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Good Practices for Agrobiodiversity Management

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2. Red Zoning and Red Listing

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A. Introduction

Agricultural diversity is at risk of loss, even though all genetic resources could not be collected for long term conservation within a short period of time. Therefore, red zoning and red listing are very useful for prioritizing conservation and utilization efforts as well as for initiating in-situ, on-farm and ex-situ conservation appropriately. Red listing is more common in wild fauna and flora. The World Conservation Union (IUCN) and Convention on International Trade in Endangered Species of wild flora and fauna (CITES) have developed their own criteria for wild fauna and flora for red listing since 1965. Red list categories for agricultural plant genetic resources (APGRs) have been started since 1998 in Nepal (Joshi et al 2004, Sthapit et al 2005, Joshi and Gauchan 2017).

Red zone is any areas where agricultural land is going turned to other uses, and native genetic resources are at risk of loss because of modern varieties, development works, natural disasters, etc. Red zoning is the process of identifying red zone in agricultural land. Collection gap is the areas from where any genetic resources have not been collected before or if collected, in very few numbers. Red list (also termed conservation status) is the list of crop species, and cultivars (varieties or landraces), prepared from the conservation aspects and considered trend of genetic erosion. The process of listing under red list categories is called red listing. It also includes rare and unique cultivars which are based upon the geographic range, habitat specificity, trait specificity and local population size. For example decreasing population size over the time of any landrace indicates that this landrace is at endangered state and it may extinct soon. This is important to determine the red zone, collection gap and red list status of crop landraces for setting priority attention for conservation as well as planning different types of actions for groups of landraces (Joshi and Gauchan 2017).

B. Objectives

- To prioritize the conservation areas and agricultural genetic resources
- To identify the farming areas that are at the edge of changing use pattern and map the red zone in farming areas
- To group the genetic resources based on the distribution and population size for accelerating conservation of rare, endangered and unique resources (red list)

C. Methods and Process

Red Zoning Farming Areas

Red zone is the agricultural areas where the diversity in native agricultural genetic resources is decreasing over the seasons and years due to many natural and socioeconomic factors. There are major six factors that turn agricultural lands in to red zone (Figure 1). These factors include ad hoc distribution of modern varieties, heavy drought, disease and pests, natural disasters, migration of farmers after disasters, change in land use and commercialization. Red zone area is identified through the analysis on the degree of these factors in a particular site. Area coverage during analysis can be village, municipality, district, province or nation. Four approaches are used for red zoning. 1. Focus group discussion (FGD) and Key Informant Survey (KIS) are conducted to analyze the degree of these factors in the area coverage. 2. Report, news and social media are referred particularly for knowing natural calamities eg earthquake, drought, etc. 3. Interaction meeting with the developmental organizations (both governmental and non-governmental) particularly for locating mega project eg hydro electricity project, urbanization, new settlement, etc. 4. Collection gap analysis using Genebank passport data.

Geographical information system (eg DIVA-GIS) is applied to generate the existing collections map of any crop species based on the passport data of National Genebank. Based on the collection map, gaps are located (areas from where no collections have not been made). To validate the gaps, it is more effective to relate gaps with information generated from literature review, FGD and KIS. These gaps are the potential areas for extinction of crop diversity, therefore needs to rescue them. After identifying gaps, further discussion and information collection should be organized to know the red list status of landraces available in these gap areas.

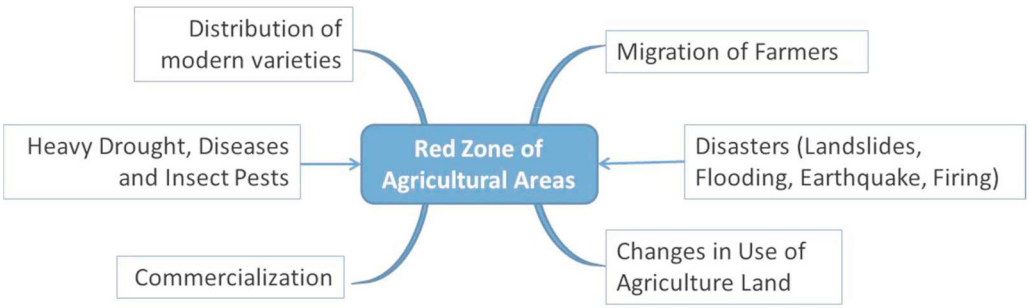

Figure 1. Factors that turn agricultural land to red zone (ie area where crop landraces become endangered).

