

Global Change and Socioecological Interactions

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Socioecological Interactions amid Global Change

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Abstract

How a group relates to agrobiodiversity differs greatly within and between user groups. This chapter explores the socioecological changes that are driven globally by migration and urbanization, agrarian change (de- and reagrarianization), market pressures, and climate. It introduces the concepts of *intentionality by default* and *conscious intentionality* to explore how two archetypical smallholder farmer groups, traditional/Indigenous and neoagrarian farmers, use agrobiodiversity. These groups represent the extremes of smallholder farmers for whom agrobiodiversity plays an important role in their lives. To increase understanding of how the use of agrobiodiversity can vary in response to the effects of global change, knowledge gaps and entry points are identified for different groups of actors (e.g., smallholder farmers, public breeders, private companies, NGOs, international organizations, and governments).

Current drivers of global change affect these groups on a local level in unique ways, and responding to them provides the potential for novel initiatives that can form the basis for a compelling overarching narrative to support the use of agrobiodiversity in multiple ways. Such a narrative would connect the wide diversity of agrobiodiversity users and provide a critical mass to reinforce ongoing efforts to find solutions to the challenges of global change. Important gaps in our knowledge remain to be considered by this new, integrative science, including the way in which participation and empowerment of vulnerable groups will be incorporated.

Group photos (top left to bottom right) Conny Almekinders, Glenn Davis Stone, Jan Hanspach, Vijesh Krishna, Marci Baranski, Karl Zimmerer, Julian Ramirez-Villegas, Conny Almekinders, Jacob van Etten, Judith Carney, Julian Ramirez-Villegas, Karl Zimmerer, Vijesh Krishna, Glenn Davis Stone, Marci Baranski, Judith Carney, Jan Hanspach, Conny Almekinders, Jacob van Etten, Glenn Davis Stone, Karl Zimmerer

Agrobiodiversity Functions, Values, and Interests

In whose interest is it to utilize or own agrobiodiversity? Tremendous profits have been made through industrialized agriculture, which tends to be low in agrobiodiversity and associated functions (e.g., resilience, food security, cultural identity). Policies associated with the industrialized agricultural sector tend to promote a regime of low functional agrobiodiversity, and expansion of this sector has pushed many farmers into production regimes with intended and unintended negative consequences for agrobiodiversity (IPES-Food 2017). A range of alternative production systems with different values and functions is currently emerging, also with intended and unintended consequences for agrobiodiversity. As a result, we see different groups and organizations with different value systems using agrobiodiversity in a variety of ways. While the relations of these actors to agrobiodiversity vary, they are all subject to global socioecological changes (Zimmerer 2010) that are driven by migration and urbanization, agrarian change (de- and reagrarization), market pressures as well as climate change (see Chapters 7 and 8). The varied responses of diverse actors to these changes involve and affect their use and relation to agrobiodiversity, including different types and levels of agrobiodiversity. The ways by which agrobiodiversity functions change in the face of interacting global trends that need to be understood if we are to identify opportunities and threats to agrobiodiversity.

Agrobiodiversity has a wide variety of functions through which it contributes to human well-being (e.g., income provision, food security, resilience, absorption, and adaptation capacity), and the empirical relationship between agrobiodiversity and livelihoods is complex. Three types of values are associated with agrobiodiversity and can be distinguished on the basis of comparison with biodiversity: intrinsic, instrumental, and relational values (Chan et al. 2016; Ives and Kendal 2014). As in biodiversity more broadly, the intrinsic values of agrobiodiversity point to the value of it in its own right. Assigning intrinsic values to agrobiodiversity might seem less obvious, but the consideration is especially relevant for the conservation of associated biodiversity that supports agroecosystems. Instrumental values place emphasis on the utilitarian nature of agrobiodiversity and relate, for example, the contribution of agrobiodiversity to the production of food, fiber, fodder, and fuel (Almekinders et al. 1995). Relational values underpin the nuanced associations, interactions, and responsibilities that people can have with agrobiodiversity and describe the contribution of agrobiodiversity to personal and cultural identity.

In this chapter, we discuss how agrobiodiversity can be better used by diverse groups and organizations in newly emerging situations to contribute to improved human well-being in the context of different drivers and multiple pathways of change (Figure 6.1). We address sustainability and social justice issues across a wide range of the social, ecological, and agronomic sciences. In addition, we review institutional approaches, policy making, analysis, and

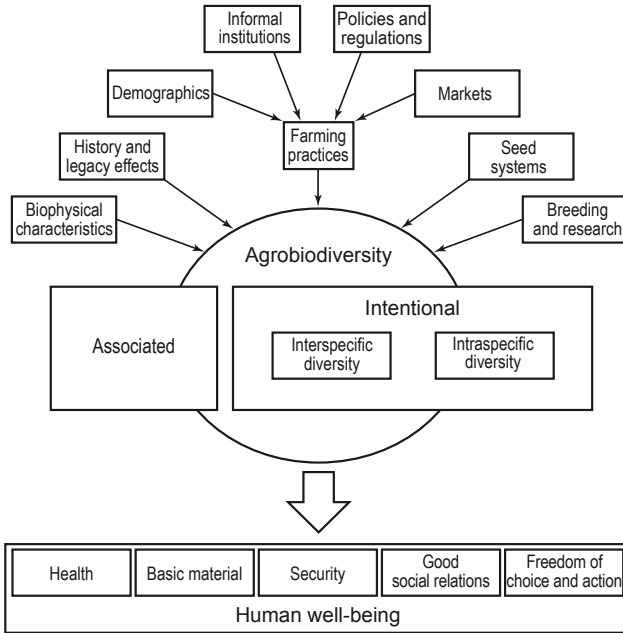


Figure 6.1 Conceptualization of agrobiodiversity showing how multiple pathways and drivers collectively influence agrobiodiversity, with farming practices assuming a crucial role. In turn, agrobiodiversity contributes directly and indirectly to different aspects of human well-being.

activism among the broadly defined public, which includes diverse civil society groups (Almekinders and de Boef 1999).

Archetypes of Agrobiodiversity Users

When identifying agrobiodiversity user groups (producers, breeders, consumers, and other stakeholders), one quickly discerns vast differences within and between groups (see also Chapter 8). Our focus here is primarily on farmers (i.e., smallholder producers, some extreme archetypes) as well as private and government organizations.

