ELEMENTA
Science of the Anthropocene

Heckelman, A, et al. 2022. A polycentric food sovereignty approach to climate resilience in the Philippines. *Elem Sci Anth*, 10: 1. DOI: https://doi.org/10.1525/elementa.2020.00033

RESEARCH ARTICLE

A polycentric food sovereignty approach to climate resilience in the Philippines

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Enhancing climate resilience in agrarian communities requires improving the underlying socioecological conditions for farmers to engage in adaptation and mitigation strategies, alongside collaborative and redistributive community development to reduce vulnerabilities. To overcome barriers to climate resilience in the Philippines, a grassroots farmer-led organization comprised of resource-poor smallholders, scientists, and nongovernmental organizations have organized a polycentric network over the past 30 years to implement food sovereignty initiatives. We explore the extent to which the network's decentralized and farmer-led organizational structure; programming and services; promotion of diversified, organic, and agroecological farming systems; and political organizing and advocacy create broadly accessible and diverse pathways for resource-poor smallholders to build climate resilience. We find that the *Magsasaka at Siyentipiko para sa Pag-Unlad ng Agrikultura*'s (Farmer-Scientist Partnership for Development) polycentric governance approach directly addresses the root causes of vulnerability, particularly in working to reclaim farmer rights and control over resources, connecting local and global struggles, and revitalizing agrobiodiversity and place-based knowledge.

Keywords: Resilience, Polycentricity, Food sovereignty, Philippines, MASIPAG

Introduction

Agrifood system researchers are calling for a transdisciplinary and decentralized approach (Méndez et al., 2013) to climate change interventions that recognize the coevolution of social and natural systems (Vandermeer, 2011; Blann and Light, 2018) and involve citizens, farmers, indigenous, and rural people (Thompson and Scoones, 2009; Anderson et al. 2019). These researchers attribute a significant portion of the degradation of planetary systems—including climate change and declines in agrobiodiversity—to the spread of the so-called Green Revolution over the last half-century (Montenegro de Wit, 2015).

Enhancing peasant capacities for climate resilience will require improving the socioecological conditions for farmers to engage in adaptation and mitigation strategies, alongside collaborative and redistributive community development to reduce vulnerabilities (Hart et al., 2015). This process, in turn, depends on the ability of peasant groups to attain autonomy from the state, agroindustry, and agricultural knowledge regimes responsible for the consolidation of resources in the agroindustrial complex (Borras, 2001; van der Ploeg, 2008; Perfecto et al., 2019). Following decades of resistance to the consolidation of resources within the agricultural sector, social movements have generated alternative approaches that are visibly different in shape, form, and priorities, with a particular focus on climate resilience and the maintenance of diversity, when compared to state-led, top-down, and centralized initiatives advancing the Green Revolution approach.

Agrobiodiversity represents the aggregation of species, genetic, and ecological diversity of cultivated plants and livestock that contribute to ecosystem health and adaptive capacity and includes the associated local knowledge essential to well-being, equity, and sustainability (Folke et al., 2004; Mijatovic, et al. 2013). By institutionalizing the large-scale adoption of modern high-yielding, genetically similar seed varieties, the Green Revolution displaced "hundreds of genetically diverse local varieties selected by farmers over millennia for specific adaptation to their own environment and uses" (Ceccarelli, 2012, p. 41). By the 1990s, approximately 75% of rice, 50% of wheat, and 70% of the world's corn were derived from Green Revolution seeds (Ong'wen and Wright, 2007; Patel, 2013). At the turn of the century, Lappé et al. (1998) estimated that 40% of all farmers in developing countries used Green Revolution seeds, with the highest proportion in Asia.

The widespread adoption of modern, high-yielding seed varieties was promoted and administered by transnational and national research institutes with the assistance of state agricultural development policies and programs,

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as well as funding from agroindustry (Sumberg et al., 2012; Patel, 2013). What followed was the consolidation of sources of seed, technology, fertilizers, and pesticides and the subsequent dominance of a small number of commodity grain crops with a narrowing genetic base (Pingali and Traxler, 2002; Khoury et al., 2014). The global consolidation of the seed grain industry (Ceccarelli, 2012; Howard, 2021) reduced genetic variation by limiting the free flow of genes between populations through cross-pollination or mixing of seeds that have allowed landraces to evolve in response to climatic change for millennia (Mercer et al., 2012). The ability of farmers to choose appropriate seeds for changing climate conditions are further constrained by the implementation of international Intellectual Property Rights regimes, which restrict farmers' freedom to engage in seed saving, sharing, and participatory breeding activities to generate locally adapted crop varieties. Such restrictions are antithetical to key attributes of resilience building such as social learning, collective action, and the generation of local agricultural resources (Magis, 2010; Cabell and Oelofse, 2012; Berkes and Ross, 2013; Frankenberger et al., 2013).

In this article, we explore a case study in the Philippines to assess whether, and to what extent, a nonstate-based, polycentric network engaged in farmer-led agricultural development initiatives are addressing the root causes and drivers of peasant vulnerability, while also building pathways to climate resilience.[1] The Philippines was one of the first countries to implement the Green Revolution in 1966 and is the home of *Magsasaka at Siyentipiko para sa Pag-Unlad ng Agrikultura* (MASIPAG, Farmer-Scientist Partnership for Development), a decentralized, grassroots farmer-led network pursuing food sovereignty strategies for rural development in direct opposition to state-led agricultural development initiatives.

Analytical framework

Carrying out an analysis of MASIPAG's capacity to generate pathways to climate resilience requires a multipronged analytical framework capable of identifying complex and decentralized organizational features that are distinct from state-led and centralized strategies. Unlike monocentric systems that have a tendency toward a single unitary structure in control (Aligica and Tarko, 2012), polycentric systems are characterized as a bottom-up, dispersed, and multilevel pattern of governing that is capable of enhancing "innovation, learning, adaptation, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales" (Ostrom, 2010, p. 552).

An additional analytical tool is needed to assess how polycentric organizational features and food sovereignty development strategies translate (or not) into resilience-building outcomes. We used a rubric based on developments in resilience theory to assess whether particular network activities and outcomes support features of resilience. Our analytical framework enables an examination of how the nexus of MASIPAG's polycentric arrangement and food sovereignty development strategies facilitate climate resilience within Philippine agrarian communities.

Understanding polycentric systems

The late Nobel Laureate Elinor Ostrom drew attention to the need for diverse localized efforts to address the problems brought by climate change and challenged the notion of "universal solutions" and the idea that an "external authority and outside knowledge" can solve problems in the same way for diverse and context-specific communities (Ostrom, 2009). She and other scholars have underscored the need to move away from generic, top-down, or centralized interventions toward an increased consideration of both socioecological variability and interventions that serve to empower community capacities for social learning, collective action, and local resource development (Ostrom and Cox, 2010; also see Ong'wen and Wright, 2007). Fundamental to this shift, they argue, are polycentric arrangements that enable users to develop rules and organizations at multiple, dispersed levels (Ostrom and Cox, 2010).

For example, the climate governance landscape is experiencing shifts from primarily state-led policy-making (a relatively monocentric top-down approach) embodied in the 1997 Kyoto Protocol to greater polycentricity with the inclusion of nonstate and subnational actors and initiatives, such as regional governments making commitments to reduce emissions (Jordan et al., 2018; Wurzel et al., 2019). Although polycentric governance theory recognizes the coevolutionary role of social movements, civil society organizations, businesses, local governments, and nation-states in shaping collective action (Jordan et al., 2018), very little systematic research has focused on the leadership of nonstate actors (Wurzel et al., 2019). Social movements and civil society actors, in particular, are often left out of the discussion despite their important role in generating polycentric governing structures that can enable more democratic (versus authoritarian) regimes (Stehr and Ruser, 2017). Further, although agriculture remains a key driver of global environmental change (Steffen et al., 2015), there remains a paucity of socioecological systems research that directly deals with agricultural management for climate resilience (Rivera-Ferre et al., 2013). Hence, this article aims to contribute to our understanding of the food sovereignty movement's role in creating polycentricity in agricultural systems management and the impact of this alternative development model on generating pathways for building climate resilience.

An existing body of work on polycentric systems focuses on the comparative advantages of local peoples in gathering and maintaining knowledge of local ecological complexity (Moller et al., 2004; Ostrom, 2010) and the comparative disadvantages local peoples have in

1. Peasant is a term used by *Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura* to link the network and its members to national and international food sovereignty and peasants' rights movements aimed at improving the conditions of rural communities, farmers, agricultural laborers, and indigenous peoples (Bachmann et al., 2009; Brenni, 2015).

managing large-scale natural resources and environmental pollution problems (Rose, 2002; Groenfeldt and Schmidt, 2013; Jordan et al., 2018). The loss of agrobiodiversity in the face of climate change provides a case in point, where smallholders who grow a wide variety of landraces serve as custodians of crop diversity, providing plant breeders and farmers the capacity to select resilient varieties, with agrobiodiversity itself further providing "insurance" and resilience (Lin, 2011; Mercer et al., 2012; see also Halpert and Chappell 2017). Yet dominant agricultural development programs and policies often exacerbate smallholder vulnerability, threatening not only the yields and livelihoods of farmers but also the traditional/indigenous varieties they cultivate and subsequently "the ability for agriculturalists worldwide to cope with the effects of climate change through advances in crop breeding" (Mercer et al., 2012, p. 495). Individual farmers can do very little to address these structural problems because of their limited agency and capacities. They can, however, organize agrarian movements committed to food sovereignty. In this way, polycentric systems within the agricultural sector could help ensure that agricultural development policies are "led by farmers themselves rather than being crafted by external agents" (Ong'wen and Wright 2007, p. 47), which also indicates an attention to the distribution of power within a polycentric arrangement (see Morrison et al., 2019). Jordan et al. (2018) identify five features of polycentric systems and their implications for climate change governance (see **Figure 1a**). For instance, an arrangement that is structured to support bottom-up governance, as well as open and democratic decision making, creates opportunities for the consideration of local knowledge and skills, which translates to a commitment to *local action*, an important feature of polycentricity. Facilitating participation, information sharing, and creating opportunities for repeated interactions among members and partners helps develop collective ambitions and build *trust*, another feature of polycentricity (Jordan et al., 2018).