Red Listing Agricultural Genetic Resources

Red list is the name list of genetic resources (at genotype, landrace, variety, strain and breed levels) under different groups based on the analysis of distribution and population size (also called five cell analysis), and trait distribution. Red listing is the process of preparing the red list.

Five Cell Analysis (Distribution and Population Size Analysis): Landraces are grouped under five classes based on the distribution pattern and population size as well as based on the area coverage and number of farmers growing these particular landraces in a village. Earlier it was commonly called Four Cell Analysis (Sthapit et al 2006, Joshi et al 2004), which considers areas and number of farmers growing this landrace to group into four classes (large area by many farmers, small area by many farmers, large areas by few farmers and small area by few farmers). To have a complete picture of any particular areas of total native genetic resources, five different classes which is called red list status, is prepared (**Figure** 2). The distribution and population size of any landrace can be analyzed either by directly measuring the variables or organizing the focus group discussion (FGD). FGD is the simplest method to list the genetic resources under these five cells based on the criteria presented in Figure 2 and area coverage for analysis at the village level. During listing, some genetic resources may not be listed under not evaluated cell if information is lacking.

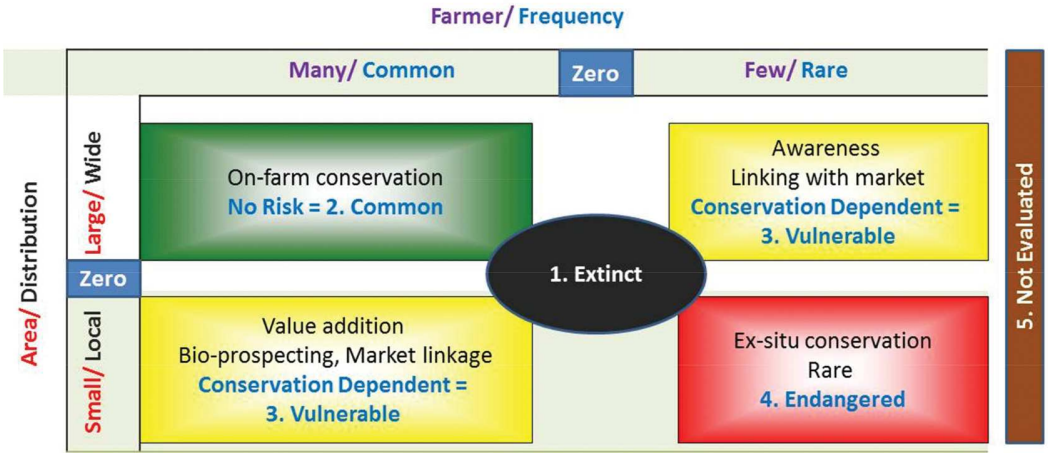

Figure 2. Categorization of crop landraces based on the distribution and population size.
Source: Joshi et al 2004 (modified)

Trait Distribution Analysis: Specific trait distribution is analyzed like areas and number of growers of any landraces. Four classes of trait distribution analysis are given in **Figure** 3. Landrace with specific trait which is not available in other landraces is called unique landrace. Potential danger in such case is possibility of loss of particular trait, therefore considered such landrace as endangered state and need immediate attention for conservation. Landraces falling in other three classes are not at risk of extinction for a time period. For example, Bhate Phaper (rice Tartary buckwheat) which has loose husk and available and cultivated for main staple in small area only in Dolpa district of western high mountains in Nepal. This

landrace is considered as unique and falls under endangered class. Field assessment for this analysis is costly and tedious, therefore, FGD and KIS are used.

