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Multi-functional landscapes from the grassroots? The role of rural producer movements

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Abstract Around the world, agricultural landscapes are increasingly seen as "multi-functional" spaces, expected to deliver food supplies while improving rural livelihoods and protecting and restoring healthy ecosystems. To support this array of functions and benefits, governments and civil society in many regions are now promoting integrated farm- and landscape-scale management strategies, in lieu of fragmented management strategies. While rural producers are fundamental to achieving multi-functional landscapes, they are frequently viewed as targets of, or barriers to, landscape-oriented initiatives, rather than as leading agents of change. In reality, however, rural producers in many areas have embraced elements of multi-functional land management. In this paper, we explore the role and recent evolution of producer movements in influencing multi-functional farm and landscape management. We explore these roles through six case studies, including a land reform movement in Brazil, indigenous territorial development in Bolivia, conservation agriculture associations in Canada, environmental cooperatives in the Netherlands, indigenous and biocultural heritage associations in Peru, and Landcare groups in the Philippines. These experiences suggest that producer movements are playing pivotal roles in supporting landscape multi-functionality, not only through agroecological farming practices but also through off-farm efforts to conserve ecosystems and support multi-stakeholder landscape planning. On the other hand, interests of producer movements are not always fully aligned with multi-functional landscape management approaches. The contribution of producer movements to multi-functional landscapes depends on these movements including farm and landscape stewardship in their values and goals, and having the political support and capacity to engage meaningfully in multi-stakeholder processes.

Keywords Agriculture · Agroecology · Diversified farming systems · Farmer organization · Landscape · Multi-functional · Producer movements · Integrated landscape management

Abbreviations

ANAPQUI	Asociación Nacional de Productores de Quinua, The National Quinoa Producers' Association
ATO	Alternative trade organization
BMP	Best management practice
CCA	Community Conserved Area
CIP	International Potato Center
COCAMP	Cooperativa dos Assentados da Reforma Agraria do Pontal, Agrarian Reform Settlers' Cooperative in the Pontal
CSFSP	Canada–Saskatchewan Farmer Stewardship Program
ICRAF	World Agroforestry Center

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IFOAM	International Federation of Organic Agriculture Movements
IPE	Institute of Ecological Research
MST	Movimento dos Trabalhadores Rurais Sem Terra, Rural Landless Workers' Movement
NFW	Northern Friesian Woodlands Agricultural Cooperative
NGO	Non-government organization
NVS	Natural vegetative strips
PFRA	Prairie Farm Rehabilitation Act
PROQUINAT	Natural Quinoa Production Standard
SSCA	Saskatchewan Soil Conservation Association

Introduction

Agricultural regions are facing a host of new expectations for performance—to supply more food, to ensure food security and provide sustainable livelihoods for farming communities, to protect and restore biodiversity and critical ecosystem services, while providing resilience in the face of climate change and mitigating greenhouse gas emissions (UNDESA 2012). Despite significant gains in agricultural productivity made in the twentieth century, continued low productivity in some regions, paired with a leveling-off of yields and declining response to agricultural inputs in others, raises concerns about the viability of current agricultural approaches to meet future food demands of a global population. Similarly, while ambitious poverty alleviation targets have been set through the Millennium Development Goals, hundreds of millions of rural households continue to live in extreme poverty. At the same time, the Millennium Ecosystem Assessment and subsequent analyses have identified agriculture as a primary driver of biodiversity loss, greenhouse gas emissions, and perturbations to global biogeochemical systems. To address this multitude of challenges, the world's agricultural systems are now being called upon to provide a much larger set of goods and services to society. Accordingly, food security, rural development and conservation advocates have argued for the need to make agriculture more multi-functional and to coordinate farm-level production systems with other land uses to ensure reliable flows of agricultural goods and ecosystem services.

Over the past few decades, collaborations among farmers, other land managers, researchers and civil society organizations have led to widespread innovation to advance these goals at field, farm and landscape scales (Roling and Wagemakers 2000). These collaborative initiatives have developed and applied innovative alternatives to high external input, monoculture cropping systems and industrial livestock production systems. These include agroecological or resource-conserving practices that deliberately manage and foster ecological processes to improve soil fertility, nutrient recycling, efficient water management, and natural pest, predator, and disease control (Altieri 1995; Gliessman et al. 1998). Such farms typically produce multiple crop and livestock species and/or varieties, together with complementary management of non-agricultural species and plots, including organic agriculture, agroforestry, mixed crop-livestock systems, silvopastoralism, and others (Kremen and Miles 2012). Evidence from the developing world suggests that such diversified farming systems can provide a viable pathway for sustainable intensification of smallholder agriculture, more than doubling crop yields over baseline local farming systems (Pretty et al. 2005, 2011). Meanwhile, large-scale mechanized agriculture has also pursued farm-level innovations to improve environmental performance, particularly through increasing input-use efficiency (Zhang et al. 2013).

At the landscape scale, collaborative initiatives among land managers, governments and civil society organizations have shown that deliberate management of land-use mosaics consisting of small- and large-scale farms together with non-agricultural lands, water resources, and native ecosystems, can increase synergies and reduce tradeoffs among landscape objectives (LPFN 2014). This outcome is achieved through a variety of institutional models that foster multi-stakeholder planning and collective action (Ichikawa and Toth 2012; Koohafkan and Altieri 2011; Scherr et al. 2012). In the past few years, there has been a surge of interest in multi-functional farm and landscape management, which aims to describe and measure the benefits and services these spaces provide as a result of their social and ecological structure and diversity (Fry 2001; Brandt and Vejre 2004; Selman 2009). Increased multi-functionality of production landscapes is posited as an important solution to achieve goals related to food security, poverty alleviation, climate change adaptation and mitigation and sustainable development simultaneously (de Schutter 2011; IAASTD 2009). However, this interest begs the question of which types of organizations and actors are best suited and best positioned to support increased multi-functionality across a wide range of contexts. While policymakers, international organizations, and non-governmental organizations will often have a strong role to play, changes in agricultural paradigms ultimately hinge on farmers' individual and collective decision-making.

Historically, farmers' role in multi-functional landscapes has often been framed as that of a beneficiary or target of a program or policy, rather than as a leading agent

of change. Indeed, in areas experiencing high rates of environmental degradation, farmers are often seen as a hindrance to change, or, if viewed more benignly, as having limited potential to mobilize action at large scales. Although recent assessments of initiatives supporting landscape multi-functionality in Africa (Milder et al. 2014) and Latin America (Estrada-Carmona et al. 2014) found that producer groups are often key stakeholders, their involvement is often limited to the implementation, rather than the design, of the initiatives' activities. Even where programs support farmers to adopt diversified farming practices, there is rarely recognition of the other roles that producers may play in landscape governance—for instance as public servants, citizens, landowners, and business owners—and how these roles may lead producers to make different decisions than those they would make as mere producers (Primdahl and Kristensen 2011).

One way that farmers may contribute to landscape multifunctionality is through rural producer movements, which we define broadly to refer to self-organized associations of agricultural producers who have convened to pursue collective action for economic development, stabilization of rural communities and environments, sharing of farming experiences and knowledge, and championing of land rights for current and future farmers. Such movements, we argue, are more than the organization by farmers to facilitate business transactions (i.e., cooperatives), marketing, technical assistance or institutional representation. Rather, they demonstrate certain characteristics of social movements—namely collective action outside of existing institutional channels, change-oriented objectives, and organization, by engaging in processes of consciousness-raising, visioning and mobilization (Snow et al. 2007). They frame their activities in particular ways to create meaning (Benford and Snow 2000), mobilize political, structural, economic and natural resources to accomplish their goals (Snow and Benford 1992), and often express their objectives in terms of grievances, opportunities and rights (Foweraker 1995; Tarrow 1992), or in terms of cultural values and identity. Much of the literature on rural producer movements has focused on peasant movements in the context of struggles for land rights and autonomous decision-making, rather than such movements' contributions to land management, ecosystem stewardship, and livelihood security. In this article we focus on rural producer movements that operate locally (i.e., at scales ranging from a community or cooperative to a landscape or subnational level) to support land management on the ground.

In some cases, rural producer movements are supporting and influencing decision-making by serving as member-constructed platforms for knowledge sharing, technology transfer, and advocacy around shared interests (Ward et al. 2010; Wittman 2010; Renting and van der Ploeg 2001). Such movements mainly represent independent family farmers (as distinct from corporate farm estates or outgrowers), who may have interest in and motivation to adopt multi-functional practices that benefit local livelihoods. Thus, the priorities, competencies, and ideologies of the groups that represent these small- and medium-scale farmers are critical in shaping the extent to which and the form in which these practices are adopted.

Many producer movements have achieved, or aim to have, profound impacts on the way that lands and waters are managed. There appear to be several potential strengths of drawing more leadership from producer movement organizations to support multi-functional landscapes. These include the construction of a shared vision for the landscape among producers and their communities; mobilization of farmer networks to share, test, and expand the adoption of multi-functional practices; representation of farmers and farming communities in negotiations with other land user groups; facilitation of collective action and coordination of activities across farms and non-farm lands; and advocacy for policy change toward integrated objectives. On the other hand, producer movements may pose barriers to multi-stakeholder landscape processes where their members are unwilling to participate in these platforms, or consider them illegitimate. They may prioritize only economic outcomes or may lack the motivation, capacity, or power to influence land and water management outside their own parcels.

