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Expressing the public value of plant genetic resources by organising novel relationships: The contribution of selected participatory plant breeding and market-based arrangements



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A B S T R A C T

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After more than a decade of successful collaboration in participatory plant breeding (PPB) between farmers and maize breeders in southwest China, and release of new improved varieties and hybrids, it was realised that their conservation objectives could not also be secured unless farmers had incentives to maintain their traditional cultivars in production. This article explores their experience of expressing the public value of farmers' cultivars through organizing novel relationships among public and private actors, by means of PPB programmes and market-based arrangements. The researchers reached beyond common agri-food development practices and theories, to apply concepts used in public administrations studies, in order to consider public and private interest and value in relation to the direct, indirect and option value of the plant genetic resources (PGRs) represented by farmers' cultivars. In this paper, seven organizational options from selected countries are examined in relation to their roles in (i) creating indirect and options values; (ii) sustaining the legitimacy of and support for related practices; and (iii) developing operational capacity of the associated organizations and actors. The three main findings are (a) innovations in breeding and conservation developed through PPB are key factors in the management by smallholders of the indirect and option value of agro-biodiversity; (b) market-based arrangements and the creation of new sets of property rights in the products developed from farmer-bred cultivars legitimize and support PPB and PGRs conservation; and (c), the organization of the indirect and option value of farmer-bred cultivars calls for the integration of the joint efforts of producers, consumers, market actors and public sector agencies in networked governance, that can take a variety of forms. Lessons are drawn from and for China, where legal and regulatory practices in the seed sector are still under development and smallholders still maintain crop and varietal diversity by their agricultural practices.

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1. Introduction

It is increasingly recognised that valuable, dynamically evolving germplasm resources are disappearing from production at the very time they are needed for developing sustainable agriculture in the context of climate change (Newton et al., 2010). There has been considerable debate in the literature and policy circles about how to value these resources. Recent research has discussed valuation issues

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from a range of perspectives. Some studies investigate the public and private valuation of crop genetic resources from an agricultural economics perspective (Smale, 2006) that pinpoints locations in harsh environments, and where markets function imperfectly, as offering the least-cost opportunity for biodiversity conservation in terms of public investments and effective subsidies. Payments for Agro-biodiversity Conservation services may have a role in creating incentives for on-farm agro-biodiversity conservation in such locations (Narloch et al., 2011). They point also to a category problem that affects the design of effective policy responses, that is, agro-biodiversity is an impure public good. In so far as agro-biodiversity has private value (Smale et al., 2004) farmers may incur not only one-off costs in learning how to manage modern agriculture for conservation, but also opportunity costs. Others emphasise the 'development opportunity' that commercially under-valued agro-

biodiversity represents for smallholders and rural communities (GFAR, 2012) or the future benefits for crop breeders and wider society (Bellon, 2008). Ostrom (2009) suggests another way forward. She argues that the value of agricultural biodiversity is evidenced by communities' willingness to engage in self-organization and collective action to sustain the social-ecological systems that conserve agro-biodiversity. The contributors to Pilgrim and Pretty (2010) explore how likely it is that such efforts are sufficient, unaided by public policy support, to halt or reverse the potential loss of the genetic resources managed by farmers in the 'agricultural commons' that typify many local agro-ecosystems. They provide much evidence for pessimism but also some hope that initiatives such as community-conserved areas will prove effective.

The debate is of urgent practical concern because most countries are experiencing a rapid transition in their seed systems, with power to control the commercial seed development and supply of all major crops passing to the commercial seed sector at both the global and national levels (Renwick et al., 2012). The production and utilization of genetic resources that have commercial value only in local markets is not a priority for private commercial breeders and the expansion of intellectual property rights (IPR) into agriculture, in the form of patent and plant variety protection, has accelerated the development of the commercial seed sector (Phillips and Onwuekwe, 2007; Renwick et al., 2012). The economic growth of the commercial seed sector in practice has diminished the public interest in agro-biodiversity and the actual and potential contribution of smallholder farmers' seed enterprises to agricultural modernization and trade.

On the other hand, the majority of the world's smallholder farmers continue to source their seed from their own harvests and from informal seed markets and exchange networks. The attention and efforts of some parts of the public sector and non-governmental organization (NGO) community are turning towards neglected and underutilized crops or varieties, on various grounds, including conservation, nutrition, power, and climate change concerns (Bellon and Risopoulous, 2001; Gruere et al., 2007; Van Dusen et al., 2007). This paper examines selected examples of novel arrangements that seek to harmonise rather than make trade-offs among these goals, and relates these to opportunities in China.