Food sovereignty as a development approach

Since its articulation by La Vía Campesina in 1996 as the right of local people to control their own regional and national food systems (Nyéléni, 2007), food sovereignty has been proposed as one solution to food insecurity and the climate crisis, supported by the promotion of agroecological practices that simultaneously preserve diversity, enhance ecosystem service functions, reduce reliance on energy-intensive inputs, and link farmer knowledge with political mobilization (Altieri et al., 2011; Wittman, 2011; Vandermeer and Perfecto, 2012; Pimbert, 2017; High Level Panel of Experts, 2019). Food sovereignty principles operate with/at different scales (household to global), factors (policies to resources), and dimensions (equity to sustainability; Heckelman and Wittman, 2015) and facilitate equity within agrarian communities through promoting agroecology, agrarian citizenship, and social justice initiatives (Desmarais, 2007; Wittman, 2009; Chappell et al., 2013).

Food sovereignty also offers a rights-based development framework aimed at empowering citizens, farmers, and states and restraining corporate and supranational controls over the global food system (Ishii-Eiteman, 2009). The emphasis on redistributing resources and power to state and local-level governing coalitions to better address environmental and climate-related concerns (McMichael, 2009) is in line with core elements of polycentricity (see Iles and Montenegro, 2013, 2015; Anderson et al., 2019). Agrarian movements advocating for food sovereignty have therefore come to represent a paradigm shift in approaches to development, a move from and/or resistance to industrial agriculture and single-crop specialization (Issaoui-Mansouri, 2012) in favor of small-scale agricultural production with a strong focus on agroecology (Pimbert, 2017). In this way, food sovereignty advocates are challenging spaces within the agricultural sector that are dominated by elements of the corporate food regime[2] and pursuing polycentric mechanisms and institutional structures.

A framework for food sovereignty emerged at the Nyéléni Forum for Food Sovereignty in 2007 (see **Figure 1b**). Given some of the consistencies between polycentricity and food sovereignty (discussed further below), we use the Nyéléni framework to explore whether and how MASIPAG's food sovereignty development strategies are complementary to its polycentric structure and vice versa. We also pay particular attention to the subsequent processes and outcomes that improve (or not) capacities for building climate resilience.

Delineating pathways to peasant resilience

Although there is no consensus on how to define resilience, agri-food system researchers provide several key insights on how to conceptualize resilient agroecosystems and rural communities. Agri-food system researchers suggest farmers should pursue production strategies that enhance both their adaptive capacity and mitigation potential and that the separation of these activities is problematic for agrarian systems as trade-offs and synergies may occur over different temporal or spatial scales (Thornton and Mansafi, 2010). For instance, the use of agrochemicals may increase yields in the short-term, but at the expense of long-term cumulative contributions to carbon emissions; and the use of agroecological practices may reduce yields over the short-term but often result in greater productivity and carbon sequestration over the long-term (Rusinamhodzi et al., 2011; Lin, 2011; Harvey et al., 2013).

Vulnerability research has also been identified as key to understanding and building resilience. This is because resilience and vulnerability research are complementary in that the former generally emphasizes ecological–biophysical

2. The corporate food regime, according to McMichael (2009), is a "vector" of global capitalism that has facilitated the global displacement of peasant cultures through the deployment of aid and other development programs that translate into, for example, (a) the dumping of excess crops from one country to another, thereby undermining the existing agricultural sector in the latter; (b) the expansion of the supermarket revolution, which has disadvantaged small-scale producers while empowering large-scale producers; and (c) the conversion of land for agricultural exports which involves the dispossession of land from peasants and indigenous peoples across the globe.

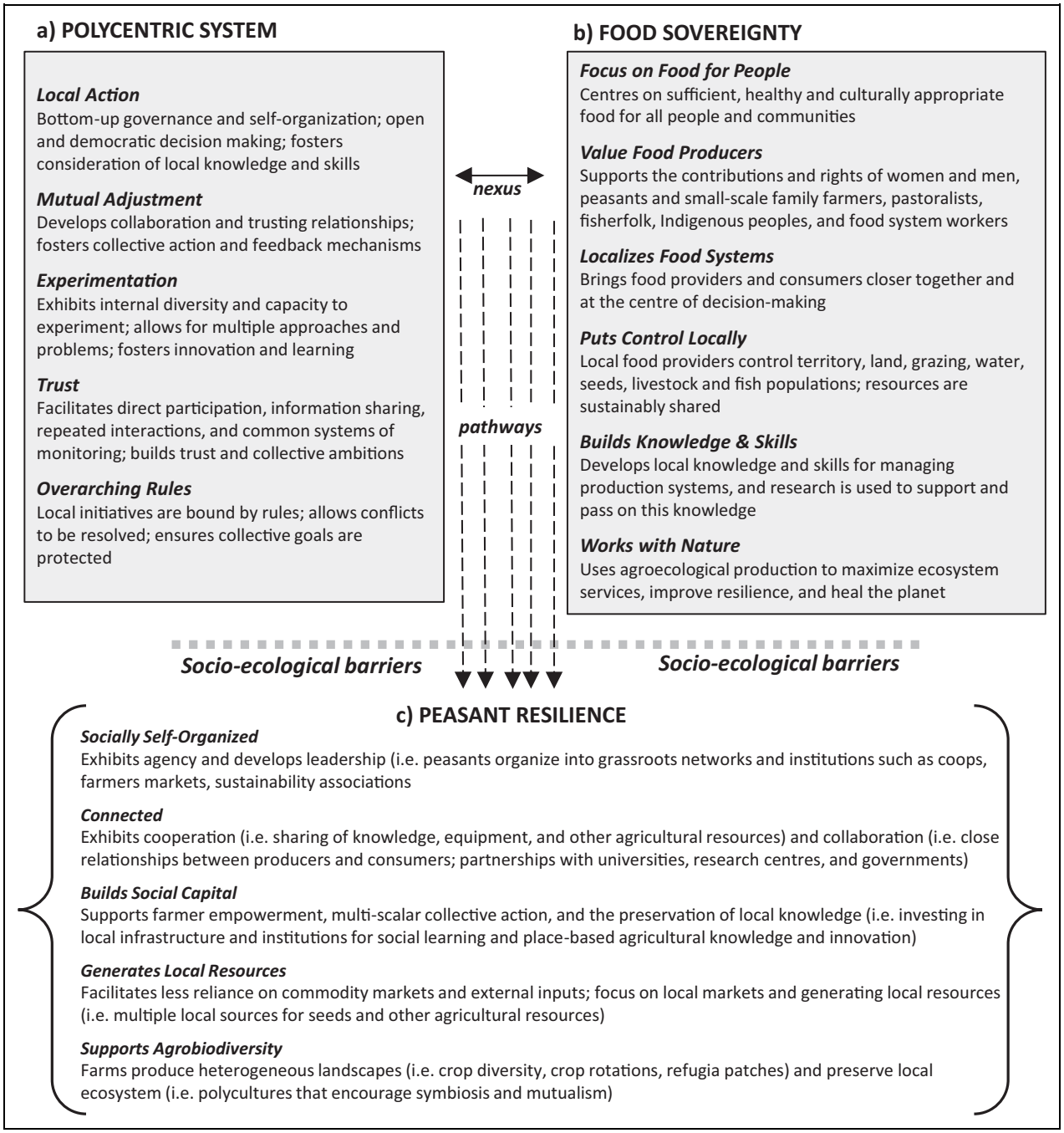

Figure 1. Linking features of a polycentric food sovereignty development approach to features of peasant resilience. Adapted from Jordan et al. (2018), Nyéléni (2007), Cabell and Oelofse (2012), and Berkes and Ross (2013). DOI: https://doi.org/10.1525/elementa.2020.00033.f1

dynamics, such as ecosystem services, thresholds, and feedbacks, while the later generally focuses on social–political dimensions such as power and inequity that affect the capacity for socioecological systems to engage in activities that enhance adaptation and mitigation potential. Hence, in order to account for the biophysical and social dimensions of global environmental change, Miller et al. (2010) have called for integrating the two concepts.

Researchers are also drawing attention to the need for interventions that consider political processes and the distribution of costs, risks, and benefits (Miller et al., 2010). Such concerns over issues of fairness (Paavola and Adger, 2006) have resulted in calls for rights and capacity-based approaches to resilience building (Schlosberg, 2012; Blesh and Wittman, 2015) to address poor living conditions, political marginalization, and economic volatility afflicting rural communities (Barret and Constas, 2014). To this end, researchers have underscored the need to develop community resources, as well as support collective action, social learning, and equity as mechanisms for enhancing "community resilience" (Magis, 2010; Berkes and Ross, 2013).