Local producer movements in many cases are affiliated with international or transnational movements. Such transnational or meta-movements often refer to a particular paradigm of production for agriculture and society, rural economic development, or environmental management, and articulate the experiences of local movements within master frames that influence the orientation and activities of the movements in their scope (Snow 2004). Historic examples of meta-movements are the farmer cooperative movement (since the early twentieth century) (Develtere et al. 2008; Mooney 2004), movements to promote forest land rights (with major reforms from 1970 to 2000) (Larson et al. 2010), and agrarian reform (mainly since the early twentieth century) (Borras 2008; Kay 1998; McMichael 2006; Tuma 1965).

More recently, there has been a spread of transnational movements to resist or find alternatives to industrial farming, such as the organic farming movement (IFOAM 2012; Rigby and Cáceres 2001), the food sovereignty movement (Martinez-Torres and Rosset 2010; Pimbert 2008) and the agroecology movement (Altieri 1995; Wezel et al. 2011). These movements highlight the social and ecological benefits of the systems they promote, though chiefly for on-farm sustainability and community wellbeing. In the past decade, these have come to demonstrate—

and seek ways to enhance—broader landscape benefits. - Other movements, such as the Landcare movement in Australia (Curtis and de Lacy 1998) and the Philippines (Dano et al. 2009), have embraced the mission of restoring degraded landscapes for a renewal of livelihoods and ecosystems. We hypothesize that many rural producer movements play an important role in promoting multi-functional farm and landscape practices, either by maintaining existing land management systems—often rooted in traditional or indigenous practices—or by diversifying or re-diversifying agricultural landscapes to improve rural livelihoods, increase resilience, or achieve other benefits. Similar hypotheses have been posed and explored previously. For instance, smallholder producer movements have been highlighted as key protagonists in the shift toward agroecological intensification of farming systems (Altieri and Toledo 2011) as well as critical stewards of "nature's matrix" of mosaic production landscapes whose sustained ecological integrity is necessary to protect biological diversity that cannot be conserved in nature reserves alone (Perfecto et al. 2009). However, while specific positive examples have been highlighted in the literature, there has been little broader examination of the degree to which, and the pathways and limitations by which, producer movements contribute to multifunctional landscapes across a diversity of production paradigms and contexts.

This paper examines the experience of diverse producer movements managing for multi-functionality at farm and landscape scales. It interrogates how such movements are implementing multifunctional farm and landscape practices on the ground. In doing that, it takes into account how the producer movements are engaging with international networks, meta-movements and other stakeholder groups in the landscape in management activities. The study addresses two research questions. First, in what ways are producer movements under different paradigms of production promoting or fostering multi-functional farm and landscape scale management in practice? Second, what are the conditions that enable producer movements to function as effective institutions for driving multifunctional landscape management? From the findings, we draw some implications for scaling up the geographic scope of existing producer-led and multi-stakeholder initiatives that implement multi-functional landscape management.

Methods

To address these research questions, we analyzed a set of cases from the secondary literature, drawing where possible on primary accounts by rural producers of their goals and experiences with multi-functional farm and landscape practices. We selected these cases to represent a range of geographic, agroecological, and socio-cultural contexts under which rural producer movements operate.

The first phase of the study was an investigative process through review of formal literature and consultation with experts in the field. The aim was to search for cases representing a range of local producer movements operating in both developed and developing countries and to identify those for which environmental stewardship is identified as a significant element of self-defined identity. Other criteria for case selection included: sustainable agriculture or agroecological activities at farm scale (e.g., conservation agriculture, promotion of agrobiodiversity, water conservation, agroforestry, etc.); engagement with other stakeholders at landscape or regional scales; diversity of experiences in terms of geography, culture, management approach, and stakeholder engagement; and availability of information on their history. We reviewed a total of ten cases, six of which we selected for the final analysis based on the quality and amount of information available in the peer-reviewed and grey literature, the centrality of the producer movement to multi-functional farm and landscape management in the context of the case, and the potential of the case to elucidate the conditions enabling producer-movement participation and leadership in multi-functional management.

In the second phase of the study, we conducted a detailed review of each case and characterized each according to a set of common parameters including promotion of on-farm practices, relationships with other actors, connections with meta-movements and contributions (both intentional and unintentional) to landscape-scale management and landscape functions. We collected information on the objectives, activities, and outcomes of these movements. We also considered the pursuit of these activities in the context of these movements' other activities, objectives, and ideological orientation, as well as their engagement in markets and policy change. We then synthesized this information to evaluate the extent, scale, intentionality, modalities, partnerships, linkages to meta-movements, and potential sustainability of efforts by the producer movements to support integrated landscape management.

Case studies of producer movements

The six case examples that we reviewed collectively represent a broad range of producer movements from both developed and developing countries, spanning diverse cropping systems, ecological settings, and sociocultural contexts. We report on the first three cases in detail and more briefly summarize the remaining three in order to highlight the history of the producer movements, the conditions enabling multi-functional management (particularly

links to meta-movements and international communities of practice), and the activities and practices to support multi-functionality at farm and landscape scales. The key features of all the cases are summarized in Table 1.

The *Rural Landless Workers' Movement* and land reform in Pontal do Paranapanema, Brazil

The growth of the agricultural sector is recognized as a primary driver for the socio-economic development that has occurred in southeastern Brazil over the past ten to twenty years (Martinelli et al. 2010). However, despite rapid improvement on poverty and other development indicators, Brazil's land distribution patterns have remained skewed toward *latifundos*, or large estate producers. Established in 1984, the *Movimento dos Trabalhadores Rurais Sem Terra* (Rural Landless Workers' Movement, or MST) initially concentrated on obtaining land for the landless and stabilizing food production, but has since introduced "ecological land reform" combining food production with environmental management in community settlement planning (Wittman 2010). The movement, which now includes more than one million people throughout Brazil, resulted in the settlement of more than 100,000 families onto redistributed land as of 2000 (Ashoka 2002). More than 3000 of these families were settled in the *Pontal do Paranapanema* in São Paulo State, part of the Atlantic Forest region, and formed the *Cooperativa dos Assentados da Reforma Agrária do Pontal* (Agrarian Reform Settlers' Cooperative in the Pontal [COCAMP]) (Valladares-Padua et al. 2002).

COCAMP members were settled in an area known as the *Reserva do Pontal*, designated as a protected area in 1942, which covers 260,000 ha of the highly threatened Atlantic Forest ecosystem. This area has faced significant conflicts of landownership and deforestation for timber and cattle pasture, contributing to the shrinking of the forests to only 36,000 ha associated with the *Morro do Diabo* State Park and neighboring forest fragments by 2002 (Valladares-Padua et al. 2002). The Pontal is important to the conservation of critically endangered endemic species and is a critical source of seed for Atlantic forest restoration programs in the region (Cullen et al. 2005). The settlements were intentionally placed on marginal lands buffering the Park and remaining forest fragments to reduce conflicts with latifundos managing areas under intensive agriculture at the time of settlement (Cullen et al. 2005). However, the placement of the settlements generated concerns in the conservation community that land reform "diminished the priority of nature conservation" (Valladares-Padua et al. 2002).

COCAMP members, like many MST members entered the movement having worked as farm workers, sharecroppers or in urban jobs. Thus, they initially promoted large-scale collective production, following green revolution industrial agricultural techniques (Karriem et al. 2012). However, this type of agriculture proved economically and environmentally unsuitable to the small parcels that settlers managed (Holt-Giménez 2009). In 2000, the MST renamed its "Sector of Production" the "Sector of Production, Cooperation and Environment," and published its *Commitment to Land and Life*, setting out its philosophical relationship with nature and affirming a constitutional right to social production and environmental sustainability (Wittman 2010).

COCAMP members initially did not have expertise in agroecology and agroforestry farming methods. However, a conservation organization, the Institute of Ecological Research (IPE), which previously had seen the land reform settlements as a threat to the remaining forest fragments, began to see the struggle of COCAMP members as an opportunity to raise awareness about the value of more conservation-friendly practices (Valladares-Padua et al. 2002). Since 2003, there has been a concerted effort on the part of MST, local NGOs and public agencies in the Pontal to use the opportunity afforded by land reform to develop sustainable agroforestry initiatives and support rural livelihoods through landscape-level coordination. Their reforestation program includes forest corridors to link fragments, buffer zones to protect fragments, and small patches that serve as stepping-stones between fragments (Wittman 2010). In particular, diversified agroforestry, which incorporates endangered Atlantic Forest species, fruit, timber and fuel wood species into the subsistence system of maize, beans and cassava, has served as a buffer for wildlife reserves (Cullen et al. 2005), as well as a source of income for local communities (Rodrigues et al. 2007).

