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INTERNATIONAL PANEL OF EXPERTS ON SUSTAINABLE FOOD SYSTEMS




BREAKING AWAY FROM INDUSTRIAL FOOD AND FARMING SYSTEMS

Seven case studies of agroecological transition



CASE STUDIES 02

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Executive summary

BREAKING AWAY FROM INDUSTRIAL FOOD AND FARMING SYSTEMS:
Seven case studies of agroecological transition

Food and farming systems around the world are driving environmental degradation, loss of vital ecosystem services, economic hardship for smallholders, socio-economic inequities, and debilitating health impacts and food insecurity for many. The majority of these problems are linked to 'industrial agriculture': the input-intensive crop monocultures and industrial-scale feedlots that now dominate many farming landscapes.

A new agroecological paradigm is required, rooted in fundamentally different relationships between agriculture and the environment, and between food systems and society. The seven case studies in this report provide concrete examples of how, in spite of the many barriers to change, people around the world have been able to fundamentally rethink and redesign food systems around agroecological principles:

- **Case study 1.** Santa Cruz, California, USA: Turning strawberry monocultures into sustainable food and farming systems through a 30-year farmer-researcher partnership
- **Case study 2.** San Ramón, Nicaragua, and Veracruz, Mexico: Breaking away from industrial commodity production in Central American coffee-growing communities
- **Case study 3.** Chololo, Tanzania: Rethinking food, farming, forestry and resource management to build an 'Ecovillage'
- **Case study 4.** Puhan Rural Community, Shanxi, China: Rebuilding community ties as a pathway to cooperative-led food systems
- **Case study 5.** Drôme Valley, France: Making the radical mainstream and the mainstream radical to build Europe's first organic region
- **Case study 6.** Vega, Andalusia, Spain: Sustaining transition through changing political winds
- **Case study 7.** Cuba: Turning economic isolation into an opportunity for agroecological transition

The findings of the seven case studies are summarized in the table in Section 4.

Overall, the case studies show that it is possible for communities, regions, and whole countries to fundamentally redesign their food and farming systems. The change process can be initiated from a variety of entry points, and does not always begin on the farm with input substitution. Transition can also be kick-started by community-building activities, farmer-researcher partnerships, and even by external shocks that make people question the status quo.

However, change must spread to other dimensions in order to drive forward and sustain transitions. Ultimately, changes are required in four key dimensions – in production practices, in knowledge generation and dissemination, in social and economic relations, and in institutional frameworks.

It is when these different types of change combine and reinforce one another that power is reconfigured, and reliance on the existing brokers of inputs, knowledge, and market access is drastically reduced. In other words, the multiple 'lock-ins' of industrial food systems can be overcome and new sustainable food systems can start to emerge.

The following leverage points proved particularly important for driving transitions across the case studies:

1. **Building new community-led governance structures and economic systems between the state and the market.** Several transitions were driven forward by the emergence of hybrid, informal, community-led institutions, and governance structures – rather than relying on change happening within formal institutional frameworks. In some cases, the transition process was tantamount to a civil society-led rural development strategy, entailing steps to relocalize food systems, to reserve productive capacity and resources for supplying local communities, to provide a range of services to rural populations, and to reinvest profits into the community when selling into formal/distant markets.

2. **Developing hybrid roles for key actors.** Change can be unlocked when actors take on hybrid roles, allowing new brokers of knowledge, inputs, and market access to emerge. The cases show that politicized farmer/peasant organizations and cooperatives can be highly influential, particularly if they combine cooperative marketing functions, farmer-to-farmer knowledge sharing, community-building activities, and political advocacy.

3. **Forging new alliances across disconnected domains.** In some cases, change was unlocked by creating improbable alliances that brought together farmers, consumers, and environmental groups, and brought institutional actors into contact with more radical actors. Avoiding organic/agroecology becoming closed niches, facilitating ongoing exchanges with mainstream actors, and keeping the door open for late adopters were key factors in maintaining momentum and building powerful alliances over time.

4. **Anchoring transitions in counter-narratives and theories of change.** Narratives and theories of change matter, and can help to root transitions in local identity and culture, as well as allowing people to differentiate themselves from the previous/dominant model and to embark on a new course. Examples of this ranged from the emergence of influential opinion-forming media and information sources, to the use of cultural media like song and dance to make sense of the transition, and critical historical reflections to build a basis for transition. Across the cases, agroecology itself provided a unifying narrative to capture the change process underway.

5. **Relocalizing food and farming systems.** Some degree of reconnection to local markets, culture, and community proved crucial across the cases. This included a focus on home gardens, farmers' markets, CSA schemes and other forms of direct sales, local public procurement, as well as steps to source inputs within the farming communities. This did not come at the expense of external trade: actors were able to negotiate better terms on national/international markets on the basis of the new organizational capacities developed through the transition initiatives. With its own infrastructures, extension agents and retail circuits, organic agriculture provided a key focus in many of the cases and helped to secure local and distant markets, as well as political support and funding, as farmers shifted their practices.

6. **Promoting farmer-to-farmer knowledge sharing.** Farmer-to-farmer knowledge sharing, farmer-field schools, and demonstration farms emerged across the case studies as powerful drivers of transition – succeeding where linear extension models have failed. In several cases, they helped to bring a large number of farmers on board and build solidarity between them. As evidenced in the broader literature on agroecological transitions, farmer-based systems allow micro-regional agroecological knowledge to persist in the face of standardized approaches of-

fered by state- or agribusiness-led extension services. Several of the cases in fact show fruitful interaction between farmer-to-farmer systems and government research centres.

7. **Empowering women and young people to drive transition.** In several cases in the global South, dedicated steps were taken to expand women's livelihood options, and to allow women to play a meaningful role in decision-making regarding their activities. Initial steps in this direction appear to have led to sustained engagement of women in the projects, helping to drive positive impacts for women and for the community more broadly. A focus on youth also helped to spark and sustain transition, particularly where young people were encouraged to remain in the countryside and take up agroecological farming.

While these initiatives benefitted from some form of political support, it did not always endure over time. Prevailing political incentives have continued to support industrial agriculture and to lock out alternatives.

Some of the most impressive impacts of these transitions – greater resource efficiency, improvements in community livelihoods and nutrition, increased resilience to shocks, biodiversity enhancement – tend to be overlooked at the political level. Moreover, transition initiatives may be delivering positive impacts simply by keeping land in (sustainable) agricultural production and keeping people in rural communities in the face of unfavourable macro-economic and political conditions.

Globally, the policy environment may now be shifting. The FAO's increasing receptiveness to agroecology testifies to this policy opening. The risks of dilution and co-optation are nonetheless high, as interest arises in bringing experiments to scale and large-scale actors enter the playing field. Debate must therefore be refocused on 'scaling out' agroecology. Transitions must be designed with local communities – not imposed from the outside based on a one-size-fits-all model, or reduced to a focus on export-oriented value chains.

While different analytical approaches must continue to cross-fertilize, it will be important to converge on common approaches to promote agroecology in the emerging policy spaces. Referring systematically to the different dimensions of change helps to capture the breadth of agroecological transitions, and to focus attention on documenting and measuring what matters – including but not limited to shifts in production practices.

More evidence on transitions occurring at large scales with strong political support will be useful to complement the case studies gathered here. Finding synergies between different bodies of transition literature (e.g. between agroecological transitions and urban food initiatives), and between the different actors underpinning those transitions, is also a major opportunity to be explored.

Moving forward, agroecological transition must increasingly be articulated as part of a broader transformation of society, extending to other facets of environmental and social relationships beyond food, recognizing the limits to growth, and asking what it really means to live sustainably.

01 The need for transition in food systems

Food and farming systems around the world are facing severe sustainability challenges. These systems are driving environmental degradation and loss of vital ecosystem services, economic hardship for small-scale farmers, socio-economic inequities, and debilitating health impacts and food insecurity for many. The majority of these problems are linked to 'industrial agriculture': the input-intensive crop monocultures and industrial-scale feedlots that now dominate many farming landscapes (IPES-Food, 2016).[1]

Given the severity and interconnectedness of these challenges, reducing specific impacts – on biodiversity, on climate change, on small-scale farming communities – will be difficult without rethinking the whole basis of food and farming systems (IPES-Food, 2017a, 2016). New paradigms are required, rooted in fundamentally different relationships between agriculture and the environment, and between food systems and society (IAASTD, 2009; IPES-Food, 2016). Agroecology – as a holistic set of principles for redesigning food systems – captures the essence of the paradigm shift that is required (see Section 2).

IPES-Food's first thematic report, *From Uniformity to Diversity* (2016), describes a series of vicious cycles holding industrial food systems in place, in spite of their many negative social and environmental impacts (see Figure 1).

These 'lock-ins' include the *path dependency* of industrial agriculture, where upscaling, rationalization, and specialization reinforce one another; the export orientation of food and farming systems in many countries, based around large-scale monocultures; the societal expectation of cheap food, requiring low-cost (and high externality) commodity production; the *compartmentalized* and short-term thinking that prevails in politics, research and business, driving short-term, productivist approaches; the *'feed the world' narratives* that focus attention on increasing production volumes of staple crops above all else; and the correspondingly narrow *measures of success* used to identify progress in food systems. All of these lock-ins are underpinned by the ever-increasing *concentration of power* in food systems, whereby value accrues to a limited number of actors, strengthening their economic and political dominance, and thus their ability to influence the policies and incentives guiding those systems (IPES-Food, 2016).

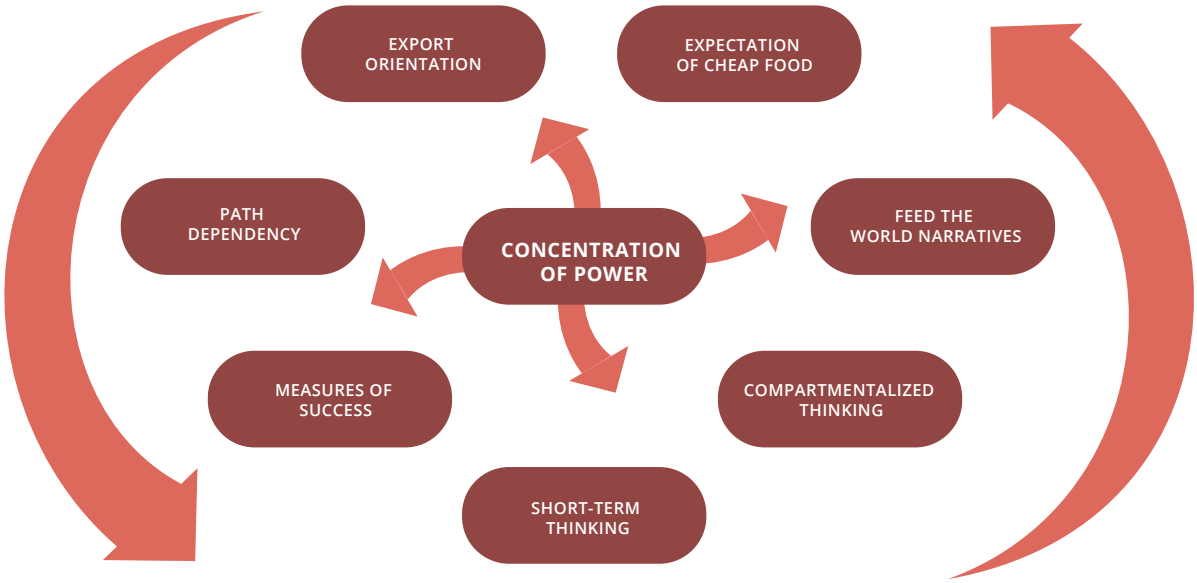
The focus on addressing systemic lock-ins reflects IPES-Food's view of food systems as an interconnected whole. From this perspective, food systems refer not only to market transactions and connections between different points in the food chain (e.g. agriculture and food retail), but also to a broader web of institutional and regulatory frameworks, and the prevailing conditions in which science and knowledge are generated.

Furthermore, the various components of food systems (e.g. trade policies, agricultural subsidies, market structures and prices, research and educational priorities) have co-evolved over time to become mutually-reinforcing, with powerful coalitions of interest evolving alongside them (De Schutter, 2017; IPES-Food, 2015). In other words, different problems in food systems are deeply interconnected: they are systemic problems.

In spite of these barriers to change, farmers, researchers, consumers, NGOs, and many

1. For the purposes of this report, industrial agriculture refers to a wide spectrum of farming models based around specialized commodity-crop production and the use of synthetic inputs. This definition thus encompasses smaller-scale 'conventional agriculture' as well as larger-scale industrialised systems.

FIGURE 1 - THE EIGHT KEY LOCK-INS OF INDUSTRIAL AGRICULTURE
(Source: IPES-Food, 2016)



other food system actors have found ways to drive transitions in food and farming systems – breaking away from industrial agriculture, or circumventing it where it is yet to take root.

This report shines a light on these initiatives through seven case studies of agroecological transition.[2] The cases cover a variety of scales (single farmer, community level, regional and national) and geographical locations (Europe, North America, Central America, Africa, Asia). The primary focus of the transitions is also wide-ranging (e.g. income diversification, climate adaptation, rural development), with a range of actors taking the lead in different cases (international non-governmental organizations (NGOs), producer organizations, research bodies, governments).

What is common to these case studies is the willingness to question the assumptions of industrial agriculture, and to fundamentally rethink and redesign food and farming systems.

The selection is limited to cases for which IPES-Food had access to extensive, up-to-date, original information on the change process (see Box 1). As examples of agroecological transition, the case studies included in this report are all rooted in rural/farming communities – although they are by no means limited to shifts in production practices.

The following cases are included in this report:

- **Case study 1. Santa Cruz, California, USA:** Turning strawberry monocultures into sustainable food and farming systems through a 30-year farmer-researcher partnership
- **Case study 2. San Ramón, Nicaragua, and Veracruz, Mexico:** Breaking away from industrial commodity production in Central American coffee-growing communities
- **Case study 3. Chololo, Tanzania:** Rethinking food, farming, forestry and resource management to build an 'Ecovillage'

2. This report focuses on transition as opposed to transformation, although both terms are frequently used in the literature. Transition is understood here as a change process, or a period of changing from one state or condition to another, tending to include distinct steps and stages. Transformation is also referred to at specific points in the report, referring to a broader societal shift emerging out of multiple transition processes in food systems and beyond, and characterized by marked changes in form, nature, beliefs, values, action, or appearance.

- **Case study 4. Puhan Rural Community, Shanxi, China:** Rebuilding community ties as a pathway to cooperative-led food systems
- **Case study 5. Drôme Valley, France:** Making the radical mainstream and the mainstream radical to build Europe's first organic region
- **Case study 6. Vega, Andalusia, Spain:** Sustaining transition through changing political winds
- **Case study 7. Cuba:** Turning economic isolation into an opportunity for agroecological transition

Before introducing the seven case studies, the report summarizes the findings of recent collections of case studies and the theoretical literature on agroecological transition. Four types of change – in practices, in knowledge generation and dissemination, in social and economic relations, and in institutional framework – emerge from the literature as key dimensions of agroecological transitions, and provide a basic framework for analyzing the case studies in this report (Section 2). The seven case studies of transition are then presented, including a general overview of how the transition occurred, followed by additional detail on the changes that occurred in each of the four dimensions mentioned above (Section 3). Through this approach, a detailed picture is painted of the change process, yielding insights into: how initiatives managed to address/overcome barriers to change and the systemic lock-ins of industrial food systems; what strategies actors used to open up niches in which to experiment; and what prevented change from advancing further. Finally, conclusions are drawn from the cases on how the lock-ins of industrial food systems can be overcome, how the different dimensions of change interact, where the key leverage points for transition are located, and what can be done by various actors to promote agroecological transitions moving forward (Section 4).

BOX 1 - METHODS AND LIMITATIONS

The case studies have been compiled by IPES-Food based on detailed documentation provided by researchers or organizations close to or involved in the transition initiatives. The findings are thus based on the accounts of those involved as they have experienced and recounted developments over time. These individuals and organizations have worked alongside IPES-Food to compile and document these transitions. IPES-Food has taken stock of the information provided, structuring it into a common analytical framework across the cases, and requesting additional information where needed in order to be able to paint a full picture of the change process. Additional sources of information have been drawn on and published data has been included (e.g. on yields or environmental impacts) wherever possible. The case study selection is not exhaustive, and is based on securing access to detailed, original information about the change process, as well as ensuring representation of various world regions.

02 What do we know about agroecological transitions?

MOVING TOWARDS A COMPREHENSIVE ANALYTICAL FRAMEWORK

Transitions towards sustainable food and farming systems have occurred under many banners: depending on the local context and background, innovators and experimenters have identified their approaches as organic, biodynamic, permaculture, alternative, sustainable, regenerative, as forms of community supported agriculture (CSA), as cooperative food system initiatives, or as urban food transitions – and their various equivalents in different languages.

Agroecology is emerging as an umbrella term for the various alternatives to industrial agriculture mentioned above (see full definition used by IPES-Food in Box 2). Increasingly, transitions focused on fundamentally redesigning food and farming systems have been identified as *agroecological*. For example, the Beacons of Hope project[3] used holistic approaches rooted in "agroecological solutions" as one of the selection criteria for the transition initiatives making their final selection (Biovision, 2018)[4]. A research group in southern Mexico cites five emblematic case studies of food system transformation as examples of the scaling of agroecology, noting that "agroecology is key for transitioning to fair, environmentally responsible food systems, as well as broader movements for social, political, and economic justice" (Mier y Terán Giménez Cacho et al., 2018). Meanwhile, the first comprehensive report on CSA initiatives in Europe points out that "the Nyéléni definition of Agroecology[5] fits CSA" (European CSA Research Group, 2016, p. 5).

In April 2018, the UN Food and Agriculture Organization (FAO) underlined the potential of agroecology to underpin sustainable food system transitions at the 2nd FAO International Symposium on Agroecology: Scaling up Agroecology to Achieve the Sustainable Development Goals (FAO, 2018a)[6]. The FAO has highlighted the systemic nature of agroecological approaches and initiatives, identifying ten key elements of agroecology (see Figure 2).

A growing archive of case studies from around the world is demonstrating agroecology's capacity to provide "immense economic, social, and food security benefits while ensuring climate justice and restoring soils and the environment" (Oakland Institute, 2018). The increasing documentation of agroecological transitions is significant in itself. Members of the budding social movement surrounding agroecological transitions have recognized that the first step is to be seen, heard, and recognized as a valid alternative to business-as-usual, i.e. to overcome the 'lock-in' of narratives that present large-scale, agribusiness-led industrial agriculture as the only solution (IPES-Food, 2016).

3. Launched by the Global Alliance for the Future of Food and the Biovision Foundation in 2016, the Beacons of Hope project brings together examples of transition towards more sustainable food and agriculture systems.

4. These cases include the farmer-to-farmer movement in Latin America, the national peasant agroecology movement in Cuba, the organic coffee boom in Chiapas, Mexico, the spread of Zero Budget Natural Farming in Karnataka, India, and the agroecological farmer–consumer marketing network, Rede Ecovida, in Brazil.

5. The full Nyéléni definition of agroecology is available here: http://www.foodsovereignty.org/wp-content/uploads/2015/02/Download-declaration-Agroecology-Nyeleni-2015.pdf

6. The Symposium presented the findings of the 1st International Symposium on Agroecology in 2014 and the subsequent regional agroecology seminars held between 2015-2017. Many examples of transition from around the world, along with barriers, drivers, and future recommendations for scaling up, are presented in the symposium report as well as on the FAO Agroecology website (FAO, 2018b).

BOX 2 - AGROECOLOGY AS SCIENCE, PRACTICE, AND SOCIAL MOVEMENT

Agroecology is the application of the science of ecology (the science of how nature works) to the study, design, and management of sustainable food systems, the integration of the diverse knowledge systems generated by food system practitioners, and the involvement of the social movements that are promoting the transition to fair, just, and sovereign food systems (FAO, 2018a; Gliessman, 2015). In other words, agroecology is understood in this report as a science, practice, and as a social movement, in line with the internationally agreed-upon Nyéléni definition (cf. International Forum for Agroecology, 2015). Diversified agroecological systems, as defined by IPES-Food (2016), encompass wide-ranging approaches with a clear direction of travel: diversifying farms and farming landscapes; replacing chemical inputs with ecologically-based materials, practices, and processes; optimizing biodiversity; and stimulating interactions between different species as part of holistic strategies to build long-term fertility, healthy agroecosystems, and just livelihoods.