Drawing from these key developments in resilience theory, climate resilience for farmers is defined as a function of social, ecological, and political integrative

processes and outcomes (Cabell and Oelofse, 2012) that enhance adaptive capacity, augment environmental mitigation potential, and reduce the vulnerability of agricultural systems in the face of climate change and rising inequities. Essentially, it is the ability of farmers to engage in adaptive activities, implement mitigation measures, and reduce their vulnerability to adverse socioecological conditions. As such, a resilient agrarian system should have the capacity to (a) cope with droughts, floods, pests, extreme weather conditions, salinization, and erosion; (b) mitigate greenhouse gas (GHG) emissions and ecological degradation; and (c) address worsening inequalities, limited resources, social unrest, and economic uncertainty. We use "climate resilience," "smallholder resilience," and "peasant resilience" synonymously.

Cabell and Oelofse (2012) identified a number of agroecosystem indicators for resilience, including exhibiting self-organization, investing in human capital, relying on local markets and local resources, and preserving local knowledge and diversity. Berkes and Ross (2013) found that enhancing resilience also requires identifying and developing community strengths and fostering agency, self-organization, people–place connections, knowledge sharing, and social learning. Drawing from these two works, we identify five features of peasant resilience (see **Figure 1c**). The presence of these five features among peasant communities indicate a greater capacity for adaptation and mitigation, while their absence signals vulnerability and the need for intervention.

There are consistencies between the narratives on polycentricity, food sovereignty, and resilience particularly with respect to recommendations on how to respond to the challenges posed by the climate crisis. The three frameworks share similar diagnoses and prescriptions, including empowering marginalized communities, local control of natural resources, strengthening sustainable people–place relationships, and privileging indigenous/traditional knowledge systems. Polycentric systems undertaking food sovereignty initiatives have the potential to create the socioecological conditions necessary for enhancing peasant resilience (see **Figure 1a**–**c**). For instance, "local actions" that are aimed at "localizing food systems" and generating "local control" of agricultural resources have the potential to foster "self-organization" and "connection," as well as "build social capital." Having "overarching rules" that are guided by a commitment to "building local knowledge and skills" and "working with nature" have the potential to create rural communities committed to "generating local resources" and "supporting agrobiodiversity." A consideration of such physical, procedural, and social characteristics (e.g., local infrastructure, social learning, and community cohesion) illuminates heterogenous pathways to building resilience and underscores the idea that resilience is a process rather than a static state (Frankenberger et al., 2013). After describing the case study context, and building on the theoretical synergies between polycentricity, food sovereignty, and resilience, we explore how and to what extent MASIPAG's nonstate-based polycentric food sovereignty development approach creates pathways to enhancing peasant resilience in the Philippines.

The Philippine agrarian context

The Philippine agrarian experience is instructive for understanding the potential for social movements to challenge the persistence of centralized top-down development within the agricultural sector, and in doing so, increase peasant capacities for building climate resilience. First, the Philippines was one of the first countries to institutionalize the Green Revolution in the 1960s, which was followed by the emergence of an organic movement in the 1980s, led by civil society and nongovernmental organizations (NGOs) calling for an end to dependencies on research organizations and external inputs, and mobilizing farmer and community resources to revitalize traditional seeds and management practices that put farmers in control of agricultural resources (Olano, 1993; Frossard, 2002; Bachmann et al., 2009; Sanchez, 2011; Broad and Cavanagh, 2012). Second, the Philippines is one of the foremost countries at risk to climate change (Birkmann and Welle, 2016; Kreft et al., 2016), with all regions in the Philippines "very vulnerable" due to extensive coastlines, high population density, and heavy dependence on agriculture, natural resources, and forestry (Yusuf and Francisco, 2010). Although climate interventions have been specifically targeted at the agricultural sector due to its contribution to the economy, food security, as well as GHG emissions, many Philippine farmers are still struggling to cope with intensified typhoons, changing rain patterns, floods, droughts, and temperature and sea-level rise (Institute for Global Environmental Studies and Southeast Asian Research Center for Graduate Study and Research in Agriculture, 2012). Hence, there is a sense of urgency to develop and deploy interventions aimed at enhancing climate resilience.

The green revolution and the emergence of MASIPAG

Following centuries of peasant unrest and landlessness, the Green Revolution was institutionalized in the Philippines under conditions of inequity, asymmetrical distributions of power, and government corruption (Putzel, 1992; Stone, 2019). These conditions ensured that associated foreign investment, state credit programs, and restrictive and weak agrarian reform policies primarily served to benefit large landholders who had access to global markets and capital to finance modern technologies and irrigation (Hazell, 2002; Patel, 2013). As the country became increasingly integrated into the global agri-food system, the Philippine peasantry had neither the political nor economic clout to influence the policy-making processes that affected their livelihoods (Oram, 2003; Bello, 2019, p. 113). The Philippines became the home of the International Rice Research Institution (IRRI), established in 1960 following an agreement between the Rockefeller and Ford Foundations and the Philippine government, as well as received substantial funding from both foundations and United States Agency for International Development (USAID; Putzel, 1992) to conduct research toward "improving" all elements of rice production, distribution, and consumption

systems. The Philippine Rice Research Institute (PhilRice) is a government-corporate entity attached to the Department of Agriculture and a sister organization of IRRI.

Nearly 2 decades after the implementation of the Green Revolution in the Philippines, a countrywide consultation between farmers and scientists was carried out in 1985 that resulted in peasant farmers issuing "A Declaration on the Root Cause of Our Problems" that attributed the exacerbation of their "misery" to the "use of high-yielding varieties of rice grains created by IRRI . . . that thrive on a package of new technologies involving use of fertilizer, pesticides, machineries, irrigation, etc." (BIGAS, 1985, Annex II; cited in Frossard, 2002). For these farmers and others, the Green Revolution failed to address—and even exacerbated—the underlying causes of peasant unrest: the consolidation of wealth and resources within the agrarian sector (Patel, 2013), government corruption (Putzel, 1992), unfair labor conditions (Borras and Franco, 2005), and persistent debt and landlessness among resource-poor farmers and farmworkers (Olano, 1993; Borras, 2001; Broad and Cavanagh, 2012).

Mobilized by these countrywide consultations, peasant participants and sympathetic scientists forged a partnership to work toward improving the quality of life of resource-poor farmers. This partnership grew into a Philippine-based grassroots farmer-led network called MASIPAG comprised of people's organizations (POs), member scientists, and NGOs. From its inception, MASIPAG aimed to empower peasants by shifting the locus of control away from fertilizer and pesticide companies, multilateral research institutes, and rice distribution cartels in the Philippines (Olano, 1993; Medina, 2004; Roxas, 2006). MASIPAG worked toward creating opportunities and spaces for peasants to freely develop and share agricultural resources, technologies, and innovations. The network's development orientation recognizes and values farmer knowledge and participation. Over time, the MASIPAG tethered their mobilizations to five main strategies (Medina, 2002, pp. 16–17):

1. *farmer-scientist partnerships* to combine the experience and practical knowledge of farmers with the theories and technical knowledge of scientists;
2. *a bottom-up approach* to ensure community needs, problems, and aspirations are prioritized;
3. *farmer-led research and training* through the establishment of farmer-managed trial farms and training centers;
4. *farmer-to-farmer* mode of technology transfer and knowledge exchange; and
5. *advocacy* for organic agriculture, genuine agrarian reform, and other issues affecting farmers.

To date, MASIPAG has grown to represent over 30,000 farmers, 41 NGO partners, 20 church-based development organizations, and 15 scientists (MASIPAG, 2018a) committed to working collectively toward increased farmer control of genetic and biological resources, agricultural production, and associated knowledge to ensure the sustainable use and management of biodiversity in the Philippines (ibid.). From the outset, MASIPAG sought to address the unequal power dynamic between farmers and scientists by taking explicit measures to empower farmers within the network (Frossard, 2002). The network's farmer-scientist partnership is emblematic of this as opportunities were (and continue to be) created for member farmers to direct network activities and scientists support their endeavors. For example, when scientists initially asked the farmers, "How can we help?" the farmers responded, "Teach us to breed rice like you do" (Frossard, 1994, Chapter 3). The subsequent trainings were so successful that farmers were able to teach other farmers the breeding, record-keeping, and selection techniques they learned (Frossard, 2002), asserting their capacities to also engage in seed innovation processes to adapt traditional and indigenous seed varieties to local environmental conditions and farmer preferences (also referred to as "MASIPAG technology"). To date, MASIPAG has recruited and trained 70 farmer rice breeders, 12 farmer corn breeders, and over 100 volunteer farmer trainers. Member scientists provide the necessary training to (re)connect farmers with agricultural knowledge, innovation, and technology. In comparison to their neighbors who do not participate in the network, MASIPAG members achieved higher levels of ecological sustainability (Sievers-Glotzbach, 2014), economic gain (Bachmann et al., 2009), and climate resilience (Heckelman et al., 2018).

Barriers to climate resilience for Philippine peasants

Not only has the Green Revolution and modern agriculture failed to achieve food and nutrition security in the Philippines (Davidson, 2016), but rural communities continue to have the highest incidences of food insecurity and poverty (Philippine Statistics Authority, 2017; Integrated Food Security Phase Classification, 2021). The socioeconomic marginalization of peasants is an outcome of the dominant state-led development paradigm which has systematically supported cash crops for international markets at the expense of low incomes for farmers and narrowing crop diversity, thereby limiting access to nutritious diets for rural communities (Davidson, 2016; Davila, 2018).

Furthermore, the establishment of the Green Revolution technological regime in the Philippines resulted in the separation of farmers from agricultural knowledge development and innovation, creating dependencies on research organizations, and consequently, the erosion of agrobiodiversity and the indigenous/traditional systems to which they were embedded (Stone and Glover, 2016; Montefrio, 2017; Davila, 2019). Many farmers in the Philippines as well as agroecological researchers globally agree that regenerating and restoring agrobiodiversity—and wild biodiversity—are important elements of increasing climate resilience.