There is an almost endless variety of farmers, and how one defines the diverse types depends on the characteristics used to describe them. This variation is most evident among the world's estimated 2.2 billion smallholder farmers (Zimmerer et al. 2015). Defined as having an area of farmland that measures less than 2.0 hectares or that occupies the smallest quintile of farm size within

a country or region (Graeub et al. 2016; Lowder et al. 2016), smallholder farmers do not only farm, many work the land part-time as they are involved in nonfarm or off-farm income-generating activities. The actual composition of smallholders is highly heterogeneous; socioeconomic, agricultural, environmental, and cultural characteristics vary widely within this group (Cohn et al. 2017; Zimmerer et al. 2018). While millions of smallholders reside in the Global North, including some who farm as a hobby, most are poor farmers located in the Global South who experience food insecurity and are vulnerable to trends and shocks in markets and their natural environment. Typically, they must combine agricultural strategies for market production with those for subsistence. Under diverse circumstances and rationales (explained below), smallholders maintain, produce, and consume the largest share of the world's *in situ* agrobiodiversity. In other words, even though they exist on the margins of the global economy, smallholder farmers disproportionately rely on agrobiodiversity. Likewise, relative to other farmers, agrobiodiversity tends to be disproportionately important to smallholders.

Two subsets of smallholders deserve being considered because of the agrobiodiversity they maintain and the relation they have with it, and the extremes they represent in the diverse gamut of smallholder farmers. The first group is comprised of *Indigenous* or *traditional farmers* (e.g., of the Americas, Africa, South Asia, Australia)—those who have managed to remain in their territories over centuries, if not millennia, despite sociopolitical change. This group is highly diverse and includes, for example, descendants of escaped slaves (e.g., maroons and *quilombolas* in South America) who practice an agrarian creolization, shaped by their African heritage and contact with New World native peoples (Carney and Rosomoff 2009). A distinguishing characteristic of this group as a whole is their cosmic worldview of nature, of which agrobiodiversity constitutes a specific part. The second group is made up of *neoagrarian farmers*—those who have established operations in recent decades in North America, Europe, and other regions. This group shares a philosophical rejection of industrial agriculture and a commitment to reforming it through humane, sustainable, and biodiverse production methods. It is estimated that farms matching this description in North America number in the tens of thousands and are in particular on the rise near large urban areas in Ecuador, Brazil, and Spain (where they are referred to as *neo-rurales*). Neoagrarian farmers aim to capture a premium by marketing farm products through short commodity chains. In this sense, they differ from most smallholder farmers in the Global South, who must frequently juggle subsistence with market production. Neoagrarian farmers stand in stark contrast to most of the world's 2.2 billion smallholders in terms of their (a) philosophical commitment to agricultural reform, balancing economic and ecological sustainability, and so forth; (b) dispersal across agricultural landscapes; and (c) organization in networks for exchange of information, seeds, and experiences (i.e., through seed saver groups).

Organizations also vary in their relation to agrobiodiversity. Interesting examples can be derived from plant breeding institutions. Although the public breeding sector tends to be lumped into one profile, Indian wheat breeders, for example, hold a plurality of views about breeding for broad versus local conditions (Baranski 2015a, b). However, the institutional structure of Indian wheat science (which is primarily public) allows for only a single view, focused on broad adaptation of wheat varieties. This view is mediated through a series of features, including both formal and informal incentives, policy (varietal testing and release system), and an institutional culture that values the widely adapted varieties of wheat. Thus, the wheat breeding system in India is implicitly biased toward less varietal diversity.

During the Green Revolution, tensions over the use of agrobiodiversity also existed among plant breeders in Mexico, in terms of the positioning and power of public sector versus private sector breeders (Bebbington and Carney 1990; Harwood 2009; Jennings 1988). Breeders who worked to strengthen the national plant breeding capacity in the Global South at the International Maize and Wheat Improvement Center (CIMMYT) offices were advocates of poor farmers, and they worked to develop breeding strategies relevant to them. They were not happy about policy changes induced by the U.S. government, which reduced public funding for research and weakened the capacity of national seed research. Yet there was little they could do to counter the concentration of seed development by corporations that relied on CIMMYT gene bank stock for developing their commercial hybrid varieties. Seed companies like Pioneer (subsequently purchased by DuPont) became increasingly in charge of setting research priorities that favored their own commercial goals. Later, many breeders also opposed CIMMYT's burgeoning repositioning of itself in terms of transgenic seed development.

Totally different breeding institutions are represented by farmers and their local breeding customs and networks. Take, for instance, smallholder rice growers in Sierra Leone who had selected and developed the hybrids of two rice species found in their fields, *Oryza glaberrima* and *Oryza sativa*, long before the Africa Rice Center formally developed and released Nerica rice in the region (Mouser et al. 2012). Examples of intermediate institutional forms of breeding include the participatory potato breeding programs with both conventional and organic farmers in the Netherlands working with conventional commercial companies and supported or mediated by semipublic research organizations (Almekinders et al. 2014).

It is important to keep the heterogeneity of views and values in breeding institutions in mind. There is increasing awareness among breeders as to the importance of public goods and the need to serve smallholder farmers. In many countries, public breeding efforts are progressing from a reduction of diversity to an increased use of diversity in response to smallholder demands, climate change, and production system rationales (Dawson et al. 2016a; Murphy et al. 2016). However, public breeding programs are on the decline. Currently, there

are two prevailing paradigms: the productivist and alternative models. We anticipate that other breeding institutions and approaches will gain in importance, further diversifying this spectrum in the future. In this respect it is encouraging to note that a large number of public–private partnerships are emerging to develop and disseminate varietal technologies even in the major cash crops like maize.

Intentionality and the Use of Agrobiodiversity

Among smallholder farmers, intentionality around the use of agrobiodiversity varies greatly. It represents a spectrum that ranges between and combines what we call *intentionality by default* and *conscious intentionality*. Smallholders are highly aware and knowledgeable about agrobiodiversity. Each year they choose to work with certain varieties and species in crop fields and landscapes. In other words, significant skills and management inform their planting strategies. Still, their rationale for producing and consuming agrobiodiversity varies and is often multifaceted:

- Hardy crops may be needed in marginal, stress-prone growing environments to reduce the risk of crop loss (e.g., in response to extreme variation associated with climate change).
- Culturally familiar foodways may be the goal.
- Accessing seed at lower cost through seed saving and the informal seed sector may be a key motivation.

For these reasons, smallholders do not typically choose agrobiodiversity for its own sake but rather because it fits with underlying farming rationales or trait preferences (e.g., Almekinders et al. 1995). This type of agrobiodiversity management can combine one or more functions and is what we term “intentionality by default.”