Case studies compiled to date have examined micro-level experiments (Access to Land, 2018; Brescia, 2017; Focus on the Global South, 2014; Wezel, 2017) as well as regional and national-level initiatives (Isgren and Ness, 2017; McKay, 2012; Mier y Terán Giménez Cacho et al., 2018; Rosset et al., 2011). They cover a range of geographical regions, including Africa (AFSA, 2017; Fitzpatrick, 2015; Groundswell International, 2018; Oakland Institute, 2018), the Americas (Cohn et al., 2006; McKay, 2012; Warner, 2006), Europe (Access to Land, 2018; ARC2020, 2015; Elzen et al., 2017; European CSA Research Group, 2016), and Asia (ActionAid, 2012; Focus on the Global South, 2014). Others have taken a global focus (Ecumenical Advocacy Alliance, 2012; FAO, 2018b, 2018a, 2018c; IPAM, 2018; PAN UK, 2017; van Walsum et al., 2014; Watts and Williamson, 2015).

Some reports have archived individual case studies (FAO, 2018b; IPAM, 2018; Oakland Institute, 2018; PAN UK, 2017) while others have combined cases to illustrate particular themes in reports (AFSA, 2017; ARC2020, 2015; FAO, 2018c; Groundswell International, 2018; Watts and Williamson, 2015) or academic writing (Isgren and Ness, 2017; Rosset et al., 2011; van Walsum et al., 2014). Melding research and practice, the scientific journal Agroecology and Sustainable Food Systems now provides many examples and analyzes of research-based experiences by farmers transitioning their production systems and consumers changing their purchasing patterns to support such transitions.

There has also been increasing attention to the question of how to scale agroecology up and out (Anderson et al., 2015; González de Molina and Caporal, 2013; IATP, 2013; Mier y Terán Giménez Cacho et al., 2018; Silici, 2014), alongside a broader literature on transitions to sustainability. Various studies have put forward benchmarks and criteria for measuring the viability and durability of change pathways, with a particular focus on identifying the multiple, reinforcing dimensions of change and sequential progress over time. The following frameworks are among those offering holistic visions of the change process:

- The 5 levels approach (Gliessman, 2016 – see Annex)
- Agroecological city-regions (Vaarst et al., 2017)
- The resource-based model of innovation (Blesh and Wolf, 2014)
- Social-ecological frameworks (Foxon et al., 2009; Moraine et al., 2017)
- The Practice-Oriented Multi-level perspective on Innovation and Scaling (PROMIS) (Wigboldus et al., 2016)

FIGURE 2 - FAO'S 10 ELEMENTS OF AGROECOLOGY
(Source: FAO, 2018a)

- Agroecological transition as a co-innovation process (Duru et al., 2015)
- Agroecology as a transition process driven by actors (FAO, 2018c)
- The political ecology of education perspective (Meek, 2016)

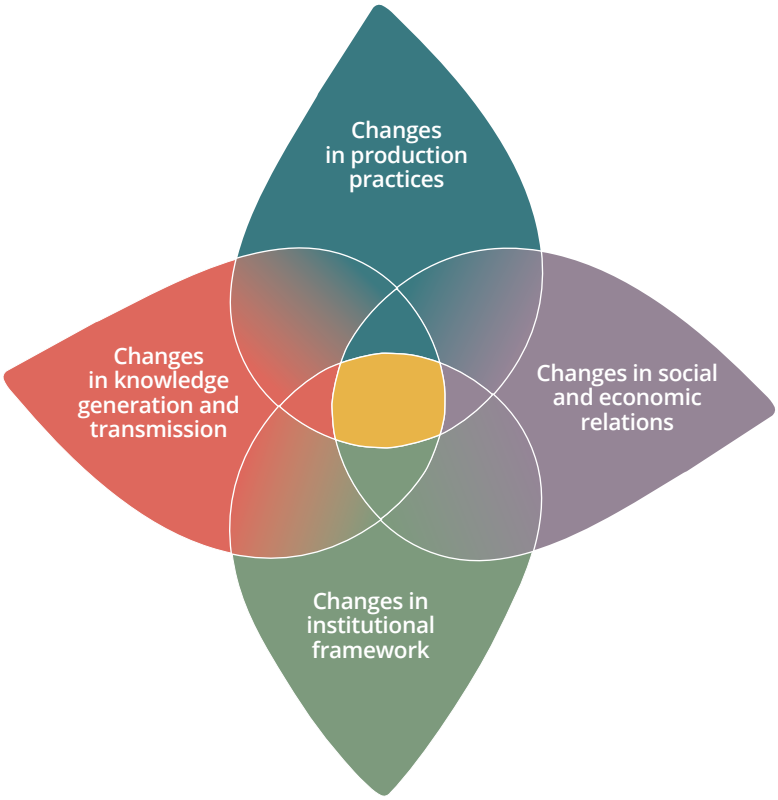
Most existing compendia of case studies (particularly those collected from the Global South) have focused on changes in agricultural practice, and do not systematically address other dimensions of change. At the same time, reports that focus more on the strategic scaling up of agroecology (Anderson et al., 2015; Duru et al., 2015; González de Molina and Caporal, 2013; IATP, 2013; Silici, 2014) seldom use real-world case studies to illustrate and test their hypotheses (with the important exception of Mier y Terán Giménez Cacho et al. (2018)).

FOUR KEY DIMENSIONS OF CHANGE

While shifts in production practice continue to be the most documented, the importance of change in multiple dimensions is nonetheless highlighted across the literature. In particular, four different dimensions of change emerge as key components of agroecological transition: changes in production practices, in knowledge generation and dissemination, in social and economic relations, and in institutional framework. The sub-sections below describe how these different dimensions of change feature in the literature, and why they are seen as crucial to transition. It is worth noting that the order in which the dimensions are presented below does not imply the order in which they must occur.

The four dimensions of change provide a basic analytical framework for the case studies in Section 3. The cases are brought together with a view to testing the relevance of the different types of change, understanding the different configurations in which they occur, and identifying the range of entry points and leverage points for transition.

FIGURE 3 - THE FOUR DIMENSIONS OF CHANGE: AN ANALYTICAL FRAMEWORK



i) Changes in production practices

As noted above, agroecological farming approaches are based around recycling and minimizing losses of resources and biomass; replacing chemical inputs with ecologically-based materials, practices, and processes; diversifying farms and farming landscapes; fostering their multi-functionality and optimizing biodiversity; and stimulating interactions between different species.

Gliessman's 5 Level Transition Framework (see Annex) highlights that changes in practices differ in their complexity and transformative potential. They can build on each other, for instance, when farmers start by substituting organic inputs for conventional ones before fundamentally redesigning their crop planting patterns. Basic changes in practices, e.g. input substitution, may be important for early adoption, given that they show relatively fast and visible results that may appeal to farmers. In turn, more complex agroecological management, which leads to a slower accrual of benefits and requires landscape-level coordination, may be more difficult to promote and tends to be introduced once farmers are already familiar with the basic concepts of agroecology and have been motivated by initial successes (Mier y Terán Giménez Cacho et al., 2018).

The agronomic changes that underpin agroecological transitions do not follow a universal recipe, and tend to be designed alongside broader social and economic considerations (see below). Transitions tend to be locally specific, reflecting the importance of territories as fundamental pillars of local food systems (Moraine et al., 2017; Wezel et al., 2016), as well as the importance that agroecological and food sovereignty movements place on collective rights, access to the commons, and autonomy in production, trading, and consumption of food items (Anderson et al., 2015; Pimbert, 2010).

ii) Changes in knowledge generation and dissemination

Shifts in how knowledge is generated and disseminated also feature prominently in the literature on agroecological transitions. The Declaration of the International Forum on Agroecology highlights that "the diverse knowledges and ways of knowing of our peoples are central" (Anderson et al., 2015, p. 3). Local culture and traditional knowledge about micro-regions and successful farming practices within them is highly valued in the agroecological framework, which aims to combine these insights with formal science and modern ecology (Silici, 2014).[7]

Various case study reports highlight that deep and ongoing engagement with farmers' knowledge and experience is necessary to pave the way for holistic agroecologically-managed production systems, which are highly knowledge-intensive and location-specific (AFSA, 2017, p. 82; Silici, 2014). Farmer-led, bottom-up innovation processes are seen as crucial to identify and spread the most appropriate farming practices (Anderson et al., 2015; Ecumenical Advocacy Alliance, 2012).

Empowering farmers to use and share their knowledge in innovative ways has allowed them to adapt techniques to local conditions and contribute to reflexive processes of scaling up and out (Silici, 2014, p. 18). Approaches of this type are characterized by dialogue between farmers, scientists and extension agents. In other words, they represent a rejection of the linear extension model in which knowledge is transferred from agents to farmers with little possibility for feedback and communication (Meek, 2016; Mier y Terán Giménez Cacho et al., 2018).[8]

New forms of knowledge generation and dissemination have been central to agroecological movements and transitions to date, taking the form of campesino-a-campesino (farmer-to-farmer) knowledge dissemination, farmer field schools, and farmer-led participatory research projects (Freire, 1973, pp. 95–97).

iii) Changes in social and economic relations

Wide-reaching shifts in social and economic relations also emerge as key components of agroecological transition. The Declaration of the International Forum on Agroecology states that "families, communities, collectives, organizations, and movements are the fertile soil in which agroecology flourishes. Solidarity between peoples, between rural and urban populations, is a critical ingredient" (Warner, 2008).

The emergence of new norms rooted in direct exchange, proximity, transparency, and ethical production and consumption – a shift from a global 'food from nowhere regime' to a 'food from somewhere regime' – has been emphasized as central to transition (Wezel et al., 2016, p. 139; Anderson et al., 2015).

The 'solidarity economy', involving the sharing of risks and benefits between producers and consumers, lies at the core of many CSA schemes and other transition initiatives (Anderson et al., 2015, p. 3). For some, agroecological transitions are characterized by the involvement and shared ownership of "a great diversity of stakeholders beyond farmers and consumers, such as actors in food chains (including food processing industries and marketing operators), actors from the voluntary sector (environmental or social organizations

7. As one participant of the Forum explained, "when it comes to agroecology, this is something that links peasant agriculture with the knowledge of the ancestors. And then there is scientific research. So we have to combine all this." (Jean-Baptiste Chavannes, Mouvement Paysan Papaye, from Haiti. In: Anderson et al., 2015, p. 7).

8. In *Extension or communication?*, Freire criticises the process of "depositing something in someone" and emphasises that "the real work of the agronomists (is) in their role of educators... they must refuse to 'domesticate' people. Their task is communication, not extension". See Freire, 1973: pp. 95–97.

at the community or the national level), and policymakers, funders, and implementers" (European CSA Research Group, 2016).

The strength of social ties and organizational capacity within farming/rural communities has also been identified as a key condition for transition. Authors highlight collective action as a core driver of change – and thus emphasize the need for farmers to have a high degree of social capital to work cooperatively in regional and landscape-level initiatives (Campbell, 2009).

Furthermore, agroecological transition frameworks frequently involve the development of a critical consciousness and politicization surrounding the underlying power structures in society (Silici, 2014). In Latin America, agroecology has been associated with peasant movements protecting indigenous and traditional production practices being encroached on by industrial agriculture.

Agroecology also ties into the holistic worldview of ecological and social balance embodied in concepts such as *Pacha Mama* and *Buen Vivir*. The grounding in local culture and social activism, and the degree of organization of the corresponding social movements, has been identified as a major driver of successful transitions (Mier y Terán Giménez Cacho et al., 2018).

Some case studies focused on Africa have also identified the importance of cohesive farmer organizations (e.g. emerging through collaborative farmer-researcher processes) in building the capacity for collective action, leading to shifts in input purchasing practices and other steps towards transition (Anderson et al., 2015, p. 7).

The impetus for social reorganization has sometimes been attributed to external organizations. Case studies from Africa and Asia have emphasized the role of external/international research institutions and NGOs in jumpstarting agroecological transition processes (Isgren and Ness, 2017; Oakland Institute, 2018) – although this may reflect the disproportionate role of international NGOs in documenting case studies, rather than the full reality on the ground. Indeed, many case studies are based on international development projects in which agroecological practices were introduced through training, workshops, and (less frequently) farmer-led participatory research (AFSA, 2017; IPAM, 2018; Oakland Institute, 2018).

However, in most reported cases to date, both the initial impetus for action as well as the subsequent development and expansion has strongly relied on local civil society actors (and their collaboration with researchers and, in some cases, international NGOs and governments).

iv) Changes in institutional framework

Lastly, a number of transition frameworks – notably the literature on transitions in socio-technical systems, also known as the multi-level perspective[9] – highlight the importance of changes in institutional frameworks and the development of alternative governance structures as key factors in shaping and accelerating transition processes.

A wide range of public policies set the underlying conditions and economic incentives for sustainable food systems to emerge. These include policies that secure access to land, water, forests, common property resources, and seeds; policies providing access to credit; supporting urban and peri-urban agroecological production, particu-

9. The multi-level perspective (Blesh and Wolf, 2014; Foxon et al., 2009; Geels, 2002; Geels and Schot, 2007; Wigboldus et al., 2016) conceptualizes socio-technical transitions as occurring on three levels: the niche, regime and landscape level. Innovative approaches and practices are likely to emerge in sheltered niches that favour their rise (and limited scaling) due to, for instance, project financing, dedicated consumer demand, or other beneficial conditions. Regimes, on the other hand, refer to "the constellation or system of interacting practices and structures that have come to a certain relative stability and status quo" (Wigboldus et al., 2016, p. 4) and may involve dominant configurations of infrastructure, markets, and technologies, underpinned by 'institutional logics' and supportive public policies. Landscapes, are the broadest and least dynamic level, involving worldviews, paradigms and cultures.

larly of small- and medium-sized enterprises; reorienting national and international trade policies to reverse the incentives for export-oriented monoculture; agreeing on the valuation and incorporation of externalities in national and international markets; or providing incentives for multi-functional agriculture and the provision of ecosystem services (ActionAid, 2012; Anderson et al., 2015ARC2020, 2015; Ecumenical Advocacy Alliance, 2012; Fitzpatrick, 2015; IATP, 2013; Silici, 2014; Vaarst et al., 2017; van Walsum et al., 2014; Watts and Williamson, 2015; Wezel et al., 2016). Mier y Terán Giménez Cacho et al. (2018, p. 17) identify the "reformulation and roll-back of policies supporting the reproduction of the agro-industrial model" as a key factor in supporting agroecological transition.

Examples of supportive national policies for agroecology have been few and far between.[10] In an overview of sustainable agriculture transitions in Europe, active policy intervention was observed in several cases, although "some demonstrate that transition processes can occur endogenously without such assistance" (Sutherland et al., 2015, p. 2). The CSA movement in turn is mainly self-organized without considerable policy involvement (European CSA Research Group, 2016).

Meanwhile, the majority of cases in the Global South have taken place under neutral or adverse policy conditions for agroecology. Some commentators have suggested that the ineffectiveness of state policies actually creates room for action, in the context of the "NGO-ization" of public service functions. For instance, one case study presented by the Oakland Institute noted that "the so-called crisis in Zimbabwe has actually opened a lot of space for farmer-led innovation at the local level" (Oakland Institute, 2018).

In some rare cases, governmental policies have played a decisive role in supporting agroecological transitions, e.g. by incentivizing crop diversification in Zambia, or by spreading agroecological advice through governmental extension services in Malawi (Oakland Institute, 2018). In other cases, governments have reacted supportively to emerging farmer-led agroecological movements (Mier y Terán Giménez Cacho et al., 2018).

At the global level, policy openings are emerging. As described above, the FAO is placing an increasing emphasis on agroecology as a systemic solution. The African Union's Ecological Organic Agriculture initiative is also highly promising (EOA-I, 2017).[11] This initiative was successfully piloted in 2012/2013 in six countries (Ethiopia, Kenya, Nigeria, Tanzania, Uganda, and Zambia), and represents a landmark commitment from African leaders in terms of support for sustainable agriculture.

The transition literature draws attention to the importance of broader institutional frameworks and regimes. Wigboldus et al. (2016) highlight both push- and pull-mechanisms that may be at work, depending on whether the regime is conceived as a type of 'iron dome' that has to crack open to allow for the scaling of new practices (the 'push approach'), or conversely is seen as a 'magnet' that attracts and stimulates the emergence of appropriate new innovations (the 'pull approach'). Recognizing this, Duru et al. (2015) call on agroecological transition researchers to focus their attention on infrastructures, policies and institutions in favour of innovation; Meek (2016, p. 279) draws attention to "social processes constituting the external structures that condition and contain the actions of agents", and Vaarst et al. (2017) highlight important links between agroecology and fundamental environmental, ethical, political, and governance-related questions.

10. Policies in support of agroecology have been increasingly developed and documented over recent years; opportunities on this front are discussed in Section 4.

11. The latest strategy from the EOA, and its congruence with the Sustainable Development Goals, is developed in the EOA Strategic (EOA-I, 2015a) and Action Plans (EOA-I, 2015b).

Data collection on experimental plots by UCSC team. Swanton Berry Farm, California.

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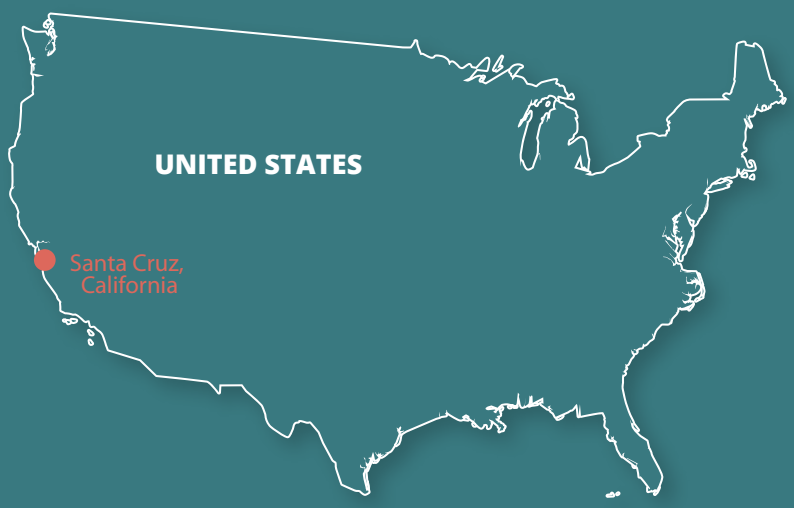

Turning strawberry monocultures into sustainable food and farming systems through a 30-year farmer-researcher partnership

3.1 SANTA CRUZ, CALIFORNIA, USA

In the early 1980s, after years of farming with agro-chemicals, Jim Cochran of Swanton Berry Farm in Santa Cruz, California, decided to try farming strawberries organically. At the same time, at the University of California at Santa Cruz (UCSC), agroecologist Steve Gliessman founded the UCSC Agroecology Program with a focus on researching alternative farming systems. The collaborative, multifaceted research project that followed over the next 30 years demonstrated that organic strawberries could be grown successfully, ultimately providing impetus for the strawberry industry to shift a significant portion of its production to organic management.

The transition occurred on the central coast of California, where the Mediterranean climate has made it a key world region for strawberry production. Like in many settings, the region's conventional strawberry production is highly dependent on expensive, energy-intensive, and environmentally harmful synthetic inputs.

In the early 1980s, farmers started responding to rising market interest in organic food, and growing attention to the issues of pesticide safety and environmental protection. Yet the idea of departing from the conventional model was considered radical, and when Cochran and Gliessman teamed up, many people in their immediate environment thought that the research would only show why the conversion would not work, and why it was impossible to grow organic strawberries commercially.