A number of institutional barriers need to be addressed in order to regenerate agrobiodiversity in the Philippines. First, indigenous varieties are a low priority for the dominant national and international research and breeding systems, and at high risk of being lost, as they have been sidelined from mainstream production systems (Altoveros and Borromeo, 2007). Coupled with a donor/investment policy and infrastructure promoting monocultures of "modern" high-yielding varieties, the country is at risk of losing a diverse suite of locally adapted cultivars, landraces, and the indigenous knowledge associated with their cultivation, utilization, and conservation (ibid.). Second, compared to four decades of systematic ex situ conservation efforts implemented nationally and internationally, the Philippine government was late to recognize the value of in situ conservation of indigenous crop species, wild relatives of crops, and associated knowledge systems (ibid.). The lack of commitment to in situ conservation efforts is evidenced by the lack of action by the Department of Agriculture to revitalize or support farmer-led and village-centered seed production and exchange of traditional/indigenous cultivars that are locally adapted (Altoveros and Borromeo, 2007; Rapera et al., 2014). Researchers have noted that MASIPAG remains the only entity in the Philippines engaged in these kinds of efforts (Rapera et al., 2014; discussed further in the Results section). At the same time, the revaluing of alternative cultivars by IRRI and PhilRice is restricted to genetic material, as these cultivars supply their seed banks with additional genetic material, as well as give these research institutions access to new sources of funding that can be used for the research and development of new commercial seed products (Romero et al., 2011; Stone and Glover, 2016; PhilRice, 2018). The state's lack of interest in systematically supporting in situ conservation undermines farmer and community capacities to address unique regional and local socioecological conditions through social learning, collective action, and the generation of local agricultural resources—all of which are key attributes of resilience building identified by resilience researchers (Magis, 2010; Cabell and Oelofse, 2012; Berkes and Ross, 2013; Frankenberger et al., 2013).

Our examination centers on the experiences of MASIPAG farmers in Negros Occidental Province, located in the central region of the Philippines (see **Figure 2**). Farmers from Negros, a predominantly sugarcane-producing island comprised of Negros Occidental and Negros Oriental provinces, are renowned for their struggle for agrarian reform and food sovereignty. Peasant uprisings were (and are) often met with violent attacks inflicted by sugar plantation owners wanting to retain their landholdings (see Aguilar, 1998; Sánchez, 2011; Saludes, 2019). Military conflict and other forms of violence and intimidation by security forces and local elites are pervasive among Negrense agrarian communities (Angeles, 1999; Oram, 2003). Recent examples involve community leaders, including MASIPAG members, being assassinated or targeted for their advocacies for genuine agrarian reform (see Heckelman, 2018; MASIPAG, 2018c). A focus on Negrense farmers, therefore, offers insight into long-standing agrarian conflicts and conditions that emerge out of the widespread inequity, hunger, poverty, and landlessness that shape the experiences of Philippine peasants and their capacities for building resilience.

Methods

This article uses primary and secondary data drawn from fieldwork conducted by the first author between August and December 2016, which included focus group discussions, farmer interviews, key informant interviews, and participant observation. Three focus group discussions were facilitated with Negrense smallholders ($n = 40$), 21 male and 19 female, comprised of conventional (22) and MASIPAG organic (18) rice farmers from four neighboring villages located in Negros Occidental. These farmers assessed their farm-level climate resilience using the Self-Evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists Tool[3] tool (comparative outcomes for conventional and organic farmers are reported in Heckelman et al., 2018). The focus group discussions were used to characterize socioecological conditions and identify appropriate interventions for enhancing resilience. Recruited from focus group participants, 11 additional semistructured farmer interviews provided deeper insights into individual perspectives on farm management practices, current socioecological conditions, and challenges related to the climate crisis.

Seven key informant interviews were also carried out with representatives from MASIPAG, universities, an NGO, and the PhilRice-Negros station. Questions were designed to explore how smallholders are affected by and responding to the governance environment, including policies and laws occurring at the national, regional, and local levels. These questions explored insights on the institutions shaping production systems (i.e., agricultural management practices, input access, knowledge and information), the environment (i.e., land management practices, rights to land and water), social mechanisms (i.e., cooperatives, labor, skills, and education), and economic conditions (i.e., insurance, market information, fiscal incentives; see Choptiany et al., 2015, pp. 64–65), which in turn served to understand both MASIPAG's polycentric structure and the socioecological conditions that are driving its food sovereignty development strategies. Key informants were also asked to discuss how their respective organizations are navigating and responding to climate change given social, environmental, and institutional conditions. Derived from the Agroecological Risk and Resilience Tool (MercyCorps, 2014), this line of questioning was directed specifically to MASIPAG and PhilRice scientists to better understand the agroecosystem impacts of their respective resilience

3. The Self-Evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists tool was created in a collaborative manner by the Food and Agriculture Organization of the United Nations and external partners (i.e., academics and practitioners), for the purpose of measuring and monitoring climate resilience while at the same time empowering smallholder farmers to develop climate resilience in a participatory manner (Choptiany et al., 2015).

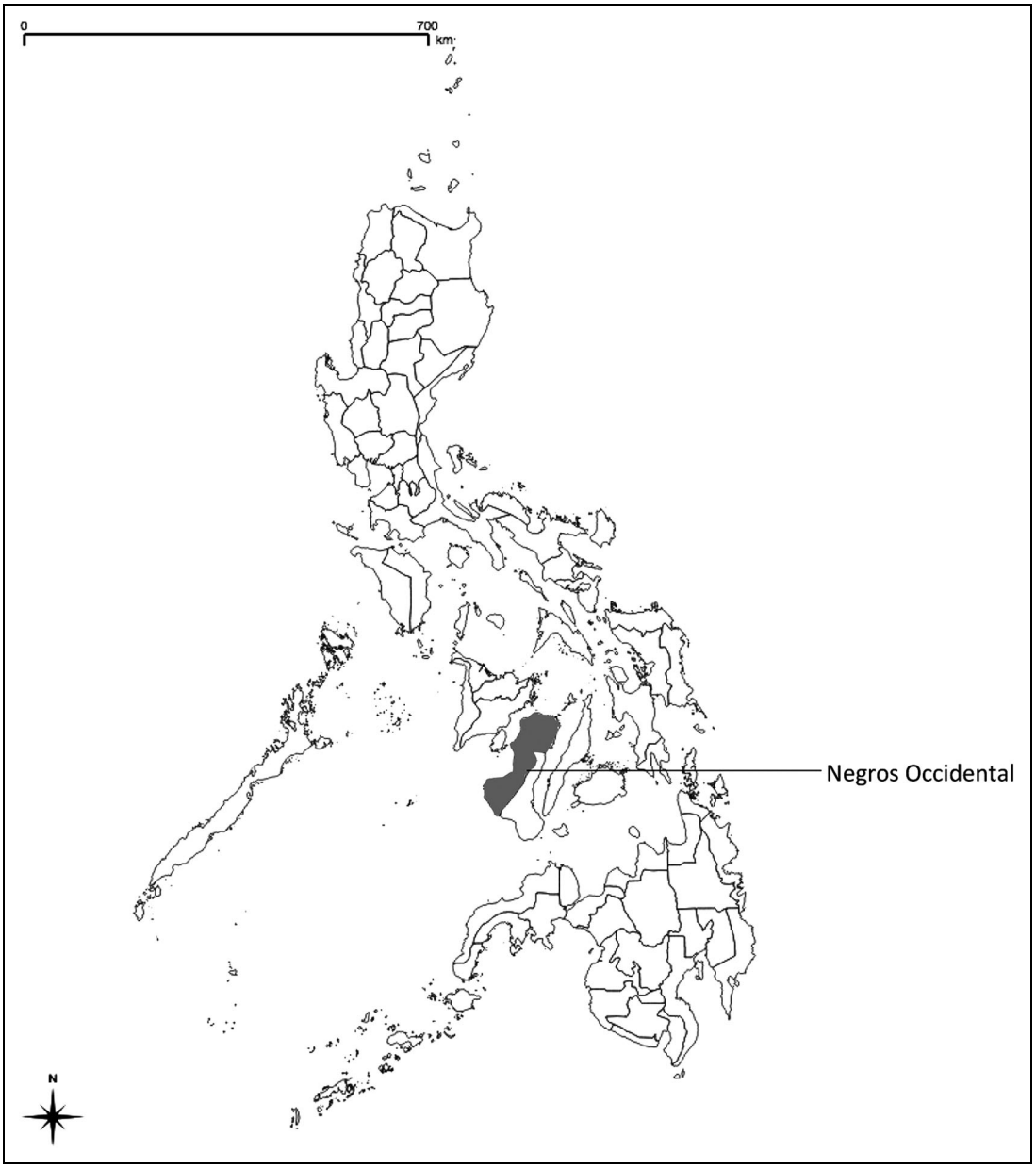

Figure 2. The Philippine Islands, Negros Occidental Province (shaded). DOI: https://doi.org/10.1525/elementa.2020.00033.f2

strategies. Participant observation included attendance at meetings with government, farmer organizations, and research institutions.

Results

To determine the influence of MASIPAG's polycentric structure and food sovereignty development strategies for peasant climate resilience, our analysis is organized into three sections. The first section describes MASIPAG's organizational structure, including the network's commitment to local action, experimentation, and farmer empowerment through its bottom-up, farmer-led development approach and establishment of local/community-based institutions. We highlight how MASIPAG's polycentric structure and food sovereignty orientation enhances farmers' capacities to self-organize, build social capital, and generate local resources. The second section describes the network's effort to foster mutual adjustment and trust to support local food systems, through multiscalar and multisectoral collective action. The last section describes MASIPAG's overarching rules with respect to its commitment to the propagation of traditional/indigenous rice varieties and promotion of diversified organic agroecosystems. We identify the ways in which these polycentric food sovereignty initiatives are revitalizing agrobiodiversity and place-based knowledge in the Philippines.