Together the different stakeholders have engaged in a participatory approach to environmental education and implementation of conservation strategies that facilitates early resolution of new conflicts between settlers, latifundos, conservation NGOs and researchers in the landscape. The approach takes into account the individual opinions of participants, their cultural values and the local context. It then guides stakeholders through several steps designed to build respect and self-esteem. Finally it leads stakeholders to recognize shared values and to construct a common vision for their landscape (Valladares-Padua et al. 2002). This process continues through the regular meeting of a territorial development group that includes COCAMP members, IPE and local partner organizations. By redefining the conflicts surrounding land reform and conservation in a way that identified shared interests between small-scale producers (COCAMP) and the conservation community (IPE and others), these stakeholder groups have

Table 1 Activities, practices and enabling conditions for promoting and implementing multifunctional farm and landscape management in six rural producer cases

Cases	Connections to meta-movements, international communities of practice and markets	Multi-functional farm-level practices promoted	Training and technical assistance to foster multi-functional management	Awareness-raising and knowledge sharing to promote multi-functionality	Improved management of off-farm lands	Participation of producers in landscape decision-making
The *Movimento dos Trabalhadores Rurais Sem Terra* and land reform in Pontal do Paranapanema, Brazil	Connected with international peasant movements (e.g., La Via Campesina) and food sovereignty movements	Adoption of agroecological intensification methods with traditional crop varieties	Training and technical assistance on agroforestry was carried out by a NGO partner	Knowledge sharing on the benefits of agroforestry for conservation and productivity occurs within the territory and with other MST settlements	Off-farm lands, especially forest fragments and their buffer zones, are actively managed by the territorial planning group	Settlement members participate in the territorial planning group, the main body for decision-making in the Pontal do Paranapanema
The *Associación Nacional de Productores de Quinua* (ANAPQUI) in the southern Altiplano, Bolivia	Participating in international fair trade and organic markets, with strong ties with the international fair-trade community and indigenous territorial development	Widespread adoption of organic production of quinoa	ANAPQUI provided training and technical assistance in organic agriculture	ANAPQUI holds regular meetings and quinoa fairs where information is exchanged; however, the focus is not typically on sustainability issues such as erosion and land degradation	Little or none	ANAPQUI members have their own decision-making body which establishes production standards and facilitates connections with fair trade organizations
Saskatchewan Soil Conservation Association (SSCA) and crop diversification on the prairies of Saskatchewan, Canada	Contributing to conservation tillage (no-till) movements in the Americas and increasingly in carbon offset programs	Promotion of mechanized conservation tillage of annual crops, new cover crops introduced, improved fallows, and crop rotation strategies	SSCA was one of the primary supporters and suppliers of training in conservation tillage equipment and practice	Annual meetings, publications, extension services, workshops and farmer-to-farmer communication	Little or none	The SSCA has helped producers link to government and participate in decision and policy-making through partnership
Environmental cooperatives in the Northern Friesian Woodlands, Netherlands	Participating in European cooperative and rural governance movements	Implementation of nutrient management practices, especially for nitrogen; introduction of on-farm nature protection through field margins	Training and technical assistance on nutrient management and hedge management, and meadow bird conservation is done by producers with support from research organizations	Knowledge sharing is done between farmers in the cooperative and with research institutions to clarify the benefits and outcomes of adopted practices; several working groups have been established to focus on monitoring and sharing knowledge on specific areas on management	The environmental cooperative approach inherently encompasses farm and landscape scale objectives. Farmers consider management of non-agricultural lands to be one of their primary responsibilities	The cooperative makes collective decisions about rural development and facilitates dialogue with the government on policy-making

Table 1 continued

Cases	Connections to meta-movements, international communities of practice and markets	Multi-functional farm-level practices promoted	Training and technical assistance to foster multi-functional management	Awareness-raising and knowledge sharing to promote multi-functionality	Improved management of off-farm lands	Participation of producers in landscape decision-making
Ayllu biocultural management in the Potato Park in Pisac, Peru	Linked to international biocultural and indigenous movements as well as the international agrobiodiversity research community	Families collectively manage a shared territory, coordinating cropping, fallowing and grazing on farmlands along the vertical gradient of the mountains	Producers rely on traditional production systems passed down as traditional knowledge rather than receiving technical assistance from outside sources	The communities, along with NGO partners, especially Asociación ANDES, raised awareness on the importance of indigenous communities for managing for and protecting crop genetic diversity; Traditional knowledge is exchanged freely between communities and with research centers. Repatriation of hundreds of cultivars is representative of knowledge sharing at between the Potato Park Association and International Potato Center	Communities manage the entire park for balance according to traditional cultural values, including land under cultivation and otherwise through wise use of resources, wild harvest and traditional practices focused on honoring the earth and seeking social, ecological and spiritual balance	Communities govern the parkland through customary laws and traditional institutions. All decisions on park management and cultivation are made by the communities
Landcare groups in Claveria, Philippines	The international Landcare network and movements for rural governance	Promotion of agroforestry and natural vegetative strips on contours, and planting of woodlots on a portion of farm land	Training supported by the local Landcare associations with technical assistance provided by World Agroforestry Centre	Initially knowledge exchange occurred between Landcare groups in the Philippines and some Landcare groups in Australia. A combination of farmer innovation and formal extension supported dissemination of natural vegetative strips (NVS) and sloping land technologies (SALT)	Active role in managing watersheds and forests, though on-farm activity a priority	Active role of local landcare groups in defining community land management priorities, and coordination among landcare groups to address watershed and forest management

succeeded in improving the productivity and sustainability of COCAMP members' farming systems with agroforestry practices while simultaneously increasing landscape connectivity and helping to protect the remaining forest fragments surrounding *Morro do Diabo* Park (Cullen et al. 2005).

The National Association of Quinoa Producers in the southern Altiplano of Bolivia

The area surrounding the salt flats of Bolivia's southern altiplano is home to Quechua and Aymara communities whose culture and traditional cultivation practices for quinoa, potato and other crops have co-evolved alongside the frost and drought prone environment of the altiplano. Managing for diversity has been integral to the survival of these and other Andean cultures that have selected food crop varieties suited to particular niches along the steep vertical gradient of the Andes. The southern altiplano—especially the departments of Oruro and Potosí—is one of the most important quinoa producing regions in the world. Although quinoa was unknown to most of the world until the 1980s, quinoa producers since have made efforts to intensify production and connect to global value chains. The *Asociación Nacional de Productores de Quinua* (The National Quinoa Producers Association, or ANAPQUI) is one example of a producer movement that has aligned with larger movements, including the fair trade, organic, food sovereignty and indigenous rights movements to protect agricultural biodiversity and support sustainable production.

Producers traditionally farmed quinoa on relatively small portions of their land, the rest of which was used for grazing llamas, the primary source of fertilizer, and cultivating potatoes and other traditional crops. Although quinoa was produced regularly for local markets, it was often sold for less than the cost of production (Ayaviri et al. 2003). Many producers in La Paz, Oruro and Potosí, committed to improving the markets for quinoa, were interested in organizing themselves as early as the 1960s. However, dictatorial political regimes in Bolivia prevented large-scale organization of producers until the 1980s, when the government returned to democracy (Ayaviri et al. 2003). Despite political challenges, during these early years small associations formed which established early linkages to alternative trade organizations (ATOs) in Europe and the United States. When ANAPQUI was founded in 1983, international markets for the *Real Blanca* quinoa grain, a highly nutritious variety of quinoa, were growing rapidly thanks to the work of ATOs in increasing interest in specialty markets for fair trade and organic quinoa. Additional support from the United Nations helped construct an ANAPQUI owned processing facility, allowing ANAPQUI producers to capture more of the market value of this crop (Cáceres et al. 2007).

ATOs primarily enabled ANAPQUI farmers to receive higher prices for quinoa grown under traditional agricultural systems. At the same time, ANAPQUI's growing influence facilitated the diffusion of sustainable farming practices through the establishment of production standards and producer associations supporting ecological production practices. In particular, ANAPQUI established the Natural Quinoa Production Standard (PROQUINAT), which complies with a number of international organic standards including IFOAM, Bolivian and European standards. PROQUINAT was designed to promote soil conservation through conservation tillage practices, ecological equilibrium between domesticated and wild species, balanced production of livestock, grains and horticulture, and organic and integrated pest management and crop fertilization (Ramos Santalla 2000).

Although ANAPQUI has promoted organic and ecological production because of their commitment to preserve the altiplano and traditional practice, international markets have contributed significantly to the expansion of organic quinoa production. In 2003, only 2000 metric tons of organic quinoa were exported. By 2008, producers expected to export more than 16,000 metric tons of organic quinoa (CABOLQUI 2009). Increasing market demand over the past several decades caused farmers in the southern altiplano to begin farming quinoa in the *pampas* or flats where tractors could be used, rather than on hillsides where production traditionally occurred. The soil in the *pampas* is naturally less fertile than the hillsides, and its high sand content makes is more vulnerable to wind erosion, which is exacerbated by mechanical production practices (Liberman 2008). As of 2010, there were at least 134,000 ha under quinoa, representing an increase in percent of land area from 4 % in 2005 to 15 % in 2010 (El Diario 2012). Smallholders also shifted from producing multiple varieties of quinoa, to planting almost exclusively Quinoa Real, the most popular and profitable variety, which is particularly well suited to the climate of the southern altiplano. The predominance of one variety has caused many farmers to stop practicing traditional grain selection, which paired the traits of particular varieties with the ecological zone to which they were best suited (Brett 2010). Increasingly frequent severe weather events such as droughts and extreme temperatures pose additional threats to the already fragile ecological system.

Although organic quinoa production initially benefitted smallholder households with improved cash income, there is growing concern about the long term sustainability of a rural economy that is supported almost entirely by the export of a single variety of grain (Hellin and Higman 2005). The ecological production practices supported by

ANAPQUI may protect the altiplano from severe degradation in the short run, but current standards may not be stringent enough to protect against long-term ecological land degradation, especially desertification and erosion (Reynolds et al. 2008; Winkel et al. 2012). Partnerships between government ministries, research institutions and smallholders association including ANAPQUI have formed to investigate potential adaptation strategies, including applying of green manure and crop residues, implementing new conservation tillage techniques, and experimenting with new planting and fallow periods in the *pampas* (Aroni 2008; Cossio 2008; Joffre and Acho 2008). Recently, fair trade certifiers have required ANAPQUI to spend at least one-third of their fair trade premium on investments to improve the environmental quality of the landscape by reintegrating llamas and alpacas onto farms, planting Thola trees around plots to prevent wind erosion and increase environmental education in the surrounding communities (AlterEco 2013). However, other private sector actors will also need to be included in the development of strategies that use market forces to enable smallholders in the southern altiplano to adapt their production to changing social and environmental conditions.