The project was rooted in redesigning strawberry production systems into more sustainable agroecosystems in which fumigation is no longer required. A series of stepwise changes in production practices were introduced, evolving from simple input substitution to comprehensive, system-wide redesign, based around sophisticated crop rotations and 'push-pull' pest management techniques. These steps reflected the evolution of the project as a farmer-researcher partnership, with research questions emerging out of the changes on Cochran's farm.

A series of increasingly ambitious innovations have also occurred on the social front and played an essential role in sustaining and advancing the transition. An alternative direct sales network has emerged around the farm, while an increasing focus on workers' rights has culminated in Swanton Berry Farm's attainment of the Food Justice Certification.

With organic now occupying a substantial foothold in the market, the California strawberry industry stands at a crossroads. A national ban on the use of the key fumigant (methyl bromide – MeBr) was originally proposed in 2005, and finally came into effect in 2017. This has stimulated research on alternatives, from organic management systems to other acutely toxic chemicals. Market developments have also proven double-edged. As more growers have learned how to substitute organic for synthetic inputs, competition has increased, and the sector has consolidated into the hands of fewer and larger players, with problematic implications for sustainability.

CHANGES IN PRODUCTION PRACTICES

Monterey and Santa Cruz counties account for about half of the total California strawberry crop, producing more than $953 million worth of strawberries on 13,063 acres in 2016 (Monterey County Agricultural Commissioner, 2016; Santa Cruz County Agricultural Commissioner, 2016).

The system of industrial/conventional strawberry production in California can be traced back to the early 1960s, when MeBr was intro-

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Releasing predator mites onto an organic strawberry field. Watsonville, California.

duced (Wilhelm and Paulus, 1980). Until that time, growers treated strawberries as a perennial crop, with each field requiring rotation out of strawberries for several years. The use of MeBr allowed growers to manage strawberries as an annual crop by planting the berry plants year after year on the same piece of land, removing them at the end of the growing season in late summer or early fall, and then cultivating and fumigating the soil before replanting them for the next season. Intensive systems of drip irrigation, plastic mulch, and soil manipulation were required.

The first efforts at improving input use efficiency and safety on Swanton Berry Farm, carried out before the involvement of the Agroecology Research Group, were focused as much on increasing yields and profitability as on changing the nature of the production system. In parallel, extensive research was being carried out by researchers in the UC Land Grant system (i.e. UC Davis and UC Berkeley) to find more effective ways of controlling common pests (such as the two-spotted spider mite) and diseases that kept evolving resistance to synthetic chemicals, as well as reducing the environmental impacts of those treatments.

It was in this context that researchers at UC Santa Cruz, headed by Steve Gliessman, formed a partnership for organic conversion of strawberry production with Jim Cochran. The farmer-researcher collaboration was underpinned by a clear vision of agroecological transition[12]. The changes implemented on Swanton Berry Farm evolved over time from simple input substitution to more comprehensive and systematic innovations.

In 1987, this partnership became a comparative strawberry conversion research project. For three years, strawberries were grown in plots using conventional inputs and management alongside strawberries grown under organic management. In the organic plots, each

12. In particular the first three levels of Gliessman's Five Levels Transition framework (see Annex).

conventional input or practice was substituted with an organic equivalent – for instance, synthetic miticides were replaced with beneficial predator mites, and ideal release rates were established (Gliessman et al., 1996).[13]

After the three-year comparison study, researchers continued to observe changes and the farmer continued to make adjustments in input uses and practices. Soil-borne diseases producing root rot were particularly problematic, and triggered a number of experimental innovations.[14]

Even as input substitution approaches were refined, it became clear that the system of monoculture itself was the root cause of some of the most intractable problems. It was at this stage that a whole-system approach was adopted. This meant returning to the crop rotations that had been used before the appearance of MeBr.

The researchers used their knowledge of ecological interactions to redesign the strawberry agroecosystem in a way that nurtured diversity and complexity. Rotations needed to become more effective, and in some cases, shorter (Shennan et al., 2016). And rather than rely on biopesticides, which still had to be purchased outside the system, redesign approaches were focused on incorporating natural control agents into the system and keeping them active on a continuous basis.

For example, mustard cover crops were used to reduce weeds and diseases by releasing toxic natural compounds.[15] 'Push-pull' techniques were also applied, based around the intercropping of alfalfa rows to draw harmful pests away from strawberry plants and facilitate targeted treatments.[16]

Changes in production practices therefore occurred through a step-by-step process, moving from the substitution of conventional inputs with more efficient and less noxious ones, to substitution with organic inputs and alternative practices such as Anaerobic Soil Disinfestation, and finally to a reorganization of cropping patterns to allow for agroecological push-pull pest management.

13. Different miticides for control of the common pest two-spotted spider mite (Tetranychus urticae) were tested with the goal of overcoming the problems of evolving mite resistance to pesticides, negative impacts on non-target organisms, pollution of ground water, persistent residues on harvested berries, and health impacts for farmworkers (Sances et al., 1982). Rather than control the two-spotted spider mite with a miticide, beneficial predator mites (Phytoseiulis persimilis) were released into the organic plots. Over the three-year conversion period, population levels of the two-spot were monitored, releases of the predator carried out, and responses quantified. By the end of the third year of the study, ideal rates and release amounts for the predator—now the norm for the industry—had been worked out (Gliessman et al., 1996).

14. Further research to substitute for MeBr fumigation is still underway with a practice called Anaerobic Soil Disinfestation (ASD). This approach incorporates different sources of organic matter, from broccoli crop residue to mustard seed cake, into the soil, floods the soil with water, then covers the soil with an impermeable plastic tarp. The combination of anaerobic conditions and breakdown products of the organic matter fulfil the same function as MeBr, but with materials accepted by organic certification standards (Shennan et al., 2010).

15. Mustard cover crops were tested for their ability to allelopathically reduce weeds and diseases through the release of toxic natural compounds. Broccoli has been shown to be very important as a rotation crop since it is not a host for the Verticillium disease organism, and broccoli residues incorporated into the soil release biofumigants that reduce the presence of disease organisms (Muramoto et al., 2014). Other crops that are not hosts for the disease have also been successfully used in rotation with strawberries, such as spinach, peas, and artichokes.

16. Because the western tarnished plant bug (Lygus Hesperus) is a generalist pest, it is very difficult to control through input substitution. By replacing every 25th row in a strawberry field with a row of alfalfa (approximately 3% of the field), and then concentrating control strategies on that row (such as vacuuming or biopesticide application), it was possible to reduce Lygus damage to acceptable levels (Swezey et al., 2013). Alfalfa rows have also proved effective as reservoirs of beneficial insects for better natural pest control.

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New environmental challenges may need to be addressed in the coming years, as growing conditions across the region are threatened. Soil erosion and nutrient leaching have been observed in large organic strawberry monocultures (Derouin and Hiolski, 2017; RCDMonterey, 2015), while groundwater depletion and saltwater intrusion into aquifers in strawberry growing regions is occurring (Hanson, 2003; Walton, 2015).

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

The innovations described above were underpinned by a novel form of farmer-researcher knowledge generation enabled by the UCSC Agroecology Program. From the beginning of the partnership, research questions arose directly from challenges in the field, while the hypotheses, methods, and implementation were established in collaboration.

Knowledge was treated, *de facto*, as something that needed to be regularly adapted to ecological and economic conditions, with the partners taking stock of progress and outstanding problems at the end of the three-year conversion period.

As weeds, pests, beneficial insects, soil organisms, soil chemical and physical conditions changed through the diversification process, it became evident that production systems would need to be further redesigned to include crop rotations and trap crops. This observation came not only from agroecological research, but also from 're-learning' practices (e.g. traditional crop rotations) used before the advent of MeBr.

The dissemination of new knowledge – e.g. on the ideal rates and release amounts of beneficial predator mites, or on intercropping alfalfa as a trap crop for the western tarnished plant bug – occurred both through traditional scientific journals and through informal interactions with other strawberry growers in the region. Following discussions with Cochran and UCSC researchers, and as the commercial viability of organic strawberry farming became apparent (see below), many farmers adopted the input substitution changes pioneered at Swanton Berry Farm

The emergence of a local market for organic strawberries was also contingent on disseminating knowledge and building relationships with consumers. Visitors to Swanton Berry Farm, including school groups, can now follow a self-guided tour that tells the full story of the strawberries from field to market.

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

The new production model described above had to be made economically viable. During the first two years of conversion, non-renewable input costs associated with pesticides, fertilizers, and fuel were lower than for conventional production systems, although the organic system required more hours of mechanical weeding by tractor and longer picking time per unit of production, leading to higher labour costs (Gliessman et al., 1996).

Cochran started selling organic berries at about a 50% price premium to local markets: this price differential permitted a positive profit margin, despite lower production levels. By the third year, leaving the plants in the ground saved approximately $288/acre of cultural labour costs in the conventional production system, and $1,717/acre in the organic system. Mulching the beds with black plastic immediately after pruning eliminated the need to hand weed the organic plots, which accounted for most of the savings. Leaving the plants for a second year also saved money in field ma-

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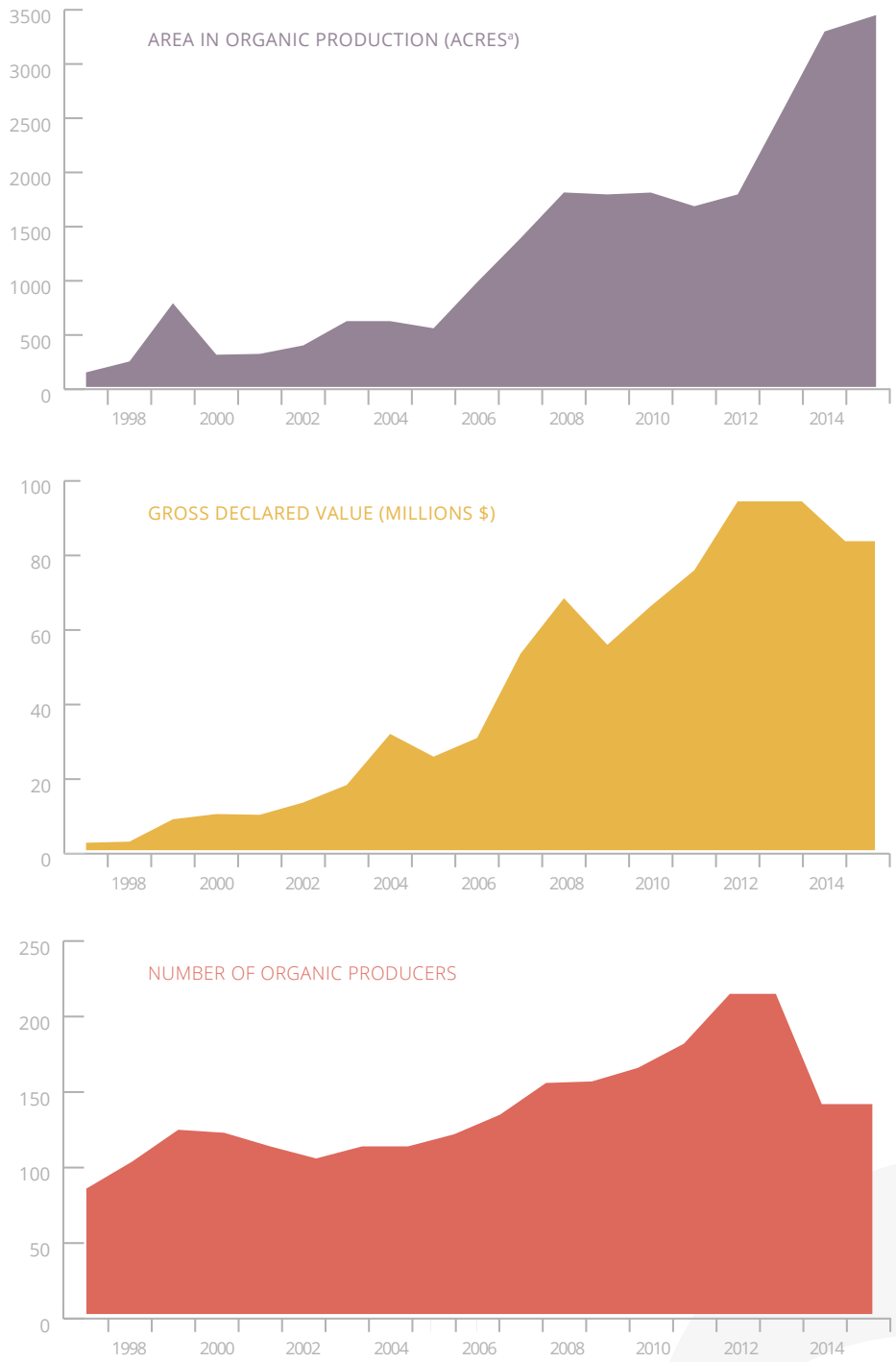
FIGURE 4 - CHANGES IN ORGANIC STRAWBERRY PRODUCTION IN CALIFORNIA, 1997-2015

(Data source: California Department of Food and Agriculture, 2018; California Strawberry Commission, 2018)



[a]Acreage may tend to be an over-estimate since it may also include fallow or unplanted land set aside for future plantings.

terials and power – approximately $3,648/acre in the conventional system and $3,032/acre in the organic system.

Nonetheless, adaptive strategies were required to maintain economic viability over time. As more – and larger – growers began to implement input substitution practices (see Figure 4), the farm's normal wholesale outlets became more difficult to maintain.

In response, the farm decided to sell organic strawberries directly to consumers at farmers' markets in order to capture a larger percentage of the sales price. Additional direct marketing approaches were later adopted, including on-farm U-Pick and a farm stand for fresh strawberries and value-added products like pies and jams.

Through these channels, a committed network of consumers has emerged, made up of customers who know Cochran, know his organic system, and know how his farm values the people who work there and the land they work on.

Meanwhile, students at the UCSC campus convinced the campus dining service managers to begin integrating local, organic, and fair-trade items – including Swanton Berry Farm's organic strawberries – into the meal service.

The relationship between the farmer and his workers has also changed dramatically over the years. Since organic strawberry production usually requires more labour, issues of worker health, safety, immigration status, and pay equity came to the fore.

In 1998, Swanton Berry Farm was pioneering in its willingness to sign a contract with the United Farm Workers (UFW) union, guaranteeing wage, health, and vacation benefits. Going well beyond the average relationship between growers and workers, the contract was established with a view to allowing workers to see themselves as professionals rather than as 'cogs' in a system. In 2014, Swanton Berry Farm was one of the first two farms to achieve the 'Food Justice Certification'.[17]

Over time, the profitability of organic strawberry production has drawn in bigger players such as Driscoll's, and led to increasing farm size in the area. In 2016, the total farmgate revenue from organic farming in California's two strawberry-producing central coast counties was more than $480 million (Monterey County Agricultural Commissioner, 2016; Santa Cruz County Agricultural Commissioner, 2016). By 2016, organic-certified acreage was more than eight times higher than in 1997 in these two counties, compared to a threefold nation-wide average increase of organic acres over the same period (USDA, 2018).

Recent ballooning of the organic strawberry supply has led to market saturation and price crashes. These changes have only deepened the incentives for small growers to focus on local and direct marketing strategies, and to diversify their production, as many have been shut out of mainstream markets. As described above, environmental threats are also arising from large-scale strawberry production, and may also threaten yields and profits across the sector in the coming years.

17. The Food Justice Certification protects workers' rights under the farm certification (including transparent contract specifications, clear conflict resolution processes, rights to freedom of association and collective bargaining, preference for direct hiring of farm workers, safe and adequate housing, health and safety protections, regular and timely payments, sick leave and parental leave, and compensation sufficient to pay for childcare) and farmers' rights under the buyer certification (including fair, transparent and equitable negotiations and pricing with minimum price fairness protection, timely payments, profit sharing, long term relationships with farmers, and the prohibition of the termination of contracts without just cause). For more information see: www.agriculturaljusticeproject.org

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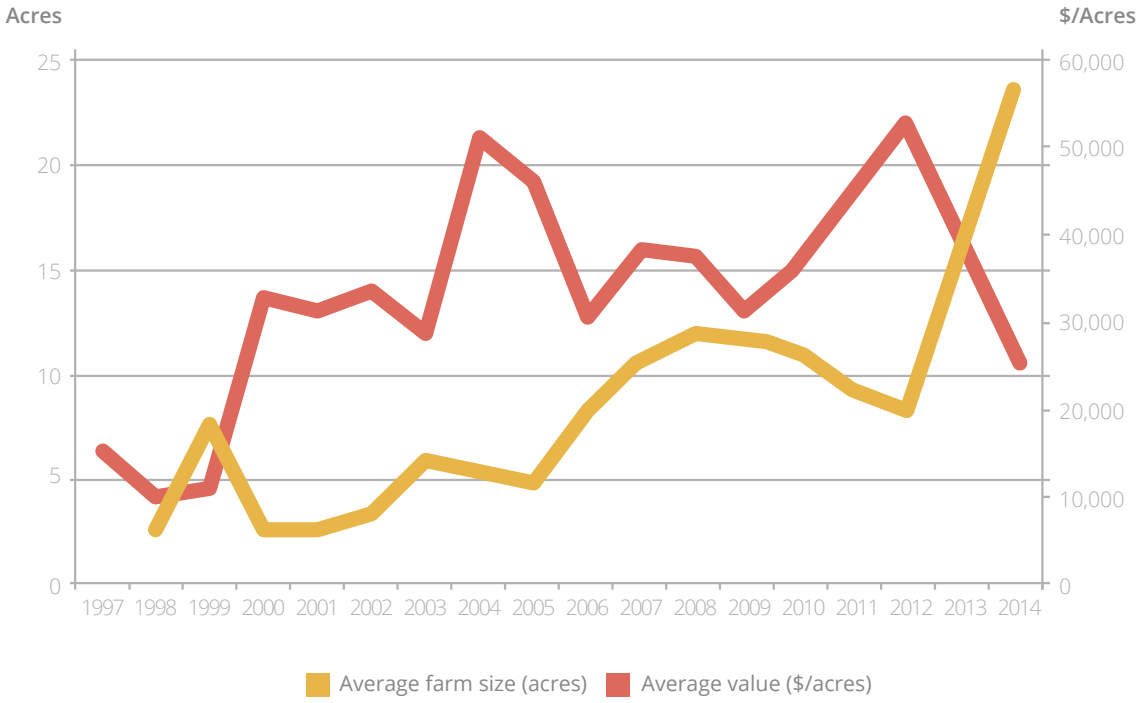
FIGURE 5 - ORGANIC STRAWBERRY PRODUCTION IN CALIFORNIA

(Data source: California Department of Food and Agriculture, 2018; California Strawberry Commission, 2018)



CHANGES IN INSTITUTIONAL FRAMEWORK

Funding for the initial three-year conversion project between Swanton Berry Farm and UCSC's Agroecology Program came from the UC Sustainable Agriculture Research and Education Fund (SAREP). This Fund was established in 1985 under new state legislation, mandating the University of California system to develop a grants program in support of small farm systems and farm labour.[18] Institutional incentives from the state legislation and public education infrastructure therefore opened up space for the intensive co-learning process to evolve.

A second significant change in the institutional conditions was the regulatory ban of MeBr, which reduced farmers' conventional management options and raised their interest in seeking alternatives. The time that elapsed from the proposal to ban MeBr in 2005 to its implementation in 2017 allowed for substantial experimentation to occur, paving the way for alternative models to be calibrated and substitution costs to fall.

Institutional changes of relevance also occurred in regard to organic certification, with double-edged implications for agroecological innovation. The demand for organic food in the US has steadily risen, alongside formalization of organic certification following the 1990 Organic Food Production Act.

On the one hand, the rise of the USDA organic

18. The UC Sustainable Agriculture Research and Education Fund (UCSAREP). For more information see: asi.ucdavis.edu/programs/sarep

3.1 SANTA CRUZ, CALIFORNIA, USA

Introduction of alfalfa strips into strawberry fields. Watsonville, California.

label is seen to have improved the quality assurances offered to consumers, protecting them against the (possibly fraudulent) proliferation of private organic labels (Vos, 2000). On the other, authors have argued that certification and labelling has paved the way for the 'conventionalization' of organic production and a gradual watering down of standards, with ever more non-organic input substances permitted for organic production (Arcuri, 2014; Guthman, 2004; Jaffee and Howard, 2010).