Structuring a network that builds social capital and local resources

Responding to the monocentric regime supporting the Green Revolution and the subsequent socioeconomic marginalization of farmers and driven by the commitment to

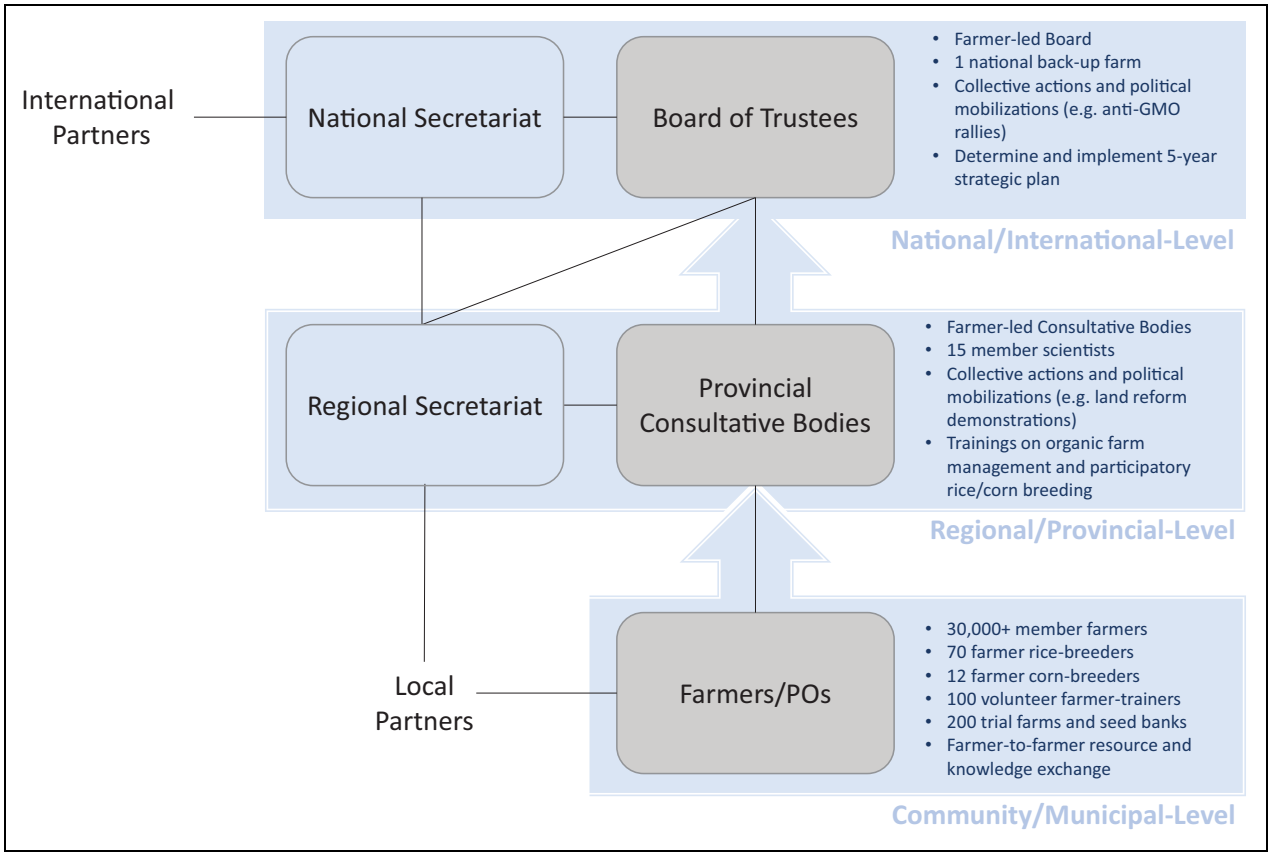

Figure 3. Magsasaka at Siyentipiko para sa Pag-Unlad ng Agrikultura's polycentric organizational structure.
DOI: https://doi.org/10.1525/elementa.2020.00033.f3

farmer empowerment, MASIPAG's organizational structure is designed to give priority to farmers in decision-making at all levels of the network (Bachmann et al., 2009; see **Figure 3**). First, farmers join the network through People's Organizations (POs), which are multipurpose cooperatives that are often allied with other NGOs (Roxas, 2006). Members adopt MASIPAG technology and commit to working with other farmers in their area to promote the technology. They attend seminars, lectures, dialogues, and farm visits and work collectively to ensure the development of new varieties are based on traditional seeds (Interview 4, 2016). Member farmers also identify the research agenda (Medina, 2004), and every 5 years, the network devises a strategic plan that is reviewed and approved by the Board of Trustees, National Coordinator, and Regional Coordinators. The Board of Trustees is comprised of five farmer leaders from across the Philippines and two scientists (Frossard, 1994) and oversees policy-making (Interview 2, 2016). The National Secretariat Office uses the strategic plan to prioritize the network's activities at the national level (Interview 3, 2016). The National Secretariat also maintains relationships and responsibilities to international partners. The Regional Secretariat oversees the implementation of the annual plans at the regional level (i.e., Luzon, Visayas, and Mindanao), including oversight of regional programming (Interview 2, 2016). This includes supporting local partnerships, such as with the Rural Reconstruction Movement and Davao Provinces Rural Development Institute which have collaborated with MASIPAG and other NGOs to develop and advocate for alternative models for sustainable rice production in southern Philippines (Regalado et al., 2007). As well as the Center for Social Concerns and Development and the Social Action Center of the local Catholic church diocese, local NGOs that also advocate for MASIPAG and recruit farmers to join the network (Roxas, 2006; Interview 2, 2016). Provincial Consultative Bodies made up of elected farmer leaders meet regularly to respond to issues and problems occurring at the local level and provide opportunities for farmer-to-farmer knowledge and resource exchange. Women farmers are members of MASIPAG and occupy leadership roles within the network (i.e., National Coordinator, Regional Coordinator, and Provincial Coordinator) indicating attention to fostering gender representation and equity (see also Bachmann et al., 2009, p. 83).

MASIPAG's member requirements and engagements result in the sharing of benefits, knowledge, seeds, and technologies, as well as the increase of genetic resources and innovations over time (Medina, 2004). For example, establishing a PO is the first step to joining the network, which also involves bringing farmers, scientists, and NGOs together to establish a noncommercial seed bank, build local community organizational capacity, and provide farmer-to-farmer trainings (Oram, 2003). MASIPAG learned the value of social organization and local

resources in meeting the needs of farmers, as members who were surrounded by other members tended to transition to diversified organic systems more successfully than members who were isolated. This is because having to learn new farm management skills can be challenging and the initial decline in yields that happens during the transition can be costly. Hence, isolated farmers who lack the necessary support to overcome the transition process often give up and return to conventional farming. This prompted the network to request farmers to form POs of 15 or more member farmers. If a farmer needs help recruiting and organizing other farmers, then MASIPAG solicits the help of a community organizer of the nearest PO or NGO partner (Medina, 2004).

MASIPAG's bottom-up farmer-led structure and commitment to building local partnerships are indicative of a polycentric system committed to food sovereignty. By establishing feedback mechanisms to support farmers in overcoming challenges and committing to local knowledge and skill development, the network is generating pathways for farmer empowerment and multiscalar collective action, both identified as important vectors for enhancing peasant resilience.

Once member farmers establish their POs, the network then helps them cultivate local knowledge through experimentation by providing the necessary agricultural resources and technical support from NGOs or partner scientists (Oram, 2003). Every PO begins with a trial farm approximately 600 square meters in size (Medina, 2009). Requiring POs to establish local trial farms ensures that members have a designated space for learning how to observe, characterize, and monitor rice-growing agroecosystems (Medina, 2004). In some cases, lands designated for trial farms are volunteered by a single member. In others, it is a designated parcel of land under Collective Certificate of Land Ownership, a land redistribution mechanism under the Comprehensive Agrarian Reform Program that awarded land to groups of farmers rather than to individuals. MASIPAG provides each PO with 50–100 rice varieties, thereby enhancing community seed resources and capacity for members to carryout experiments and observations to determine which varieties are locally adapted.

Trial farms serve as field sites for farmer-breeders and in situ seed banks (Medina, 2004) and entail "no cost to the farmer except for the collective work required for its maintenance" (Roxas, 2006, p. 5). In Negros, a trial farm was growing 84 rice varieties and served as a site for farmer-breeder trainings. According to a farmer-breeder at the site, a major priority is to develop and select varieties that are best suited for either the dry or wet season, where dry season varieties would exhibit heat tolerance and wet season varieties would exhibit flood tolerance (Interview 11, 2016). One Negrense farmer explained how the region experienced 6 months of drought conditions in 2016, and that having access to MASIPAG's drought resistant rice varieties and the capacity to freely breed and adapt these varieties to local conditions, have been important mechanisms for coping with climate change (Interview 9, 2016). The trial farm is also used to explore other crops and allows "farmers to be scientists" and share their findings with others (ibid.). MASIPAG farmers see the trial farm as a space for revitalizing *bayanihan* (collective work), a practice that has eroded with the spread of conventional farming (Interviews 11 and 13, 2016). As one conventional farmer explained, *bayanihan* is no longer practiced: if you need help on your farm, "you have to pay laborers" (Interview 12, 2016). In this way, MASIPAG is not only revitalizing traditional rice varieties, as well as developing new varieties, but farmers are also "learning again the value of extending communal assistance to fellow farmers as a way of building social solidarity while lowering the cost of labor" (Roxas, 2006, p. 9). MASIPAG's strategic effort to augment community seed resources and establish local infrastructure to capacitate farmers to locally develop and share agricultural knowledge and resources speaks to the networks ability to generate local resources necessary for building climate resilience.

