources to farmers, the main actors in on-farm conservation. The weight that the respective arguments carry with farmers must be taken into consideration, as must their level of knowledge or awareness. Perceptions and attitudes also serve to explain how the present situation has evolved. The discussion will first centre around these aspects in relation to different crop types, followed by agrobiodiversity loss; lastly, possible measures for conservation are discussed.

Different crop types

The farmers largely share a view of old versus new varieties that comes down to mainly two attributes: taste and yield. Apart from that, there are two main differences in attitude or opinion between commercial farmers and home garden owners regarding the value of

different seed types. One is that home garden owners value storability to a greater extent. This aspect naturally carries more weight with farmers producing crops for household consumption, who need to store produce in order to guarantee a secure food supply throughout the year, than for commercial farmers who sell their produce soon after harvest. For subsistence farmers, this could be an argument in favour of local varieties from a food security perspective.

The other difference is that commercial farmers put more emphasis on the growing season of different varieties. To them, the possibility to grow leaf vegetables during the rainy season is a major reason to choose imported seeds. As commercial farmers are motivated by market demand, they naturally seek options that allow them to meet the expectations of consumers. The home garden owners, concerned rather with meeting the nutritional demand of their families, tackle the problem with the limited growing season of some vegetables by choosing a different set of crop species during summer.

The biggest contrast lies instead between farmers' and the official perception of the issue. While there appears to be universal agreement that local varieties taste better, the fact that losing landraces means losing their broad genetic base, a major concern to the official side, is not mentioned by the farmers. While the official attitude, as reflected both in policy documents and in the responses of the NAGRC official, puts great emphasis on the potential future role of local varieties in resilience to climate change and meeting other needs, farmers are focusing on everyday aspects such as taste and yield.

The respondents were unanimous in their views regarding the taste of local vegetable varieties. This is the most obvious advantage, while other aspects of concern for farmers – such as pest resistance and storability – are perhaps not immediately apparent and not observed by all respondents. However, as these are concrete aspects with economic implications for farmers, they are potentially useful arguments and can be subjects for awareness raising campaigns.

Looking at on the one hand farmers' opinions about crop types, and on the other hand what they actually grow, it is apparent that the most commonly mentioned advantages were also the most commonly mentioned criteria for choice of crops. In other words, taste and yield are the main qualities that influence farmers' choice – with yield appearing to carry most weight, which serves to explain the rapid replacement of local seeds with improved and hybrid varieties in recent years. Apart from yield and taste, growing season is an important factor, especially for commercial farmers. If national self-sufficiency is a target, in order to reduce dependency on foreign imports, then domestic plant breeding has a role in providing varieties with higher yield and an extended or different growing season.

Local varieties were most frequently chosen for winter cultivation of leaf vegetables. It is possible that in those cases, the perceived difference in flavour (to the local varieties' advantage) is significant, while improved or hybrid varieties of those species do not show sufficient advantages regarding yield and/or other aspects to warrant abandoning the local types. However, the precise mechanisms and appraisals underlaying farmers' choices require further study.

The general tendency is that while the farmers are aware that there are different types of seeds, for example distinguishing between local and imported, they have a vague knowledge of the differences between hybrid and improved imported seeds, and between landraces and domestic improved varieties. Better knowledge in this area would help farmers make informed choices.

Agrobiodiversity loss

Both commercial farmers and home garden owners are aware that local varieties are disappearing and/or becoming difficult to find. Somewhat paradoxically, however, the spontaneous response from the respondents was that there is a greater variety now compared to earlier. From their perspective the addition of new varieties has resulted in a wider spectrum of seeds to choose from. Respectfully acknowledging this perspective should be a practicable route to a strategy based on compromise, on embracing the respective advantages of different types of crops. This was expressed by the NAGRC official – *"don't say: don't grow improved varieties […] but: don't lose the local varieties"* – and illustrated by home garden farmer SA who grows hybrid maize for the cows and local maize for her family.

The farmers generally expressed an unsentimental attitude towards the loss of old varieties. There was no mention of tradition, heritage or other emotive concepts. They regret the loss of tasty food but seem to take a matter-of-fact view of the situation – the high-yielding modern varieties trump the flavoursome local crops, and therefore the local seeds are lost. Based on this, concepts like tradition cannot be seen as useful arguments in communicating the importance of conservation.