Given the difficulties smaller growers are now confronting in the face of multinational competitors, it would appear that current institutional frameworks and policies – including the organic certification process – are not doing enough to support those seeking to fundamentally redesign their production systems.

Jim Cochran, farmer and owner of Swanton Berry farm, openly provided information on his farm and reviewed an early draft of this case study. Steve Gliessman was his research partner while on the faculty at UCSC's Department of Environmental Studies where he began the UCSC Agroecology Program. Joji Muramoto, a researcher in agroecology at UCSC, provided much of the recent data on strawberry production in California and information on new lines of research, some of which is being carried out in partnership with Jim Cochran.

Photo: CAN

Community youth group workshop on bio-fertilizer production. San Ramón, Nicaragua.

SAN RAMÓN NICARAGUA
VERACRUZ MEXICO

Breaking away from industrial commodity production in Central American coffee-growing communities

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

In the late 1990s, with coffee prices plummeting and a handful of multinational buyers able to set prices, coffee growers around the world found themselves in crisis (Bacon et al., 2008). In many regions, farmers planted more coffee in an attempt to increase their incomes, reducing or eliminating the crops that previously provided local food security. In Nicaragua, coffee farmers and their families experienced severe hunger (Bacon et al., 2014).

It was into this environment that researchers from the Environmental Studies Department at the University of California at Santa Cruz (UCSC) established a new non-profit organization: the Community Agroecology Network (CAN).[19] In 2011, the NGO joined forces with local organizations in smallholder coffee-growing communities in San Ramón, Nicaragua, and Veracruz, Mexico. Together they launched a project to accompany the communities through a transition to reduce dependency on export-oriented industrial commodity production.[20]

The project was rooted in participatory exercises to harness local experience, experimentation, and knowledge. As the project fostered both positive and negative results, the partner communities developed greater ownership of the change process and adapted their approaches along the way in response to evolving challenges. After five years of participatory interaction, learning, and monitoring, coffee-growing communities in San Ramón and Veracruz have been able to transition towards sustainable food systems in a variety of ways.

The project built immediate resistance to diseases afflicting coffee crops through agroecological practices, while diversifying production in order to build resilient livelihoods over the long-term. It also built the capacity of women and youth in the communities. Through the project, a new coffee export brand emerged built on long-term relationships, predictable demand, and price premiums well above Fair Trade or organic prices.

These integrated approaches allowed San Ramón and Veracruz to increase food security, improve overall nutrition, and reduce the 'thin months' (*los meses de las vacas flacas*), helping to create a viable future in coffee production for the next generation. Furthermore, the project paved the way for local stakeholders, particularly the cooperative movements in Nicaragua and Mexico, to become important political actors and advocates of institutional change.[21]

The transition initiatives in San Ramón and Veracruz — which linked household nutrition, local food production, building alternative markets (locally and globally), diversification, improving natural soil fertility, and empowering community members — underline the benefits of casting the net wide in order to build sustainable food systems.

19. CAN has been actively working for seventeen years in Mexico and Central America, using an agroecological approach to foster food systems change. For more information, see: www.canunite.org.

20. The 'Youth Leadership and Education for Sustainable Agriculture and Food Sovereignty Project' (Youth Leadership & Food Sovereignty for short) was launched in 2011 as a collaborative initiative of the Community Agroecology Network (CAN), the Union of Cooperatives San Ramón (UCA San Ramón) in Nicaragua, and the local NGO Vinculación y Desarrollo Agroecológico en el Café (VIDA) in Mexico, funded by Keurig Green Mountain and individual donors.

21 The cooperative movement in Nicaragua was rooted strongly in the Sandinista resistance during the years of conflict, and flourished after the Peace Accords. Central and Latin America in general has a long history of cooperativism that has been well documented in recent studies, and provides an important basis for agroecological transitions for food security and food sovereignty (ICA, 2017; Leindecker and Fox, 2016).

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

Woman in her own home garden. San Ramón, Nicaragua.

CHANGES IN PRODUCTION PRACTICES

The project was focused on coffee farming families and cooperatives in eight communities in San Ramón, Nicaragua, and with four community groups in Veracruz, Mexico. At the outset of the project, the communities were experiencing many of the challenges faced by smallholder cash crop producers around the world, including seasonal food insecurity.

Following participatory knowledge-generating exercises (see below), a series of 'action plans' were developed to focus on diversification of production in order to improve both household dietary diversity and women's income options. The project thus began with capacity-building activities in agroecological food production, the establishment of home gardens, the reforestation of coffee plantations with fruit, wood, and fuel trees, and diversification into chicken and egg production. Steps were also taken to find outlets for this produce via farmers' markets.

The beginning of the second project phase in 2013 coincided with the onset of a severe coffee rust disease known as *la roya*, followed in 2014 by a two-year drought in Northern Nicaragua and reduced rainfall in Veracruz that severely impacted food production. These shocks reinforced participants' understanding of the positive mitigating effects of the agroecological strategies being promoted, and reinforced the project's focus on climate resilience and sustainable livelihoods. However, they also made it harder to convince people to take on new risks and move into uncharted territory.

For example, participating farmers proved particularly risk averse in regard to soil practices. Growers in one cooperative recognized the necessity to improve organic soil fertility, and considered supporting a composting project to produce compost from local resources. However, they remained hesitant despite having participated in farmer-to-farmer exchanges with communities already engaged in similar soil building projects.

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

After extensive dialogue between CAN researchers, youth leaders, and cooperative extension agents in Nicaragua, a group of women farmers stepped forward and convinced their male counterparts to invest in buying natural materials and inputs (raw flour, molasses, rock minerals, etc.) for making artisanal fertilizers, as well as culturing fungi in leaf litter from the mountains above their communities to make foliar sprays for disease suppression. At about 10% of the cost of conventional fungicides and fertilizers, the new practices enhanced disease resistance and paved the way for speedy recovery from the disease outbreak (CAN, 2015a).

The efficacy of agroecological soil health and plant nutrition techniques became evident one year after they had been applied to vegetable gardens and coffee had been replanted with seedlings; the new coffee plants were robust and started to fruit after only 17 months in the ground. Following successful experimentation in the pioneering cooperative, CAN and the Union of Cooperatives (UCA) San Ramón facilitated a process of horizontal exchange so that the other seven cooperatives engaged in the project could learn the same techniques.[22]

A similar process unfolded in the Central Highlands of Veracruz, where CAN researchers, working with the local NGO Vinculación y Desarrollo Agroecológico en el Café (VIDA), performed a full diagnosis of the impact of la roya on the coffee parcels of 151 farmers in 2014, as well as an inventory of agroecological practices already being used. They subsequently identified twelve soil fertility improvement applications and other agroecological techniques including mineral foliar sprays, and began implementing farmer-to-farmer learning exchange workshops.

Since *la roya* fully hit the Veracruz region approximately eighteen months after it hit Nicaragua, farmers are still in the process of implementing recovery and resilience-building measures. These include agroecological soil building and plant nutrition practices to protect seedlings against the rust and other infestations like anthracnose.

Seed availability has arisen as a potential obstacle to shifting production practices. However, when it was found that there were no local sources for seeds or that people were not saving seeds in San Ramón, a system of seven cooperative-level seed banks was developed to facilitate the collection, storage, and distribution of basic grains seed.

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

The first step in the project was a comprehensive baseline study of food insecurity and household livelihoods, and the creation of a participatory monitoring and evaluation system. Subsequently, the project was built around Participatory Action Research (PAR) cycles to develop action plans in line with the ideas and expectations of the local partners.

Horizontal farmer-to-farmer and cooperative-to-cooperative learning exchanges were central to the project, for example in regard to spreading knowledge on agroecological soil fertility techniques. As agroecologists, CAN re-

22. The exchanges included capacity building through the development of nine different soil and foliar applications, including compost, worm compost, effective microorganisms, biofertilizers and mineral foliar applications for both food and coffee production areas. Investments were made in barrels and other equipment to allow groups to produce the fertilizers and preparations collectively where appropriate.

searchers had an understanding of sustainability and alternative farming practices and designs. As farmers, the community members had generations of farming experience and understanding of their local environment. These 'ways of knowing' came together in a transdisciplinary and mutually-respecting approach to knowledge. Trust and transparency were built, for example, through joint observation and monitoring exercises; project partners taught local youth to record and analyze data. Findings were shared, discussed, and used to take new steps, try alternative management practices, and begin diversifying and redesigning farms.

New and creative ways of spreading knowledge were also developed in response to emerging obstacles to the transition process. For instance, the home gardens initially faced many challenges. At first, people were not eating the food they were growing, and were feeding the produce to their pigs instead.

In response, a series of nutrition workshops were developed and led by local women and youth. In Veracruz, a cookbook of traditional and innovative recipes was also produced by community members, promoting dietary diversification and providing hands-on advice on new ways to feed one's family.[23] Meanwhile, when issues with seed availability arose in San Ramón, families were trained in household seed saving techniques for vegetable and fruit seed and reproductive material, in addition to the creation of cooperative seed banks described above.

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

Coffee farming faced a major crisis in the 1990s. The International Coffee Agreement – which had maintained global price levels and governed coffee exports – expired in 1989, prompting wide fluctuation in coffee supplies and prices. Meanwhile, the industry was consolidating, with five transnational corporations accounting for more than 70% of the world coffee market by the mid-2000s (Bacon et al., 2008). This market power increased their ability to consolidate supply chains and dictate purchasing conditions. By the early 2000s, prices paid to farmers fell below the cost of production, such that farmers could not even afford to harvest their coffee.

In San Ramón, households only had adequate access to food for seven months of the year. Diets were highly uniform, with only 12% of households consuming more than six food groups daily – reflecting broader trends across Nicaragua. People struggled to feed their families for at least four months per year, between the time when coffee harvest income ran out and the grain harvest began – the 'thin months' (Bacon et al., 2014). Food security was also a concern in Veracruz: Mexican coffee-producing families experienced two 'thin months' per year.

Given limited domestic consumption of coffee in producing nations such as Nicaragua and Mexico, CAN focused on shifting socio-economic relations and developing new coffee export supply chains in order to generate cash income for farmers, alongside steps to diversify production. In a first phase, CAN-affiliated researchers working in these communities found that approaches based solely on finding higher value markets (e.g. via certified fair trade or organic premiums) did not

23. For an example of these cookbooks, see: http://www.canunite.org/wp-content/uploads/2015/03/VeracruzCookbook.png

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

FIGURE 6 - IMPACTS OF TRANSITION IN SAN RAMÓN & VERACRUZ[1]

(Data source: Putnam et al., 2016; CAN, 2015a)

INDICATORS OF CHANGE	2011	2012	2013	2014	2015
SAN RAMÓN					
Months of adequate provisioning	7.37	7.3	8.12	9.76	9.7
Length of "thin months"	4.63	4.7	3.88	2.24	2.3
Dietary Diversity Score[2]	-	6.61	7.84	7.06	7.46
% households consuming more than 6 food groups daily	12%	83%	100%	83%[3]	82%[3]
Coping Strategies Index (CSI)[4]	16.83	10.98	17.53	15.08	8.14
VERACRUZ					
Months of adequate provisioning	No data	10	10	9	10
Length of "thin months"	No data	2	2	3	2
Dietary Diversity Score	-	6.9	6.86	7.3	8.5
% households consuming more than 6 food groups daily	-	100%	84%	94%	100%
Coping Strategies Index (CSI)	No data	20	24,35	9.3	4.4

1. *Based on 95 households in eight communities in San Ramón (Nicaragua), and 139 households in four communities in Veracruz (Mexico).*
2. *Dietary Diversity Scores based on the number of food groups consumed during a given time period, with 12 food groups used as a foundation (based on methods reported in Swindale, & Bilinsky (2006).*
3. *These slightly lower numbers can be explained by the drought, which affected some families in the sample who had less access to water to irrigate their gardens.*
4. *CSI=Coping Strategies Index= this score measures the variety of behaviors that people implement to cope with scarcity. Lower score means the usage of less severe strategies or less frequency use of strategies, hence less scarcity. Strategies based on activities described in Levels 1-4.*

reduce vulnerability. Even as coffee prices picked up, CAN found that farmers continued to face seasonal hunger and food insecurity.

In response, a branded agroecological coffee called AgroEco® Coffee was developed, based on involving the key stakeholders of a much-shortened coffee commodity chain in a new collaborative process. Rather than providing a certification, the brand is based on a commitment among suppliers to transition to an agroecological production model. A price-setting process was developed for AgroEco® coffee based on shortening the commodity chain and bringing

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

Baristas of women owned-coffee shop using beans grown by local women's cooperative. San Ramón, Nicaragua.

all relevant voices to the table. Farmers received a base price for their coffee that exceeded the premium for fair trade or organically certified coffee. An additional 5% of the price paid by the roaster goes to a "Sustainable Agriculture Fund" to finance coffee innovation projects decided upon by the communities themselves.

A highly targeted customer base has been built around Café AgroEco®, including institutional and individual purchasers.[24] Building on initial advances, the project collaborators decided to return to the bargaining table. With buyer, importer, cooperative leaders, CAN, and men and women farmers all present, a second fund was created, the Women's Unpaid Labour Fund, which added another 4% to the price of the coffee, to be invested in initiatives led by the women themselves.

This relationship has continued through the 2017/18 harvest. Today, AgroEco® coffee continues to provide a premium of at least 15% beyond Fair Trade certified, thanks to the 4% premium paid into the Women's Fund, 5% to the Sustainable Agricultural Fund, and an additional 5-6% premium paid by the roaster. AgroEco® coffee's approach to value chain integration and institutional strengthening further represents best practices in ensuring that alternative coffee brands actually provide livelihood benefits (c.f. Bray and Neilson, 2017; Méndez et al., 2010).

In Nicaragua, the women's group decided to invest their fund in the agroecological renovation of 0.5 hectares in each of their family coffee parcels. Since then, the women have expanded their agroecological coffee plots to a total of

24. The customer base is comprised of: i) the dining halls of UC Santa Cruz, through a long-term contract to purchase CAN coffee in solidarity with the NGO's work; ii) consumers who visit the cafés of Santa Cruz Coffee Roasting Company (SCCRC), which has an agreement to source from the growers in Nicaragua and Mexico; and iii) individual consumers who subscribe to SCCRC to establish a standing order for delivery of AgroEco® coffee. For the 2013/2014 harvest, the brand moved 25,000 pounds of coffee beans from the farmers in Nicaragua to consumers, and 18,000 pounds of coffee from Mexico.

approximately ten hectares, and men and women gather every two weeks to make organic fertilizers to support the process.

In Mexico, the women's group invested the premium in the development of a branded coffee, FEMCAFE, to be sold locally and via direct sales throughout Mexico, and investment in a roasting facility. In 2016/2017, five years after initiating FEMCAFE, the women were able to export a shipping container of unroasted beans to the US.[25] However, the greatest returns have come through the roasting facility. For the 2016/17 season, the equivalent of almost four containers of coffee was sold to a solidarity network of women in cities across Mexico via a passenger bus-based shipping service. Most of the value added goes back to the women and their communities – not to distributors in the middle of the chain.

Enabling local social organizations to build capacity, share knowledge and build shared ownership was an essential ingredient of the project from the outset. In particular, steps to empower youth and women were prioritized: a youth- and women-centred methodology was employed, as well as targeted training programs. Fundamental changes in culture and custom were required in order to create the conditions for women to take the lead, and be rewarded, in key steps towards meeting the project's goals, e.g. installing home gardens, planting coffee plots, and building a café and farm store in a nearby urban centre.

Even as the first home gardens flourished and the farmers' markets allowed women to generate additional income, CAN, the UCA San Ramón, and VIDA sought to further strengthen women's access to capital, since it was evident that women were contributing more labour to coffee production (and other agricultural and household tasks) than they were being compensated for.

Capacity-building and broad ownership of the project proved essential in keeping it moving forward as challenges emerged. For example, in the absence of formal markets for the vegetables produced in home gardens, the cooperatives established monthly farmers' markets in the nearby municipal centre of San Ramón, and a group of women set up a café to sell their coffee and surplus fruits and vegetables directly to consumers.

As Don Pedro, a farmer from La Pita, noted during an exchange about halfway through this five-year project: "When you first came to our community, you said that we had in our own hands what we needed to change. We did not understand what you meant at that time. But now we do. And we are making the change happen."

CHANGES IN INSTITUTIONAL FRAMEWORK

While the impetus for changes seen in this project came from civil society groups (CAN and local partners), it is important to acknowledge the regional institutional context, namely the strength of the cooperative movement in both Mexico and Nicaragua.

CAN chose early on to work closely with farmers and their cooperatives as equal partners in the change process. This empowered the cooperatives to become involved in local and national politics, especially in Nicaragua, where cooperatives operate at three different levels and

25 One shipping container contains approximately 250 sacks (150 pounds) of unroasted green coffee beans. The sacks are shipped from Matamoros on the east coast of Mexico to Washington, DC. The importer has asked for 6-7 containers from the 2017/2018 harvest, but FEMCAFE will only be able provide two.

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

Youth from Nicaragua, Mexico & the US learning participatory research methods during a CAN-led youth exchange. San Ramón, Nicaragua.

play an active political lobbying role.[26] In 2004, a process began to reform Nicaragua's rules governing cooperatives. The UCA San Ramón participated in the dialogues and promoted the *Ley General de Cooperativas* once it passed in 2006; the new law broadened the focus beyond a strictly economic one, to include areas such as gender, environment and youth.[27]

The project was embedded in this complex institutional framework through the collaboration with the UCA San Ramón, a second-level cooperative. This allowed the project to amplify its outreach and knowledge dissemination, while also providing local institutional structures with greater resources to lobby on behalf of their farmers.

The multi-stakeholder price-setting process and solidarity-based relationships underpinning AgroEco® coffee may also represent a new institutional/governance structure – underlining the importance of looking beyond formal institutional frameworks for levers of change.

The willingness of the communities in San Ramón and Veracruz to open their homes, farms, and hearts, and their engagement in the project reported in this case study, must be acknowledged. Most of the data in this case study was gathered through participatory research projects coordinated by Heather R. Putnam while she was the Associate Director of the Community Agroecology Network (CAN). Steve Gliessman, co-founder of CAN and current President of the Board of Directors, coordinated the writing of the case study. The study was reviewed by the Executive Director of CAN, Rose Cohen.

26. In Nicaragua, cooperatives operate at three different levels. The first level is a cooperative of farmers dealing mostly with local production issues in their own community. The second level is a "cooperative of cooperatives" where anywhere from 10-20 first level cooperatives form a second level cooperative to aggregate support for finances, product procurement, and social programs relating to health, education, training, and extension. Third level cooperatives are focused on negotiating international sales, and lobbying the government for political and policy support for their farmers and their cooperatives.

27. Information on the reform of cooperative laws was provided by Yadira Montenegro, CAN's local coordinator at the UCA San Ramón cooperative, in a September 2018 interview.

3.2 SAN RAMÓN, NICARAGUA & VERACRUZ, MEXICO

FIGURE 7 - FIVE LEVELS OF CHANGE IN SAN RAMÓN AND VERACRUZ

(Data source: Putnam et al., 2016; CAN, 2015a)

LEVEL 1

	SAN RAMÓN	VERACRUZ
Households with garden irrigation systems installed	35	3
Water catchment systems installed	9	46

LEVEL 2

	SAN RAMÓN	VERACRUZ
Soil fertility and conservation practices implemented[2]	9	13
Number of households adopting Best Agricultural Practices[3] promoted by the project	95	139

LEVEL 3

	SAN RAMÓN	VERACRUZ
Wood, fuel, or fruit tree seedlings planted in the community	28,403	2,995
Fruit trees planted	5,560	1,875
Households diversifying with fruit trees and vine crops, vegetable crops	95	139
Species of heirloom vegetable seed being saved by households	20	18
Area for diversified vegetable production in home-gardens or patios in manzanas[4] per household (mz)	0.73	-

LEVEL 4

	SAN RAMÓN	VERACRUZ
Households consuming more than 6 food groups daily over 2013-2015	82-100%	84-100%
Number of Food Storage and Distribution Centers (CADA5) at a cooperative serving 200 families	7	0
Pounds of corn and beans distributed as food by CADA[5]	2,415 lbs beans - 2,400 lbs corn	0
Households with functioning homegardens	95	139
Number of farmers markets 2011-2015	21	25

LEVEL 5

	SAN RAMÓN	VERACRUZ
Community Seedbanks[6] at a cooperative serving 100 families	7	5
Home chicken coops constructed	62	94
Value added rural enterprises for women or youth established	2	5
Women selling in rural enterprises and markets	30	59
Youth selling in rural enterprises and markets	10	31
Youth leaders participating in project activities	12	8
School gardens functioning and supported by youth leaders	3	3
Community or cooperative-based commissions functioning and running food security and sovereignty infrastructure	7	4
Community workshops, trainings, and exchanges in 2015	16	44

1. Data for 95 households in San Ramón and 139 households in Veracruz. In most outputs the initial value was at or close to zero.