POs also serve as a mechanism for members to organize and participate in regular meetings and trainings on sustainable agriculture techniques, leadership skills, and more (Oram, 2003; Bachmann et al., 2009; Medina, 2009). Members often engage in collective action to address resource limitations such as campaigning for land reform, forming marketing cooperatives, and organizing meetings with neighboring farmers to discuss the harmful effects of agrochemicals. For example, one collectively owned farm in Negros managed primarily by MASIPAG farmers had successfully transitioned the land from conventional sugarcane to organic rice and vegetables (Interview 9, 2016). However, their collective success was not lasting due to "some farmers [experiencing] an emergency and needing to lease the land" in exchange for credit (financial resources; ibid.). Once you become an *ariendo* (someone that has leased his or her land), you "don't have the choice to go organic" as you are forced to cultivate and manage the land according to the lender (ibid.). In Negros, many lenders are also sellers of Green Revolution seeds and chemical inputs, so it is in their best interest for farmers to engage in conventional farming (Interview 2, 2016). The PO, however, devised a solution to this problem, advising farmers "to lease the land to the association rather than someone outside" (Interview 9, 2016). And so far, "this strategy is working" to prevent further erosion of their organic communal farm (ibid.). Other examples of the role and contribution of POs include groups located in coastal areas working with local governments to plant mangroves in an effort to control erosion during storm surges and POs in mountainous regions working with *barangays* (village government) to plant native trees, including fruit bearing trees, to protect the watershed and control erosion (Interview 3, 2016). As such, MASIPAG's polycentric organizing strategy to address challenges facilitates participation in efforts to improve local and regional sustainability and builds the necessary trust for social learning.

Features of peasant resilience include exhibiting the capacity to self-organize at the grassroots level; build social capital, such as local institutions and infrastructure

for social learning; and generate local resources to reduce farmer reliance on commodity markets and external inputs (Cabell and Oelofse, 2012; Berkes and Ross, 2013). MASIPAG's commitment to local action, experimentation, and farmer empowerment helped peasants to develop such capacities in the face of limited resources and an institutional arrangement that treats farmers as passive recipients of modern agricultural technologies. Through the network's community-based and people-centered approach, which requires the participation of farmers from the planning to the implementation stages of initiatives, MASIPAG not only involves the people for whom development is intended but also develops community self-reliance (Olano, 1993). The network's persistence and achievements over the past 4 decades can be largely attributed to its decentralized structure, and more specifically, its farmer-led approach at all levels of the organization—both key features of polycentricity and food sovereignty (see also Sievers-Glotzbach, 2014).

Self-organizing and connecting local mobilizations to national and global campaigns

MASIPAG first reached Negrense peasants in 1996 when it forged a partnership with a local NGO, the Catholic church, and several farmer organizations who coalesced to campaign for land reform in the region (Interview 2, 2016; also see Oram, 2003; Roxas, 2006). A food sovereignty movement[4] had already been underway in the region since the mid-1980s (Sánchez, 2011). Responding to the near-famine conditions spawned by the monoculture-based sugar industry and price crises during the 1970s and 1980s, peasants began advocating for food security as a human right and calling for state policy to protect and defend the right to seeds, indigenous knowledge systems, and the promotion of ecologically friendly farm technologies (ibid.). Growing out of these earlier food sovereignty mobilizations, Negrense peasants identified organic agriculture as a measure for breaking dependence on export-based sugarcane monoculture and costly chemical inputs (Interview 2, 2016). They saw organic agriculture as a mechanism for redistributive justice and farmer empowerment, as it transformed dependent farm laborers into self-sufficient agroecosystem managers, and thereby reinforced efforts to reshape land tenure relations (Sánchez, 2011).

However, because many Negrense peasants were formerly sugarcane plantation workers, they often lacked the experience to manage diversified organic farming systems (Interview 9, 2016). Centered on being "responsive to the needs of small farmers" and "provid[ing] an alternative to the chemical farming system," MASIPAG provided land reform beneficiaries in the region with access to traditional/indigenous seed varieties and trainings on organic farm management (Interview 2, 2016). And because MASIPAG farmers are primarily resource poor smallholders with previous inadequate food access, an important "benefit of MASIPAG" is the shared principle of growing diversity of food for your family that is nutritious and safe from toxic chemicals (Interview 10, 2016). It is only after ensuring the food security of one's family that any surplus crops are sold locally to community members (ibid.). As one farmer summarized, "the philosophy of conventional [agriculture] is profit before people; the philosophy of MASIPAG is people first before profit" (ibid.).

MASIPAG also gave farmers the means to organize and participate in "radical actions such as land occupations or mass mobilisations outside government agrarian reform offices" as part of efforts to support the causes of other farmers (Oram, 2003, p. 99). Negrense peasants perceived MASIPAG as a pathway to achieving greater self-sufficiency, control over their farming systems, and food security. They could rehabilitate their land and strengthen their community ties. In this way, MASIPAG provided the infrastructure for connecting farmers to agricultural knowledge and resources that build household and community capacities for improving food security and security of land tenure, as well as organizational tools for supporting peasant campaigns for genuine land reform. By enabling farmers to exhibit agency and engage in leadership and cooperation to address adverse socioecological conditions, MASIPAG is improving the ability for peasants to address their vulnerabilities and build climate resilience.

Beyond rallying for land reform, MASIPAG members are highly politicized and mobilize on a range of issues that affect the viability and sustainability of their livelihoods (Focus Group 3, 2016). For example, due to the network's advocacy for farmers to have control of agricultural knowledge and resources, MASIPAG has positioned itself as a staunch opponent of transgenics (Interview 4, 2016). The drought-, flood-, and saline-tolerant transgenic varieties that are being marketed as "climate-ready," for instance, are identified as antithetical to the MASIPAG approach due to the resulting narrow genetic makeup of transgenic technology, its targeted response to chemical fertilizers, and potential to displace many farmers' varieties (Medina, 2012). Not only would the implementation of such technologies risk resulting in a narrow genetic base, making the agricultural landscape susceptible to pest and disease outbreaks, but it could also perpetuate farmer dependencies on costly modern seed varieties that began with the Green Revolution (ibid.). This is in part due to the 2002 Philippines' plant varietal protection law (RA 9168), which restricts farmers from growing, saving, exchanging, improving, and marketing seeds that have been certified as "new plant varieties." The implementation of Intellectual Property Rights (IPR) on new, the so-called climate-ready seed varieties relegates farmers using these varieties to buying new seeds every planting season, continuing the cycle that ensures profits for commercial seed companies while impoverishing farmers (ibid.). Unlike the Green Revolution regime, MASIPAG works to ensure that traditional and indigenous plant varieties remain in the hands of communities and are not subject

4. Although food sovereignty as a concept did not emerge in the global discourse until the mid-1990s, Sánchez (2011, p. 361) argues that key aspects of the peasant campaigns in Negros Occidental in the mid-1980s "hew to the classical definitions of food sovereignty."

to patenting via IPR, as the latter has been identified as an affront to farmers' "freedom" and their "ancestors" history (Institute for Agriculture and Trade Policy, 1998; see also Halpert and Chappell, 2017). In this way, and consistent with their commitment to food sovereignty, MASIPAG is working to "(re)root" or "(re)embed" traditional and indigenous rice varieties in local agroecological contexts (see Broad and Cavanagh, 2012 and Stone and Glover, 2016, respectively).

In response to the perceived threats posed by transgenic seeds, MASIPAG has engaged in coalition building with national and international partners, resulting in a campaign that prompted local governments to ban genetically modified organisms (GMOs) and expand organic agriculture in their respective legislative districts (Medina, 2012). Forums were conducted at universities and within communities to inform farmers of the reasoning behind resisting GMOs (Interview 4, 2016). In partnership with Greenpeace Southeast Asia, as well as other activists and politicians, the network submitted a petition that succeeded in granting a temporary moratorium on the development of GMOs in the Philippines (Medina et al., 2015, December 11).

Golden Rice is a highly contentious variety of rice that was genetically engineered to contain vitamin A and marketed as a measure for addressing deficiencies in vitamin A occurring in the developing world (Stone and Glover, 2020). Golden Rice arguably represents a costly, highly modernist technical response to vitamin A deficiency (Stone and Glover, 2016). In 2013, to demonstrate their disapproval of Golden Rice, MASIPAG members and allies—comprised of 400 farmers, consumers, and youth—uprooted test plots in Bicol Province (Ranada, Sep 14, 2013). And in 2018, farmers and allies from Isabela, Nueva Ecija, and Bicol Provinces, as well as Bangladesh, Indonesia, and Cambodia commemorated the "historical Golden Rice uprooting" by holding a forum to express farmer contentions with Golden Rice and hosting an organic festival to showcase the diversity of Vitamin A-rich food available in the country (MASIPAG, 2018b). In partnership with GRAIN and Stop Golden Rice! Network, MASIPAG also produced a report drawing attention to the many flaws and concerns surrounding Golden Rice, as well as natural sources of Vitamin A and the need for comprehensive approaches to ensure diverse diets (MASIPAG, GRAIN, 2018; see also Stone and Glover, 2016). MASIPAG's ability to engage in an array of activities, from producing reports to organizing rallies and demonstrations, speaks to the networks ability to self-organize and collaborate in order to address the conditions that contribute to their vulnerability.