There is little or no awareness among the farmers in this study of the risks associated with losing genetic diversity. The official attitude, as reflected in both policy documents and the responses of the NAGRC official, puts great emphasis on this aspect. This has implications for communication of conservation goals. If awareness is low, and the immediate concerns of farmers (as described above) are of a different nature, then communication shouldn't be based on arguments about future need for genetic diversity. A better strategy would be to focus on

arguments with direct significance for the everyday needs of farmers, coupled with awareness raising on the issue.

Conservation

The farmers all expressed that they cannot do anything about the loss of local varieties. Making ends meet, even survival, is their most pressing concern. Those who expressed a belief that conservation of local varieties to some extent is possible all stressed the need for the government and concerned authorities to assume a leading role. This is echoed by the NAGRC official, who emphasized the need for economic incentives for farmers growing a large number of landraces.

Based on the above, it can be concluded that conservation needs to be made profitable. One way of addressing this is through strengthening market incentives. Another way is through direct financial incentives or payments to farmers.

As farmers generally display a low degree of insight into the role of landraces as a source of genetic diversity, awareness raising in this area could serve to strengthen motivation to promote conservation. For this purpose, and because of their potential to contribute to conservation efforts in other ways, community seed banks have a role to play.

The market route

Labelling, certification or origin schemes and niche market development are ways to increase the market value of agricultural products (FAO 2007). Increasing consumer awareness of the qualities of landraces or products of certain geographic origin, coupled with a trustworthy and transparent certification system, could make cultivation of local varieties more profitable.

In addition to various government bodies, farmers' organizations are possible stakeholders that could contribute in the marketing of local products.

One emerging niche market is organic produce – there is a growing demand and consumer awareness in urban areas which makes organic production in peri-urban areas profitable (Bhatta & Doppler 2016), as there is a willingness among consumers to pay more for organic products.

This demand can be linked to conservation of crop diversity, as the use of landraces adapted to local conditions instead of improved varieties that depend largely on agrochemical inputs can be a feature of environment-friendly farming, as can associated farming practices like integrated pest management that support agrobiodiversity in a broader sense.

The financial incentives route

The impact – positive or negative – that farming practices have on ecosystem services, where biodiversity plays an overarching role, is normally not reflected in the income of farmers (FAO 2007). Therefore, payment for environmental/ecosystem services – PES programmes – is a possible route to influence farmers' decisions regarding production practices that have an impact on environmental values.

In the area of biodiversity conservation, possible measures to be rewarded include avoiding expansion of agriculture into areas rich in wild biodiversity, conserving wild biodiversity in agricultural ecosystems (for example through using farming systems that reduce pollution, or mimicking natural habitats on agricultural lands), and conserving agricultural genetic resources (FAO 2007). Instituting a system for rewarding farmers that grow many landraces was mentioned by the NAGRC official as a desirable development. The farmers interviewed in this study expressed that their hands were tied by economic concerns, which indicates that economic incentives is a possible way forward. In this area, the government has a role to play, but this can also be an arena for international development cooperation or assistance.

Awareness raising and community seed banks

A possible tool for raising awareness about agrobiodiversity is the continued promotion of community seed banks, as CSBs provide a communication channel between local communities and authorities or donor organisations. Activities of the CSB, such as diversity fairs and participatory plant breeding, can serve to illustrate the value of preserving a multitude of local varieties. The possible role of landraces in increasing food security – thanks to among other things resistance to biotic and abiotic stress, and better storability – should be a good argument in their favour.

Seed retailers are a source of information for farmers and can influence what is being grown. They are therefore another potential channel for communicating with local communities, and a potential target group for awareness raising campaigns.

Awareness about the consequences of climate change can lead to awareness of the value of a broad genetic base. Although the limited scope of this study prevented the covering of this subject, it is possible that with the effects of climate change becoming increasingly apparent, this aspect will carry more weight with farmers.

Apart from the role of CSBs in raising awareness about agrobiodiversity, they appear to present a number of solutions to both everyday problems of farmers – such as availability of seeds or secure seed storage – and the more abstract issue of genetic erosion. Individual

farmers cannot grow all rare varieties, but involving local communities in joint efforts to conserve local crop varieties makes it possible to coordinate on-farm conservation.