2. For example, cover cropping, composting, reduced tillage, etc.

3. Based on community-based experiences developed by CAN (CAN, 2015b).

4. In Nicaragua, approximately 0.7 hectare or ~7000 sq. meters.

5. CADAs (Spanish acronym) are Food Storage (especially corn and bean grain for consumption) and Distribution Centers of basic household goods purchased in bulk and housed at the cooperative for cooperative members at a reduced price.

6. Community Seed banks are part of CADA's, where local seed for planting is properly stored and made available to cooperative members through a 2:1 exchange and return system.

Chololo villagers adopt minimum tillage practices with magoye ripper.

CHOLOLO TANZANIA

Rethinking food, farming, forestry and resource management to build a climate-resilient 'Ecovillage'

3.3 CHOLOLO, TANZANIA

Chololo village, a 5,500-strong community located in the semi-arid drylands of Central Tanzania, faces challenges typical to this agro-pastoralist region: recurrent drought, food insecurity, and vulnerability to climate change. When a participatory climate vulnerability and capacity analysis was carried out in Chololo, key issues identified by residents and the village committee ranged from increased drought frequency, deforestation, flooding and strong winds, to human diseases, livestock diseases, crop pests, and inadequate ground water recharge.

These problems were compounded by the traditional dependency on rain-fed agriculture, the use of simple farm implements (such as hand hoes), the unsustainable use of natural resources, a lack of enforcement of natural resource by-laws, and a lack of awareness of climate change. 'Slash and burn' agriculture was often practiced, but was reaching its limits. In response to food shortages, people typically travelled out of the district to seek work as farm labourers or migrated to the city.

The Chololo Ecovillage project – running in its initial phase from September 2011 to May 2014 – aimed to address these problems and create a model of good practice in climate adaptation, based on testing, evaluating and rolling out over 20 ecological 'technologies' in agriculture, livestock, water, energy, and forestry. A multidisciplinary team – including a higher learning institute, a government agricultural research institution, a local authority, and three NGOs specializing in water, organic agriculture, and forestry – was formed to drive forward the project in a way that addressed a breadth of issues and entry points.[28]

A second-phase 'scaling up' project, 'Chololo 2.0', began in 2015 and is rolling out the practices to three more villages, building the capacity of the two local authorities to plan and implement climate change strategies, and developing a knowledge management system to share the learning nationally.

Following a participatory appraisal of the village's challenges and capacities, the project was centred on encouraging villagers to take up and refine a package of agroecological practices, from manure-based soil fertility improvements to water conservation features and optimal planting schedules. The project also included a series of livestock-specific interventions, alongside a focus on sustainable forestry and water management. Together, these steps aimed to put the village's economy, natural resource base, and agroecosystems on sustainable footing.

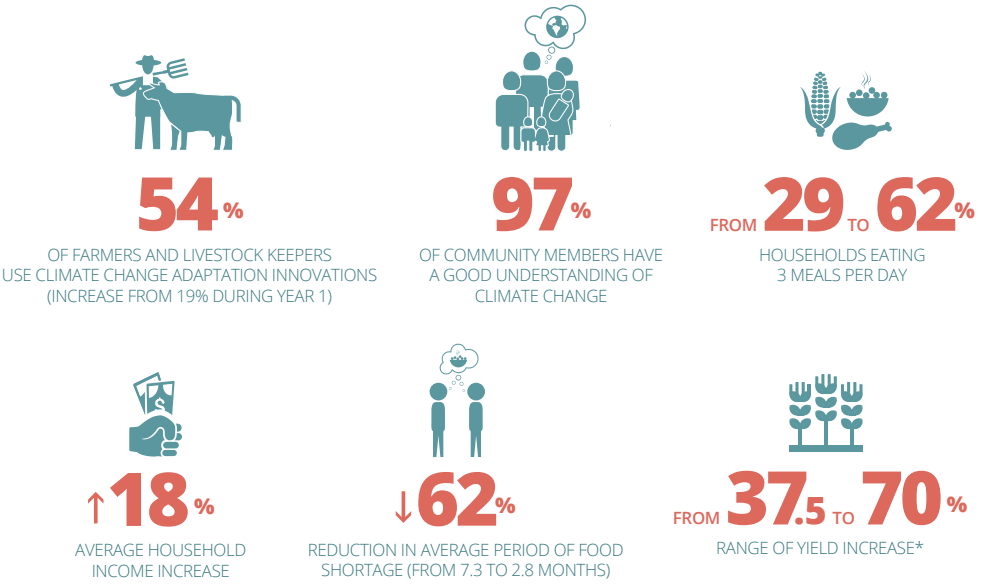
The dissemination of knowledge and uptake of practices was highly contingent on social demonstration effects and farmer-to-farmer outreach. Motivation was built and practices were shared within the 'technology groups' in which villagers were organized. Enthusiastic early adopters of the broader agroecological package helped to pioneer new and more sophisticated approaches (e.g. time-staggered planting to identify optimal times), bringing others on board once positive impacts could be demonstrated. Farmers' field days were held to celebrate and disseminate good practice, while community assessment meetings

28 Chololo Ecovillage is part of the EU's Global Climate Change Alliance (GCCA); the project was funded by a €700,000 EU grant. The project was led by The Institute of Rural Development Planning (IRDP). The partners are Dodoma Municipal Council, Dodoma Environment Network (DONET), Hombolo Agricultural Research Institute, Maji na Maendeleo Dodoma (MAMADO), and Tanzania Organic Agriculture Movement (TOAM). The contracting authority is the Tanzanian Ministry of Finance & Economic Affairs (European Development Fund). For more information, see: https://chololoecovillage.wordpress.com/2011/10/31/launch-press-release/

3.3 CHOLOLO, TANZANIA

FIGURE 8 - IMPACTS OF AGROECOLOGICAL TRANSITION IN CHOLOLO (2011-2014)

(Data source : Tanzania Organic Agriculture Movement, 2014)



** Data compared between progressive/transitioning farmers and a control group during a normal rain year. Participants that had a high technology uptake achieved significantly higher yields (ranging from 100% to 157% increase over the control group) in a drought year.*

allowed farmers to evaluate and reflect on the technologies.

In the eyes of participants and outside observers, the project was successful because of its multi-dimensionality. Given the interconnected challenges that the village was facing, solutions were needed that would be both integrated and holistic, underpinning the decision to work across agriculture, livestock, water, energy and natural resources – while keeping the focus on immediate livelihood concerns. This created buy-in from the community, as a variety of village residents were able to see benefits in the areas that concerned them the most.

The project design was consciously aligned with national climate adaptation policy in order to ensure maximum impact. Meanwhile efforts have been undertaken to showcase the results to visiting policymakers, including the Minister of Environment, and to share the experiences with neighbouring communities. This has paved the way for rollout to other villages, and for Chololo Ecovillage to emerge as a benchmark case for climate adaptation and resilience.

CHANGES IN PRODUCTION PRACTICES

Tanzania has experienced a 1°C increase in mean temperatures since 1960. Annual rainfall has decreased at an average of 3.3% per decade. Six major droughts over the past 30 years caused severe damage to agricultural production, which provides one third of the nation's gross domestic product (GDP), and accounts for more than 80% of employment. Extreme events such as droughts, floods, tropical storms, and cyclones are expected to become more frequent, intense and unpredictable in Tanzania.

Existing coping strategies (e.g. pit tillage, dry planting, well deepening, movement of live-

stock) were of limited or short-term effectiveness. Traditionally, farmers in Chololo employed "kuberega" slash and burn methods. Often a field was planted with the same crop year after year, and crop residues were burned. When the soil was depleted of nutrients, the farmer would shift to a new field, cutting down the trees to clear the land, and preparing for planting using hand hoes. Seeds were saved from the previous year's harvest and replanted; this led to low yields, given villagers' low knowledge of optimal seed selection and storage practices. In Chololo's drought-prone region, a number of farmers were also harvesting unripe crops to feed their families, further reducing yields. The Ecovillage project came at a time when the slash and burn model was nearing exhaustion, and often-recycled seeds were reaching their productivity limits.

The Ecovillage project revolved around a package of agroecological practices or 'technologies', aimed at making the most of the limited rainfall, improving soil fertility, reducing farmers' workload, and improving the quality of local seeds.

These technologies included: the use of ox-drawn tillage implements which reduced farmers' workloads and improved rainwater harvesting; water conservation measures such as contour ridges, *fanya juu* bunds[29], grass strips and gully healing to capture rainwater and prevent soil erosion; the use of farmyard manure to improve soil fertility; the use of improved early-maturing, high-yielding seed varieties[30] of maize, sorghum, millet, cowpeas and groundnuts; and the adoption of optimal planting, spacing, thinning and weeding practices as well as intercropping and crop rotation in order to control weeds and improve yields.

The project also focused on helping farmers to decide what to plant and when. In the past, farmers were encouraged to plant their seeds early, in line with the popular national farming slogan from the 1970s: "*Mvua za kwanza ni za kupandia*" ("The first rains are for planting"). However, the changing climate has disrupted this pattern, with farmers now reporting rainy seasons that start later and finish earlier – resulting in low productivity or crop failure. In Chololo, farmers were encouraged to resist the temptation to plant early, waiting three to four weeks until late December or early January, when the rains were well established. Data gathered by Hombolo Agricultural Research Institute supports farmers' testimonies that yields have more than doubled since the project introduced the improved seeds and new agricultural practices (Farrelly, 2014); additional income has been generated from sales of cash crops, and household food security has risen (see Figure 8).

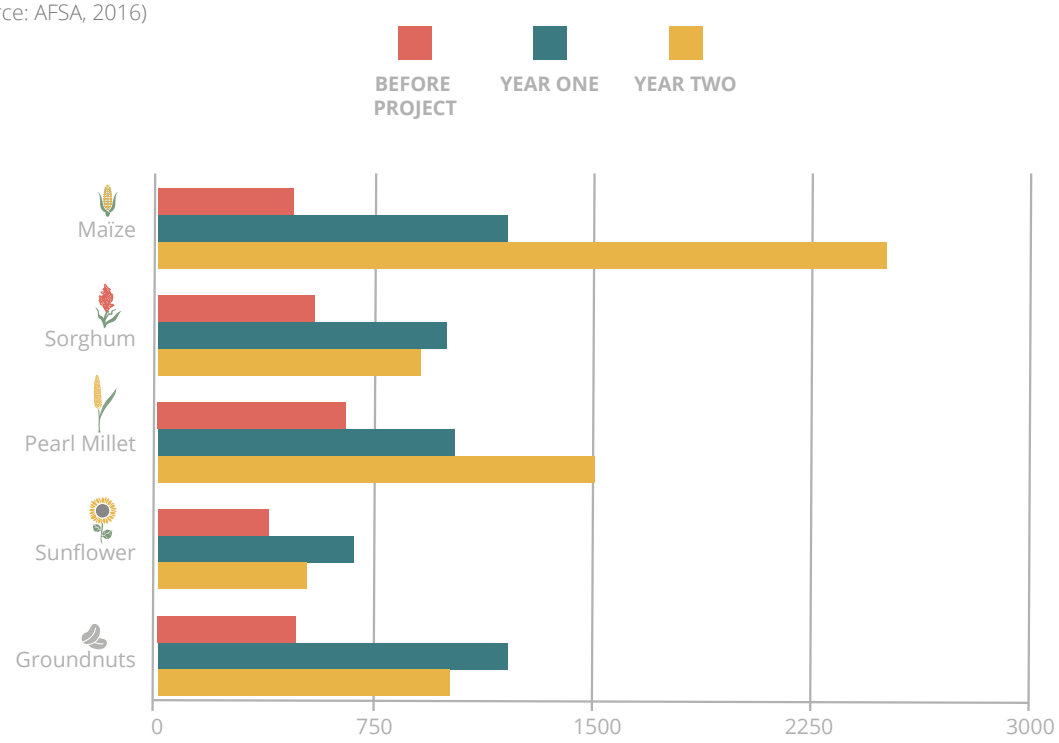
The project also included a specific focus on livestock, which had previously generated negative impacts due to overgrazing of common land, compacting the earth, eating crops, and competing for scarce water resources. The project aimed to reduce these impacts and develop positive interactions between livestock and arable farming. Oxen are now being used to prepare land for planting, reducing farmers' workload. And farmyard manure is being used to help fertilize the soil, while crop residues are being used to feed livestock. The project has increased the genetic potential of livestock in the

29 Bunds are mounds of stone or earth, sometimes combined with crop residues, formed into an embankment and constructed along a contour in order to reduce water run-off.

30 Seeds were initially bought from national agricultural research agencies and commercial breeders. At later stages, the project trained a cohort of farmers to produce seeds locally using Quality Declared Seed (QDS) methods, thereby reducing their dependence on external inputs and generating incomes for the QDS producers.

3.3 CHOLOLO, TANZANIA

FIGURE 9 - YIELD INCREASES IN CHOLOLO ECOVILLAGE (IN KG PER HA)
(Source: AFSA, 2016)



village through the introduction of improved breeds of cattle, goats and chickens.[31] Training has enhanced the ability of livestock keepers to keep their animals healthy and to ensure adequate feed grown in the community and land for grazing, particularly during the dry season. As a spinoff from the livestock focus, the project furthermore trained 40 people – men, women and young people – in vegetable leather tanning using Mimosa tree bark extracts.[32]

The project integrated new agricultural approaches with changes in forestry practices. Tanzania loses around 1% of its forest cover every year, with one million acres of forest cut down annually.[33] The project tackled

31 The improved breeds were selected for their ability to be crossed with local breeds and produce offspring that are resilient to the harsh local environment, yet higher yielding and earlier maturing. For example, participatory evaluation workshops found that the cross-bred goats reached maturity in half the time and sold for twice as much as the local breeds – a fourfold increase. The goats also attracted higher prices not just because they were bigger and produced more meat, but because they were valued as breeding stock. The selection of the new breeds was done by the project leader, Dr. Francis Njau, a researcher at the National Livestock Research Institute.

32 Four members of the Chololo leather group were trained in making leather goods by SIDO - the Small Scale Industrial Development Organization. This allowed one goatskin to be transformed into five pairs of sandals, which fetch three times the price of one piece of goat leather, or over 30 times the value of a raw goatskin. These value addition activities strengthened the off-farm rural economy, enabling people to gain skills, making better use of local resources, and bringing more income into the village.

33 Reliance on wood fuel and charcoal for cooking is a key driver of deforestation, as 94% of all (rural and urban) energy consumption is derived from these sources. Women typically walk five hours to collect firewood from the forest, as the trees have been cut down for agriculture, fuel, charcoal and construction.

this problem through the promotion of tree planting, agroforestry, and community land use planning and management. Community members were also encouraged to take up, test, and evaluate a range of alternative energy technologies, including energy-saving cooking stoves and low-cost domestic biogas plants. Extensive steps were also taken to build the capacity of villagers to maintain and spread sustainable forestry practices.[34]

Water management was also key to building a sustainable future in Chololo, and was tackled directly by a range of interventions. When the project began in October 2011, there was no drinking water supply to the village as the borehole equipment had broken down; villagers – mostly women and girls – had to walk for two hours a day to get a bucket of water from the next village. When the rains came, the water quickly ran off the land, creating gullies and causing soil erosion, while the groundwater aquifer was not being recharged. Rivers swelled during the rainy season then dried up as the water flowed downstream.

The project tackled these issues by using solar energy to power the borehole that supplies the village with water, providing the local primary school with roof catchment rainwater harvesting equipment. Meanwhile, 60,000 litres of water was captured, filtered, and stored in underground tanks. The project also built a subsurface dam that now captures many tons of water in the sandy riverbed, providing water for domestic use and livestock through the dry season. A sand dam was also built to capture seasonal rainfall and feed a hand pump for domestic water supply. These developments have increased water supply in the village, leading to a reduction of time spent fetching water, and halving the price of drinking water at the village standpipes.

When the project was subjected to a participatory evaluation, agricultural innovations, especially those related to agroecology, ranked highly.[35] However, the popularity of some innovations (e.g. improved animal breeds) was held back by affordability issues.

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

The project took a participatory approach to knowledge generation and dissemination. The multi-disciplinary project team worked with the community, starting from what they knew and building on what they had, with a view to delivering enduring, long-term impacts. While the project was still in the conceptual development stage, a series of community workshops used participatory appraisal methods to explore the village's background and history, livelihood resources and hazards, climate vulnerability and capacity.

The assessment was undertaken using a combination of participatory tools from the Climate Vulnerability and Capacity Analysis toolkit de-

34 Over the course of the project, community members and village leaders were trained on afforestation, nursery management and tree planting; created tree nurseries at the school and several community institutions; and planted tree seedlings (including *Leuceana, Acacia polycanth*, neem, mango, guava) at hundreds of households, six churches, the primary school, and the dispensary, as well as in three acres of village forest reserve. An end-line survey showed that there is increased community awareness on tree planting, and that many households have planted trees for various uses.

35 Women identified improved seeds, intercropping, good agricultural practices, ox-tillage implements, and farmyard manure as most beneficial. In the livestock session, disease management emerged as a clear and affordable favourite innovation. Improved breeds of roosters, while effective and beneficial to women, were only affordable to around half of the farmers. Improved bulls would require major subsidies, while goat bucks would need significant access to loan finance or subsidy.

3.3 CHOLOLO, TANZANIA

Ox-drawn tillage

veloped by CARE International (2009),[36] facilitated by staff from the six project partners plus district officials. The tools used to gather information in the field included seasonal calendars, historical timelines and climate change vulnerability matrices – helping to quantify the impact of each key hazard on the most important livelihood resource, then identifying and evaluating current coping strategies. Notably, the workshops identified the 'value chains' of most benefit to Chololo women, which led to the focus on local chicken and goats.

The project implementation began with a series of meetings, first with village leaders, then with other community members. Community meetings were held in each of Chololo's six sub-villages to introduce the project. The respective leaders were tasked with providing a 'census' of the community (households, populations), and its resources (acres, crops, livestock numbers). Each sub-village was asked to nominate and invite villagers to join various 'technology groups' (e.g. chicken keepers, ox tillage, tree planting, etc.) and it was agreed that an overall gender balance should be achieved.

The dissemination of knowledge and uptake of practices was highly contingent on demonstration effects and farmer-to-farmer outreach. Many farmers jumped at the opportunity to improve their livelihoods by taking up one or more of the technologies offered by the project. These early adopters were encouraged and supported to try out new ideas. These included experimenting with time-staggered planting of cereals to identify optimal planting times in the face of erratic rainfall patterns, and using different intercrop combinations (e.g. grains, legumes, and sweet potato). More risk-averse farmers gradually joined as the benefits became apparent.[37]

36 By combining local knowledge with scientific data, the CVCA process builds people's understanding about climate risks and adaptation strategies. It provides a framework for dialogue within communities, as well as between communities and other stakeholders (e.g. local and national government agencies). The results provide a basis for the identification of strategies to facilitate community-based adaptation to climate change. For more information see: https://careclimatechange.org/tool-kits/cvca/

37 The external ex-post evaluation reported the words of one of the villagers: "The first season (2011/2012 rains), not many were sure it will work, then in the second season (2012/2013 rains) more people joined, in the third season (2013/2014 rains) we were all convinced. So we are waiting for a bumper harvest this season and things will never be the same here again."