Building capacities for farming communities to self-organize and establish connections are critical features of peasant resilience, as they provide a mechanisms for farmers to engage in multiscalar and multisectoral collective action to address adverse socioecological conditions to resilience building (Cabell and Oelofse, 2012; Berkes and Ross, 2013). MASIPAG's effort to foster mutual adjustment and trust to support local food systems provides such an example, as it mobilizes farmers to advocate for themselves, organize multiscalar and multisectoral collective action, as well as participate in the development discourse by communicating contentions with and alternatives to the dominant development paradigm. In this way, MASIPAG bridges local and national mobilizations to global campaigns, amplifying the voices of peasants while also providing organizational and leadership development at various levels of the network. According to Negrense farmers, advocacy for farmers is one of the benefits of being a MASIPAG member, along with trainings on organic farming and access to safe and nutritious food (Interview 9, 2016; Interview 10, 2016). Through its multisectoral partnerships across the Philippines and beyond, MASIPAG farmers build effective movements centered on reasserting farmer control over production systems and improving farmer capacities for agricultural knowledge generation and innovation (Oram, 2003).

Revitalizing agrobiodiversity and place-based knowledge

Regenerating agrobiodiversity is fundamental to facilitating the adoption of diversified farming systems required to enhance climate resilience in the Philippines (Rapera et al., 2014). Accomplishing this requires building the availability of seeds and planting materials in villages, fostering on-farm seed exchange among local farmers, as well as supporting the adoption of indigenous knowledge and locally adapted seed technology (ibid.).

MASIPAG is the only entity producing indigenous or traditional seed varieties for distribution or exchange in multiple localities across the Philippines (ibid.). To date, MASIPAG has collected 600 traditional rice varieties and bred approximately 1,800 MASIPAG rice varieties, resulting in over 2,000 rice varieties currently maintained by the network (MASIPAG, 2018a). MASIPAG's seed collection is a result of member farmers gathering and/or developing locally cultured rice varieties and distributing them to the network's nearly 200 in situ seed banks located across the Philippines (Sievers-Glotzbach, 2014; MASIPAG, 2018a). Unlike ex situ seed banks that store seeds in refrigerated vaults, MASIPAG continuously cultivates its seed collection to ensure the varieties evolve alongside changing environmental and climatic conditions (cf. Altieri and Merrick, 1987). To date, farmer breeders have identified and developed 12 flood tolerant varieties, 18 drought tolerant varieties, 20 saline tolerant varieties, and 24 pest or disease resistant varieties (MASIPAG, 2018a).

Alongside the network's efforts to revitalize traditional/indigenous cultivars and the diversified farming systems to which they are derived, MASIPAG also supports the development of local indigenous/traditional knowledge (Roxas, 2006), also referred to as place-based knowledge. For example, using the trial farm, members plant indigenous/traditional varieties and engage in seed selections to determine what varieties are best suited for their local environments (ibid.). For MASIPAG, "there is no such thing as one variety which is good for everybody in the entire Philippines"; rather, farmers develop and identify multiple varieties that are best suited for their respective agro-climatic conditions (Interview 3, 2016). The activities

occurring at the trial farm provide an opportunity for participating farmers to "re-learn important skills" such as producing and preserving seeds for the next cropping season (Roxas, 2006, p. 5).

Members also use the trial farm to engage in pest management experimentation. Member farmers, for instance, were seeking solutions to *tungro*, one of the most destructive rice diseases in South and Southeast Asia that infects cultivated rice. MASIPAG members found they can treat the disease and recover the land by leaving it idle, then planting "creeping plants" like *camote* (sweet potato), *gabi* (taro), or *kangkong* (water spinach) for a year before planting rice again (Interview 4, 2016). Other farmers found that managing Golden Snails, another common pest in paddy rice systems, can be addressed through water management rather than relying on chemical pesticides (Interview 3, 2016). Member farmers also learn to plant buffer zones to protect against erosion and contamination, such as planting *kangkong* and cacao to filter water contaminated by agrochemicals (Interview 11, 2016). The learning, observing, and experimenting that occurs at the trial farm teaches farmers how to use agroecological techniques to manage their farms.

MASIPAG is also a leader in the organic movement in the Philippines (Salazar, 2014; Suh, 2015). MASIPAG's success in helping farmers across the Philippines transition to diversified organic farming systems has had the impact of revitalizing lost species and local food sources. Prior to the Green Revolution, rice paddies contained frogs, mudfish, tilapia, birds, crabs, snails, and insects as well as water spinach and water chestnuts (Mendoza, 2004; Medina, 2004; Ong'wen and Wright, 2007). The increased use of agrochemicals and highly monocultured farm systems resulted in the loss of these supplemental food resources. There were even reports of *carabao* (water buffalo) dying after drinking from irrigation canals saturated with toxic chemicals (see Frossard, 2002). And one Negrense farmer recalls that when she was a child, her aunt said, "the cleanest water is the rainwater" but now the farmer explained, "there are warnings to stay out of the rain because of aerial spraying" (Interview 9, 2016). However, with the adoption of diversified organic systems, Philippine smallholders noticed that many creatures started to reappear on their farms, returning important sources of protein to rural households (Mendoza, 2004). Nitrogen-fixing legumes, vegetables, root crops, and fruit trees are now planted, biological (nontoxic) fertilizers and pesticides are made using on-farm resources, and livestock (e.g., chickens and ducks) are integrated into the farming system (Interview 4, 2016). Farmers are planting and managing wild forest tree species, such as *katmon* (*Dillenia philippinensis*) and *lipote* (*Syzygium polycephaloides*), which bear fruit that are used as a spice and to make wine, respectively (Interview 3, 2016). Through the diversification of crops, food security is augmented in the household and in the community (ibid.), and resilience is enhanced as farmers are no longer relying on one product as a source of livelihood, but many (Interview 2, 2016). MASIPAG organic rice farmers indeed reported higher incidences of crop, farm, and landscape diversity than their conventional neighbors (Heckelman et al., 2018). Further, production and landscape management practices also contribute to maintaining native tree species against state initiatives to plant nonnative tree species (Interview 3, 2016). To date, MASIPAG (2018a) has helped over 30,000 farmers located in 63 of the 81 provinces transition to diversified organic systems. However, organic farming remains marginal in the Philippines, occupying less than 2%[5] of the agricultural landscape (Willer and Lernoud, 2017).

An important feature of peasant resilience is agrobiodiversity, which is inextricable from the place-based knowledge to which traditional/indigenous crop varieties are derived (Cabell and Oelofse, 2012; Berkes and Ross, 2013). Through revitalizing traditional/indigenous rice varieties and promoting diversified organic agroecosystems, MASIPAG is improving farmer capacities to cultivate and manage agrobiodiversity in their local communities. By supporting communal farming and institutionalizing place-based knowledge, farmers learn to pass on their knowledge and technology to other farmers, as well as from generation to generation; thereby ensuring the "viability of nature vis-à-vis human interventions" (Roxas 2006, p. 7).

Discussion: Building diverse pathways to peasant resilience

The technological regime responsible for "modernizing" agriculture through developing and deploying Green Revolution technologies is now working to develop supposed drought-, flood-, and saline-tolerant transgenic seed varieties that are marketed as resilience-enhancing agricultural technologies or "climate-ready" crops (Medina, 2012; Ismail et al., 2013). Mercer et al. (2012) and others suggest that the implementation of this "transgenic adaptation strategy" could displace a diversity of existing landraces that may possess the best capacity to survive climatic fluctuations in the long term due to high levels of genetic variation that is already tightly coupled with environmental variation (Halpert and Chappell, 2017).

Thompson and Scoones (2009, p. 386) attribute the "modernist project's" failure to provide sustainable outcomes to the tendency for conventional agricultural science to neglect the dynamic nature of agri-food systems and the complex ecological, economic, and social processes in which they are embedded. In problematizing responses to the climate crisis, researchers are calling for transformative change, highlighting "the need and opportunities for integrative responses" to address the "regional differences, social inequities and uneven capacities and drivers of global social-environmental changes" (Intergovernmental Panel on Climate Change Report, 2018, pp. 7–9; also see Pimbert, 2017). For many agri-food system researchers, developing climate change interventions

5. This number only captures certified organic or in conversion to certified organic. Many more farmers may be using organic practices but are not certified and therefore are not accounted for in official statistics.

requires a perspective that recognizes the coevolution of social and natural systems and cultivates people–place relationships that are dynamic, interdependent, irreducible, and unpredictable (Vandermeer, 2011; Blann and Light, 2018). Such interventions are contingent upon the involvement of citizens, farmers, indigenous, and rural people (Thompson and Scoones, 2009; Anderson et al., 2019), challenging conventional processes for knowledge construction that privilege "expert" knowledge associated with research institutions. Instead, they advocate for a transdisciplinary approach that includes experiential, local, and indigenous knowledge (Méndez et al., 2013).