CSBs can also function as a link in the interdependent relationship between *ex situ* and *in situ* conservation, a source of information for both farmers and government bodies or NGOs. The national gene bank and CSBs can also be said to function as each other's safety copies. Both government bodies, such as NARC and NAGRC, and NGOs can play a role in instituting and supporting CSBs.

Limitations of the study

The fact that the interviews were conducted through an interpreter presents certain difficulties. There is an inescapable filter between the respondent and the researcher, as the preconceptions and previous knowledge of the interpreter affect how the translation is worded. As respondents were often conversational and eager to share their experiences, giving a word-for-word translation was not feasible. Nuances were inevitably lost, and there is a risk that salient points were missed.

Only a limited geographical area was covered in the study, as the limited time frame prevented extending the study into other parts of the country. This means for example that differences between peri-urban and rural settings could not be addressed.

The time frame also restricted the number of interviews that could be carried out. From a validity perspective, a larger number of respondents among farmers would have been desirable. Gaining access to the experience of NGOs and/or extension workers in the relevant field would also have added depth to the analysis.

5 Conclusion

The results of this study show that the potential for higher yield is seen by the respondents as the major advantage of improved or hybrid seeds, and that they as individuals cannot do anything to stop the loss of local varieties. Therefore, conservation efforts need to take into consideration the economic reality of farmers; economic incentives to grow landraces should be strengthened, for example through a PES system and through strategies oriented at increasing the market value of local varieties.

The results also show that the farmers have a limited knowledge about possible consequences of agrobiodiversity loss. For that reason, awareness raising should also be part of any strategy, as increased knowledge about the value of agrobiodiversity could contribute to a greater wish to conserve it. Based on this, continued support to community seed banks is

appropriate, as they can play a role in awareness raising as well as practical aspects of *in situ* conservation.

Lastly, the results indicate that the role of landraces as a source of genetic diversity is not a matter of concern to farmers in general, and that farmers decisions are guided by practical rather than sentimental values. Communication regarding conservation should therefore emphasize the perceived advantages of superior taste, increased food security, and potential economic benefits.

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Interview guide **Appendix 1**

The aim of the interviews is to gain insight into the following areas:
The respondents' knowledge: of differences between different types of crops; that agro-biodiversity is declining; of the consequences of biodiversity loss.
The respondents' attitudes: towards traditional varieties vs. new; towards conservation; regarding the value they put on different crops (instrumental, or having a value in itself?).

Farmers (commercial farmers and home garden owners)

Introduction
Explain the aim of the study
Explain that the recording will not be made public and that the informants will remain anonymous.

Opening questions; attitudes towards/knowledge of different types of crops
(Starting point for further discussion, also to establish the interviewee's vocabulary regarding crop types.)
"What crops are you growing?"
"What type of […]?" (local/improved/hybrid …) (open question to avoid nudging respondents towards interviewer's categorization)
Criteria for choice of crops.
"How would you describe the difference between old varieties and new?" (phrasing depending on previous answers)
Pros and cons of the respective types.
Source of seeds/planting material.
"Has your choice of crops changed over the years?"
If so, how and why.
"Do you think your choice will change in the future?"
How and why.

Attitudes towards/knowledge of biodiversity loss
"What do you think about the number of varieties that are cultivated by farmers in Nepal? How has it changed?"
Old vs. new varieties.
"Research shows that old cultivars disappear, many are no longer available. What are your thoughts on that?"
"What do you think will be the consequences of this change?"
Positive/negative?

Attitudes towards conservation
How could this development be stopped?
Should it be attempted? Why?
Is it realistic?

Government official

Introduction
Explain the aim of the study
Explain that the recording will not be made public and that the informants will remain anonymous.

Opening questions; attitudes towards/knowledge of different types of crops
If informant represents NAGRC (gene bank):
”What types of genetic material is conserved by the NAGRC?”
How is it selected?
”How would you describe the difference between old varieties/local genetic material and new/improved/hybrid varieties?”
Pros and cons of the respective types.

Attitudes towards/knowledge of biodiversity loss
”How would you describe the development in recent years, regarding the total number of crops that are cultivated”
”… and the relative importance of old vs. new varieties?”
”What are your thoughts on that?”
”What do you think will be the consequences of this change?”

Attitudes towards conservation
”What are the most efficient methods to conserve agrobiodiversity?”
”Is it realistic to halt the loss of diversity?”