The functions of agrobiodiversity underlying “intentionality by default” are important when we consider the relationship with food security and income in smallholders, Indigenous farmers, and others whose land use and rights are based on collective or group identity and historical land ownership (e.g., the *ejidos* in Mexico). For instance, in the Amazon areas of Brazil, the production systems of many maroon (*quilombo*) communities are quite diverse, characterized by a mixture of seed, tuber, and tree crops. Because many men migrate to the gold fields of the Guianas, and children are in school, the agrobiodiversity-rich plots are often managed by the women. These plots provide maroon communities income benefits and enhance household food security. Cash earnings from the market can be reinvested into the farm to support continuous growth (in crops and agrobiodiversity) (Steward and Lima 2017). In other smallholder areas in the Global South, the poorest farmers may be forced to reduce agrobiodiversity by abandoning tastier and more nutritious

crops in favor of higher-yielding varieties. A typical smallholder in Western Kenya may use more agrobiodiversity (number of crop/animal species) as she farms, but it may not bring tangible benefits, whereas an Indonesian smallholder may realize higher income benefits using less agrobiodiversity than the Kenya farmer (Sibhatu et al. 2015). Still, in parts of sub-Saharan Africa, the rural poor are deeply reliant on agrobiodiversity. In West Africa, for instance, farmers (often women) harvest semiwild yams and collect wild foods (notably vegetable greens and fruits) to supplement their diets. Such gathering strategies may involve active tending of wild resources and habitat manipulation to encourage wild plant progeny for future collection. It may also encourage ongoing selection, domestication, and crop evolution. In the Brazilian Amazon, peasant and Afro-descendant farmers recognize the fertility of dark earth (*terra preta*) soils created from cumulative swiddens by pre-Columbian Amerindians and they manage them differently to take advantage and manage the soil fertility of these plots. These plots serve as genetic reservoirs for specific cultivars and allow for agrobiodiversity maintenance (Glaser et al. 2003; Junqueira et al. 2016).

Many examples exist to illustrate the complex relationship between the use of agrobiodiversity and its possible benefits to the user: agrobiodiversity emerges out of processes associated with both (multi)functional and agrobiodiversity-conscious intentionality. These processes, however, may not always be present. For example, in most commercial agriculture, private seed companies produce an inadvertent increase in agrobiodiversity, based on number of varieties as well as a low functional agrobiodiversity due to the similar genetics of the varieties. Similarly, a farmer in India may plant different hybrid cotton varieties and brands to compare crop traits, but the effect on agrobiodiversity is tiny or even zero when the different brands are actually the same varieties (Stone 2016). The neoagrarian archetype occupies a highly distinct and limited portion of the smallholder spectrum (see Chapter 8): the neoagrarian tends to exercise more agrobiodiversity conscious intentionality. By making it an explicit part of their farming philosophy, neoagrarians are often focused on the marketing of agrobiodiversity while emphasizing the intrinsic value of it and prioritizing ecological sustainability over the profit motive. They are smallholders whose farm operations are based on a “moral economy” of capturing a market premium for farm methods that promote agrobiodiversity, whether marketed explicitly as such or as an implied “credence quality” to their clients (Darby and Karni 1973). For some of these producers, the use of heirloom varieties and the exchange of seeds is a core element of their philosophy. However, preliminary investigation of seed diversity employed by many of these small-scale “consciously intentional” growers in the United States indicates that seed sourcing is restricted to purchases from a limited number of companies. These sources are often presented as relatively small and local in their company histories; still, many sell nationally and receive a portion of their seed stock from large corporate conglomerates (e.g.,

Seminis). As a result, seeds used by neoagrarian farmers are not very different across the United States. Similar concerns pertain to the animals raised on these smallholder operations. For Joel Salatin, whose Polyface Farm is famous in the neoagrarian movement (although atypical in that Salatin actually grew up on the farm), the biggest moneymaker is called “Salad Bar Beef,” in reference to Polyface’s biodiverse pastures (Pollan 2006). While Salatin’s pastures may be biodiverse, his farm animals are not: his chickens enjoy a diverse pasture diet but the flock is uniform Cornish Cross, the classic industrial bird. In other words, a local food movement is not necessarily a local seed movement or one that boosts agrobiodiversity. The relationship between the practices of these neoagrarian farmers and their belief system, and how they use agrobiodiversity, gives rise to interesting new research questions. Does the conscious intentionality of farmers, breeders, collectors, and seed exchangers, apart from providing good stories, really contribute to desirable agrobiodiversity outcomes?

The relationship between agrobiodiversity and intentionality is variable. It occurs in a socioecological context, mediated by farmers, organizations, values, and power relations. Intentionality is not a dichotomy; it operates along a continuum between and combines “intentionality by default” and “conscious intentionality.” Within a particular smallholder system there are different degrees of intentionality that vary from place to place and are expressed in diverse ways along a farmscape. Among neoagrarian farming units in the southern United States, for instance, agrobiodiversity may not be so much evident at the scale unit of an individual field but rather across a farming landscape: smallholders may grow and raise different species but share a commitment to organic, sustainable, and diverse foodsheds. For this reason, the analysis of agrobiodiversity in temperate, smallholder zones demands a multiscale approach—one that examines diversity at the field, farm, landscape, and regional levels. Neoagrarian farms may appear initially as a patchwork of alternative cultivation, existing in the interstices of a conventional industrial agricultural landscape. In tropical smallholder contexts, analysis of use of agrobiodiversity can require an entirely different approach since rural poverty is often associated with functional use of agrobiodiversity. For example, inorganic pesticides and herbicides being unaffordable, polycultural production with less insect predation and crop loss in year-round growing conditions continues to be more attractive. In such systems, in some cases, off-farm income opportunities may prove decisive for being able or choosing to maintain local knowledge of agrobiodiversity and shaping “intentionality by default.” Certainly, this discussion of intentionality through two contrasting temperate and tropical zones underscores substantive differences in how distinct smallholder systems experience, and respond to, exogenous global agricultural trends. The institutions that mediate responses locally are thus situated.

The Intersection of Agrobiodiversity Use with Global Changes

Socioeconomic Trajectories and Scientific Models

Global trends such as climate change, migration, commodity market integration, population growth, and urbanization/deagrarianization exert highly varied impacts on the different archetypes of agrobiodiversity user groups, especially farmers (for further discussion, see Chapters 7 and 8; Zimmerer 2010). These differentiated impacts also modify the policy and action context of breeders, nongovernmental organizations (NGOs), and governments. In addition, health and nutrition needs (such as those related to noncommunicable diseases) provide important novel impacts. Many hold that climate change constitutes the most influential driver of global change. Climate change policy targets primarily food security through diversification, genetic adaptation of main crops, and different crop management practices (different planting dates, irrigation). Chapter 7 of the IPCC Fifth Assessment Report (Porter et al. 2014) comprehensively assesses the available literature on climate change impacts and adaptation for food production systems.

Although there is general consensus that climate change will reduce agricultural productivity globally, particularly across the Tropics (Challinor et al. 2014; Porter et al. 2014), biases are clear in the available literature. Specifically, the number of citations for livestock and fisheries is roughly one sixth of the number of citations for crops (Campbell et al. 2016). In addition, the types of adaptation strategies assessed in the climate change impacts and adaptation literature is biased toward agronomic management (e.g., irrigation and fertilizer optimization, varietal substitution, shifts in planting dates), whereas agrobiodiversity-related adaptation strategies are relatively poorly investigated (e.g., crop and varietal diversification, agroforestry, silvopastoral systems) (Porter et al. 2014).