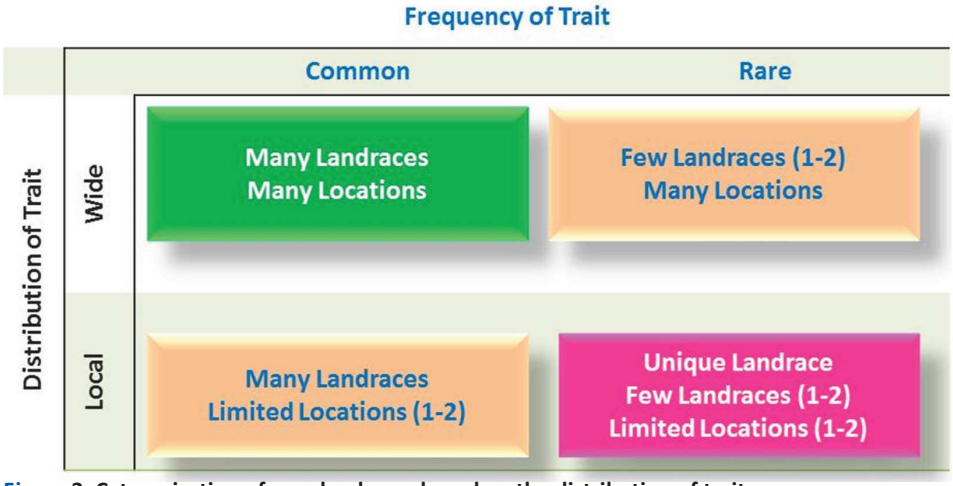

Figure 3. Categorization of crop landraces based on the distribution of traits.

D. Advantages and Disadvantages

Advantages

- Conservation of genetic resources before losing from the site due to adhoc promotion of modern varieties, natural calamities and changes in land use
- Create awareness and make familiar among stakeholders on existing diversity along with their status and urgency of conservation
- Involvement of many farmers and officials
- Simple and low cost techniques for assessing diversity along with status and importance of genetic resources
- Sensitize farmers and researchers to involve on conservation and utilization of native genetic resources

Disadvantages

- Information collected on native genetic resources might further be needed to verify
- Difficult to demark the areas for analysis of diversity. Area coverage is based on administrative rather than adaptation of genetic resources

E. Success Cases

Through red zoning, collection gap analysis and red listing, more than 1000 landraces of more than 20 crop species have been listed, collected, rescued and conserved. This good practice is exercised 250 times in 30 districts involving 1000 farmers and 100 officials.

Farming areas in earthquake affected districts (Lamjung, Gorkha, Dolakha) are red zones. Urban areas eg Simikot, Humla and Bijayanagar, Jumla are also red zones. We have noticed

loss of many landraces from these red zones. Collection maps of more than 10 crop species have been generated using GIS (DIVA), one example is given in Figure 4. There are many districts from where finger millet has not been collected and these areas are prime concern for further red listing and collection. Red list of some crop species from Jumla and Humla are given in Figure 5. Some unique trait landraces are Bhate phaper (local Tartary buckwheat), Jumli Marshi rice, Jumli bean, Dudhe chino (proso millet), Raato Kodo (finger millet), Jugu Simi (bean), etc.

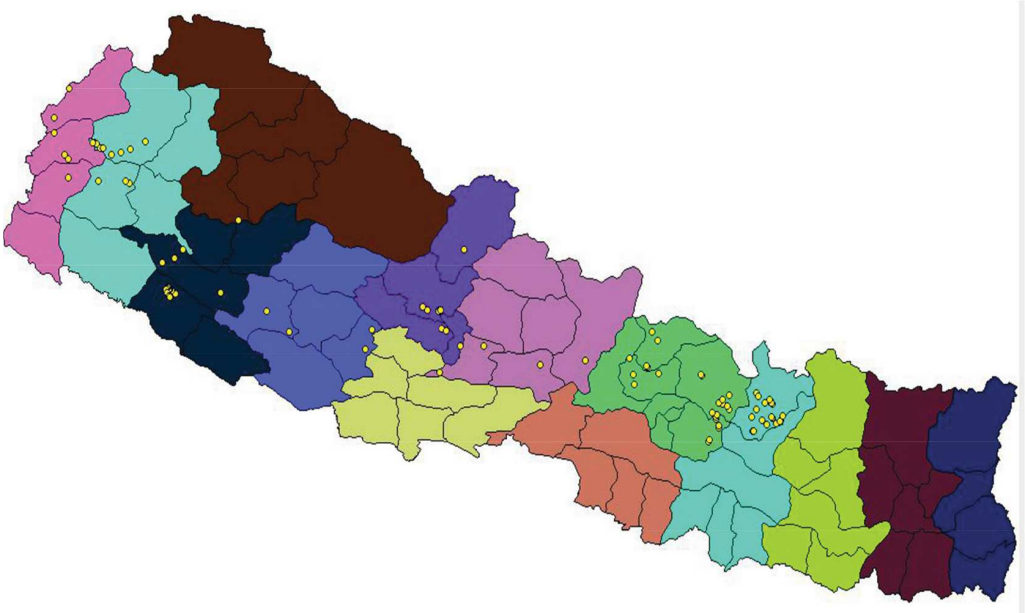

Figure 4. Collections map of finger millet using DIVA-GIS to analyze the gaps in collections

