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o Didier BAZILE

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Reconsidering farmers in the process of the dynamics of biodiversity: a new agricultural perspective of sustainability

o **Didier BAZILE, Researcher Agroecologist / Profesor of University**
Centre de cooperation internationale en recherche agronomique pour le developpement - CIRAD (France)

Analyses of the impact of agricultural intensification on biodiversity only consider the management of territorial ecosystems serving human needs, automatically assuming a conflict between productive crops and 'natural' biodiversity. Studies of changes in biodiversity induced by agriculture thereby tend to focus only on the particular biodiversity associated with agricultural landscapes. To round out this thoroughly presented point of view (Firbank et al., 2008), we need to reverse this characterisation to take a new look at the impact of farmers' practices on biodiversity dynamics (Chevassus-au-Louis & Bazile, 2008). In developed countries, agriculture is under increasing societal pressure to conserve natural resources and enhance the environment (Thompson, 2005). Research needs to focus on developing an acceptable balance between meeting the needs of agricultural production, the maintenance of ecosystem services, and the conservation of biodiversity. Firbank (2005) examines the gap between the short term imperatives of policy makers and the complexity of the multi-scale management needed to assess the environmental services furnished by biodiversity.

Human activity, and in particular agricultural activity, often is perceived as contributing to environmental pollution. The transformation of environments by modern agriculture accentuates this image with the genetic uniformity which has been imposed. Today, modern agriculture is based on a dangerously limited number of crops and only a few improved high-output varieties (Barbault, 1997; CIP-UPWARD, 2003). Biologists have shown through ecological history research that the erosion of the biodiversity is closely related to human activities. This vision of agriculture as a destructive force remains widespread among various scientists working on biodiversity. Similarly, the domestication of species, which lies at the origins of agriculture in the world, often is perceived by biologists as a negative process bent on eroding biodiversity.

However, many of the phytogenetic resources used in agriculture are the direct result of the coordinated intervention of man (Mazoyer and Roudart, 2002). Farmers have consciously selected and improved these resources since the birth of agriculture. In more modern times, plant breeders have used this diversity with remarkable effects on the improvement of varieties (Vernooy, 2003). However, the viability of these resources requires specific strategies that are adapted to their unique nature. Contrary to the bulk of natural biodiversity, agrobiodiversity requires an active and continuous management on the part of man. Moreover, the *in situ* diversity of food plants often is concentrated in areas of the world that are different from those endowed with a wealth of other forms of biodiversity. These centres of agricultural diversity are largely located in developing countries where traditional agricultural practices render it possible to preserve a diversity of cultivated environments (Boerma, 2004).

In these areas, cropping systems are still based on a broad range of genetic diversity. This diversity has been generated by farmers' knowledge of varietal creation and has been maintained over countless generations by seed management practices (Brookfield, 2001; Brookfield et al, 2002; Wood and Lenne, 1999). This is why small family farms, which today are threatened by the globalization of agricultural trade, hold the key to the growth of biological and crop diversity. The farmers recognize that plant varieties must evolve if they are to be able to adapt to change in marginal environments and continue working on poor soils with limited resources. These farmers consequently are the guardians of diversity. Thanks to their skills in phytogenetics, shaped by experience and observation, they are preserving the genetic variability that is essential for vegetable genotypes to evolve and adapt to global changes (Chloupek et al. 2004).

The preservation of these phytogenetic resources is a precondition to sustainable development because they provide the raw materials for the production of new cultivars and new races. They constitute an adaptable gene reservoir that may be used to mitigate potentially harmful effects of economic and environmental changes (FAO, 1996). Vast exchanges of genetic resources between farmers, communities, and countries are critical to the maintenance and viability of agrarian systems, endowing them with the capacity to adapt to change and meet evolving needs.

There are two contrasting views regarding the conservation of diversity. The first, known as 'conservationist', considers that the *in situ* preservation of diversity (Jarvis, D., Sthapit, B. and Sears, L., 2000; Jarvis, D.I. and Hodgkin, T., 1998) is not sufficient to preserve all genetic resources and it therefore is indispensable to conserve genetic resources *ex situ* in gene banks (Wood and Lenne, 1997). The second is based on the concept of ecosystem services and argues that *in situ* diversity is useful for agrosystems and farmers, in particular in relation to risk management strategies (Altieri, 1999; Collins and Qualset, 1999; Flora, 2001).

Arguments justifying the *in situ* or *ex situ* conservation of genetic diversity continue to rely on contradictory elements which exclude the possibility of complementary actions. In areas where difficult climatic conditions pose considerable challenges to agricultural activity, the maintenance of high genetic diversity has allowed the survival and development of the local human populations over many centuries (Bazile et al., 2008; Begossi, 1998). Yet the aim of agricultural research in such countries remains largely focussed on producing improved varieties to cope with their growing populations. Yet high-output varieties are beyond the reach of millions of small farmers who cannot afford expensive seeds and fertilizers. Furthermore, when farmers are provided access to seed catalogues, the majority decline to accept the offers of breeders because the modern varieties proposed are unsuitable for the climate and poor soil on which they must cultivate: these varieties satisfy neither the farmers' needs nor local preferences (Bazile, 2006). In contrast, the development of traditional seed systems is based on the possibility of using known varieties that farmers have seen their neighbours growing. This aspect facilitates the adoption and the immediate use of these varieties, which is an asset when a country is seeking to minimize risk. The fact that these exchanges are free consolidates the sense of solidarity that characterise traditional communities confronting difficult environments (Almekinders, 2001; Brocke et al., 2003; Dusen, 2004).

From this complementary perspective of biodiversity in agricultural landscapes, we are able to build a new vision of sustainable agricultural that will be able to reconcile human needs with human well-being today and in the future.

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