It is not clear how farming systems will change and adapt to global changes. Farmers have many ways of dealing with climate change on their farm, and creativity is essential. Scientists, by contrast, tend to look for simple solutions that can be generalized across populations. For example, during the early Cold War era, U.S. national security interests framed population growth and communism as the problem, and promoted yield increases per acre through transferable technologies as the solution; this led to the development of the global research institution, the Consultative Group for International Agricultural Research (CGIAR), and massive investments in the agricultural research that spawned the Green Revolution (Cullather 2010).

Currently, global socioeconomic scenarios use expected population growth and socioeconomic development to characterize future trajectories (Moss et al. 2010; van Vuuren et al. 2014). The results point to different challenges, in terms of adaptation and mitigation, both globally and regionally (O'Neill et al. 2014; van Vuuren et al. 2014). While mitigation challenges

result from the need to keep greenhouse gas emissions at a specified level, adaptation challenges emerge from the warming that results from greenhouse gas emissions and concentrations. By definition, therefore, trade-offs and synergies exist between adaptation and mitigation (Lipper et al. 2014; Rogelj et al. 2016). Locally, however, adaptation and mitigation challenges are varied. For instance, projected reductions in the yields of maize, bean, and napier grass in the mixed crop–livestock systems in southern Kenya may imply modification of farm composition (e.g., number of livestock units) that are needed to cope with changes (Claessens et al. 2012). A different strategy would be needed for crop or livestock systems in other parts of the world (cf. Nendel et al. 2014).

Identification of Knowledge Gaps and Entry Points

Global changes create new situations that affect people’s use of resources, their values and identities and, consequently, their production and consumption of food and use of agrobiodiversity. To be able to identify knowledge gaps and develop narratives that can help lead to better interventions, we assessed a series of agrobiodiversity-related characteristics for different user groups. We decided to focus on smallholder farmers, public breeders, private companies, national and international NGOs, and governments, which are discussed below. For smallholder farmers, we identified the archetypical neoagrarians and Indigenous farmers as being quite distinct from the large majority of smallholder farmers in this world. We based our exercise on the following questions:

- How does the group use agrobiodiversity (differently) in response to climate change and market integration?
- How can the use of agrobiodiversity by the group be characterized in terms of vision, values, and intentionality?
- What are the opportunities or entry points to support agrobiodiversity use for the group?

The results are summarized in Appendix 6.1 and discussed below.

Smallholder Farmers

Cuba provides a good example of how a political change created space for agroecological production and the potential for enhanced agrobiodiversity use. Creativity was needed to develop urban agriculture in Cuba (Chapter 8). In addition, global movements in gastronomy (taste and flavor) provide important incentives for farmers to produce agrobiodiversity, although this is only relevant to a relatively small number of smallholder farmers. Similarly, neoagrarian farmers and specific farmer groups are generating interesting new pathways. Still, such alternatives leave out the majority of the 2.2 billion smallholder farmers, who by themselves form a highly varied group in terms of

vision, value, and intentionality. The future of this group, which includes many vulnerable populations, particularly in terms of how they will cope with global change, is unclear. Will smallholders need to leave the farm? If so, why? Will they be driven by other sources of income? What are the gender implications of rural-to-urban migration for maintaining agrobiodiversity? Will there be opportunities to use agrobiodiversity in novel ways, such as selling and shipping blue maize from Oaxaca to New York? What can the Fair Trade Movement offer? In addition, how can current examples of innovative agricultural production and marketing become more relevant for the large majority of smallholder farmers?

Indigenous and Neoagrarian Farmers

Although they are quite distinct, Indigenous Peoples and neoagrarian farmers both use agrobiodiversity more intentionally, compared to the rest of the aggregated but heterogeneous group of 2.2 billion smallholders. Nonetheless, how they use agrobiodiversity is also quite distinct. This diverse group of Indigenous Peoples holds the bulk of the globe's agrobiodiversity. For many Indigenous People, agrobiodiversity is an integral part of their being: it is embedded in their worldview and an element of what constitutes quality of life ("the living well movement," which has emerged in the Bolivian Andes). Although our knowledge is limited on how global drivers currently affect the livelihoods and agrobiodiversity use of Indigenous and traditional farmers, their capacity to sustain ongoing evolution has been well documented (e.g., Bonnave et al. 2015; Thomann et al. 2015; Vigouroux et al. 2011b): selection for new diversity has enabled adaption to new circumstances.

As commented above, the actual agrobiodiversity deployed by neoagrarian farmers may be limited and far less than that of Indigenous and traditional farmers. However, their practices and views represent interesting new opportunities. Many neoagrarian farmers acknowledge agrobiodiversity as a unique "credence quality" of their produce, which links to its intrinsic value and agrobiodiversity-conscious intentionality. More commonly, agrobiodiversity is an assumed (rather than explicitly advertised) credence quality, since pasturing livestock and agroecological practices generally require conditions for biodiversity integration. Two key issues emerge regarding the impact of neoagrarians on agrobiodiversity: (a) the type and quality of agrobiodiversity promoted on neoagrarian farms, and (b) the scale of the neoagrarian impact on agrobiodiversity. There are reasons to suspect that neoagrarian farms tend to be hotspots of biodiversity, but this is so far woefully understudied. Despite the explosive growth of farmers' markets and other channels, neoagrarian farms only account for a tiny proportion of U.S. and E.U. farmland. No solid measure of the acreage is available, but the U.S. Department of Agriculture provides a rough indication of the scale of neoagrarian farming: "144,530 farms sold USD 1.3 billion in fresh edible agricultural products directly to consumers in

2012” (USDA 2014:1). As this sector continues to grow, empirical research on its economic and ecological impacts will be necessary.

Certification needs to be mentioned as an opportunity to foster the value of agrobiodiversity produce. The process could be supported by an organization similar to the International Federation of Organic Agriculture Movements. On the other hand, people may be wary of yet another certification measure. Alternative forms of providing trust and legitimacy on short chains and direct consumer–producer relations should be explored.

Public Breeders

There is, when it comes to national agricultural programs and as discussed above, ample diversity in the vision, values, and intentionality among public breeders. Some public breeders have more freedom to engage explicitly with agrobiodiversity than others, but the goals of government funding may vary. We discern differences between modernized breeders and regenerational breeding: the former is more oriented to privatizing the benefits of the program and, consequently, in prioritizing the instrumental use value of agrobiodiversity. Public breeding programs as run by the CGIAR research centers have a logic of their own. With their dependency on fickle and unpredictable donor support, their goal is to fight hunger and poverty.

With the recent focus on breeding for climate change resilience, there are opportunities to reconceptualize the relationship between plant breeding and agrobiodiversity. For example, participatory and evolutionary plant breeding allows more user testing and engagement in the breeding process, which can lead to better adapted varieties (or mixtures) and quicker varietal turnover, both of which are crucial for climate adaptation. Creating a shift in the public plant breeding culture toward participatory, evolutionary, and location-specific breeding requires shifts in incentives and institutional values. Climate change, however, offers an opportunity space for organizations to reorganize their goals, incentives, and challenges.

