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Developing incentives and economic mechanisms for *in situ* biodiversity conservation in agricultural landscapes

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Abstract

The main focus of this paper is agrobiodiversity and its effects on agricultural production within agricultural landscapes. The interest is to shed light about the fundamental causes of agrobiodiversity loss by focusing upon the institutional or meso-economic environment that mediates farmers' decentralized decisions. Since the main causes of farmers' decisions to 'disinvest' in agrobiodiversity as an asset lie in the incentives offered by current markets and other institutions, the solution to the problem also lies in corrective institutional design. This paper discusses the institutional issues involved in establishing market-like mechanisms for agrobiodiversity conservation. Three steps are highlighted in such process: demonstration (valuation), capture and sharing of conservation benefits (mechanism design). This information is then used to examine the potential success of nascent market creation incentive mechanisms for biodiversity conservation, including: (i) payments/rewards for ecosystem services, (ii) direct compensation payments, (iii) land use development rights, and (iv) auctions for biodiversity conservation. The potential gains to society from their use with regard to agrobiodiversity conservation are discussed and some illustrative examples involving their application in different parts of the world are also described.

Keywords: Agrobiodiversity; Market creation; Institutional design; Meso-economy

1. Introduction

The most important anthropogenic cause of agrobiodiversity loss is rapid land use and land cover change (LUCC) and the subsequent transformation of habitats (MEA, 2005). In agricultural landscapes LUCC usually takes the form of land development. Most land development at the landscape level stems from the decentralized economic decisions of economic agents, including small scale farmers, agribusiness and governments at different scales. The ecological causes and effects of such landscape transformations are increasingly well understood and documented, especially with regard to deforestation and desertification in developing regions (Lambin et al., 2001; Perrings and Gadgil, 2003). In agricultural landscapes, one impact of LUCC that is attracting increasing attention is the alteration of the flow of ecosystem services that are mediated by biodiversity (MEA, 2005; Perrings et al., 2006). This has significant implications for biodiversity conservation strategies in agroecosystems.

Agrobiodiversity is not a fixed asset that every person experiences similarly. Since it is experienced contextually, it is socially constructed (Rodríguez et al., 2006). There are differences in the way that social groups identify and value biodiversity-based services. Nevertheless, agrobiodiversity change can be seen as an investment/disinvestment decision made in the context of a certain set of preferences, 'value systems', moral structures, endowments, information, technological possibilities, and social, cultural and institutional conditions. An important starting point for science is therefore to understand how (a) biodiversity supports the production of ecosystem services, and (b) those services are valued by different social groups.

From an economic perspective, biodiversity change is most obviously a problem wherever it yields negative net benefits. More generally, it is a problem wherever it is

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socially inefficient (given social distributional priorities). In most cases, this reflects market failures that are due to the existence of externalities (incomplete property rights) and the public-good nature of conservation. That is, there exists a wedge between individual agents' perceived net benefits from LUCC actions and those realized by the community that is affected by those same actions (Swanson, 1998; Perrings, 2001; MEA, 2005). Part of the problem in understanding the social value of biodiversity change is that while some of the opportunity costs of conservation or foregone benefits from land development are easily identified, there remain important gaps in the understanding both the on- and off-farm benefits of agrobiodiversity conservation.

In many cases a preservation-centred strategy that involves allocating valuable resources (e.g. land) towards maximum *in situ* biodiversity conservation will not be socially efficient. The cost, in terms of the foregone food and fibre production, of allocating an additional hectare of land for conservation, may be larger than the additional conservation benefits. The 'optimal' intensification debate reflects this fact (Green et al., 2005). Such a debate would be enriched if scientists were able to identify the complex relationships between land management options, biodiversity impacts, changes in ecological services and their values (Perrings et al., 2006).

LUCC and concomitant agrobiodiversity effects depend on the social, economic and institutional conditions that frame economic agents' decisions. In this context, institutions encompass formal rules (e.g. laws, constitutions) and informal constraints (norms of behavior, self-imposed codes of conduct) that govern land users' behavior. They can also be referred to as 'rules in use' (North, 1990) as the ones found in markets. In this vein, decentralized decisions regarding the desired level of *in situ* planned agrobiodiversity, e.g., crop and livestock genetic diversity (Vandermeer and Perfecto, 1995; Jackson et al., 2007) usually depend on conditions in the relevant food, fuel and fiber markets (Smale et al., 2001). Market signals affect farmers' private land use decisions by fixing the private net benefits of their individual actions, given their risk aversion and rate of time preference.

One type of agrobiodiversity that is reasonably well-understood is genetic diversity of cultivars and breeds (Smale et al., 2001). Since the social insurance benefits of higher levels of crop genetic diversity are not rewarded in many current markets, farmers have little private incentive to conserve genetic diversity (Perrings, 2001). The most profitable decision is frequently to grow only a few crop varieties, and not to invest in conservation of the varieties that are less 'favored' by the market.

The problem, in this case, lies both in the public good nature of conservation, and the fact that there are no markets for off-site ecosystem services that depend on on-farm agrobiodiversity. A good is catalogued as public if it does not exhibit rivalry and excludability characteristics. Biodiversity is non-rival as one individual's use of biodiversity does not affect another individual's use of it, i.e., individuals can be equally satisfied simultaneously by the fact that biodiversity is conserved. It is generally non-excludable because it is impossible or very difficult to exclude or prevent someone from benefiting from its conservation. In the case of genetic diversity, farmers who maintain *in situ* crop genetic diversity are essentially conserving a global public good and thus they can be seen as net-subsidizers of modern agriculture and food consumers worldwide. However, global institutions are not in place to provide compensation for generating such global benefits. Indeed, one reason for the profitability of modern specialized agriculture is that it is free-riding on those farmers who are investing in such genetic diversity. The net result is that global crop genetic diversity is being rapidly reduced, since the custodians of the global genetic portfolio are uncompensated by current international markets, and there are no corrective policies or mechanisms in place. For other types of agrobiodiversity, e.g., at the community and landscape level, the situation is even more complex because inventories and functions are so much more difficult to assess.

The fundamental causes of agrobiodiversity loss, therefore, lie in the institutional or meso-economic environment that mediates farmers' decentralized decisions. This paper discusses such institutional (meso-economic) dimensions of *in situ* agrobiodiversity change in the context of a framework that identifies: (i) the forces at play at the microeconomic (farm economy) and meso-economic (market/institutional) level leading to (dis)investment in biodiversity within agricultural landscapes, and (ii) the economic consequences of biodiversity change at the individual and social level. This allows us to discuss mechanisms that can help align the social and private values of biodiversity conservation.

The main focus of this paper is agrobiodiversity and its effects on the multiple services that agriculture provides to society, especially those related to the provision of foods and fibers within agricultural landscapes. The impacts of agriculture on wild species without apparent agricultural value, their habitats, and their contribution to other non-agriculturally related ecosystem services are not emphasized. The scope is purposefully limited, and the paper is organized as follows: The next section addresses institutional failures at the micro-meso-and macro-scales. In Section 3 we discuss the private and social value of agrobiodiversity conservation. Section 4 then addresses the two main stages in market creation: capture and sharing of conservation benefits. We consider various nascent and potentially fruitful incentive mechanisms that can re-create decentralized markets to foster agrobiodiversity conservation. A final section recapitulates the main points and draws out the implications for the conservation of agrobiodiversity.

2. The drivers of agrobiodiversity change

Farmers' agrobiodiversity choices reflect a number of factors aside from market prices, including the social,