We focus on China for the following reasons. China is the world's second largest economy but still has millions of smallholder farmers who are dependent on informal seed systems and are likely to remain so in the coming decades. None the less, here too the displacement of farmers' locally adapted traditional cultivars has been rapid (for maize, Li et al., 2012a). More than a decade of successful development of participatory plant breeding (PPB), in a partnership between the villages and farmers' groups, Guangxi Maize Research Institute, the Chinese Academy of Agricultural Sciences in Beijing, the Centre for Chinese Agricultural Policy in Beijing, and local municipalities in three provinces in southwest China has led to local release of several improved varieties of maize (*Zea mays*), and to specialist groups of farmer seed breeders who grow, package and sell the named varieties, and to one officially registered hybrid that is maintained and sold by the maize institute (Li et al., 2012b). The maize breeders have come to appreciate the value to maize breeding, especially under climate change, of the continuously evolving plant genetic resources (PGRs) maintained in farmers' fields in a region of globally important agro-biodiversity, yet the partners also realize that farmers in general are reluctant to continue these practices unless they received a market-return for conservation of their PGRs. Moreover, since the policy, legal and regulatory provisions in China's seed sector are still under development, the lessons of recent experience, from novel arrangements developed inside China and from elsewhere, may have significant impact on the choices policy makers might yet make.

Furthermore, the researchers realised the opening up of China's domestic seed market in the mid-1990s and China's entry into the global trading system had brought about new tensions between agricultural modernization and agro-biodiversity conservation. The transition to a more open economy has been accompanied by changes in seed regulation in order to bring China into compliance with international agreements, leading to the rapid emergence and expansion of the commercial seed sector and changes in the functions of public research institutes as they too expand the scope of their work into commercial seed development and marketing enterprises. However, policy-makers recognize that the market-driven demand for crop varieties that suit dominant market actors' interests cannot fully represent smallholder farmers' needs. In China's more remote mountainous regions, local seed systems and farmer conserved plant genetic resources still play an important role in farmers' livelihoods (Li et al., 2012a).

The government and the public sector are seeking ways to protect on-farm conserved PGRs and smallholder farmers' interests, within the frame of rapid commercial development of agriculture and food systems. The diverse, competing and intensifying claims on farmer-maintained agro-biodiversity underscore the importance to global science and technology of retaining such resources in the public domain (Smale and Rubenstein, 2002), yet the problem remains of designing an effective policy and operational response. The aim of this paper is to contribute to resolving the problem.

Because public authorities and party leaders continue to play a major role in strategic decision-making in China, we have found it helpful to frame our evidence, analysis and discussion in terms of concepts drawn from public administration. By reaching beyond the concepts more commonly employed in crop breeding, agri-food and rural studies, we seek to both clarify and advance understanding and practice. We show how by their application to cases, we are able to identify and explore creative market-making practices linked to crop improvement and conservation, and to show how these offer a way forward to policy-makers in China and elsewhere.

2. The concept of value

We begin by unpacking the concept of value in order to dissolve the private-public dichotomy. Brush (2000) distinguishes three different types of value for crop genetic resources: direct, indirect and an option value. Direct values are derived from the non-commercial (e.g., on-farm own-consumption) and commercial (e.g., marketed surpluses) benefits derived from production, and the benefits (e.g., utility, happiness, nourishment, sustenance, etc.) derived from consumption. Indirect values refer to the environmental services rendered by genetic resources and to the benefits that result from biological resources irrespective of harvest and consumption. For *in situ* conservation, the most important asset of local varieties is their indirect value in maintaining crop evolutionary relationships. Option values are derived from the future use of a resource that may be expressed as the desire to bequeath a specific or more general cultural patrimony to future generations or as the potential of a variety to meet future demands or conditions of production. Farmers are most likely to be interested in the direct values exemplified by the consumption or income benefits associated with enhanced productivity, e.g., higher or less volatile yields, lower costs of production per unit area, greater nutritional or consumption value. Farmers tend to be less sensitive to indirect and option values; these represent the public value of crop genetic resources for humankind as a whole or for particular societies. Public investments typically are needed to sustain or enhance indirect and option values, with private actors showing little willingness to take these values into account unless rewarded by subsidy (for instance,

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