Private Companies

Food manufacturers, insurance companies, and seed companies have obvious interests in agrobiodiversity as it creates new profit making and alternative opportunities. Above we discussed the potential for novel public–private sector partnerships in developing varietal technologies (see section on Archetypes of Agrobiodiversity Users). When there is a market, seed companies use agrobiodiversity to promote new crops (e.g., teff in California, quinoa in the Global North). Climate change can also open up alternative production systems for commodity production (e.g., the wine industry in new areas in Australia). Agrobiodiversity may become of interest to insurance companies concerned with production risks. Furthermore, many companies

have established philanthropic organizations to finance research to support social responsibility and to create innovative opportunities (e.g., Monsanto and its carbon footprinting program). Since companies rely on data, and scientists may possess more comprehensive data, novel ways to support agrobiodiversity may be encouraged. Efforts to establish “sustainable sourcing” by multinationals may at times appear as “window dressing,” but such initiatives also offer opportunities for collaboration.

NGOs and International Organizations

NGOs can employ agrobiodiversity for food security, which includes aspects of food quality and malnutrition, for adaptation to and mitigation of climate change as well as in relation to changing market opportunities. Many of the agendas that social and environmental justice NGOs promote are complementary to agrobiodiversity (see Appendix 6.1). Agrobiodiversity links into food and seed sovereignty, as shown in the work of the Action Group on Erosion, Technology, and Concentration (ETC Group) and La Via Campesina. They could also become practically involved in delivery of seeds.

There are many opportunities to tailor an agrobiodiversity message to and via NGOs, but there is also a knowledge gap in the link between agrobiodiversity and environmental and social outcomes promoted by NGOs. Agrobiodiversity is often complex and location specific, making it difficult to study and draw universal conclusions about the relationship between agrobiodiversity and environmental and socioeconomic outcomes. Targeted research on the links between agrobiodiversity and livelihood outcomes (see Figure 6.1) can help produce useful knowledge for NGOs and allow them to focus their efforts on critical agrobiodiversity-related interventions.

Governments

There are different ways in which governments can employ and support the use of agrobiodiversity in the context of global changes. Decentralization of land-use decisions has been adopted by developing country governments for the last two decades. In Indonesia, for example, the decision-making processes involved in land use of community landscapes has been turned over to the local governments. Prior to this, customary or common (“adat”) lands were not recognized in Indonesia. On many occasions, this democratic decentralization has been found to have increased agrobiodiversity because local governments pay more attention to its constituents’ needs. The governments of Brazil and India have instituted seed repatriation programs as a response to climate change. Peru and Bolivia have engaged in systematic monitoring of landrace diversity. In Europe, seed collections are directly available to farmers. Through information and communication technology, there are many new ways in which

farmers can be given access to seeds and associated information. This does not, however, eliminate the need for farmers to experiment and adapt the provided seeds and information to their local conditions.

Global Drivers, Better Use of Agrobiodiversity, and Novel Institutional Arrangements

Different global drivers (e.g., climate change, population growth, urbanization and re- or deagrarianization and migration, market integration, and global market and food system transitions) generate new needs and create opportunities for better use of agrobiodiversity. Each driver requires a reconfiguration of the roles and linkages between groups of actors and organizations. The variation in values of breeders as well as among different groups of farmers and other agrobiodiversity users (e.g., governments, NGOs) raises the question of how these divergent archetypes of agrobiodiversity users, with their different values and uses, can be understood in relation to each other. In response, agrobiodiversity science can pursue three options:

1. Attempt to ignore this divergence by creating a “neutral” definition of agrobiodiversity.
2. Adhere to one particular set of beliefs about agrobiodiversity to the exclusion of others.
3. Try to explore how diverse definitions of agrobiodiversity systematically vary across different groups of people.

For us, the first option would be difficult or impossible to achieve and the second option fails to recognize the diversity in perspectives, even among scientists, and would thus be doomed to failure. The third option is attractive, as it provides an opening to reconcile differences that stand in the way of effective solutions.

A framework is required to analyze this variation in perceptions and their relations. One way to do this is by using ideas informed by grid-group cultural theory (for an introduction and review of this critique, see Tansey and O’Riordan 1999). This theory holds that people’s value systems are embedded in social relationships in ways that are relatively consistent and predictable. For example, people who form highly bonded social groups will tend to uphold value systems that reflect this by emphasizing group solidarity and by measuring behavior against this standard. Beliefs are not only relevant to interactions with other people, but also with nature. A highly bonded social group will tend to emphasize external dangers, including environmental ones, as these dangers resonate most with the challenge of maintaining the social boundary between the inside and outside world of the group. Grid-group cultural theory originally proposes four archetypes of institutional culture: hierarchy (or top-down), individualism (egocentric), and isolation (isolates) are advanced as unique, consistent patterns of social relationships and value systems in addition to bonded

groups (egalitarianism). In relation to agrobiodiversity, a gene bank, for example, needs an ordered structure with clear procedures; thus, a gene bank produces a hierarchical institutional culture based on an idea of agrobiodiversity as a classifiable set of entities. Entrepreneurs, on the other hand, tend to be embedded in a more individualistic institutional culture that is less concerned about producing shared and stable classifications, but views agrobiodiversity as a resource.

Different archetypes can be recognized in any social context, with varying degrees of divergence. What is of interest here is how the varied organizations that represent these different archetypes form stable institutional arrangements, which lead to more or less sustainable ways of using agrobiodiversity. Agrobiodiversity plays a role across these different organizational actors, who tend to have divergent views on what it exactly is and what role it plays, but need each other to sustain agrobiodiversity. To continue with the example, in order to obtain political support, gene banks need entrepreneurs to show the economic value of agrobiodiversity. In turn, entrepreneurs may rely on gene banks to introduce, for example, new variety or crop products. Although these actors' views on agrobiodiversity may conflict at times, shared understandings are needed if they are to collaborate.

Below, we explore the way each of these specific drivers of global change could lead to different opportunities for collaboration in the use of agrobiodiversity.

Climate Change

Climate change, as one of the principal drivers of global change, is responsible for negative impacts on the yields of agricultural systems on a global scale (Lobell et al. 2011; Tubiello et al. 2007). Initial projections a decade ago held that the worldwide yields of major crops would increase under conditions up to 2°C of global warming. More recent modeling estimates, however, now point to the probability of aggregate loss at this level of temperature increase unless significant adaptations are undertaken (Challinor et al. 2014). At the same time, biodiversity across a range of ecosystems is known to reduce the temporal variation of yield (Loreau et al. 2001). As a consequence, the biological diversity of agriculture and food systems is becoming a priority in the design of agroecological resilience to climate change (Altieri et al. 2015; Branca et al. 2013).

