Rice Landraces

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Abstract

Rice (*Oryza sativa* L) landraces are most often heterogeneous with a blend of different individual plants maintained by farmers in a local environment and constitute a significant portion of the cultivated rice gene pool in Asia. There is a direct relationship between genetic heterogeneity in crop plants and stable production particularly for resource-poor farmers in marginal environments. These rice landraces are the genetic resources of the agricultural crops that sustain the world's growing population, and the genetic building blocks for more productive crop varieties.

Keywords: Rice, landraces, genetic resources

1. Introduction

Landraces are the heterogeneous crop populations that humans deliberately cultivate[1] and are not the product of modern plant breeding[2]. Landraces are crop populations selected and maintained by farmers within the natural system of evolution[3]. More than natural selection, the selection imposed by farmers makes landraces significant with their social, cultural and religious ties in farming communities.

2. Development of rice Landraces

A large number of *Oryza sativa* L. cultivars have been developed in 'primitive' agriculture by human and natural selection, over a long period of time and they remain relatively unmodified, despite generations of selection by farmers and have become adapted to different human and environmental influences[4]. The combined effects of adaptation to different environments, the breakdown of reproductive isolation between domesticated species and their wild relatives, and selection by farmers over many generations led to a multiplicity of varieties, each with particular traits valued by the communities that developed them. These resulted in the landraces or folk varieties. Landraces are most often heterogeneous with a blend of different individual plants maintained by farmers in a local environment and constitute a significant portion of the cultivated rice genepool in Asia[5]. These are the genetic resources of the agricultural crops that sustain the world's growing population, and the genetic building blocks for more productive crop varieties[6]. These cultivars, grown in subsistence agriculture, are diverse and generally carry a great amount of genetic variability in their populations, which contrast with improved cultivars whose populations are exceedingly homogenous[7].

3. Unique features of rice landraces

Moreover, landraces are understood to differ from improved cultivars in adaptation to soil types, sowing and ripening period, nutritive value and show high yield stability, especially in regions where seasons are unpredictable[8]. They also constitute a good source of unique genes for stress tolerance[9], and are well adapted to their environments. These landraces constitute a conspicuous source of variation for crop improvement[10]. They are passed from generation to generation of farmers and are exposed to natural and human selections in a local environment[11]. These landraces are the only resource available in a resource-poor environment and this genetic variation could be exploited in rice breeding where access to new technology is difficult.[12]

4. Role of landraces

Farmers maintain a complex population of landraces of crops because no single variety could satisfy their main concerns like environmental heterogeneity effects, pest and pathogen problems, risk management, and demands of landraces for its cultural, ritual and dietary values. This strategy of minimizing risk stabilizes yields, promotes dietary diversity, and maximizes returns using low levels of technology and limited resources. They are the source of traits to transfer to commercial varieties through conventional breeding techniques or through genetic transformation. Diversity is the only defence against the unknown.

The basic diversity data of landraces has been found important to monitor the dynamics of crop genetic resource management. The diversity data generated in time and space have been valuable to communtities, scientists and policy managers to formulate and implement conservation strategies of *in situ*, on-farm as well as *ex situ* conservation and management of genetic resources[11, 12]. The variability patterns of landrace diversity indices consist of two parts: richness, which represents the number of landraces in a community, and evenness, representing the relative abundance of the individuals among the various landraces present in the community. Landrace '*richness'* is determined by counting the number of landraces in the community, which is a simple and effective tool to estimate the diversity[13].

Three different types of values for the selection and cultivation of landraces can be distinguished: direct, indirect and option value. Direct or use value is the simplest and obvious one that refers to harvest and uses of crop varieties. Socioeconomic and cultural (food security, market, religious and cultural uses) and adaptive traits, which jointly represent 'use value' of variety determine the existence of these landraces on-farm. Farmers value certain aspects in the varieties—either socioeconomic or adaptive traits or both—and the comparative advantages of their preference directly determine the area coverage and the number of households cultivating these landraces at community level[14].

Indirect values refer to the environmental services or ecological health to which the crop varieties contribute, but farmers may not observe or notice the relationship. Option values refer to future use of crop varieties.

5. Rice Landraces in modern times

However, the intensive selection in modern breeding practices has led to a severe loss of genetic diversity in the cultivated rice gene pool, rendering rice varieties more vulnerable to disease and insect epidemics and consequently affecting the stability of stability of rice productivity, growth duration in relation with climate, adaptations to different agricultural practices (upland, lowland, swampland, etc.), the photo-periodic response and the use for food[15.16]. Therefore, there is the need to diversify the genetic base of improved varieties. The first step towards this is to characterize available landrace rice genotypes at the morphological level. This is because the evaluation of phenotypic diversity usually reveals important traits of interest to plant breeders[17]. Also the effective utility and conservation management of the valuable genetic diversity in the rice gene pool rely significantly on a clear understanding of the evolutionary relationships of rice species and subsequently the development of a natural classification of the genus *Oryza* [18]. The knowledge of agro-morphological diversity and the distribution pattern of variation among conserved accessions could be an invaluable aid in germplasm management and crop improvement strategies[19].

Studies have asserted the need to understand the inter-connectedness of cultural diversity and agro-biodiversity, including how farmers incorporate new crops and varieties in their current repertoire to meet cultural and environmental needs of society and its farming systems[20, 21]. Other studies have indicated that economic status and food culture/culinary preferences promote diversity on-farm[22].

6. Quantification of rice landraces

To measure the status of crop diversity in the field the most common method is counting named landraces/varieties. The number of landraces/varieties (richness) and their pattern of distribution in terms of area coverage (evenness) are key indicators for local crop diversity at the landscape level. For farmers, genetic diversity means varietal diversity, which farmers can clearly distinguish on the basis of agromorphological traits, phenological attributes, postharvest characteristics, and differential adaptive performance under abiotic and biotic stresses. The complex issues of agro-biodiversity conservation, and the need to develop methodologies that combine understanding of biological and social aspects was raised[22].

Farmers have developed and utilized diverse rice folk varieties to meet the complexity of a multitude of spatio-temporal agro-ecological systems and to provide reliable sustenance and a sustainable food source to local communities). However, the distribution of crops/landraces in traditional farms is determined by environmental conditions and farmers' objectives. Farmers have been the generators and curators of the rich assemblage of crop biodiversity under their custodianship. Study of the dispersion of this diversity across the cultivated landscape along with associated local knowledge base is central for understanding the scientific basis of *in situ* conservation of crop biodiversity on-farm. Perspectives in this direction would provide a platform for studying the nature of crop genetic resources and relevance of ethno-agriculture in farming communities.

7. Conclusion

There is a direct relationship between genetic heterogeneity in crop plants and stable production particularly for resource-poor farmers in marginal environments. However, there is no well documented evidence to show that farmers' decisions regarding the choice of landrace/varieties is based on the level of genetic biodiversity within and between varieties. Although there are encouraging examples of farmers in many regions retaining old varieties for special needs, usually farmers have a logical preference for cultivars that produce higher yield and better quality and ensure stable production under seasonal fluctuations in crop growing conditions. Folk or traditional rice varieties are important reservoirs of valuable traits and need special attention for future conservation[23].

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