3.3 CHOLOLO, TANZANIA

The organization of villagers into technology groups (e.g. chicken rearing, tree planting) paved the way for group members to consult for technical advice and guidance. Farmers' field days were held to celebrate and disseminate good practice, with prizes for best performing farmers (male and female). The village's established group of singers, dancers, and drummers was encouraged to develop songs around the new approaches and more generally around climate change awareness, and frequently performed at farmers' field days. Finally, community assessment meetings enabled participants to share, compare, and internalize the benefits of the steps they had taken in the remit of the project. A community workshop assessed the 26 innovations using effectiveness, gender friendliness, and affordability criteria. The workshop, which brought together some 55 participants (60% female), used participatory methods such as community matrix ranking to assess the innovations.

Over time, the experience and knowledge generated in the Ecovillage was widely shared amongst neighbouring communities. Farmers were supported to visit the annual National Farmers Week exhibition in nearby Dodoma, both to share their experiences and to learn from others. Early adopters from Chololo – both male and female – were encouraged to address village community meetings in neighbouring areas, to share their knowledge of how the uptake of agroecological methods had benefited them, and to encourage others to do the same.

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

Based on what was known to have worked in communities facing similar challenges, the project placed economic and livelihood improvements at centre stage. However, other components of change were far from neglected, and were key to reinforcing the positive economic impacts. In particular, approaches allowing women to take a leading role and to become income providers were prioritized, and feedback loops were created to measure and further advance these shifts.

This partnership of experts from different fields was able to offer complementary skills and knowledge, and break new ground in ways of working. The project design drew on pre-existing social groups, e.g. working with church groups on tree planting, with a view to motivating community members to stay engaged with the transition process. Meanwhile, participatory land use approaches sought to build a sense of ownership as community members, as well as developing capacity to promote and uphold sustainable land use.[38]

As a central component of the project, women's empowerment was embedded across the project design. In particular, steps were taken to identify and develop market sub-sectors of particular benefit to women, in which they previously had little involvement. Community workshops ranked income-generating activities against criteria assessing both market demand and women's attitudes on whether they were able to carry out the activity, whether they liked doing it, and whether they could keep the

38 The village community identified areas suitable for crop and livestock production, settlements, woodlands, conservation, beekeeping, and industry in accordance with land policy and land laws. The work included educating community members on land policy and laws; training village land committees and ward tribunals; surveying and mapping the boundaries of village land and acquiring a village land certificate; forming and training District and Village land use planning teams; supporting the preparation of village land use plans and by-laws; and facilitating registration of village land use plan at district level.

money earned. Chicken rearing emerged as the most beneficial sub-sector for women,[39] followed by dairy cattle and goats.

Reductions in gender dependencies, as a result of women's growing earning capacities, featured prominently among the documented impacts of the project. Many women felt less dependent upon their husbands for cash to pay for school fees or medical costs for their children, and some women reported that they were now the main providers of income to the family. The project also encouraged village institutions and committees to demonstrate more gender balance, leading to more women holding positions of responsibility, e.g. as committee office bearers (secretary, treasurer, etc.). By 2014, 50% of village leadership positions were held by women, compared to 40% in 2012.

CHANGES IN INSTITUTIONAL FRAMEWORK

Efforts were undertaken to ensure virtuous circles between the project and national policies, particularly around climate adaptation. The project design was consciously aligned with the National Adaptation Programme of Action (NAPA). Meanwhile, two Chololo Ecovillage project staff participated in a government technical working group to develop the national Agriculture Climate Resilience Plan and helped orient it towards agroecological methods.

Chololo's multi-dimensional approach – targeting crops, livestock, sustainable resource use for water, energy, and forestry – made it possible to show wide uptake and impact. The learning from this project has been shared with many visiting policymakers, including the Minister of Environment, helping to build legitimacy and drive the project forward. High profile visits to the village created a buzz that boosted farmers' participation, as well as paving the way for rollout elsewhere.

The inclusion of local institutions in both project design and implementation has further allowed Chololo Ecovillage to become relevant to national-level policymaking and to emerge as a benchmark case for building climate resilience. The involvement of local political leaders (village chairman, councillor, members of parliament) proved essential to raise awareness and encourage farmer participation in the project. With responsibility for providing key services (health, education, and agricultural extension) and administrative support through the village executive, the involvement of local authorities as an implementation partner brought major leverage.

Meanwhile, the regional agricultural research institution provided farmers with a further recognized authority on agronomy. Fortunately, the Principal Agricultural Research Officer was happy to work within an agroecological framework, based on substantial experience of working with poor rural communities in this semi-arid region.

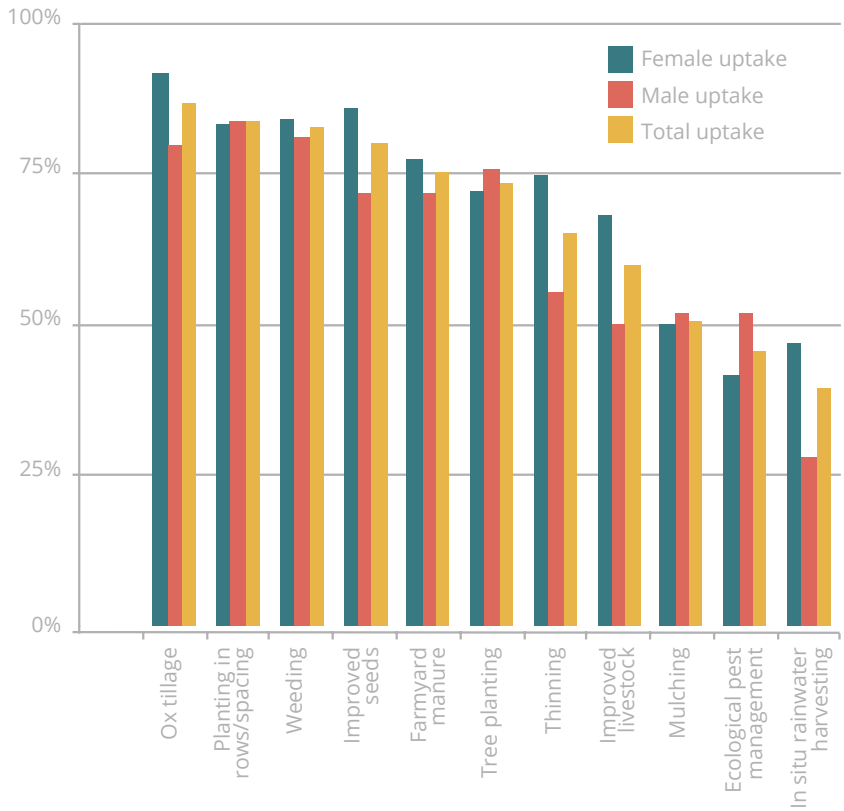
Over time, the experience and knowledge generated in the Ecovillage has been widely shared amongst neighbouring communities. Farmers were supported to visit the annual National Farmers Week exhibition in nearby Dodoma, both to share their experiences and to learn from others. The Chololo model – at least the agricultural practices component – has been rolled out under a separate project to three villages in a neighbouring (Chamwino) district facing similar climate challenges, with encouraging results (see Figure 9). Meanwhile, the second phase EU-funded GCCA programme identified Chololo as a model that other applicants should study and emulate.

39 The project supported chicken and goat keeping improvements, leading to an average 64% increase in women's incomes.

3.3 CHOLOLO, TANZANIA

Though major shifts in national policy are yet to emerge,[40] the second phase of the project (Chololo 2.0) led to the first ever national climate change adaptation conference, bringing five sister projects from across the country together with government officials and donors, during which the benefits of agroecological approaches were widely recognized. Climate change adaptation has thus proven a powerful entry point for promoting the Chololo Ecovillage project. As a political agenda yet to be fully captured by agribusiness lobbies or other vested interests, climate adaptation may offer a powerful avenue for advancing and scaling out the Chololo experience in Tanzania and other parts of Africa. A Global Ecovillage Network (GEN) is now in place, suggesting that attempts to do so could benefit from strong alliances for change.

FIGURE 10 - SCALING OUT CHOLOLO'S MODEL: TECHNOLOGY UPTAKE ACROSS CHAMWINO PROJECT VILLAGES
(Source: Tanzania Organic Agriculture Movement, 2014)



This case study was selected and developed with the support of the Alliance for Food Sovereignty in Africa (AFSA). Michael Farrelly, Project Officer at AFSA, provided extensive information and support in drafting the case.

40 Analysis of climate change policy and practice in Tanzania shows that three key issues (lack of coordination between agencies, lack of capacity of government staff, and lack of knowledge and information) need to be resolved in order to achieve greater policy effectiveness (Agrawala and van Aalst, 2008; Burgess et al., 2010).

Women practicing traditional dancing in village square.

PUHAN RURAL COMMUNITY

SHANXI • CHINA

Rebuilding community ties as a pathway to cooperative-led local food systems

3.4 PUHAN RURAL COMMUNITY, SHANXI, CHINA

With the intention of modernizing Chinese agriculture and increasing productivity, the post-Mao reforms of the late 1970s replaced a thirty-year state-managed system of planned/collectivized production and consumption with a fast-growing free-market economy. Rural communes previously operating under a collective farming policy were phased out to make way for a 'household responsibility system'. While the village collectives retained ownership of land, rural households were granted land use rights allowing them to make their own choices regarding production and marketing. This opened up unprecedented possibilities for selling food produced outside of state quotas at unregulated prices.

Yet, after four decades of marketization and rapid economic growth, rural areas are facing an increasing number of difficulties. Despite reforms, markets remain difficult to access and often unpredictable. China's 230 million smallholder farmers – the backbone of the rural economy – remain economically and socially marginalized (Jen and Chen, 2017; Wen, 2008). A growing rural crisis has been acknowledged by the Chinese government, but policies have failed to stem the tide of rural decline. While 41.5% of the Chinese population still lived in rural areas in 2017 (FAO, 2017), over 900,000 villages have disappeared from the Chinese countryside since the turn of the century – and with them local culture, traditions, and knowledge (Johnson, 2014). The rural population is rapidly aging as younger generations flock to urban areas in search of alternative economic opportunities outside of agriculture, leaving a shortage of skilled farmers (Fenghuang Caijing, 2017).

Major environmental problems are also emerging due to overuse of chemical inputs, hormones and feed additives, accumulated waste from large-scale animal production leading to toxic runoff, and the rise of industrial pollutant emissions and contamination of farmland.

In this context, the agroecology and eco-agriculture movement in China has been gaining momentum. There is growing consensus that Chinese agriculture must transition towards agroecological practices to ensure food security while providing sustainable livelihoods for farmers and minimising environmental risks (Luo, 2016; Wu Wenliang et al., 2016). The transition under way in Puhan Rural Community in Shanxi province has taken up this challenge. Initially established as a farmer training service, Puhan is now a multifunctional cooperative made up of 3,865 households from 43 villages in the Puzhou and Hanyang townships (58% of the local population), cultivating on some 5,300ha of farmland (GIFT, 2017).

The first seeds of Puhan's agroecological transition came when Zheng Bing, a local primary school teacher, realized that a lack of technical support to farmers was affecting decision-making, and allowing for over-use of chemical inputs and environmental damage. Zheng became a full-time organizer, focusing on technical training services to provide farmers with a broader range of knowledge. She organized lecture series and training sessions with agricultural experts that attracted over 400 farmers in the area.

However, obstacles to transition remained, and the process refocused over time on broader livelihoods and community-building activities in order to build the social foundations for shifting food and farming systems. It was only once community morale and solidarity had improved that an integrated, multi-functional farmers' cooperative was developed. The cooperative's activities range from organizing the production of bulk agricultural products and local handicrafts, to offering training in sustainable farming practices and crop protection, and delivering a series of social services to community members. Most of these activities

generate revenue and have become self-sustaining over time.[41]

While 90% of Chinese agricultural production is destined for external markets (Yan and Chen, 2015), one third of Puhan's production feeds community members, one third is sold to urban consumers in surrounding counties through CSA networks, and one third is sold through conventional market agents selected by Puhan members (Hua, 2016).

The Puhan cooperative's development highlights the potential for bottom-up processes of rural regeneration and community-building to spark wide-reaching agroecological transition. The initiative highlights communities' ability to develop their own locally-adapted solutions to the challenges they face – in a Chinese rural context still characterized by poverty and food insecurity.

CHANGES IN PRODUCTION PRACTICES

China is now the highest producer of GHG emissions in the world (FAO et al., 2015), although less than 15% of emissions are related to food and agriculture (Liu, 2016). Irrigation of rural crops takes up 60% of China's total water usage, severely depleting groundwater sources in a number of northern regions (Cui and Shoemaker, 2018). The country's use of chemical fertilizers has tripled over the past three

FIGURE 11 - CHANGING AGRICULTURE AND A CHANGING SOCIETY IN CHINA (1980-2015)
(Source: Chinese Ministry of Agriculture, 2017)

	UNIT	1980	1985	1990	1995	2000	2005	2010	2015
POPULATION	Billions	0.987	1.580	1.143	1.211	1.188	1.307	1.34	1.347
URBANIZATION RATE	%	19.38	23.71	26.41	29.04	36.22	42.99	49.94	56.10
GDP	Yuan (trillions)	0.66	1.62	1.88	6.11	9.98	18.23	40.89	67.67
AGRICULTURE GDP	Yuan (trillions)	0.16	0.36	0.74	2.03	2.49	3.94	4.10	6.09
CHEMICAL FERTILIZER USE	Tons (millions)	12.69	17.76	23.73	25.90	35.94	41.46	59.96	60.23
AGRI-MACHINERY USE	Kw (millions)	--	--	--	287.08	361.18	525.74	1,080.57	1,116.62

41 In 2016, Puhan had total revenue of RMB 80 million ($11.8 million) and a net profit of RMB 2 million ($294,000). Initial capital came from mutual credit or Puhan's community fund.

3.4 PUHAN RURAL COMMUNITY, SHANXI, CHINA

Local staff members of Puhan cooperatives in the field.

decades, with usage efficiencies averaging only around 32% compared to a global average of 55% (Chinese Ministry of Agriculture, 2017). It is now estimated that soil contamination has affected almost one-sixth of land in China; in 2013, eight million acres of land were taken out of farming due to high levels of contamination (China Power, 2017; Ren et al., 2009).

In 1998, the 'Puhan Rural Community' cooperative (from hereon Puhan or 'the cooperative') was founded by Zheng Bing, a local primary school teacher whose husband owned a small conventional agricultural inputs store. Conversations with customers allowed her to realize that a lack of technical support to farmers in her area was affecting their ability to make sound financial decisions for their businesses.

The dominant production model, based around large-scale mono-cropping, was promoted by central and local government policies. As public extension services were eroded, the technical advice on offer from agro-chemical companies reinforced input-intensive industrial production models. Zheng observed that chemical inputs were frequently being over-purchased and thus overused by farmers, causing severe environmental pollution and health issues in the local area.

Puhan initially developed as a training program to improve knowledge surrounding the proper use of chemical inputs. The training sessions initially organized by Zheng brought growing business to the family store, as more farmers who attended purchased inputs on credit to be paid after harvest. Progressively, the cooperative focused on promoting closed loop farming practices and supporting on and off-farm biodiversity.

Early on, farmers were encouraged to adopt a number of traditional practices already familiar to the older generation of farmers: intercropping, crop rotations, green manures and composting, and integrated crop-livestock farming. The more than 5,000 hectares cultivated by

members of the cooperative focused on crops suited to the local environment – wheat, cotton, beans, and fruit. Members have been allowed to shift practices gradually, starting with soil improvements on a very small portion of their land, as little as 1-5 mu.[42]

Over time, an ambitious conversion process to organic agricultural practices was launched. In 2008, Puhan developed a ten-year plan, which included bringing 60% of its 80,000 mu arable land under organic practices. In 2010, the cooperative signed a sales contract with Mecilla, a Hong Kong-based company. The contract, which offered prices 20-30% above market rates, was put in place after organic practices in Puhan had been audited and validated by a third party (Tsui et al., 2017). Though Mecilla has requested Puhan further increase its cotton production to make an additional 30,000 mu available for purchase, Puhan has only marginally increased its cotton production area in order to avoid shifting to monocultures (ibid). Nonetheless, these market developments have allowed Puhan members to tap into new markets in major cities, alongside the direct marketing networks (CSAs) launched in nearby villages and towns.

Adopting a more holistic approach to livestock management, Puhan has also collaborated with the Rural Youth Training Program of Liang Shuming Rural Reconstruction Centre to introduce fermentation beds[43] for local livestock. Young farmers who have settled in the area have created a demonstration farm to showcase ecological farming and husbandry practices, and as a model of rural youth engagement in organic agriculture (Tsui et al., 2017). From 2017, the technique will be introduced in over 600 households, the majority of whom are farmers over the age of 55.

Shifts in agricultural practices were contingent on the gradual development of fully-functioning cooperatives and the community relations underpinning them, which were rebuilt over several years (see below). Over time, eight cooperatives were launched under the overarching Puhan Rural Community cooperative, including in handicrafts, agroecological produce (grown on a collective 53 hectares), traditional foods, and a paint factory. Most failed within the first year, leading to further adaptation and adjustment, and further strengthening and diversification of Puhan's activities.

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

Recognizing that local farmers were beholden to agro-chemical companies, Zheng Bing's original intention was to empower local farmers with the necessary tools and information to farm more independently. Between 1998 and 2001, Zheng organized free quarterly technical training for local farmers, funded partly by her family's input store and partly by the local government's agricultural bureau.

Puhan Community now requires its members to attend four trainings a year for five yuan ($0.73) to learn new agroecological practices and receive up-to-date policy information. Members also elect 180 farmers from their cooperative to participate in a series of six large agricultural seminars that offer a variety of crop specializations. These farmers are

42 Mu is a Chinese unit of land measurement that is commonly measured at 0.067 hectares.

43 Thick natural woodchip or sawdust bedding that reuses animal waste as natural compost to improve soils. As a low-labour and low-cost technique, it also provides greater natural warmth to livestock during colder months, and helps prevent the outbreak of disease.

3.4 PUHAN RURAL COMMUNITY, SHANXI, CHINA

Children learn traditional paper-cutting skills from village elders.

then tasked with sharing their knowledge and skills with other members of the cooperative. Informal information sharing is also facilitated by the small size of the community. By word of mouth and by observing each other's activities, members have been able to collectively test new practices and adapt elements of each other's more successful ventures.

Intergenerational knowledge transfer has also been an important component of Puhan's development strategy. Following the initial failure to develop cooperatives in 2008, core members of the community persuaded their children to return to the village. Puhan has made it a primary goal to pass the knowledge and experience of older farmers onto a younger, healthier generation. However, it took a year or two for the older and younger staff to overcome generation gaps. In 2008, when Puhan community registered 28 cooperatives through the new Chinese cooperative law, young people were assigned three key tasks: farm one mu (0.06ha) of land, engage in village activities, and follow the work of one cooperative.

Through these tasks, young people learned farming skills, developed solidarity with each other and with the older generation, reconnected with the land, and came to understand the cooperative business model – which stood in contrast to the company business model many had been trained for. As Zheng Bing put it, "If a young person does not know how to farm, they cannot really speak about respecting farmers. Respecting farmers is not about being polite towards them or about offering them money, but is about really understanding and experiencing their hardship." These activities helped to rebuild perceptions of farming as a profession holding career potential. Since 2008, young people have progressively chosen to remain or return to the countryside. Today, over one hundred full-time staff work for Puhan, 85% of whom are under the age of 35.

3.4 PUHAN RURAL COMMUNITY, SHANXI, CHINA

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

Rebuilding community ties has played a decisive role in driving forward Puhan's development. Changes to local social dynamics were a key entry point for unlocking transition, and a key outcome as the initiative unfolded.

Zheng and her team realized early on that the technical training on offer was placing too much emphasis on agricultural productivity, without creating space for the rural regeneration clearly needed in the region. They also discovered that while they had been successful in organizing technical training and other social activities to strengthen social solidarity, once cooperatives were established around economic activity, all other dimensions were neglected. When economic ventures failed on the back of insufficient trust and solidarity between members, they also witnessed a drop in solidarity in the community.