Saskatchewan Soil Conservation Association and crop diversification on the prairies of Saskatchewan, Canada

Widespread soil erosion and nutrient loss due to conventional farming practices stimulated the formation of the Saskatchewan Soil Conservation Association and other farmers associations across the southern Canadian prairies, who joined together to develop technologies and farming practices that would restore soil resources and simultaneously boost farm profitability. The Canadian prairies were a vast expanse of grasslands and wetlands characterized by fertile soils, rich in organic matter. In the late 1800s the Canadian government implemented policies to support the settlement of European immigrants who would convert the prairies to farmlands and rangelands. The government's settlement policy resulted in many small farms being settled by immigrants with little or no knowledge of farming systems (Fulton and Sonntag 2010). As a result, cultivated soils lost 20–30 % of their original organic content by the early 1900s (Janzen 2001). Through extension, producers quickly adopted the summer fallow period as best practice for controlling weeds and maintaining soil moisture. However, the loss of soil organic content and wind erosion remained serious environmental and economic threats, costing up to $700 million per year in foregone revenues (Fox et al. 2012).

The earliest soil conservation efforts began in 1935 with the Prairie Farm Rehabilitation Act (PFRA) following a period of prolonged drought, severe wind erosion, and falling market prices which caused many farmers to abandon their land. Soil conservation practices remained unchanged for several decades until research on tillage systems and herbicides coincided with rising grain prices, the fuel crisis and the emergence of self-organizing producer groups (Ward et al. 2010). The continual threat of soil degradation to farm sustainability, lack of knowledge on new technologies and best practices, and an interest in preserving the economic viability of farming prompted the formation of producer groups. The first such group was ManDak, an association of producers from Manitoba and North Dakota, which hosted the region's first meeting on conservation tillage, held in 1978. Within a decade Saskatchewan farmers formed their own association, the Saskatchewan Soil Conservation Association (SSCA) (McClinton and Polegi 2010). Since its inception, the SSCA has been recognized as a farmer-led movement, promoting change in tillage practices as well as facilitating the exchange of knowledge and awareness of new technologies between farmers, researchers, extension services and industry (Lafond et al. 2009, 2014). By 2010, more than 60 % of agricultural lands in Saskatchewan were under conservation tillage (Ward et al. 2010). Significant decreases in blowing dust across the plains concurrent with the widespread adoption of conservation tillage in the 1990s, suggest that soil conservation measures have had measurable impacts (Fox et al. 2012).

The SSCA established an approach to conservation tillage based on five pillars that have become the foundation of conservation tillage practices in Canada. Such practices supported secondary innovations such as the rethinking of the summer fallow to incorporate crop diversification of oilseed and pulses. In general, accompanying conservation tillage with crop diversification further increased farm profitability and soil fertility, especially in Saskatchewan, where the soils are well suited to pulse production (Barr et al. 2009). Conservation tillage and pulse–oilseed–grain crop rotations are now common practice because they have proven to be economically viable and to enhance production through improved soil fertility. However, many of the earliest adopters were guided strongly by ethical considerations of land stewardship, as well as by the utilitarian benefits of soil conservation. Thus, with increased evidence on its benefits, soil conservation practices have gone from the right thing to do to, simply, "the thing to do" (McClinton and Polegi 2010).

However, only in more recent years has the government of Saskatchewan explicitly framed incentive programs for farmers in terms of the contribution of best management practices (BMPs) to landscape multi-functionality. The Canada-Saskatchewan Farmer Stewardship Program (CSFSP) has shifted the emphasis from conservation tillage

and crop rotation to a list of 18 BMPs that provide a range of ecosystem services (Government of Saskatchewan 2014) The SSCA also has been a key actor in stimulating policy dialogue on the role of agricultural soil carbon in climate change mitigation. In 2005, the SSCA launched a pilot program for farmers to sell "temporary emissions removals" as part of Canada's first soil sink offset program (SSCA 2012). However, while conservation tillage can promote carbon sequestration and landscape diversity through specific practices such as crop diversification and fostering of soil biota in less-disturbed soils, in the Canadian plains the most common conservation tillage and crop rotation practices are highly dependent on herbicides and crop varieties modified for herbicide resistance. Pulses, which benefit soil fertility and are frequently more profitable than oilseeds or grains, are particularly vulnerable to being out-competed by weeds (Barr et al. 2009). Although the SSCA has adapted to take advantage of new opportunities in voluntary carbon markets, it remains to be seen if farmer innovation and new programs like the CSFSP will be able to address new challenges, like pest resistance, which may threaten the long-term sustainability of agricultural systems in the Canadian prairies.

Environmental cooperatives in the Northern Friesian Woodlands, Netherlands

The Northern Friesian Woodlands (NFW) Agricultural Cooperative is an example of an environmental cooperative in the Netherlands, involved in re-linking the rural population as participants in rural development processes and agrarian transition (van der Ploeg 2009). The rapid growth of such cooperatives in the Netherlands from the first in 1992 to more than 100 today (Renting and van der Ploeg 2001), primarily was in response to the generic nature of government policies which were designed to curb the negative effects of industrial agriculture, but conversely have posed an even greater threat by failing to recognize the particularities of the local context and the potential of small producers to understand and manage their landscapes (de Rooij 2006). The primary difference between these cooperatives and other farmers' organizations is the right to increased self-regulation allowed by new cooperative policies (Wiskerke et al. 2003). These new cooperatives strive to integrate farming practices based on the recognition that many resources in the landscape cannot be produced at the farm level (van der Ploeg 2009). Rather, from both a material and social angle, such practices work best on a regional scale, which is, in effect, akin to a "field laboratory" (van der Ploeg 2009). Meanwhile, the farmers articulate a "moral economy," involving the unity of humans and nature in maintaining landscapes, communally-owned dairies, commons, village associations, voluntary land consolidation and mutual help schemes, and managing the future (van der Ploeg 2009). In addition to the cultural and moral drivers to preserve local communities, participation in the cooperatives provides financial benefits to farmers of up to 18,000 euros in additional gross income per farm and an increase in local jobs.

Following the success of some farmers to obtain high fodder and milk production, NFW formally established a cooperative structure and promptly initiated a regional nutrient management project to help other farmers to impro ve production through limited nitrogen inputs (van Apeldoorn et al. 2011). The cooperative has since gained the status of a "national landscape," guided by a steering committee whose secretariat is composed of members of the association. The steering committee is composed of several working groups addressing theme areas. Each working group is charged with supporting policies and initiating and monitoring projects (NFW 2012). Farmers are the primary managers in improving the connectivity of the landscape through hedgerows and protecting meadow birds through grassland management, and they are partnering with local universities to study the impact of different agricultural intensification strategies, such as the removal of portions of hedgerows near farm buildings, on landscape biodiversity (Groot et al. 2007). By adopting an alternative set of agricultural practices, farmers have uncovered previously unrecognized relationships between the soil, domestic crops and herds, farmer communities and the landscape, creating the potential for resilient farming systems that also support the sustainability of the ecological system in which they are embedded (van Apeldoorn et al. 2011).

Ayllu biocultural management in the Potato Park in the Pisac, Peru

The Potato Park in Pisac, Peru, is a community-operated Indigenous Biocultural Heritage Territory focused on maintaining the agrobiodiversity of the Andes (Argumedo 2008; Pimbert and Argumedo 2008). Established as a Community Conserved Area (CCA) in 2000, indigenous communities manage the 12,000 ha park though dynamic conservation, which respects traditional knowledge, customary laws, and indigenous values, and emphasizes protecting the landscape as a whole, in terms of ecological and cultural diversity (Argumedo 2008; Swiderska 2009). It is recognized as an endogenous approach to sustainable development, in which the traditional Andean values of *chaninchay* (balance), *ayninakuy* (reciprocity) and *yanantin* (duality) are practiced (Association of Communities of Potato Park 2012). Altogether these values underlay the *ayllus,* or traditional Andean social organization based on family and kinship ties. Typically different *ayllus* manage

different ecological zones, and will exchange goods and products between zones because of their understanding of reciprocity and their sense of kinship to other *ayllus* (Argumedo and Wong 2010).

This producer movement is linked to international movements against bio-piracy and in favor of indigenous rights and food sovereignty. Farmers in Potato Park have supported diversified farming by implementing traditional production practices and defending certain rights and roles of indigenous people in using and preserving agrobiodiversity. The communities in the park cultivate more than 1000 cultivars, 600 of which are native to park, and more than 400 of which were given to the park for management following the signing of the repatriation agreement between the International Potato Center (CIP) and the Potato Park communities. Funding for the repatriation of genetic resources was provided through the Benefit-Sharing Fund of the International Treaty on Plant Genetic Resources for Food and Agriculture. The repatriation agreement signed by the Park's producer associations and CIP in 2005, challenged the privatization of genetic resources developed by indigenous communities. This agreement ensures that the more than 6000 residents of the six communities in the Park maintain rights to resources within their landscape where collective management of genetic materials has resulted in high genetic diversity and resources are freely exchanged between communities (Argumedo and Pimbert 2005; de Jonge 2008).