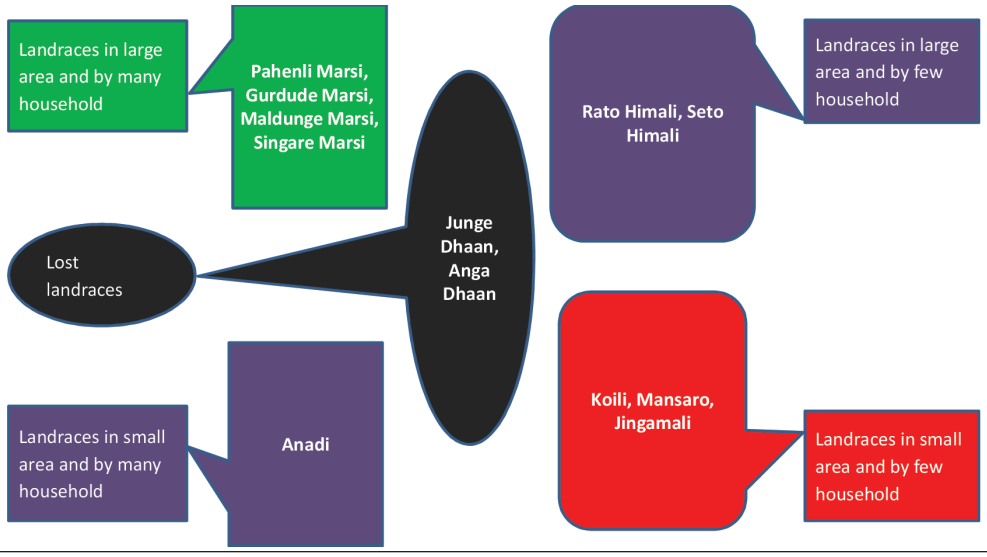

Figure 5. Some examples of five cell analysis.

F. References

Joshi BK and D Gauchan. 2017. Germplasm Rescue: Why and How? **In**: Rebuilding Local Seed System of Native Crops in Earthquake Affected Areas of Nepal (BK Joshi and D Gauchan, eds). Proceedings of a National Sharingshop, 18 Dec 2017, Kathmandu; NAGRC, Bioversity International and Crop Trust; Kathmandu, Nepal; pp.41-50. https://www.bioversityinternational.org/e-library/publications/detail/rebuilding-local seed-system-of-native-crops-in-earthquake-affected-areas-of-nepal/

Joshi BK, D Gauchan, S Sapkota, DMS Dongol, K Poudyal, S Gautam, S Khatiwada and KH Ghimire. 2017. Red Listing of Crop Landraces in Earthquake Affected Areas. **In**: Rebuilding Local Seed System of Native Crops in Earthquake Affected Areas of Nepal (BK Joshi and D Gauchan, eds). Proceedings of a National Sharingshop, 18 Dec 2017, Kathmandu; NAGRC, Bioversity International and Crop Trust; Kathmandu, Nepal; pp.108-125. https://www.bioversityinternational.org/e-library/publications/detail/rebuilding-local seed-system-of-native-crops-in-earthquake-affected-areas-of-nepal/

Joshi BK, MP Upadhyay D Gauchan, BR Sthapit and KD Joshi. 2004. Red listing of agricultural crop species, varieties and landraces. Nepal Agric. Res. J. **5**:73-80. http://www.nuscommunity.org/uploads/tx_news/red_lists_nepal.pdf

Sthapit B, RB Rana, A Subedi, S Gyawali, J Bajracharya, P Chaudhary, BK Joshi, S Sthapit, KD Joshi and MP Upadhyay. 2006. Participatory four cell analysis (FCA) for local crop diversity. In: Good practices: On-farm management of agricultural biodiversity in Nepal (BR Sthapit, PK Shrestha, and MP Upadhyay, eds). NARC, LI-BIRD, IPGRI and IDRC; **pp**.13 16.

Citation

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