Indeed, the initial barriers to Puhan's development were social and economic in nature. In 2001, farmers were unable to repay their debts following a drastic fall in the price of asparagus – the main local crop. Following this price collapse, some 30 households turned to raising chickens, although these businesses soon encountered difficulties. As the guarantor of their loans, Zheng found herself in major debt. However, Zheng noticed that a number of the household business actually had the money to repay her, but had chosen not to since other households were not repaying their loans. This convinced Zheng to refocus her efforts on building a community of 'common interest'.

Rural livelihoods, rather than economic gains, had to become the primary objective.[44] Indeed, it was only by improving relationships within the community that the cooperatives eventually took off. During the agricultural training courses, Zheng also took note that while some women attended the sessions, many still had little decision-making power in their households. Her goal became to allow for greater community interactions and preservation of local cultural traditions, while supporting a change of perspectives regarding traditional gender roles.

Yet a more holistic approach to community development took time to flourish. Zheng was inspired to organize the women in her village after seeing women in the city of Wuhan dancing in public spaces. Surprisingly, pursuing dancing as a leisure activity, and pursuing a women-only cultural activity, proved more controversial than hosting technical training programs for largely male farmers. Some women faced judgement in joining the activity, yet Zheng persisted. Within a month, 80% of village women were attending. By 2004, over one thousand women came together from 43 neighbouring villages to celebrate the lunar New Year.

Dancing as a cultural and social activity progressively changed the local mindset around women. Villagers began to notice a decrease in domestic abuse by men towards women and between women and their mothers-in-law. To tackle abuse, Zheng and her team organized village theatre to criticize abusive behaviours. Over time, women began to self-organize and take ownership of the process: six women have since become prominent activists of the Puhan Community.

44 As shared by Zheng, "Most other cooperatives focus primarily on economic development. We focus more on bringing people together and transforming how people look at things" (GIFT, 2017).

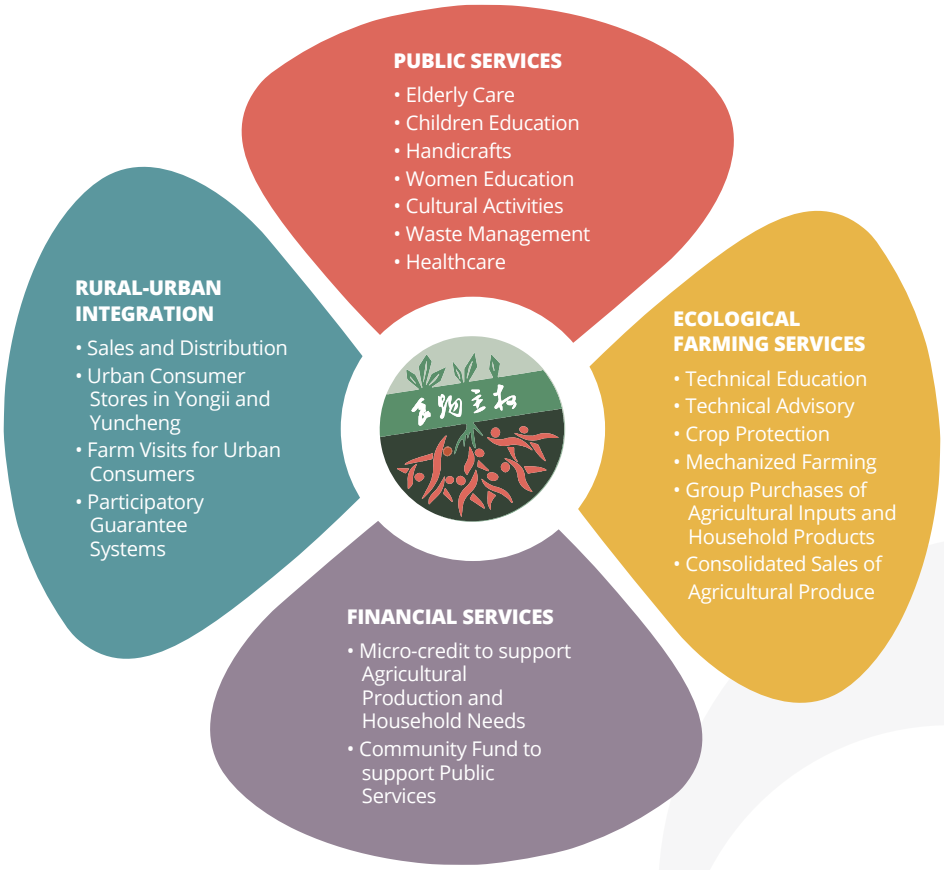
3.4 PUHAN RURAL COMMUNITY, SHANXI, CHINA

By 2004, Zheng grew confident that the village as a whole could benefit from organized activities and would now be more receptive to change. In early 2004, the women in Zheng's village sought to tackle waste management issues in their community. Shortly after a proposal on proper garbage disposal had been distributed to each household, residents were shocked by how clean their village became. Building on this newfound momentum, the women then proposed to repair village roads. Organizing a Village Construction Board with the participation of both men and women, roads were repaired within two months. By 2014, the cleaning activity covered 33 villages, with youth leadership in one of the villages. Maintaining public services became a means to bring villagers together.

The cooperative now offers a whole gamut of services, including group purchasing of household goods and farming inputs, cooperative sales of agricultural produce, microcredit loans, services for the elderly, childcare and education, and cultural activities (see Figure 12). This diversity of activities has been made possible due the funds reinvested in the community, enabled by growing incomes and social solidarity.

More recently, Puhan has shifted its attention to creating direct links between cooperative members and urban consumers. Puhan Ru-

FIGURE 12 - PUHAN COOPERATIVE'S MULTIFUNCTIONAL SERVICES
(Adapted from GIFT, 2017)



ral Community spent several months in 2013 surveying urban consumer needs before developing its urban consumer cooperatives. Aiming to provide seasonal, local, and agroecologically-grown foods, while informing urban consumers about rural experiences, Puhan built two centres in Yongji and Yuncheng to develop new consumer bases.[45] In Yongji, Puhan recruited around 2700 households for its CSAs. In Yuncheng, Puhan has members across 18 neighbourhoods, with a dedicated staff person responsible for each neighbourhood.

Puhan now sells one third of its produce through CSA schemes. The produce destined for CSAs comes from the farmers who have been practicing agroecology for at least three years and meet the requirements of Puhan's Participatory Guarantee System.

CHANGES IN INSTITUTIONAL FRAMEWORK

As described above, a rural crisis with implications for environmental sustainability, food security, and livelihoods has emerged in China. The central government acknowledged and responded to the crisis through the 2006 New Socialist Countryside policy, which sought to improve rural incomes and rebuild rural areas by abolishing rural taxes, making large investments in basic infrastructure, and providing subsidies to farmers (Wen, 2008). However, the plan has done little to strengthen rural resilience, with rural populations continuing to fall. The capacity for rural communities to coordinate and maintain public resources and infrastructure continued to weaken due to a lack of revenue and support. The policy's commitment to sustainability has remained limited to the development of large-scale organic monocultures.

More recently, the 2017 Rural Revitalisation Strategy aims to protect rural ecology, improve rural income, enhance agricultural modernization and food security. However, agricultural modernization is defined in terms of scale, specialization, and market integration, and therefore has problematic implications in terms of biodiversity and ecological protection. While rural revitalization is expected to be driven forward at the village level, the recent national policy of extending rural contract land leases has not sufficiently accounted for changing demographics within rural villages, and has instead served to maintain unequal access to land and weaken collective ownership of land.

Meanwhile, policies enabling the development of cooperatives, such as the Professional Cooperation Law of 2007, have enabled a mushrooming of rural cooperatives in China, although some of the benefits have accrued to existing elites (Yan and Chen, 2013). The policy allowed Puhan to develop a series of cooperatives differentiated by product. The new law also allows cooperatives to establish companies under their own management. Puhan hopes to leverage this new allowance by pursuing value-added processing opportunities and developing a more vertically integrated value chain, while decreasing waste of perishable foods.

In 2013, the 18th National Party Congress proposed a strategy encouraging state farms to operate according to a new national Ecological

45 Puhan's urban team also emphasises the need for face-to-face interaction between producers and consumers, and between consumers themselves, by organizing open activities including traditional dance, tai chi, information seminars, and handicraft activities for children. To connect to the countryside and learn about production practices, Puhan's urban support staff are also required to attend the cooperatives' weekly rural meetings, and are encouraged to bring urban consumers to experience rural life.

Civilization plan.[46] This builds on wide-ranging agricultural reforms detailed in a 2015 national plan to reconcile environmental sustainability with economic development – including the development of model agroecological villages.[47]

Together, these reforms hold significant potential to drive a nation-wide agroecological transition. However, their success may ultimately depend on supporting and harnessing local-level experimentation. While centralized planning continues to be the principal means to develop and implement policy, market actors and civil society organizations are increasingly playing a crucial role in shaping the outcomes of these policies. As displayed by Puhan, farmers' cooperatives are key actors in the scaling out of agroecological practices, the transmission of traditional knowledge and the revitalization of rural spaces. Cooperatives can ensure fair economic conditions for their members while providing safe and healthy foods to consumers. And civil society organizations can raise environmental awareness and support local food consumption initiatives. As will be further discussed in Section 4, there may therefore be major potential for combining top-down strategies with bottom-up initiatives – such as those driven by the Puhan Rural Community – to meet the interests and needs of rural communities across the country.

Access to information on the Puhan transition was provided by IPES-Food panel member Yan Hairong, who has studied the case in detail. Extensive information on agroecological research projects around China and government policies on ecological agriculture were also provided by Professor Luo Shiming and a dedicated team of researchers. While it was not possible to use all of this material, it enriched the case study by providing deep contextual information on ecological transition in China.

46 The following elements are included in the plan: i) ecological agriculture development, ii) restoration of forest areas, iii) ecological animal husbandry and restoration of grasslands, iv) degraded land restoration, v) wetland biodiversity conservation, vi) industrial pollution control, vii) ecological urban construction, and viii) development of clean rural energy.

47 The National Strategic Plan for Sustainable Agriculture Development (2015-2030) released in May 2015 includes the protection of grasslands, soil and water conservation and reforestation. Six hundred designated agroecology demonstration counties and more than 1,000 villages have been identified for development as model agroecological villages. In addition, effective science and technology models have been developed to conserve and control water consumption, reduce or even remove the use of synthetic fertilizers and pesticides, and efficiently use animal waste.

Photo: Communauté de communes du Val de Drôme en Biovallée

DRÔME VALLEY FRANCE

Making the radical mainstream and the mainstream radical to build Europe's first organic region

3.5 DRÔME VALLEY, FRANCE

The Drôme Valley is a rural area of 2,200 km² in the Rhône-Alpes region in the South-East of France. Hemmed in by the Drôme river's watershed and surrounding mountains, it is populated by 54,000 inhabitants and comprises 102 small towns and villages. The agricultural landscape is highly diverse due to differences in natural growing conditions, with cereals, poultry, fruit, and seed production in the lower valley, extensive livestock rearing in the mountains, and wine, cereals, and fruit production on the hillsides.

Organic production in the Valley emerged as early as the 1970s, driven by peer-to-peer knowledge sharing networks, alternative extension agents promoting organic inputs, and the arrival of migrants from urban areas seeking to reconnect with the land and pursue organic practices. In the early 1990s, a network of cooperatives in the upper valley (supplying cereals, aromatic and medicinal plants, and wine) established a program to develop organic supply chains with a view to accessing higher-value markets (Duffaud-Prevost, 2015).

Changing production practices initially proved challenging. In the lower valley, many continued to question the economic viability of organic agriculture; low availability of organic inputs, lacking extension services, and limited supply chain opportunities for organic products also proved major obstacles. It was not until new modes of inter-sectoral collaboration were introduced that alternative practices and new supply chain infrastructures truly began to emerge. In the 2000s, the value-creating potential of organic was brought to the attention of local institutions, with inter-municipal coordination helping to create the conditions for transition. This culminated in the establishment of an ambitious sustainable development project for the whole valley in 2009: the 'Biovallée project' (see Box 3).

While the plan's initial goals are yet to be met, some 40% of farmers in the Drôme now use organic practices, the highest share of any French *département*[48]; country-wide, around 8% of farmers are certified organic (Agence Bio, 2018). Major challenges have been encountered along the way. Initial plans to build large-scale processing facilities to support public procurement of organic products had to be shelved as major players pulled out. This marked a turning point in the project, with local authorities turning to smaller-scale, more 'radical' actors and initiatives to help bring the plan to fruition.

The Drôme Valley's transition provides insights into how norms can be shifted over time. Ongoing interaction between mainstream and alternative actors has allowed for rapid upscaling, access to resources, and legitimization of the transition process. The transition has also been advanced through various forms of institutionalization.

CHANGES IN PRODUCTION PRACTICES

In the mountainous areas of the upper Drôme Valley, the incentives to convert to organic agriculture were strong as yields were relatively low due to poor quality soil and unfavourable climate conditions.

However, further barriers to organic conversion remained. Farmers lacked access to organic fertilizer. In addition, organic certification procedures initially required whole-of-farm organic

48 The département is an administrative division between the region and the commune.

BOX 3 – THE BIOVALLÉE PROJECT

The Biovallée initiative aims to establish the Drôme valley as a regional leader in the management and valuation of natural resources. Its objectives are as follows:

- Develop high-level training opportunities in the field of sustainable development
- Reduce the territory's energy consumption by 20% in 2020 and by more than 50% by 2040
- Convert 50% of farmers and agricultural surface area to organic agriculture by 2020
- Supply 80% of the procurement of institutional catering using organic or regional products
- Supply 25% of energy consumption through locally-generated renewable energy by 2020, and 100% by 2040
- Change urban planning guidelines such that after 2020 no more agricultural land will be diverted to urbanisation
- Halve the amount of waste brought to waste treatment plans by 2020
- Develop education and research linked to sustainable development (10 partnerships in 2012, aim of 25 partnerships in 2020)
- Create 2,500 jobs in the eco-sectors between 2010 and 2020

Today, the Association of Biovallée Actors (Association des Acteurs de Biovallée®) has 160 members who have committed to contributing to reaching the Biovallée objectives. According to the Biovallée charter, the use of the Biovallée branding is restricted to those members that achieve a sufficient amount of points counting towards the objective. The Association also includes several working groups, such as a working group on an Investment Plan for the Future, allowing local participants to further align their actions.

production; farmers with mixed holdings – producing medicinal herbs, grains, and wine – thus faced the challenge of needing to convert multiple systems to organic, despite only having market outlets for organic medicinal herbs.

In this context, new supply chain infrastructures and new modes of inter-sectoral collaboration were crucial levers of change. Further inputs and services were required to support the widespread organic conversion that would allow the four organic cooperatives of the upper valley – for medicinal herbs, grains, supplies, and wine – to defray their investment costs. Local cooperatives moved to establish composting plants. Furthermore, the wine and grain cooperatives decided to develop procedures and facilities for the separate handling and marketing of organic wine and grains. They joined forces to establish the Committee for the Agricultural Development of the Diois, whose EU-funded Inter-cooperative Program for the Development of Organic Agriculture (PIDA Bio) provided a forum for experimentation, marketing, advice, information, and training.

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With the support of PIDA Bio, the grain cooperative was able to add additional silos for separately storing organic deliveries. The wine cooperative put in place a separate organic packaging line; and the supply cooperative built an additional storage room to accommodate the organic inputs it would subsequently be offering to producers.

Organic production emerged more slowly in the lower valley, as opportunities grew for product differentiation and value addition (Stotten et al., 2017). As local councils became interested in the possibility of local development via organic agro-industries, they proposed a cross-valley collaboration to harness the respective strengths of the upper and lower valley. In the upper valley, 15% of the population were farmers, (of which 25% were already engaged in organic production) compared to only 2.5% of the population in the lower valley. Yet the lower valley benefitted from better connections to communication and transport links and had a denser network of SMEs to build around.

The Biovallée project started to take shape in the mid-2000s with the downstream municipalities taking the financial and political lead. In this context, the project was initially focused on developing industrial processing and marketing opportunities for organic products. This led to the development of a vegetable processing factory and large-scale food hub to facilitate public procurement of organic goods. Dissemination of organic conversion practices was mainly supported by the Drôme Chamber of Agriculture, which emphasized short-term yield optimization over a more holistic understanding of organic. However, ongoing interactions between local authorities and grassroots innovators helped to spread an understanding of organic conversion that ultimately went beyond production practices.

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

The rise of organic farming in Drôme in the 1970s came in a context heavily dominated by the agricultural modernization paradigm. Farmers were trained in conventional agricultural schools and would be frequently visited by input suppliers. However, this more conventional approach jarred with the values a number of local

farmers seeking alternatives, in particular to reduce their reliance on external inputs.

Farmers were introduced to alternatives in three ways. Firstly, an independent organic input provider (the company Lemaire-Boucher) sent its own salespeople into the field, acting as *de facto* extension agents advising farmers on the best practices to pursue (in line with their company's own commercial interests). Secondly, in the 1970s and 1990s, two waves of newcomers arrived in the valley seeking to 'get back in touch with nature' and pursue a more balanced lifestyle (Sencébé, 2001). Many were eager to (re)create a social network and joined existing community groups – cooperatives, trade unions, agricultural knowledge exchange groups, and municipal councils. Some of them brought in-depth knowledge on organic markets and became instrumental in establishing the first organic marketing opportunities for the local medicinal herb cooperative.

Thirdly, agricultural knowledge exchange groups (*Centre d'études techniques agricoles* or CETAs) provided an important space for interaction between organic and conventional farmers. Such groups were traditionally established by farmers in order to pool the costs of technical assistance and gain access to a greater variety of information. In the upper valley, some organic farmers also joined local cooperatives' boards. Through these channels, the logic of organic agriculture was progressively shared, legitimized, and mainstreamed. Rather than remain a niche, organic production became an integrated part of the local agricultural landscape, and was eventually institutionalized through the PIDA Bio program and Biovallée project.

Meanwhile, the Chamber of Agriculture developed organic extension services of its own, recruiting its first organic advisor in the 1990s, and hiring additional advisors as the number of organic farmers increased. In 2001, a regional network of extension agents specialized in organic production was created. The Chamber assumed a leading role in its coordination due to its high number of organic advisors – which was and still is the highest in France. Since 2007, the Chamber of Agriculture has organized a biennial trade fair to showcase the latest organic innovations – Tech&Bio – attracting thousands of participants and media attention from across France.

The Drôme is now also host to a number of formal and informal agricultural and sustainable development training centres for both adults and children. These include the Centre de Formation Professionnelle et de Promotion Agricoles de Die (CFPPA), the Amanins Agreoecological Centre, and l'Université de l'Avenir. The CFPPA de Die became the first institution of its type fully committed to organic agriculture training.[49]

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

The Drôme transition is rooted in decades of efforts by local actors not only to embed new production practices, but also to build new social relationships and to introduce new ideas into pre-existing rural organizations and social groups. From the 1990s onwards, organic farmers increasingly took on leadership roles, winning seats on their administrative councils. Inversely, a number of the upstream valley's cereal and wine coop-

49 CFPPAs in France operate as traditional educational institutions under the Ministry of Agriculture, and typically offer training in conventional agriculture.

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erative board members converted to organic agriculture. Interaction between organic and conventional farmers was also promoted in key fora for sharing knowledge (see above).

Over time, these developments helped cement a new and expanded understanding of organic farming. They also encouraged a shift in the perception of organic farmers from "backward", "lazy" or "crazy" individuals to forward-looking innovators. As one advisor described, "in many departments in France, the image of the wacky organic farmer persists, where organic farmers have fields full of weeds and diseases, no yields, where it doesn't work. In the Drôme, it's the complete opposite. For conventional farmers, organic is the most technically advanced, the best approach [...] Here, you frequently hear conventional farmers say 'I am not good enough to engage in organic production'. [...] But they still increasingly use at least some organic practices. They understand that it works, that it's got its use" (Bui, 2015, p. 343).