The communities rely on traditional knowledge gained over several thousand years of cultivation to respond to climatic changes by the vertical movement of potatoes and other medicinal crops along the altitudinal gradient of the mountains (Kothari 2008). Decisions about resource management and agriculture in the park are made through the traditional *ayllu* governance structures at the landscape, community and family level. The Park's residents also have opened the park up to tourism to supplement public and civic sector funding of the park, and to provide knowledge on the role of traditional agricultural management within the Andean sacred tradition of seeking balance and honoring *Pacha Mama* (Mother Earth) (Argumedo 2008). Thus the producers in Potato Park call attention to and support the Park's multi-functionality by promoting agrobiodiversity alongside other economic and cultural services the landscape provides.

Landcare groups in Claveria, Philippines developing highland agroforestry systems

Claveria, a mountainous municipality just inland of the coast in the southern Philippines, is the home of a vibrant producers' movement whose members adopted a highly participatory approach from Australia, called Landcare, to establish new agroforestry and soil conservation practices. More than half of all farming in Claveria is done on slopes with at least a 15 % grade (Catacutan 2010). Throughout the Philippine uplands severe soil erosion, which has reduced maize yield by 50–80 % over 10–15 years, is a major threat to small producers who rely on maize and vegetables for household consumption and sale in local markets (Nelson and Cramb 1998). Although producers are acutely aware of the need for implementing soil conservation measures, many of the early soil conservation technologies had high labor and opportunity costs, until the 1990s when a participatory study on soil conservation strategies by the World Agroforestry Center (ICRAF) in partnership with producers from Claveria identified a farmer-adapted version of contour farming using natural vegetative strips (NVS) that was both inexpensive and easy to implement (Cramb 2006; Fujisaka et al. 1994; Mercado et al. 2001). In order to facilitate the spread of the new technology, producers adopted the Landcare approach, previously used in Australia, to organize new producer groups and disseminate knowledge on the use of natural vegetative strips and other soil conservation and agroforestry practices. The approach has spread to other municipalities in Mindanao and neighboring islands, and has been adapted to a number of new local contexts by partnering with local governments and NGOs (Catacutan 2010). Now, more than 15,000 families have formed more than 600 Landcare groups, protecting between 15 and 25 % of farmlands, especially the steepest, most vulnerable lands in the areas managed by the Landcare groups (Dano et al. 2009).

The primary technology implemented by the Landcare group in Claveria and elsewhere has been the NVS, which have effectively reduced soil erosion on small farms from 200 to 20 t/ha/year (Fujisaka et al. 1994). This basic technology provides a foundation for more complex agroforestry systems that involve fodder, timber and fruit trees (Mercado et al. 2001), further increasing the productivity and profitability of small parcels. However, the economic benefit alone does not explain the rapid adoption of NVS (Nelson and Cramb 1998). Rather the increase in social capital through the establishment of Landcare groups, which bridge otherwise isolated producers for dissemination of knowledge and technologies, is recognized a key factor in the rapid adoption of soil conservation techniques (Cramb 2006). The Claveria Landcare Association also has played an important role in bridging institutions, mobilizing government resources for resource management and improving environmental governance on soil and water management, including linking to Australian Landcare groups (Dano et al. 2009; Espaldon et al. 2006). The institutional structure created through the Landcare groups has also laid the foundation for the introduction of other

conservation strategies, including payments for ecosystems services, which are aimed at protecting the protecting entire watersheds and mitigating climate change (Lasco et al. 2008).

Analysis and discussion

In this section, we analyze the how the six cases of producer movements foster and promote multi-functional farm and landscape management. In particular, we begin by analyzing how objectives for multi-functionality were shared for the farm and landscape scales. Next we analyze the practices they employ to support multi-functional outcomes. Then we examine the conditions that support the action of the producer movements, including platforms for stakeholder engagement and supportive markets and policies. Finally, we consider the ways in which partnerships and meta-movements have influenced the producer movements, and assess the sustainability of their efforts. While the size and geographic scope, motivations for implementing multi-functional practices, and activities of these producer movements have evolved significantly over time, our analysis aims to understand the current state of these characteristics.

Shared objectives of multi-functionality for farms and landscapes

Table 1 illustrates that the extent and scale of support for multi-functional farms and landscape management varied across cases from strict farm-scale focus to distinct landscape focus. All six movements have a strong emphasis on field-level production practices with multifunctional values. However, only four of the movements studied were actively involved in managing landscape-scale processes. In three of these four cases—the peasant workers in the Pontal do Paranapanema, Landcare groups in Claveria, and the NFW environmental cooperative—producer movements helped to construct and participate in institutional processes for dialogue and planning with other stakeholders, both within their communities and with actors operating at other scales. In all cases, the objectives of producer movements were oriented toward increasing the flow of benefits to producers—whether these benefits were economic, political or cultural.

In some cases, the extent of support for multi-functionality changed from farm to landscape scale over time as new challenges to the movement emerged. This was more likely to be the case when meeting the movements' objectives was contingent upon improved off-farm management. The case of COCAMP in the Pontal do Paranapanema is one such example in which a singular focus on supporting food sovereignty at the scale of individual parcels adapted to address habitat connectivity and regional planning by looking at forests and settlement lands together, satisfying the mutual interests of producers and the conservation community.

The adoption of landscape-scale objectives was most prominent in cases where there was nearly complete geographic coincidence of the productive system managed by the producer movement and the ecosystem. ANAPQUI is an example, as the Bolivian altiplano was the most suitable region for *real blanca* quinoa production, and also encompasses the area managed by ANAPQUI producers. In such cases, linkages between the productivity of agricultural lands and health of surrounding natural systems revealed the co-dependence of these landscape components, thereby increasing the likelihood that producer movements would find it worthwhile to take action at a landscape level. For producers in the NFW, these linkages became the basis of their advocacy for self-regulation and increased autonomy. Also adopting landscape-level objectives and management activities allowed producer groups to fight for rights to and manage common pool resources affected by the activities of other stakeholders in the landscape. In the case of the Pontal do Paranapanema, the global movement that supports the landless workers movement, La Via Campesina, makes a claim for the importance of territorial identity, stressing ideological and ecological reasons for small farm families to nurture biodiversity and steward off-farm lands across entire agroecosystems (La Vía Campesina 2010).

Producer movements rarely formed with the objective of improving farm or landscape multi-functionality; in fact, many of these producer movements formed because the complex set of challenges they faced were not being addressed in any other arena. In most cases, the economic viability of the productive system was the most important objective. For example, improving the productivity and profitability of farmland was at the heart of SSCA's concerns, and the environmental benefits of conservation agriculture were a secondary concern. The SSCA case also demonstrates how complex motivations often result in tradeoffs between objectives. For instance, although conservation tillage had distinct environmental benefits at the time, it also may have contributed to hastening the expansion of industrial farms across the prairie region by increasing the efficiency and profitability of farming on what were previously considered marginal or degraded lands.

Even in the cases where preserving indigenous heritage or cultural values were important objectives, the sustainability of producer livelihoods was the highest priority for stakeholders. When multi-functional land management is linked to the economic success of producers in the short-

term, producers are often willing to support a broader set of multi-functional objectives. Sometimes these links have to be proven, as in the case of conservation tillage in Saskatchewan or sloping agricultural land technologies in Claveria, but once the economic objectives are met, adoption of multi-functional practices is almost certain to follow.

Multifunctional farm and landscape practices

All six cases focused on field-level production practices that increased production or farm incomes while also benefitting ecosystems and biodiversity. These included agroforestry, conservation tillage and permanent ground cover for soil conservation, agroecological systems, organic agriculture, diverse and traditional crop germplasm and increases in input efficiency. They ranged from traditional and modified traditional systems to new and technologically modern systems. Some of these newly adopted systems, like conservation tillage in southern Saskatchewan and vegetative strips in Claveria, resulted in notable increases in crop productivity. In other cases, diversity in agroecological and traditional systems was an important contributor to food security and sovereignty, as in the case of the Pontal do Paranapanema, ANAPQUI and the Potato Park. Other indirect impacts on farmer income, such as renewed access to or recognition of intellectual property rights, as in the Potato Park, or reduced input costs under alternative farming practices, as in NFW, also resulted from changes in farm level practice. Only in some cases did farm level practices directly influence landscape functions, as it did in Saskatchewan. Direct impacts of farm-level practices on landscape functions were more likely to happen where farmers control the majority of lands (e.g., the Canadian prairies), where they control particularly critical areas of land for maintaining or improving landscape functions (e.g., farmer management of steep portions of the Claveria highlands), and where profitability of alternative farm level practices drove widespread land use change (e.g., expansion of quinoa farming in Bolivia).

In all cases, stakeholders engaged in awareness-raising on the benefits of improved agricultural practices and landscape management. Knowledge sharing between farmer groups led directly to the development of new technologies to support improved farm and landscape management, exemplified by the development of no-till equipment by Saskatchewan farmers and contour farming technology in Claveria. In the environmental cooperative in the New Friesian Woodlands, extensive knowledge sharing on farm systems, pasture and dairy production, and nutrient management led the farmers to conclude that their new system would be more efficient than the conventional one at delivering dairy production alongside other important benefits such as improved local markets, community well-being and resilience to climate change.