Specific insertions of agrobiodiversity into food production systems must be designed in response to the particular conditions of climate change. For example, the temporal diversification of medium-intensity production systems (e.g., crop species in rotational sequences) stabilizes yields under conditions of abnormal soil moisture (Gaudin et al. 2015). More generally, the modeling of crop yield under global climate change underscores the need for adaptations, including cultivar adjustments (i.e., new uses of existing varieties and the development of new varieties), that offer promising strategies for improved

crop yield with climate change uncertainty (Challinor et al. 2014; van Etten 2011). These adaptations will depend on the strategic use and insertion of crop biodiversity.

Climate change effects and the capacity for adaptive responses are, however, most commonly experienced at the level of fields, farms, and communities in conjunction with the processes associated with other major drivers, such as global socioeconomic integration through markets and trade. In other words, climate change impacts and adaptive capacity are rarely felt as isolated impacts (O'Brien and Leichenko 2000). This insight must now be developed to encourage agrobiodiversity in diverse socioecological contexts. The idea of archetypes, as introduced and treated above, can be employed in this regard. Certain groups within the large and heterogeneous category of 2.2 billion smallholders, for example, are likely to use agrobiodiversity within the combined context of climate change and the transition to part-time farming associated with global trends of expanded labor migration, the growth of peri-urban areas, and deagrarianization (but not complete depopulation) in remote rural areas.

Climate change and other drivers of socioecological change present an opportunity space for new institutional arrangements and agrobiodiversity strategies. For example, public plant breeding in India is typically a top-down enterprise; farmers are not involved in adapting or finishing new varieties due to the agricultural policies and incentives structures of public plant breeding in the nation. Similarly, the National Bureau of Plant Genetic Resources (NBPGR) in India did not initially distribute germplasm directly to farmers for testing until Bioversity International worked with NBPGR to distribute 21 varieties of wheat in a pilot program in northeastern India for climate change adaptation (Mathur 2013). This and other scientific exchanges between the global CG-center, Bioversity, India's national NBPGR, and gene bank managers from other countries has led to a cultural shift in NBPGR that is more open toward farmers having access to germplasm. This multiscalar institutional network opens opportunities for collaboration with private organizations, such as the Swaminathan Foundation, that promote agrobiodiversity conservation, sharing, and use for climate change adaptation.

Population Growth

As a driver of global change, population growth has not yet stabilized in many low-income countries. Here, agrobiodiversity can play an important role in coping with challenges around food security and health, such as the availability of and access to nutritious and culturally appropriate food. Agrobiodiversity can contribute resilience through highly diverse and productive farming systems. For example, mixed cropping can result in higher and more stable yields in the face of environmental variation. To support the development of more agrobiodiverse farming systems, environmental schemes could be implemented

in which a range of actors participate: farmers, NGOs, government agencies, and corporations could jointly be responsible for developing such schemes. By providing farmers better access to seeds and knowledge, joint initiatives between NGOs and public gene banks can use agrobiodiversity to improve the actual access to available food.

There is also evidence that agrobiodiversity can also be used to elevate the status of women in regions with high population growth and tenuous food security. It is generally accepted that raising the status of women and increasing their education levels leads to lower birth rates. To increase female status, one possible way is to train rural women to be local caretakers of agrobiodiversity and, at the same time, to increase their participation in the seed system in which they traditionally play an extremely important role in many societies. Side benefits of this approach could include better nutrition and increased economic security, and could bring the agendas of NGOs and governments together. More research is needed, however, on the connections between women, agrobiodiversity, and economic empowerment to determine where and how agrobiodiversity can contribute to the status of rural women. In addition, attention should be paid to the regionally specific nature and culture of women's agricultural work and social status (Carney 1993; Nuijten 2010; Zimmerer et al. 2015).

Urbanization, De- and Reagrarianization, and Migration

Urbanization and the intensification of adjacent peri-urban spaces for food production are currently a major global change driver shaping environment, land use, and socioeconomic changes across the world. The processes of urban and peri-urban growth are linked closely to processes of deagrarianization (rural out-migration), reagrarianization (e.g., the movement of exurbanites or “new farmers” into rural spaces), and migration across national borders and continents. Together, these changes are associated with influential yet complex impacts on agrobiodiversity as well as the actual and potential roles of institutional configurations. For example, urbanization has been strongly linked to the growth of new consumer cultures that favor agrobiodiversity through gastronomic cuisines among well-to-do consumers as well as through food movements among educated consumers who prefer organic, unprocessed food, and healthy eating. Rural in-migrant populations who retain preferences for inexpensive traditional foodstuffs and have cultural ties with specific food also induce demand for agrobiodiversity. These include not only rural peoples of the Global South who once farmed but also Global North retirees who have migrated to tropical countries. As international migration continues, so too does the demand for foods and condiments that are often unavailable in the host culture. Whether the demand for organic vegetables stems from retirees from wealthy countries relocating to the warmer climates in the Global South or from refugee populations resettling in the Global North, our contemporary

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world of people on the move offers multiple instances and possibilities to encourage and promote agrobiodiversity, with roles for formally and informally organized networks of actors.

Restaurants and food businesses are important actors in brokering the changes in urban consumer cultures. Urban and community gardens, as well as small farms, are a significant locus of this activity and can offer migrants support from governments (city, regional, national) and international agencies. The continued links of rural-to-urban migrants with their natal communities offer additional prospects for agrobiodiversity. Although these migrants often send remittances and other resources back to rural areas, which in many cases are deagrarianizing, such resource flows are often accompanied by a demand for seeds of traditional foods not easily sourced in urban areas, but which migrants can grow on city plots made available to them through community gardens and other governmental organizations. Such migrant resource flows can be used to support agrobiodiversity under the right combination of favorable circumstances (Zimmerer 2014).

Issues of gender relations, equity, and livelihood options are an integral component of smallholder deagrarianization. Migration patterns are often gendered, and the process frequently leaves women disproportionately behind as farmers in the sending areas. The “feminization of agriculture,” reported in many smallholder farming areas of the Global South, is a globally significant feature of deagrarianization. While migration loosens household dependence on farming for family survival, it often results in pronounced gendering of land use and agrifood systems in out-migration areas (Radel et al. 2012). Female farmers and their household members must prioritize farming strategies and decide how to invest remittances from male migration. In Nepal, men’s increased rate of out-migration has been reported as a positive influence on women’s decision-making processes, including agrobiodiversity management (Bhattarai et al. 2015). Differential migration of household members carries profound implications for rural land use and agrobiodiversity. It can reduce the amount of land cultivated and diversity of crops planted, but it can also have the opposite effect: it may induce households to adopt new crops and practices into farming systems—a process that is evident today in many peri-urban areas of the Global South (Zimmerer et al. 2015). Proximity to emerging urban food networks and trends may encourage the adoption of new cultivars, including tree crops. In some rural locales with male out-migration, females create agrobiodiversity through informal seed networks that encourage risk-averse farming practices and flexibility in farm labor demands (Nuijten 2010). For example, women rice growers in The Gambia exchange seed varieties of differing maturities which are adapted to the diverse microenvironments that comprise a rice landscape. Seed diversity promotes subsistence security of a crucial dietary staple. Water retention in one rice microenvironment—the inland swamps—facilitates agrobiodiversity by permitting the planting of multiple crops and sequential cultivation. Women have

established bananas on the bunds that enclose the plots and, after the rice harvest, use the plots' residual soil moisture to grow vegetables which are then subsequently marketed (Carney 1993).

