

Preface

Biodiversity in agricultural landscapes: Investing without losing interest

Agrobiodiversity refers to the diversity of life that contributes to food and agriculture in the broadest sense. Superimposed on agrobiodiversity are agricultural landscapes that are mosaics of land use types and ownership, influenced by a complex set of biological processes from the level of genes to ecosystems, and socioeconomic processes ranging from the decisions of individual farmers to forces of globalization. Therefore, interdisciplinary science is necessary to understand the roles of agrobiodiversity in agricultural production and human well being at various temporal, socioeconomic and spatial scales.

Concerned with accelerating losses of agrobiodiversity, DIVERSITAS, an international program of biodiversity science, constituted an agrobiodiversity network to develop a science plan to evaluate the biological, social and economic impacts of changes in agrobiodiversity. Apart from developing a science plan,¹ the network has fostered a series of activities including the organization of a symposium on agrobiodiversity at the first open science conference of DIVERSITAS in Oaxaca, Mexico, in November 2005. This volume represents a partial set of papers presented at the symposium.

The papers in this special issue of *Agriculture, Ecosystems and Environment* share the common view that agrobiodiversity serves as capital in supporting agricultural sustainability by: (i) producing more and better quality food and fibre for a growing human population, (ii) protecting the natural resource base upon which agriculture as a cultural and economic sector depends and ultimately (iii) promoting social well-being of farming communities and society as a whole. These papers demonstrate that some ecosystem services from agrobiodiversity, such as production of food and fibre are relatively well-understood, while other services are more difficult to identify and quantify, such as clean water, soil fertility, timber, habitat for fisheries, pest control, pollination and aesthetic values. For making agrobiodiversity a concern and challenge for policy makers and societal organisations, such as farmer unions and nature conservation

agencies, it is of great importance to develop adequate information and knowledge on these services, so that interest is encouraged rather than lost. Time is of the essence in addressing the problem, as agrobiodiversity is declining rapidly due to anthropogenic pressures, including population growth and the rapid spread of international agricultural markets, that in turn result in furthering intensification of agricultural systems and the encroachment into semi-natural ecosystems.

Several themes weave through the set of papers in different contexts and at various scales: loss of agrobiodiversity through agricultural intensification, land use change and management of biodiversity along interfaces between agriculturally productive land and non-agricultural lands, and payments or rewards for the ecosystem services generated by agrobiodiversity. The papers demonstrate the value of interdisciplinary research for understanding the complex relationships between biodiversity conservation, land use, ecosystem services and their value to society.

Agricultural intensification, as used here, is the process by which farming systems increasingly use high levels of non-renewable, purchased inputs, e.g., inorganic fertilizers, other agrochemicals and fossil fuels, and other artificial capital invested per unit of land. Farmers may avoid intensification and invest in agrobiodiversity utilization and conservation in heterogeneous environments, as shown for landraces of maize that are maintained in the mountains of Chiapas, Mexico (Brush and Perales, 2007). In contrast, in landscapes with less environmental and cultural heterogeneity, farmers usually disinvest in agrobiodiversity as an asset due to the lack of incentives offered by markets and other institutions at both local and larger scales, especially when synthetic inputs are available as low cost alternatives (Pascual and Perrings, 2007). Two important considerations are introduced in terms of preventing agricultural intensification and preserving the ecological and socioeconomic structures in traditional, agrobiodiversity-rich agricultural landscapes. One is that traditional ways of life are no longer viable in many areas, due to loss of ancestral lands and to

¹ <http://www.diversitas-international.org/docs/Inter.%20Diversitas.pdf>.

erosion of cultural knowledge (Harrop, 2007). The other consideration is that we are only beginning to understand the functions of agrobiodiversity in conferring resilience against stress and disturbance and controlling ecological processes, particularly at the community (e.g., pest control) and ecosystem levels (e.g., nutrient and water cycles), especially in biodiversity-rich environments such as soil (Brussaard et al., 2007; Jackson et al., 2007). This makes it difficult to demonstrate management options that decelerate the agricultural intensification process.

For conserving biodiversity, the emphasis to date has been on habitats in natural areas by excluding human communities, rather than on protecting human practices that have resulted in ancient relationships between humans, the land and agrobiodiversity (Harrop, 2007). The intentional segregation of highly intensive agricultural production zones from biodiversity-rich conservation zones is unlikely to succeed due to the complexity of the ecological and social dynamics between these zones. For instance, the transport of agricultural chemicals and invasive species, as well as the likelihood that agricultural intensification can quickly dominate an agricultural landscape due to the economies of scale, can leave wildlands in a shrinking, fragmented and degraded state (Dorrough et al., 2007; Jackson et al., 2007). The use of crop wild relatives is an illuminating example. An important reason for the lack of *ex situ* conservation is the uncertainty of future benefits that could be eventually realized from a land preservation strategy. In addition, farmers undervalue the option of preserving land for maintaining habitats for crop wild relatives compared to putting it into agricultural use (Heywood et al., 2007). Although international policies exist that express support for conservation, international law, such as the Convention on Biological Diversity, typically fails to have adequate precision and clarity to save many of the unique, agrobiodiversity-rich areas on the planet (Harrop, 2007). Village level and regional institutions may assure more conservation, especially through the engagement of local communities in activities that improve their livelihoods (Bawa et al., 2007).

Compensation, in the form of rewards or payments to farmers who through their conservation efforts provide for ecosystem services to the wider society, may also foster conservation (Bawa et al., 2007; Jackson et al., 2007; Pascual and Perrings, 2007; Tomich et al., 2007). This is an appealing concept that aims at correcting the market failures that arise due to the inexistence of appropriate institutions or the incapacity of existing markets to reflect the social value of agrobiodiversity in a decentralized world. While such approach is gaining attention at international policy fora, such as the UNEP, OECD and the World Bank, the reality is that few examples of rewarding farmers for conserving agrobiodiversity and providing for ecosystem services exist (Pascual and Perrings, 2007). One problem is that valuation is a difficult

task, which needs the joint involvement of ecologists and economists alike (Jackson et al., 2007). Furthermore, the 'option'-value that arises from the future potential benefits of agrobiodiversity are not necessarily known in the present, nor are non-instrumental values stemming from human ethical views such as the extinction of species and ecosystems. From a socioeconomic perspective, reward mechanisms are most likely to work when there is clear identification of providers with a supply of ecosystem services and the beneficiaries with a willingness to pay for such provision (demand). Also, property rights surrounding land use must be established. At another level, partnerships in science, through interdisciplinary and participatory approaches between researchers, farmers and other stakeholders to integrate ecological and socioeconomic research are needed to better understand and delineate the role of ecosystem services and the trade-offs of different management scenarios within agricultural landscapes (Tomich et al., 2007), of which human livelihoods are especially important components (Bawa et al., 2007). However, such partnerships are difficult to create and to sustain in a world where science is highly compartmentalized and the links between policy and science remains fragile and subject to changing global priorities in an uncertain world (Jackson et al., 2007).

Overall, science needs to take into account policy makers' priorities in order to better target the efforts to increase the understanding of the role of agrobiodiversity on human well-being. Policy-makers also need to be aware of the potential role that biodiversity-based agricultural systems can have in advancing their social agenda. Both needs are intertwined. The agrobiodiversity network of DIVERSITAS is one such platform that can create a fertile ground for dialogue and the advancement of biodiversity science for supporting human well-being.

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