The major types of management practices beyond the farm scale relate to watershed management (Claveria), forest fragment or corridor management (Pontal do Paranapanema), forest, hedgerow and marginal land management (NFW) and management biocultural heritage and communal lands (Potato Park, NFW, and the Bolivian altiplano). In Claveria, collective action by producer organizations was key in coordinating vegetative barriers on hillsides across multiple farms, and in the Pontal the new land settlement presented the opportunity for landscape planning that would meet the demands of land reform groups while preserving the connectivity and integrity of the remaining forest fragments. In the Potato Park, climate change has pushed the communities to cultivate species that were traditionally grown at lower altitudes at higher altitudes. In this case, collective land management facilitated community adaptation by allowing for major shifts in cultivation strategies over a large area of land, as well as safeguarding food security and agrobiodiversity.

Spatial planning of management interventions was critical for many of these producer movements to meet their objectives while mitigating tradeoffs between stakeholder groups. In the Pontal do Paranapanema, farmers maintained connectivity across the landscape and maximized forest fragment size by coordinating with neighboring farmers to conserve adjacent forest patches. In the NFW environmental cooperative, careful mapping of the landscape and analysis of nutrient cycling allowed the cooperative and the government to agree on specific management goals, while granting cooperatives the flexibility to use their own agreed upon implementation and monitoring strategies to maximize benefits to the local communities and landscape.

Engagement with policies and stakeholder platforms within the landscape

In some cases, producer movements formed in reaction to policy changes that provided opportunities for producers to engage in and benefit from multi-functional management, as was the case with NFW where the Dutch government and the European Union Common Agricultural Policy provided incentives for farmers to integrate nature management into their farming practices. At other times, producer movement support of multi-functional farm and landscape management was an effort to correct environmental degradation incurred by the unforeseen and negative consequences of existing policies, which was the case with forest policy and land reform in the Pontal do Paranapanema. In Claveria, the engagement of Landcare

groups into multi-stakeholder municipal platforms facilitated the integration of agricultural and natural resource management policies at the municipal level. The SSCA was also able to engage in agricultural policy platforms at the landscape, provincial and national level, leading to new funding streams to support research and technology development for conservation agriculture. In some cases, producer movements have become key stakeholders in policy-making arenas, like the SSCA, which has helped shape Canadian agricultural policy. While new or reinvigorated indigenous, collective and cooperative forms of governance were instrumental for decision-making within the landscape, it is unclear to what extent these decision-making bodies or arenas are recognized as legitimate and included in policy platforms at higher levels. This may well change as multi-functional farm and landscape management is recognized as contributing to ecosystem protection and climate change mitigation.

Mobilization of markets and policies that support integrated farm and landscape management

In several cases, market and policy forces clearly shaped the enabling environment for producer movements to grow and the incentives for them to implement multi-functional farm and landscape practices. Only the quinoa producers explicitly sought to develop new market mechanisms to support their land management systems. However, several other movements linked their innovations to growing market demand for products. In the case of ANAPQUI, market access was facilitated by organizations sourcing fair-trade and organic products for foreign markets. The NFW environmental cooperative has been able to strengthen local markets for dairy in particular by improving nutrient efficiency and building social capital among farmers and local communities. Also a transition to policies supporting decentralized management and flexible policy implementation in the Netherlands allowed environmental cooperatives to form and achieve much greater integration of farm and landscape management than previous policies would allow. Agrarian reform and forest code policies both influenced processes of farm and landscape planning in the Pontal do Paranapanema. In addition, the network of small farmers across Brazil has established new local and national markets for agroecological products.

Supportive partnerships and links with meta-movements

External partnerships were important in all of the local producer movements studied, to the extent that it is sometimes difficult to say when the producer movements were formed and sustained purely through producer interest and participation. Diverse partnerships were demonstrated between the producer movements, international development community, government agencies, local NGOs and donors, to name a few. NGOs and conservation organizations often played important roles in transferring knowledge on suitable practices or for accessing funding to support the continuance of threatened systems as in the case of traditional crop systems for quinoa, potatoes, and maize in several of the movements. Producer movements relied on a variety of pathways for financing movement activities and organization. In some cases, access to niche markets spurred activities. In others, cost savings or improved profits from new practices were enough to incentivize participation, while organizational costs and coordination with other actors was supported by diverse funding streams included multi- and bi-lateral funding agencies, international research centers, private-sector partners, local NGOs and government funding from local, district and national levels.

Local producer movements often benefitted from identifying with a recognized school of thought, conceptual movement, or broader network. Such connections helped producer movements to access support, share their experiences, and ultimately create the potential for increasing the geographic scope of activities supported by producer groups. Such meta-movements and their networks often increased the visibility of the local producer movements' efforts and placed their activities in a larger frame of social justice and benefit to society. Some of the meta-movements have focused on establishing platforms for promoting reform and recognition of local producer rights. The most obvious example of such a connection is the link between the MST and the international peasant movement, La Via Campesina. Other meta-movements, such as the international Landcare movement, have focused on building networks primarily for exchanging knowledge, technologies, and success stories among participants. Other cases demonstrated strong links to international movements for conservation agriculture, indigenous rights, biocultural heritage, and fair trade. These larger movements have in common a recognition of the fundamental role that producers can play in governing landscapes and driving agricultural markets, as well as their need for resources to improve collaboration and negotiation with other stakeholders.

The risks and potential for adapting producer-led multi-functional management to emerging conditions and larger geographic scales

The challenges that producer movements face are evolving and, therefore, so are producers' strategies for addressing

them. As political and economic conditions change and producer movements seek to scale-up practices to larger areas, they will need to adapt practices to address the risks associated with scaling up and carefully monitor outcomes at farm and landscape scales to ensure ongoing sustainability. In some cases this means changing the language around multi-functional practices to meet new global agendas and shifts in the meta-movements that support these producer movements politically, financially and technically. The reframing of no-till farming as a strategy for carbon sequestration is one such example of a shift in the discourse on multi-functional practices to meet new objectives. In other cases, this means an adaptation of the multi-functional practices being implemented to provide a new set of functions and benefits to stakeholders at the landscape level, as well as those at the international level. Managing for resilience across the whole landscape, not only at plot or farm levels, is important in making sure that the landscape itself can withstand changes, either those brought about by natural means or those instigated by the producer movement itself. In some cases, market drivers to change practices were so strong that agricultural expansion, even under practices that were once sustainable, threatens the sustainability and resilience of the whole landscape. The case of ANAPQUI and SSCA provide striking examples of new challenges brought about by the expansion of practices supported by the producer movements. Land management systems, producer movements and landscapes will need to adapt together to be sustainable. However, many of these movements focused on promoting specific practices to improve farm and landscape management. These practices may also link them to meta-movements strongly advocating a particular approach or set of practices. Although these connections offer support, they also institutionalize practices, potentially limiting the ability of producer movements to adapt practices and approaches quickly to newly emerging challenges.

Conclusions and implications for the role of producer movements in supporting multifunctional landscapes

The diverse set of cases evaluated demonstrate several ways in which local producer movements have played strong and even leading roles in the transformation of farming systems and landscapes to achieve the full range of products and ecosystem services needed by the people who live in and depend on those landscapes. However, the potential for producer movements to foster multifunctional landscapes depends significantly upon whether the producers themselves share a broader vision of the landscape, motivation, and sense of agency. In some cases producers already share a common vision as a result of shared cultural or social values, while in other cases they actively participate in forums where they build a shared vision for their landscape. The potential of producer movements also depends on political and economic conditions that favor multi-functional practices, technical assistance on multi-functional practices, and their ability to put in place or join organizational systems that pursue multi-functional farm and landscape objectives. It also is shaped by the willingness of other key stakeholders in the landscape, like government agencies, private sector, and civil society organizations, to grant political and institutional space for the farmers to negotiate for their own priorities and solutions, or new governance mechanisms that grant space or effectively pressure other actors into giving producers a place at the negotiating table.

The scope and capacities of producer organizations have moved well beyond their early roots in securing land rights and organizing for market access. Although integrated farm and management practices were an integral part of traditional management systems in some cases, in all cases producer movements increased producers' capacity to implement or expand integrated practices on their own land or include other landscape actors in integrated management approaches. An increasing number of meta-movements promoting producer rights, alternative strategies for agriculture and development, and new platforms for producers to leverage policy change have been key influencers of the formation and continuation of local producer movements. The question of scaling up the geographic scope of on- and off-farm practices to support landscape multi-functionality raises important concerns for producer movements and opportunities for further investigation on producers' need to balance tensions between resisting unsustainable practices or management regimes that exclude producers from participating in decision-making, and increasing efforts to engage other landscape actors in collaborative management to address major challenges for livelihoods and sustainability. Future studies also should explore how producer movements negotiate with other stakeholder groups or gradually shift their affiliation with meta-movements to ensure long-term landscape multi-functionality, and how producer movements can adapt their practices and governance structures to help provide functions of importance to an evolving set of stakeholders in the landscape.

Our analysis of the cases presented here provides an overview of six producer movements, their goals, achievements, linkages with landscape and international partners, and, in particular, their roles in integrated farm and landscape management. Producer movements are just one mechanism by which producers influence land management decisions, one that demands a political environment that gives local people voice and agency. Producers

are increasingly faced with the need for effective strategies to adapt to changing environmental and political contexts. While our analysis revealed roles that producer movements have played at particular points in time, it remains to be seen if and how producer movements and the meta-movements with which they are affiliated, can adapt to changing local contexts and meet growing national and global needs for the products and services of rural landscapes.