Reagrarianization is another important process that encourages and promotes agrobiodiversity in rural areas. This refers to the patchwork of small farms that have appeared in the Global North (and in some parts of the South) in response to urban food movements. As in the "back-to-the-land" movement of the 1960s, we are again witnessing an interest in agriculture among young people with no previous farming experience. This is also encouraging those with farm experience to grow crops and animals responsive to new urban consumer demands for farm products that are produced and raised using ecologically sound practices. This convergence of trends has created the group of smallholder farmers we label neoagrarians. The reagrarianization of such landscapes is unfolding with an intentional use of agrobiodiversity, evident at several scales—within farm plots and across landscape levels—as well as through mixed cropping, agropastoral, and agroforestry methods. To what extent neoagrarian use of agrobiodiversity implies enrichment or conservation remains to be better understood. In any case, the repopulating of rural land with production techniques and crops in demand by urban "foodie" consumers is unfolding for the most part with weak institutional support. Other forms of organization are emerging as well, such as informal seed exchanges among this type of farmer to promote heirloom varieties or rescue ones that did not serve the expansion of the industrial food chain. Internet-based communication opens up an array of opportunities for disparate groups to connect.

There is a diversity of organizations involved in promoting agrobiodiversity in low-income communities of the Global North. Community-supported agriculture and farmers' markets are being increasingly encouraged by city governments. In Los Angeles public schools, school gardens are promoted to encourage better diets among low-income students, who live in urban food deserts. In areas affected by youth gangs, school gardens provide an opportunity to teach children at a young age the geographic origins of foods they like and to help gain an appreciation of the ethnic and cultural groups who developed the foods. These diverse food gardens have emerged as important sites of agrobiodiversity in urban areas, providing fresh vegetables and fruits where supermarkets are absent. Urban agriculture is also being increasingly supported by philanthropic foundations, which fund projects to encourage the availability of fresh produce for the needy, including the homeless, handicapped, and homebound senior citizens. Their efforts extend to involving at-risk youth and new immigrant groups in urban farming (Cockrall-King 2012).

The international migration of people from countries in the South to more prosperous countries in the North, for the purpose of finding better and safer futures, offers specific chances to link producers, entrepreneurs, and consumers, which may be supported or facilitated by government policies. Communities of migrants from the same country or region often find themselves in cities

(e.g., in the United States, Canada, England, Sweden, and Germany). In this new environment and cultural context, the migrants have to construct new identities; in many cases, their original food culture plays an important role either as food for consumption or in generating income (e.g., restaurant, shop). The value of having access to produce from their homeland can open up new opportunities for agrobiodiversity grown by smallholders in these countries. Mexicans and other consumers in New York eating tortillas made from blue maize or Ethiopians preparing injera with teff from their home country are examples of migrant cultures that generate opportunities for new value chains of agrobiodiversity. These value chains tend to be thought of as dominated by small entrepreneurs (often from the migrant community) and as a direct linkage to producers in the homeland production areas. Whether such value chains contribute to the livelihood of farmers growing the agrobiodiversity or result in larger areas planted with valuable agrobiodiversity is not clear. A point of tension is the threat to such value chains when these agrobiodiversity crops or varieties are being picked up by producers in the country or region of these migrant cultures. Examples of this include identifying or developing teff varieties adapted to California, growing quinoa in Denmark and Holland, and popularizing the use of chili pepper diversity across the southwestern United States. Because this contributes to income opportunities for the producers, it potentially broadens the demand as well as the agrobiodiversity portfolio being used, leading to more types of maize and chili eventually being grown. When white-grain quinoa production expanded in the European Union and the United States, marketing from the Andean countries started to focus more on yellow, black, red, and pink varieties. “Protected designation of origin” labels governed by producer groups or NGOs could add value to the produce from the country of origin; advocacy by the migrants themselves could also assure demand for the produce of their home country. In addition, governments can facilitate trade through regulation or assume a protective role, as in Colombia, where the production of coffee other than Arabica is banned to protect the quality of the renowned Colombian shade-grown coffee, which also supports biodiversity.

Global Market Integration and Food System Transitions

Around the world, food supply chains and commodity markets are undergoing a drastic transformation directly linked with food system transitions (see Chapter 9). This change is typified, for example, by the increase in the number of supermarkets involved in food retailing in developing countries (Rao and Qaim 2011). The changes in the composition of food supply chains are expected to affect the scope of on-farm conservation of agrobiodiversity. The market institutions that structure the commodity value chains are important for two reasons: (a) they transfer consumer demand for agrobiodiversity to producers and farmers, and (b) they cater effectively to the consumer demand

for diversity. These issues are particularly important for the conservation of perishable food products (e.g., vegetable, dairy, and livestock products), which are an integral part of agrobiodiversity in many farm portfolios. There are documented cases of traditional vegetable chains that are effective in conserving agrobiodiversity (Chweya and Almekinders 2000; Iskandar et al. 2018). Similarly, the demand for local products leads to the development of farmers' markets in developing and developed countries. Novel and emerging labeling and certification schemes (e.g., Happy Chickens, Roundtable on Sustainable Palm Oil) that embrace the consumer demand for nature-friendly production systems have a significant impact on on-farm conservation of agrobiodiversity. However, transmission of information on the agrobiodiversity conserved from farmers to consumers is often challenging in these commodity value chains.

Conclusion: Framing the Agrobiodiversity Narrative

Agrobiodiversity has a multitude of functions through which it contributes to the well-being of people in this world via different pathways. Agrobiodiversity and its functions in food systems transitions are subject to global change, driven by climate change, population growth, migration from rural to urban spaces, and market integration. The way in which agrobiodiversity can play a role in the world of tomorrow is likely to be different than it is at present. Historically, the dynamic nature of agrobiodiversity has allowed human–environmental relations to change adaptively. With the challenges of a warming world and agricultural uncertainty, it has the potential to continue adapting in contexts, however, where agriculture and food systems have been significantly transformed.

In this chapter we explored how current and future intentional agrobiodiversity use varies between and within different groups of users. Our examination demonstrates that current drivers of global change affect these groups locally in unique ways. Their response (in terms of value, intentionality, and use of agrobiodiversity) has created the potential for novel initiatives: user groups and organizations have been able to engage in new collaborations and diverse configurations at varying scales. Together, we consider that the experiences from these initiatives and analyses of opportunities offer the basis for a compelling overarching narrative: agrobiodiversity can be used in multiple ways by different groups of people, organizations, and networks to improve the well-being of people around the world. Such a narrative can connect the wide diversity of producers and consumers that are geographically dispersed, forming networks of personal and virtual interactions that provide a critical mass to reinforce ongoing efforts to find solutions to the challenges of global change. Farmers that seem now at the extreme poles of the gamut of diversity may connect and be of inspiration and support to each other, joining forces across geographic space amid myriad new forms of production and consumption.