Consistent with our analytical framework (see **Figure 1a–c**), these expressions of problem-solving through self-organization, collaboration, social learning, local resource generation, and agroecological management practices are vital themes across much of the resilience literature for their potential to address socioecological vulnerability (Magis, 2010; Cabell and Oelofse, 2012; Berkes and Ross, 2013). The MASIPAG case provides an example of the multiscalar and multidimensional effects of polycentric food sovereignty initiatives on the Philippine agricultural sector. MASIPAG works to ensure farmers have rights to seeds, land, and agrobiodiversity. The network builds capacities and mechanisms for farmers to directly engage in research, politics, and the social movements to protect the viability and sustainability of their livelihoods. MASIPAG members are able to collectively organize strategies, rallies, and campaigns consistent with locally identified needs, as well as align local mobilizations to national and international campaigns—all of which builds their capacity to address the adverse socioeconomic conditions contributing to their vulnerability. For many Negrense peasants, the campaign for food sovereignty and the adoption of diversified organic agriculture is inextricably tied to the historical and ongoing struggle for agrarian reform, sustainable livelihoods, food security, and social equity in the region—all of which impact their capacities for resilience building. MASIPAG enabled Negrense peasants to sever their dependencies on costly external inputs, making them less susceptible to the perpetual debt that forces conventional farmers to lease or sell their land. Since the arrival of MASIPAG in Negros, members have also organized their own associations, banded together to form larger federations, and have collectively helped train other farmers on the MASIPAG agricultural development approach (Oram, 2003).

MASIPAG's effectiveness lies in its bottom-up approach to agricultural research (Oram, 2003), as well as its ability to engage in development at the community level, a level that is often neglected by state initiatives (Olano, 1993). Unlike development planners who make policies based on laboratory research that is limited by strictly controlled conditions that are not reflective of actual field situations, MASIPAG directly conducts its research in the affected areas, resulting in the development of technologies that are area-specific and more responsive to community needs (ibid.). In this way, the network exhibits cultural sensitivity (Medina, 2002) and the necessary flexibility to adapt to local cultural, economic, and agroecological conditions (Oram, 2003). The local development and free exchange of seeds not only assures that locally adapted agricultural resources are shared across communities, but it also promotes a conception of seeds as "community property." Consistent with Ostrom's concept of the "commons," MASIPAG represents an effort being made in the Philippines to return the management of agricultural resources to agrarian communities. In this way, the network "seeks to reverse the damage inflicted by decades of government promotion of the Green Revolution" (Roxas, 2006, p. 13), including the treatment of farmers as passive recipients of environmentally damaging and costly external inputs (Oram, 2003). By building the capacity of farmers to assert their own knowledge and be their own advocates, as well as develop their own agricultural technologies and innovations, MASIPAG is helping farmers to address the root causes of their vulnerability.

Despite its achievements, MASIPAG faces a number of constraints and barriers. The political climate continues to be dangerous for peasants and community development workers located in rural sectors in the Philippines, creating obstacles for organizing and working on development issues in rural communities.

Second, there remains a lack of resources and capital directed toward smallholders to support the transition from conventional to diversified organic agricultural (or agroecological) systems—systems that MASIPAG has seen improve the resilience of its members. But smallholders are expected to endure the costs, making the transition to organic exceptionally difficult for those who have incurred debts as conventional farmers (Interview 12, 2016; Interview 13, 2016). Complicating matters is the role of religious organizations in the network. MASIPAG's partnership with the Catholic Church, for instance, may create membership barriers for non-Catholic farmers (Oram, 2003). Diversifying religious affiliations as well as retaining secular support for such polycentric food sovereignty development efforts could help ensure that non-Catholic farmers, for example, are not excluded from development efforts.

Third, land access and tenurial security remain prominent concerns shared among Philippine peasants and have been identified as fundamental to sustainable farming and resilience building (Focus Group 1, 2016; Focus Group 2, 2016). This is because, according to the MASIPAG National Coordinator,

> In order for farmers to really become resilient against climate change they have to implement diversified integrated farming systems. But if you want to implement diversified integrated farming systems, you have to have control over your land. (personal communication, December 15, 2016)

Therefore, interventions aimed at building smallholder resilience must address barriers to land access and tenurial security, especially in the developing world where land conflicts are prevalent. Although MASIPAG actively engages in demonstrations and advocacies for genuine land reform in the Philippines, it has limited political power to

ensure the implementation of land reform laws as this remains the jurisdiction of the state.

Finally, scaling out diversified organic (or agroecological) systems and improving farmer capacities for building resilience "will not be possible if the institutional machinery continues to favor industrial agribusiness and Green Revolution technology with subsidies, credits, extension programs and the whole gamut of incentives that have helped the rural development paradigm to expand over the past 50 years" (Giraldo and Rosset, 2018, p. 559). Just as governments, international aid agencies, and the agricultural knowledge regime subsidized and facilitated the transition to conventional farming, substantive public investment and effort is needed to facilitate the shift to more sustainable and resilient agroecosystems (Broad and Cavanagh, 2012). Also, institutional scientists need to create more opportunities for farmers to direct research and interventions (Hart et al., 2015), as in the case with MASIPAG scientists and their role in supporting farmer efforts to (re)generate place-based agricultural knowledge and innovation.

MASIPAG represents a collective of resource-poor farmers that occupy the periphery of agricultural development yet play a central role in agrobiodiversity conservation in the Philippines (Medina, 2004). Through their lived experiences and daily activities, MASIPAG farmers are revitalizing coevolutionary socioecological processes that are inextricably linked to agrobiodiversity. Local institutions have emerged, such as the nearly 200 local seed banks and trial farms, and the revitalization of place-based knowledge and *bayanihan* (communal labor)—all responsible for the in situ conservation of over 2,000 indigenous/traditional rice varieties across the Philippines. Beyond the development of indigenous/traditional seeds and place-based agricultural knowledge and innovation, MASIPAG's engagements have the potential to regenerate a diversity of rituals, songs, daily interactions, and cultures that serve to reembed culture in the land and revitalize the "way of life" of agrarian communities (see Ong'wen and Wright, 2007). By revitalizing agrobiodiversity, MASIPAG is not only enhancing peasant resilience but also ensuring the availability of natural resources in the future, an outcome that Sievers-Glotzbach (2014) describes as "intergenerational environmental justice."

Conclusion

The MASIPAG polycentric food sovereignty development approach represents a drastic turn from the Green Revolution model, one that is integrative, people-centered, and based on transdisciplinary synthesis, or what Thompson and Scoones (2009) refer to as a "holistic stream" of science. The network explicitly and directly addresses the root causes of peasant vulnerability, accounting for historical legacies and persisting inequities, and working toward reclaiming farmer rights and control over agricultural resources across scales. Through its promotion of diversified organic (or agroecological) farming systems and farmer developed technologies and innovations, its attention to household and community food security, and ability to organize politically to advance smallholder interests at local, national, and international scales, MASIPAG is achieving the kind of structural changes needed to pursue appropriate, economically, environmental, and socially sustainable development.

MASIPAG is not alone. Across the globe, civil society, peasant organizations, and multilateral institutions have all worked toward democratizing the food system, which has often involved recognizing the role of smallholders in sustainable development, including their associated knowledge, and promoting community-based approaches to development that are participatory and work toward equity, social responsibility, and enhancing farmers' rights (Desmarais, 2007; Van der Ploeg, 2008; Wittman et al., 2010; Pimbert, 2017). The fundamental thread connecting these people-centered bottom-up approaches to development is the recognition that the agricultural problems of today are more political than technical (Rivera-Ferre et al., 2013). Hence, achieving resilience in the food system will require efforts to counter the political and economic mechanisms that are facilitating the global production of an increasingly narrow set of crops. These strategies include sourcing food from multiple scales, diverse markets, as well as supporting polycentric loci of decision making (Schipanski et al., 2016). To this end, a polycentric food sovereignty development approach serves as an opposing force to the trend toward centralization and homogenization of agriculture and has the proven potential to generate broadly accessible and diverse pathways for resource-poor smallholders to build climate resilience.

Data accessibility statement

The focus group, key informant interview, and semistructured farmer interview guides used in this research are available in supplementary material. Transcripts of focus groups and interviews are not made publicly available to protect participant confidentiality. Research was conducted under UBC's Behavioural Research Ethics Board (UBC BREB Number: H16-00900).

Supplemental files

The supplemental files for this article can be found as follows:

Text S1. Docx

Acknowledgments

The authors are grateful to participating farmers and leaders at *Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura* for their collaboration on this work, *Paghida-et sa Kauswagan* Development Group for research assistance, the Philippine Rice Research Institute in Negros for sharing insights, and the Food and Agriculture Organization-Self-Evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP) team for technical support in adapting the SHARP survey tool (version 1.9.0) for the Philippine context. Thanks also to Nora Angeles, Sean Smukler, and Glenn Stone for feedback on earlier versions of this article.

Funding

This work was funded by the Bullitt Environmental Fellowship, Mary and David Macaree Fellowship, UBC Public Scholars Initiative, Liu Scholars' Bottom Billion Award, Walter Jeffrey Memorial Fellowship, and the Richard Claxton Palmer Scholarship.

Competing interests

The authors have no conflicts of interest to declare.

Author contributions

Contributed to conception and design: AH, MJC, HW.

Contributed to acquisition of data: AH.

Contributed to analysis and interpretation of data: AH, MJC, HW.

Drafted and/or revised this article: AH, MJC, HW.

Approved the submitted version for publication: AH, MJC, HW.

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How to cite this article: Heckelman, A, Chappell, MJ, Wittman, H. 2022. A polycentric food sovereignty approach to climate resilience in the Philippines. *Elementa: Science of the Anthropocene* 10(1). DOI: https://doi.org/10.1525/elementa.2020.00033

Domain Editor-in-Chief: Alastair Iles, University of California, Berkeley, CA, USA

Knowledge Domain: Sustainability Transitions

Published: January 7, 2022 **Accepted:** November 6, 2021 **Submitted:** March 22, 2020

ELEMENTA Science of the Anthropocene

Elem Sci Anth is a peer-reviewed open access journal published by University of California Press.

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