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References

Alter Eco. 2013. Alter Eco-ANAPQUI partnership model. Alter Eco. http://www.alterecofoods.com/wp-content/uploads/2013/06/Alter-Eco-ANAPQUI-Partnership-Model.pdf. Accessed 20 Jan 2014.

Altieri, M.A. 1995. *Agroecology: The science of sustainable agriculture*. Boulder: Westview Press.

Altieri, M.A., and V.M. Toledo. 2011. The agroecological revolution in Latin America: Rescuing nature, ensuring food sovereignty and empowering peasants. *Journal of Peasant Studies* 38: 587–612.

Argumedo, A. 2008. *The Potato Park, Peru: Conserving agrobiodiversity in an Andean indigenous biocultural heritage area. Protected landscapes and agrobiodiversity values. Volume 1 in the series, Protected landscapes and seascapes*. Geneva: IUCN & GTZ.

Argumedo, A., and M.P. Pimbert. 2005. *Traditional resource rights and indigenous people in the Andes*. London: IIED.

Argumedo, A., and B.Y.L. Wong. 2010. The ayllu system of the Potato Park (Peru). *Sustainable Use of Biological Diversity in Socio-Ecological Production Landscapes* 52: 84.

Aroni, G. 2008. Recupercaión de suelos para una producción sostenible de quinua en el Altiplano sur. *Revista Habitat* 75: 50–53.

Association of Communities of Potato Park. 2012. Somos cinco, pero somos uno: principios andinos. http://www.parquedelapapa.org/esp/02somos_02.html. Accessed 20 Dec 2013.

Ashoka. 2002. Ashoka: Innovators for the public. http://www.ashoka.org/fellow/laury-cullen. Accessed 8 Nov 2012.

Ayaviri, G.S., N. Choque, and G. Panamá. 2003. *La historia de nuestra organización: Asociación Nacional de Productores de Quinua: ANAPQUI*. La Paz: ANAPQUI.

Barr, J., A. Gough, and A. Russillo. 2009. *Rapid assessment case study: The environmental information infrastructure of pulse production in Canada*. Winnipeg: International Institute for Sustainable Development.

Benford, R.D., and D.A. Snow. 2000. Framing processes and social movements: An overview and assessment. *Annual Review of Sociology* 26: 611–639.

Borras Jr, S.M. 2008. La Vía Campesina and its global campaign for agrarian reform. *Journal of Agrarian Change* 8: 258.

Brandt, J., and H. Vejre. 2004. Multifunctional landscapes-motives, concepts and perceptions. Multifunctional landscapes. In *Multifunctional landscapes*, vol. 1, ed. J. Brandt, and H. Vejre, 3–32., Theory, values and history Southampton: WIT Press.

Brett, J.A. 2010. The political-economics of developing markets versus satisfying food needs. *Food and Foodways* 18: 28–42.

CABOLQUI. 2009. Dinamica actual del rubro quinero en Bolivia. *CPTS desarrollo agroindustrial quinua en el altiplano*: *CABOLQUI*. La Paz, Bolivia: CABOLQUI.

Cáceres, Z., A. Carimentrand, and J. Wilkinson. 2007. *11 Fair trade and quinoa from the southern Bolivian Altiplano. Fair trade: The challenges of transforming globalization*. London: Routledge.

Catacutan, D. 2010. *Scaling up landcare in the Philippines*. Colne: Lambert Academic Publishing.

Cossio, J. 2008. Agricultura de conservación con un enfoque de manejo sostenible en el Altiplano sur. *Revista Habitat* 7: 44–47.

Cramb, R. 2006. The role of social capital in the promotion of conservation farming: the case of 'landcare'in the Southern Philippines. *Land Degradation and Development* 17: 23–30.

Cullen, L., K. Alger, and D.M. Rambaldi. 2005. Land reform and biodiversity conservation in Brazil in the 1990s: Conflict and the articulation of mutual interests. *Conservation Biology* 19: 747–755.

Curtis, A., and T. de Lacy. 1998. Landcare, stewardship and sustainable agriculture in Australia. *Environmental Values* 7: 59–78.

Dano, M.N., E. Elago, D. Catacutan, and A. Mercado Jr. 2009. Landcare in the Philippines. In *Landcare: Local action—Global progress*, ed. D. Catacutan, C. Neely, M. Johnston, H. Proussard, and R. Youl, 64–78. Nairobi: World Agroforestry Centre.

de Jonge, B. 2008. Between sharing and protecting: public research on genetic resources in the year of the potato. *Life Sciences, Society and Policy* 4: 10.

de Rooij, S. 2006. Territorial cooperative networks: new social carriers for endogenous rural development. Moving worldviews, reshaping sciences, policies and practices for endogenous sustainaible development. *COMPAS series on Worldviews and Sciencies* 4: 237–253.

de Schutter O. 2011. Agroecology and the right to food. In *Report presented at the 16th session of the United Nations Human Rights Council [A/HRC/16/49]*. New York: UN.

Develtere, P., I. Pollet, and F. Wanyama. 2008. *Cooperating out of poverty: The renaissance of the African cooperative movement*. Geneva: ILO.

El Diario. 2012. *Comercialización de la quinua real del altiplano sur de Bolivia*. La Paz: El Diario.

Espaldon, M.V., M.U. Tapia, J.D. Villanueva, and P. Jaranilla-Sanchez. 2006. *Philippine landcare after nine years: A study on the impacts of agroforestry on communities, farming households and the local environment in Mindanao ICRAF Occasional Paper*. Nairobi: World Agroforestry Centre.

Estrada-Carmona, N., A.K. Hart, F.A.J. DeClerck, C.A. Harvey, and J.C. Milder. 2014. Integrated landscape management for agriculture, rural livelihoods, and ecosystem conservation: An assessment of experience from Latin America and the Caribbean. *Landscape and Urban Planning* 12: 1–11.

Foweraker, J. 1995. *Theorizing social movements*. London: Pluto Press.

Fox, T.A., T.E. Barchyn, and C.H. Hugenholtz. 2012. Successes of soil conservation in the Canadian prairies highlighted by a historical decline in blowing dust. *Environmental Research Letters* 7: 014008.

Fry, G.L. 2001. Multifunctional landscapes—Towards transdisciplinary research. *Landscape and Urban Planning* 57(3): 159–168.

Fujisaka, S., E. Jayso, and A. Dapusala. 1994. Trees, grasses, and weeds: Species choices in farmed-developed contour hedgerows. *Agroforestry Systems* 25: 13–22.

Fulton, F., and B. Sonntag. 2010. History of early Western Canadian agriculture—Setting the stage for conservation. In *Landscapes*

transformed: The history of conservation tillage and direct seeding, ed. C.W. Lindwall, and B. Sonntag. Saskatoon: Knowledge Impact in Society.

Gliessman, S.R., E. Engles, and R. Krieger. 1998. *Agroecology: Ecological processes in sustainable agriculture*. AnnArbor: Ann Arbor Press.

Government of Saskatchewan. 2014. *Growing forward 2: Farm stewardship program.* http://www.agriculture.gov.sk.ca/GF2-FarmStewardship. Accessed 20 Dec 2014.

Groot, J.C., W. Rossing, A. Jellema, D.J. Stobbelaar, H. Renting, and M.K. Van Ittersum. 2007. Exploring multi-scale trade-offs between nature conservation, agricultural profits and landscape quality—A methodology to support discussions on land-use perspectives. *Agriculture, Ecosystems & Environment* 120: 58–69.

Hellin, J., and S. Higman. 2005. Crop diversity and livelihood security in the Andes. *Development in Practice* 15: 165–174.

Holt-Giménez, E. 2009. From food crisis to food sovereignty. *Monthly Review* 61: 142–156.

IAASTD. 2009. *International assessment of agricultural knowledge, science and technology for development (IAASTD): Synthesis report*. Washington, DC: IAASTD.

Ichikawa, K., and G. Toth. 2012. The satoyama landscape of Japan: The future of an indigenous agricultural system in an industrialized society. In *Agroforestry—The future of global land use*, ed. P.K.R. Nair, and D. Garrity, 341–358. Houten: Springer.

IFOAM. 2012. *The IFOAM norms for organic production and processing*. Germany: IFOAM.

Janzen, H.H. 2001. Soil science on the Canadian prairies—Peering into the future from a century ago. *Canadian Journal of Soil Science* 81: 489–503.

Joffre, R., and J. Acho. 2008. Quinua, descanso y tholares en el sur del Altiplano Boliviano. *Revista Habitat* 75: 38–41.

Karriem, A., E. Michael, H. Gillian, K. Stefan, and L. Alex. 2012. Space, ecology, and politics in the praxis of the Brazilian Landless Movement. In *Gramsci: Space, nature, politics*, ed. M. Ekers, G. Hart, S. Kipter, and A. Loftus, 142–160. Oxford: Wiley-Blackwell.

Kay, C. 1998. Latin America's agrarian reform: Lights and shadows. *Land Reform, Land Settlement and Cooperatives* 2: 9–31.

Koohafkan, P., and M.A. Altieri. 2011. *Globally important agricultural heritage systems: A legacy for the future*. Rome: Food and Agriculture Organization of the United Nations.

Kothari, A. 2008. The 4C factor: Community conservation and climate change. *Biodiversity* 9: 19–23.

Kremen, C., and A. Miles. 2012. Ecosystem services in biologically diversified versus conventional farming systems: Benefits, externalities, and trade-offs. *Ecology and Society* 17: 40.

Campesina, La Vía. 2010. *Sustainable peasant and family farm agriculture can feed the world*. Harare: La Vía Campesina.