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The experiences and the narrative also point to important gaps in our knowledge which, when filled, should help to create space for alternative pathways of development and institutional strategies to enable adaptation and mitigation of the negative impacts of global change—perhaps by turning threats into opportunities. Different groups and organizations have different roles to play. Ensuring participation and empowerment of vulnerable groups will need to be incorporated into the responses to global change. New science integrating social, agronomic, and environmental knowledge is needed to support and analyze how initiatives of using and valuing agrobiodiversity fare, how these experiences can be connected or patterns discerned, and how experiences can be shared and linked to forge new institutions and organizational linkages.

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Appendix 6.1

For seven different groups, we present an overview of how groups currently use agrobiodiversity and their associated vision, value, and intentionality. This information can provide entry points to strengthen future agrobiodiversity use.

1. For 2.2 Billion Smallholder Farmers

Group Use Related to Climate Change

- Forces people to shift to part-time farming or off-farm income
- Migration: seasonal versus permanent/forced versus voluntary
- Gender
- Varietal change
- Crop switching
- Mixed crop and livestock
- Crop diversification
- Intensification: skill and inputs
- Extensification: expansion (environmental cost)
- Social networks/information
- Not feeding food to animals
- Eating less or differently

- Crop insurance
- Agronomy

Group Use Related to Market Integration

- Create demand by linking with consumers to finance transition
- Increase cash crop production

Vision, Values, and Intentionality

- Highly varied
- Includes food as part of cultural identity
- Intentionality is often by default

Entry Points

- Link to agrobiodiversity institutions
- Embed activities into networks
- Policy to support small-scale initiatives based on creativity and alternative narratives

2. For Indigenous Farmers

Group Use

- Sparse knowledge on agrobiodiversity responses to global changes

Vision, Values, and Intentionality

- Intentionality by default
- Agrobiodiversity is an integrated part of livelihood sustenance, security, cultural identity, etc.

3. For Neagrarian Farmers

Group Use

- Conscience intentionality: banking on “credence quality”

Vision, Values, and Intentionality

- Often a high level of intentionality toward agrobiodiversity considerations
- Short food chains with value for food and client relation

Entry Points

- Use knowledge as a product

- Support gastronomy that favors healthy tasting food
- Agrobiodiversity certification

4. For Public Breeders

Group Use Related to Climate Change

- Stress tolerance and biotic and abiotic
- Crop and variety substitution
- Conservation agriculture + resource use efficiency + agronomy
- Impact modeling → physiology

Group Use Related to Market Integration

- Food processing
- Entomophagy, shifting diets
- Productivity
- Commodification, intellectual property, seed market

Vision, Values, and Intentionality

- Modernized breeding
- Intellectual Property
- Profit oriented
- Instrumental agrobiodiversity use (e.g., drought or disease resistant), regenerative breeding
- Orphan crops
- Intrinsic (e.g., in centers of origin), relational (e.g., characteristics with cultural values), instrumental

Entry Points

- Increase public funding for location-specific breeding (more varieties)
- Increase public funding for orphan crops
- Change institutional incentives to increase the value of agrobiodiversity, away from wide adaptation
- Incentivize plant breeders to work with multiple stakeholders
- Open access to intellectual property
- Create alternative narratives

5. For Private Companies

Group Use Related to Climate Change

- Increasing yields, continuing Green Revolution (possible) trend for area-specific breeding if buyers concentrated; new crops (quinoa, teff)
- Production companies, land grabs, agrobiodiversity use in crops
- Food manufacturing, agrobiodiversity cell lines
- Insurance companies, big data approaches, maybe agrobiodiversity?
- Agrobiodiversity conditions insurance
- Food companies

Group Use Related to Market Integration

- Private companies mainly disuse agrobiodiversity for production processing, food system uniformity
- Novel products and markets, niche commodities

Vision, Values, and Intentionality

- Value: individualistic, for profit, create markets, “investment opportunities”
- Stakeholder (private wealth maximization)
- Intentionality: agrobiodiversity instrumentally for vision and values; agrobiodiversity for unique attributes of quality; patenting agrobiodiversity/intellectual property

Entry Points

- Niche markets, value chain
- Philanthropy
- Genetic resource use
- Corporate sustainability (e.g., Monsanto’s carbon-zero strategy)
- Prosocial environmental responsibility (e.g., health and diets, Fair Trade)
- Voicing of societal concerns (related to market integration)

6. For NGOs, International Organizations

Group Use Related to Climate Change

- (Forest) Food security, food quality, food sovereignty
- Low-input agriculture (low fossil fuels)
- Diversification (livelihood diversity for adaptation)
- Advocacy
- Conservation (of intrinsic value)

Group Use Related to Market Integration

- Livelihood diversification/diet diversification
- Prolocal (against globalization/self-autonomy): food, seed systems, agricultural products

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Vision, Values, and Intentionality

- Conservation (of intrinsic value), access to plant genetic resources
- Social justice, equality, collectivism (horizontal seed systems)/advocacy for rights, autonomy of Global South (e.g., property rights, intellectual property)/sustainability
- Agrobiodiversity as tool for advocacy of their values (related to market integration): self-autonomy and agroforestry/crop diversity for preservation, associated biodiversity

Entry Points

- In terms of market integration, agrobiodiversity can be a tool to advocate values
- Goal should be better linkages between NGO goals and agrobiodiversity and better tailoring of message, scientific output, and knowledge gaps
- Tailor the research agenda to knowledge needs
- Produce empirical evidence for agrobiodiversity use

7. For Governments

Group Use Related to Climate Change

- Payment schemes (agro-environment schemes), e.g., EU payments to farmers for traditional breeds
- Insurance schemes (e.g., for catastrophes):
 - Productivity → public breeder, agricultural development
 - Adaptation → breeding
 - Mitigation → control of erosion, deforestation

Group Use Related to Market Integration

- Market price regulations
- Trade regulations
- Certification schemes

Vision, Values, and Intentionality

- Support for economic growth and stability
- Cultural heritage and identity, public health
- Diverging positions and goals related to market integration (i.e., profit and yield maximization vs. societal goals), food security, diversity, conservation, culture, etc.

Entry Points Related to Climate Change

- Repatriation

- Migration
- Development of value chains for new foods
- Rewards for agrobiodiversity stewardships
- Information/communication will raise awareness
- Biodiversity prospective
- Decentralization

Entry Points Related to Market Integration

- Removing perverse incentives and hidden subsidies to production and marketing practices that negatively affect agrobiodiversity
- Provide incentives to agrobiodiversity promoting production and marketing practices