Lafond, G., G. Clayton, D. Fowler, R. Jat, K. Sahrawat, and A. Kassam. 2014. *Conservation agriculture on the Canadian prairies*, 89–107. Conservation Agriculture: Global Prospects and Challenges.

Lafond, G., B. McConkey, and M. Stumborg. 2009. Conservation tillage models for small-scale farming: Linking the Canadian experience to the small farms of Inner Mongolia Autonomous Region in China. *Soil and Tillage Research* 104: 150–155.

Larson, A.M., D. Barry, and G.R. Dahal. 2010. *Forests for people: Community rights and forest tenure reform*. Oxford: Earthscan.

Lasco, R., G. Villamor, F. Pulhin, D. Catacutan, and M. Bertomeu. 2008. From principles to numbers: Approaches in implementing payments for environmental services (PES) in the Philippines. In *Smallholder tree growing for rural development and environmental services*, ed. D. Snelder, and R. Lasco, 379–391. Dordrecht: Springer.

Liberman, M. 2008. El cultivo de la quinua orgánica en Oruro y Potosí. *Revista Habitat* 75: 18–21.

LPFN. 2014. *Integrated landscape management in Africa: A synthesis of evidence*. Washington, DC: EcoAgriculture Partners on behalf of the Landscapes for People, Food and Nature (LPFN) Initiative.

Martinelli, L.A., R. Naylor, P.M. Vitousek, and P. Moutinho. 2010. Agriculture in Brazil: Impacts, costs, and opportunities for a sustainable future. *Current Opinion in Environmental Sustainability* 2: 431–438.

Martinez-Torres, M.E., and P.M. Rosset. 2010. La Vía Campesina: The birth and evolution of a transnational social movement. *The Journal of Peasant Studies* 37: 149–175.

McClinton, B., and J. Polegi. 2010. Saskatchewan Soil Conservation Association. In *Landscapes transformed: The history of conservation tillage and direct seeding*, ed. C.W. Lindwall, and B. Sonntag. Saskatoon: Knowledge Impact and Society.

McMichael, P. 2006. Reframing development: Global peasant movements and the new agrarian question. *Canadian Journal of Development Studies/Revue canadienne d'études du développement* 27: 471–483.

Mercado Jr, A.R., M. Patindol, and D.P. Garrity. 2001. The Landcare experience in the Philippines: Technical and institutional innovations for conservation farming. *Development in Practice* 11: 495–508.

Milder, J.C., A.K. Hart, P. Dobie, J. Minai, and C. Zaleski. 2014. Integrated landscape initiatives for African agriculture, development, and conservation: A region-wide assessment. *World Development* 54: 68–80. doi:10.1016/j.worlddev.2013.07.006.

Mooney, P.H. 2004. Democratizing rural economy: Institutional friction, sustainable struggle and the cooperative movement. *Rural Sociology* 69: 76–98.

Nelson, R., and R. Cramb. 1998. Economic incentives for farmers in the Philippine uplands to adopt hedgerow intercropping. *Journal of Environmental Management* 54: 83–100.

NFW. 2012. Plaats en rol van de themagroepen binnen het Nationaal Landschap Noardlike Fryske Wâlden. http://www.noardlikefryskewalden.nl. Accessed 6 Dec 2014.

Perfecto, I., J.H. Vandermeer, and A.L. Wright. 2009. *Nature's matrix: Linking agriculture, conservation and food sovereignty*. Oxford: Earthscan.

Pimbert, M.P. 2008. *Towards food sovereignty: Reclaiming autonomous food systems*. London: IIED.

Pimbert, M.P., and A. Argumedo. 2008. *Protecting farmers' rights with indigenous biocultural heritage territories: The experience of the potato park*. London: IIED.

Pretty, J., A.D. Noble, D. Bossio, J. Dixon, R.E. Hine, F.W.T. Penning de Vries, and J.I.L. Morison. 2005. Resource-conserving agriculture increases yields in developing countries. *Environmental Science and Technology* 40: 1114–1119.

Pretty, J., C. Toulmin, and S. Williams. 2011. Sustainable intensification in African agriculture. *International Journal of Agricultural Sustainability* 9: 5–24.

Primdahl, J., and L.S. Kristensen. 2011. The farmer as a landscape manager: Management roles and change patterns in a Danish region. *Geografisk Tidsskrift-Danish Journal of Geography* 111(2): 107–116.

Ramos Santalla, N. 2000. *La quinua, el grano de oro de los Incas ANAPQUI, una experiencia de desarrollo y manejo sostenible*. La Paz: AOPEB.

Renting, H., and J.D. van der Ploeg. 2001. Reconnecting nature, farming and society: Environmental cooperatives in the Netherlands as institutional arrangements for creating coherence. *Journal of Environmental Policy & Planning* 3: 85–101.

Reynolds, J.F., E. Huber-Sannwald, and J.E. Herrick. 2008. La sustentabilidad de la producción de la quinua en el altiplano sur

de Bolivia: Aplicación del paradigma de desarrollo de zonas secas. *Revista Habitat* 75: 10–15.
Rigby, D., and D. Cáceres. 2001. Organic farming and the sustainability of agricultural systems. *Agricultural Systems* 68: 21–40.
Rodrigues, E.R., L. Cullen Jr, T.P. Beltrame, A.V. Moscogliato, and I.C. da Silva. 2007. Avaliação econômica de sistemas agroflorestais implantados para recuperação de reserva legal no Pontal do Paranapanema, São Paulo. *Revista Árvore* 31: 941–948.
Roling, N.G., and M.A.E. Wagemakers (eds.). 2000. *Facilitating sustainable agriculture: Participatory learning and adaptive management in times of environmental uncertainty*. Cambridge: Cambridge University Press.
Scherr, S.J., J.C. Milder, and L.E. Buck. 2012. *Landscapes for people, food and nature: the vision, the evidence and next steps*. Washington, DC: Landscapes for People, Food and Nature Initiative.
Selman, P. 2009. Planning for landscape multifunctionality. *Sustainability: Science, Practice, & Policy* 5: 45–52.
Snow, D.A. 2004. *Framing processes, ideology, and discursive fields. The Blackwell companion to social movements*. Oxford: Blackwell.
Snow, D.A., and R.D. Benford. 1992. *Master frames and cycles of protest. Frontiers in social movement theory*. New Haven: Yale University.
Snow, D.A., S.A. Soule, and H. Kriesi. 2007. *Mapping the terrain. The Blackwell companion to social movements*. Oxford: Blackwell.
SSCA. 2012. Background information on the Saskatchewan Soil Conservation Association. http://www.ssca.ca/sscabio.html. Accessed 6 Dec 2014.
Swiderska, K. 2009. *Protecting traditional knowledge: A holistic approach based on customary laws and bio-cultural heritage. Conserving and valuing ecosystem services and biodiversity: Economic, institutional and social challenges*. London: Earthscan.
Tarrow, S. 1992. *Mentalities, political cultures, and collective action frames. Frontiers in social movement theory*. New Haven: Yale University.
Tuma, E.H. 1965. *Twenty-six centuries of agrarian reform: A comparative analysis*. Oakland: University of California Press.
UNDESA. 2012. *The millennium development goals report 2012*. New York: United Nations Department of Economic and Social Affairs.
Valladares-Padua, C., S.M. Padua, and L. Cullen. 2002. Within and surrounding the Morro do Diabo State Park: Biological value, conflicts, mitigation and sustainable development alternatives. *Environmental Science & Policy* 5: 69–78.
van Apeldoorn, D.F., K. Kok, M.P.W. Sonneveld, and T. Veldkamp. 2011. Panarchy rules: Rethinking resilience of agroecosystems, evidence from Dutch dairy-farming. *Ecology and Society* 16: 39.
Van der Ploeg, J.D. 2009. *The new peasantries: Struggles for autonomy and sustainability in an era of empire and globalization*. London: Routledge.
Ward, B., D. Smith, G. Shaw, D. Haak, and J. Fredette. 2010. Policy and program response to land management issues. In *Landscapes transformed: The history of conservation tillage and direct seeding*, ed. C.W. Lindwall, and B. Sonntag, 15–24. Saskatoon: Knowledge Impact and Society.
Wezel, A., S. Bellon, T. Doré, C. Francis, D. Vallod, and C. David. 2011. Agroecology as a science, a movement and a practice. *Sustainable Agriculture* 2: 27–43.
Winkel, T., H. Bertero, P. Bommel, J. Bourliaud, M. Chevarría Lazo, G. Cortes, and F. Léger. 2012. The sustainability of quinoa production in southern Bolivia: From misrepresentations to questionable solutions. Comments on Jacobsen (2011, J. Agron. Crop Sci. 197:390–399). *Journal of Agronomy and Crop Science* 198: 314–319.
Wiskerke, J.S.C., B.B. Bock, M. Stuiver, and H. Renting. 2003. Environmental co-operatives as a new mode of rural governance. *NJAS—Wageningen Journal of Life Sciences* 51: 9–25.
Wittman, H. 2010. Agrarian reform and the environment: Fostering ecological citizenship in Mato Grosso, Brazil. *Canadian Journal of Development Studies/Revue canadienne d'études du développement* 29: 281–298.
Zhang, W.F., Z.X. Dou, P. He, X.T. Ju, D. Powlson, D. Chadwick, and F.S. Zhang. 2013. New technologies reduce greenhouse gas emissions from nitrogenous fertilizer in China. *Proceedings of the National Academy of Sciences* 110: 8375–8380.

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