Steps towards local food purchasing by businesses and public authorities also represented important socio-economic shifts, and helped to root the transition process in an ambitious and wide-reaching approach to sustainability.

While most organic produce from the Drôme is sold outside the region, new ways of connecting to local consumers also emerged through social enterprises such as La Carline. Originally a small organic buying group made up of a handful of families in the Drôme Valley, La Carline grew from 30 to 600 participating families in 2008 and had an annual turnover of €1.2 million in 2014. As the group expanded, it broadened its scope beyond the purchasing of organic produce to include local sourcing (30% in 2010) and paid greater attention to social equity and fair employment practices. La Carline operates using a tri-partite governance structure split equally between producers, consumers, and employees, allowing the business's values to be maintained over time. As the most progressive demand-driven initiative

FIGURE 13 - BUILDING BRIDGES BETWEEN DIFFERENT CHANGE ACTORS IN THE DRÔME
(Adapted from Bui, 2015)

3.5 DRÔME VALLEY, FRANCE

in the region, La Carline has acquired legitimacy as the face of organic consumers in the area. As a result, it has been integrated into local governance structures, and now has a seat on the Agricultural Commission of the Diois communities.

Public procurement shifts have also helped to reinforce the transition and forge new relationships. In order to meet the Biovallée's goal of 80% local/organic sourcing of food for school canteens by 2015, the project originally intended to establish large-scale sourcing and procurement operations. In 2010, the lower valley communities invested in a warehouse and collaborated with a large-scale distributor of organic products, the Societé Ardéchoise Euronat, to set up a distribution platform. However, in 2012, Euronat pulled out of the project and closed down operations, citing low margins and a lack of profitability.

Alternative sourcing options also faced challenges. A study undertaken by a local community organization demonstrated that difficulties in consolidating sufficient volume from dispersed small-scale producers across the area was the greatest barrier to local sustainable sourcing for cafeterias. In response, a consumer association in the Montélimar district that had undertaken a similar study stepped in to create the missing logistical tools, offering its services to the Biovallée project. The Agricourt association was established, governed by consumers and producers of the Drôme region, with local restaurant owners rapidly joining the initiative (Bui et al., 2016).

Once these actors were brought into the process, their way of thinking about local food systems significantly influenced institutional perspectives of what was desirable and possible, and a symbiotic relationship emerged. The local *communautés de communes*[50] ('communities of municipalities') learned that actors outside the mainstream were the ones best placed to provide the services they required, precisely because they had invented new forms of cooperation and market organization. Furthermore, these alternative actors perceived their activities as a public service and thus endeavoured to reach out to even smaller institutions, such as private day-care centres, which had otherwise struggled to source their food sustainably.

CHANGES IN INSTITUTIONAL FRAMEWORK

Institutional support has played a crucial role in promoting transition in the Drôme Valley. Public policies first mentioned organic agriculture in the late 1980s in the context of the European Program for the Development of Rural Zones (PDZR in French). In a context of over-production (e.g. the European Community's 'butter mountains and milk lakes') and pressures to remain competitive as the EU expanded southward, the PDZR identified organic conversion and the diversification of holdings as potential solutions for marginalized areas. This allowed local political actors to come into contact with organic agriculture and provided a foothold for future initiatives, even as public policies remained largely focused on intensification.

In France, the communities of municipalities[51] have traditionally been in charge of the local

50 The 'communities of municipalities' are a French administrative division federating a number of geographically-connected municipalities.

51 The two main communities of municipalities in the Drôme Valley, in the Diois (upper valley, comprising 52 municipalities and around 10,000 inhabitants) and the Val de Drôme (lower valley, comprising 36 municipalities and around 30,000 inhabitants) were established in the 1970s.

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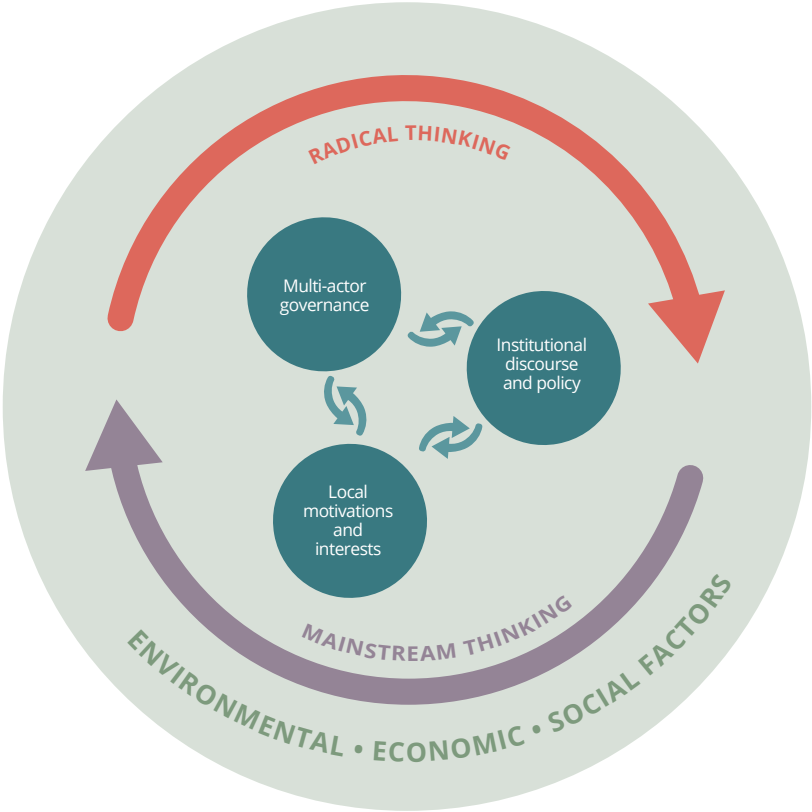
FIGURE 14 - CONVERGING ON NEW WAYS OF THINKING IN THE DRÔME
(Adapted from Bui, 2015)



implementation of state-defined rural development programs. In the municipalities of the upper valley, the establishment of the cooperative-led PIDA Bio program sparked the interest of local political actors. These municipalities had been searching for a viable territorial development pathway and a local 'brand image', rooted in high-quality production, territorial specificity, and respect for the environment.

The support of local authorities allowed cooperatives to access funding opportunities at the regional (e.g. from the Drôme General Council) and EU levels to develop their business and marketing strategies. The development of the upper valley's medicinal herb value chain enabled new local businesses to emerge, constituting the only job-creating sector at the time (Stotten et al., 2017). These types of initiatives provided a focal point for local authorities to develop policies based on locally-defined issues and objectives common to both parts of the valley for the first time in many years.

The municipalities of the lower valley originally focused on agricultural intensification rather than actively supporting alternatives. They viewed organic agriculture as a strategy of potential interest for producers in more marginal areas. As a result, only piecemeal support was provided to farmers wishing to convert to organic production. This reluctance persisted even after the launch of the Biovallée project (Stotten et al., 2017). However, when the main-

stream food business actors dropped out, they had little choice but to engage with smaller-scale, more radical actors from the organic production and consumption sectors in order to meet the goals of the project. As described above, this change in dynamics altered the nature of the project and helped to shift institutional perspectives over time.

The Chamber of Agriculture, a key institutional actor in French food and farming systems, also evolved its thinking through engagement with the Drôme project. As more farmers converted to organic agriculture – and particularly with the rise of the PIDA-Bio – the Chamber became keenly aware of the competition it faced, and recognized that organic farming was attracting regional and EU funding flows. The Chamber eventually hired organic extension agents and more recently embraced agroecological projects and alternative value chains (e.g. by organizing the 'Tech&Bio' trade fair).

Finally, in 2012, the French government launched a national strategy in favour of agroecology that could end up providing unprecedented institutional support for transitions such as has been undertaken in the Drôme Valley. Through the 2014 Law on the future of agriculture, food and forestry, France aims to become a global leader in agroecology, and aims to support the majority of French farms to transition to agroecology by 2025.[52] While this strategy has yet to translate into concerted action, the Drôme transition benefitted and may continue to benefit from the support of institutions at various levels.

This case study is based on the 2015 PhD thesis of Sibylle Bui entitled *"Pour une approche territoriale des transitions écologiques: Analyse de la transition vers l'agroécologie dans la Biovallée"* (Bui, 2015). Unless otherwise noted, all elements are drawn from her text.

52 Reform objectives include: 1) adapting programs and educational frameworks for farmers to include agroecology-related knowledge; 2) mobilising research as well as research & development (R&D) on agroecological production systems, and encouraging the dissemination of innovations in the field; 3) creating an agroecological self-assessment tool (www.diagagroeco.org) to encourage farmers to reflect on their practices and possible changes to their system; 4) reviewing and adjusting public support and investment subsidies such that they incentivise commitment to agroecology and transitions to agroecological systems; 5) implementing regular monitoring and implementation activities (Ministère de l'Agriculture, n.d.).

Photo: Gloria Guzmán Casado

Organic produce at the *ecomercado*

VEGA ANDALUSIA SPAIN

Sustaining transition through changing political winds

3.6 VEGA, ANDALUSIA, SPAIN

The *comarca* of the Vega[53] is located in the southeast of Spain, around the city of Granada. The agrarian modernization of the Vega occurred as early as the beginning of the 20th century, through the establishment of crop commodity monocultures (primarily sugar beet) and the accompanying use of commercial seeds and mineral fertilizers (Guzmán Casado and González de Molina, 2009). The process sped up from the 1960s onwards with the implementation of Green Revolution technologies, and further accelerated when Spain joined the European Economic Community (EEC) in 1986.

By the end of the 20th century, the limits of this model were starting to show in Andalusia, and particularly in the Vega district. Rural populations were abandoning agriculture, and natural resources – soil, water, biodiversity – were showing signs of depletion and degradation (Chica et al., 2004; Guzmán Casado and González de Molina, 2006; Menor Toribio, 1997). As the farming population declined, so too did agrarian institutions and infrastructures, and the organizational capacity of the agricultural sector. Local processing industries and regional resource flows (e.g. manure availability) were lost.

Nonetheless, Save the Vega and other local social movements continued to defend landscape conservation, and alongside local farmers, managed to sustain an organizational and knowledge base that would allow transition to occur. A new research and training centre, CIFAED[54] or the 'Granada Organic Farming and Rural Development Research and Training Centre', was founded in 2002 following an agreement between a new political coalition and the provision of funding from regional and provincial councils. A wide-ranging research project was initiated to evaluate the sustainability of agriculture in the Vega and to develop agroecological transition strategies, building on the existing social movements.

This culminated in the Vega de Granada Organic Farming Plan – an ambitious agenda for agroecological redesign of the district's production and marketing systems. The plan was based on local provisioning of all inputs, the development of direct sales initiatives (biofairs, shops of producers' associations, etc.) and organic public procurement – referred to as 'social consumption' schemes. Educational programmes were also developed to build awareness of sustainability in the district with the support of local farmers.

However, the political coalition in support of transition broke down in 2009, paving the way for withdrawal of regional government support. The CIFAED closed soon afterwards, alongside the newly formed Directorate General of Organic Farming and the Andalusia-wide organic public procurement programme. Yet the revival of sustainable agriculture in the Vega and the social activism underpinning the transition have endured, showcasing the capacity for non-institutional actors to sustain transition even when formal support has dissolved.

53 A *comarca* is a Spanish administrative district consisting of several towns, with common territorial features and agricultural conditions. The towns in the Vega comarca include: Armilla, Atarfe, Cájar, Cijuela, Cúllar Vega, Chauchina, Churriana de la Vega, Fuente Vaqueros, Gójar, Granada, Huétor Vega, Láchar, Ogíjares, Pinos Puente, La Zubia, Las Gabias, Vegas del Genil, and Santa Fe.

54 *Centro de investigación y formación para la agricultura y ganadería ecológicas en la provincia de Granada*

3.6 VEGA, ANDALUSIA, SPAIN

CHANGES IN PRODUCTION PRACTICES

Despite its dry Mediterranean climate, the Vega is one of the most productive Spanish districts, benefitting from flat and fertile land with abundant irrigation. Most of the cropping area in the district had long been dedicated to large-scale crop commodity production, with prices guaranteed by the administration - first the Spanish state (flax, hemp, sugar beet, and tobacco) and then the EU (tobacco).

However, high synthetic input costs and low global market prices presented severe challenges to the economic viability of small-scale farms in the district. Furthermore, farmers struggled to respond to the progressive dismantling of market support policies in recent decades. The situation has been compounded by proximity to the city of Granada, leading to the development of urban, road, and industrial infrastructures, and upward pressures on land markets.

In this context, farmers disappeared at an annual rate of 5-6% between 1989 and 2009, dropping from 8,228 to 2,523 over the two decades (INE, 2009, 1999, 1989). At the outset of the agroecological transition process, only 19 agri-food companies (of which ten were cooperatives) brought their products to market, mainly via long value chains that yielded low returns.

The potential to revive farming was initially held back due to degradation of the natural resource base, including water contamination from urban-industrial waste, nitrates and pesticides, and the loss of key material and energy flows in the Vega (Guzmán Casado and González de Molina, 2009). In particular, farmers struggled to obtain manure given a long-term trend of declining livestock production in the region – stretching back to the 19th century and accelerating when Spain joined the EEC in 1986 (Guzmán Casado and González de Molina, 2009). Spanish agriculture had shifted its production to specialize in products with high demand on EU markets (e.g. olive oil, fruit and vegetables), while dairy cows and other 'surplus' sectors declined.[55]

In the early 2000s, CIFAED identified enabling and limiting factors to regional transition using innovative knowledge generation methods (see below). A range of strategies for agroecological transition were developed, based on mutually-reinforcing sustainable practices all along the food chain. These strategies were brought together in the Vega de Granada Organic Farming Plan, developed and adopted by four organizations representing farmers and agroindustry, and three ecological and consumer organizations. In response to the wide-ranging backing it received, the regional government committed to co-financing the Plan for three years (2008-2010). The Plan contained the following components:

1. The local generation of a sufficient quality and quantity of nutrient and water flows required for production
2. The redesign of the agroecosystem and development of management techniques in accordance with the European Law on Organic Production (Council Regulation (EC) No 834/2007, of 28 June 2007)
3. The generation of alternative proximity-based food networks through public procurement and direct sales strategies for organic food products

55 In the Vega, this translated into a 3% annual decline in dairy cow populations between 1986-1999, and a steeper 9% annual decline between 1999-2009, meaning that diary is now a marginal sector (INE, 2009, 1999; MAPAMA, 2000, 1986).

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Photo: Gloria Guzman Casado

Market stand at the *ecomercado*

Steps to implement the Plan were undertaken primarily by CIFAED and the civil society groups signing onto the Plan, working alongside the fruit farmers and extensive irrigation crop farmers (corn, alfalfa) who had shown willingness to shift their practices. The need to move away from industrial practices underpinned all of the steps that followed. Evaluation activities had identified severe nitrate contamination in irrigation water, highlighting the need for protection of water supplies so as to avoid further undermining the agricultural future of the Vega.

Local horticultural varieties were introduced to the farms, drawing on the traditional practices discussed in the preparatory phases of the Plan. Efforts were made to mitigate the lack of organic matter in the Vega by setting up composting plants in bordering districts. Olive oil mills were targeted in particular, given the large amounts of waste they tend to generate, and the associated environmental problems. Attempts were made to redirect nutrient flows in a way that was environmentally and economically beneficial for both districts.

However, the Organic Farming Plan was cancelled before important additional steps could be taken, such as the installation of composting plants. Despite the abrupt rupture of the political pact and the dismantling of the institutions and measures promoting agroecological transition, the strong initial focus on strengthening local knowledge and networks allowed many farmers to continue practicing agroecological farming. Many organizations continue to defend and promote agroecological transition in the Vega, bringing forward the ideas initially developed through CIFAED. From 2010 to 2017, the total organic area (now 521 hectares) and the number of organic farmers (now 37) continued to rise, though at slower rates than during programme implementation.

3.6 VEGA, ANDALUSIA, SPAIN

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

The CIFAED research centre was founded in 2002, following an agreement between the socialist party (PSOE) and the Greens, and drawing on funding from the Andalusian regional government and provincial councils. CIFAED's aim was to promote agroecological transition in the province of Granada, especially in the Vega *comarca*, because of its high agricultural potential and the complex problems it faced. Rather than proposing a generic agroecological management plan to local stakeholders, researchers at CIFAED spent the first two years of the project (2003-2005) conducting a participatory evaluation of the sustainability of agriculture in the Vega.

The evaluation was underpinned by an Agrarian Metabolism approach[56], applied in a historical perspective. This enabled researchers to gain in-depth knowledge of the shift from traditional to industrial agriculture that had taken root in the district. It also allowed researchers to refute certain subjective views that had become entrenched within the agricultural community in the Vega, e.g. the belief in a "miracle crop" that would save the region from decline.[57] The historical analysis showed how crop monocultures were related to specific institutional frameworks, which had led to the destruction of natural resources and loss of autonomy for the agricultural sector over time.

Through this process, CIFAED was able to establish a shared understanding of current challenges with a range of food system actors, including local farmers and store owners, environmentalist groups, and consumers. This paved the way for proposing measures to improve agricultural sustainability later on.

In parallel, unstructured interviews were held with key local actors, and social actors' discourse regarding the agricultural problems in the district was analyzed via participatory observation. Researchers participated in numerous fora in which it became evident that the vast majority of locals were deeply concerned about the degradation of the Vega. Strengthening civil society organizations clearly emerged as a lever for sparking fundamental changes along the chain.

In the subsequent 'diagnostic preparation' phase of the Vega de Granada Organic Farming Plan (2006-2007), CIFAED interviewed 20 representatives from agricultural industries such as input providers and processors, who provided in-depth information about the strategies they were using to overcome the agricultural crisis. In parallel, discussion groups brought some eighty farmers, representing a range of production and marketing models (organic/non-organic, long chain/short chain). The results were discussed during feedback workshops, which debated the different strategies and enabling and limiting factors for agroecological transition. This process ensured local buy-in from a number of community groups that were subsequently mobilized to implement the Plan.

56 Agrarian Metabolism is a way of using energy, material and information flows and balances to understand important elements of farm and food system sustainability. See Guzmán Casado and González de Molina (2017, p. 399).

57 These discussions made reference to 'Historical analyzers', i.e. historical events in a territory that contribute to the construction of a subjective vision and discourse by a local population about itself. During participatory processes it may be important to identify these events and subject them to discussion and revision, with a view to developing discourses that allow populations to overcome subjective blockages inhibiting the development of problem-solving strategies.

3.6 VEGA, ANDALUSIA, SPAIN

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

Two food and farming associations emerged through the CIFAED-led evaluation process, and would later play a crucial role in the agroecological transition: The Andalusian Network of Women Promoters of Responsible Consumption and Organic Food, and the Granada Association for the Defence and Promotion of Organic Farming. Previously, only Save the Vega had existed in this space – and the group was dedicated primarily to legal corruption claims in regard to urban developers and politicians.

The increasing number of associations and the growing prominence of agricultural issues allowed a social fabric to develop around transition. The upsurge in associative activity also provided a basis for closer linkages between producers and consumers. The Organic Farming Plan included steps to relocalize markets, not only by putting farmers and consumers in direct contact (bio-fairs, shops of producers' associations, etc.), but also via public food procurement. One short supply chain initiative saw ten farmers in the Vega and six farmers from nearby districts create an association to sell their products on local markets, including a box scheme for approximately 100 families. Another ten producers grouped together to form the Association of Organic Producers of the Province of Granada and open their own shop.

One of the most popular initiatives was the *ecomercado*, an organic market held once a month in the centre of Granada. The open-air market contains 24 stands run by organic farmers, the majority of which are managed by farmers' associations or cooperatives. Almost all organic farmers in the Vega now sell through this market, alongside farmers from other districts.

Farmers, consumers, and civil society actors have shown strong ability to adapt to new circumstances – namely the withdrawal of political and financial support for the Organic Farming Plan. In addition to continued increases in the number of organic farmers, producers have shown growing organizational capacity in terms of the continued development of short supply chain initiatives.

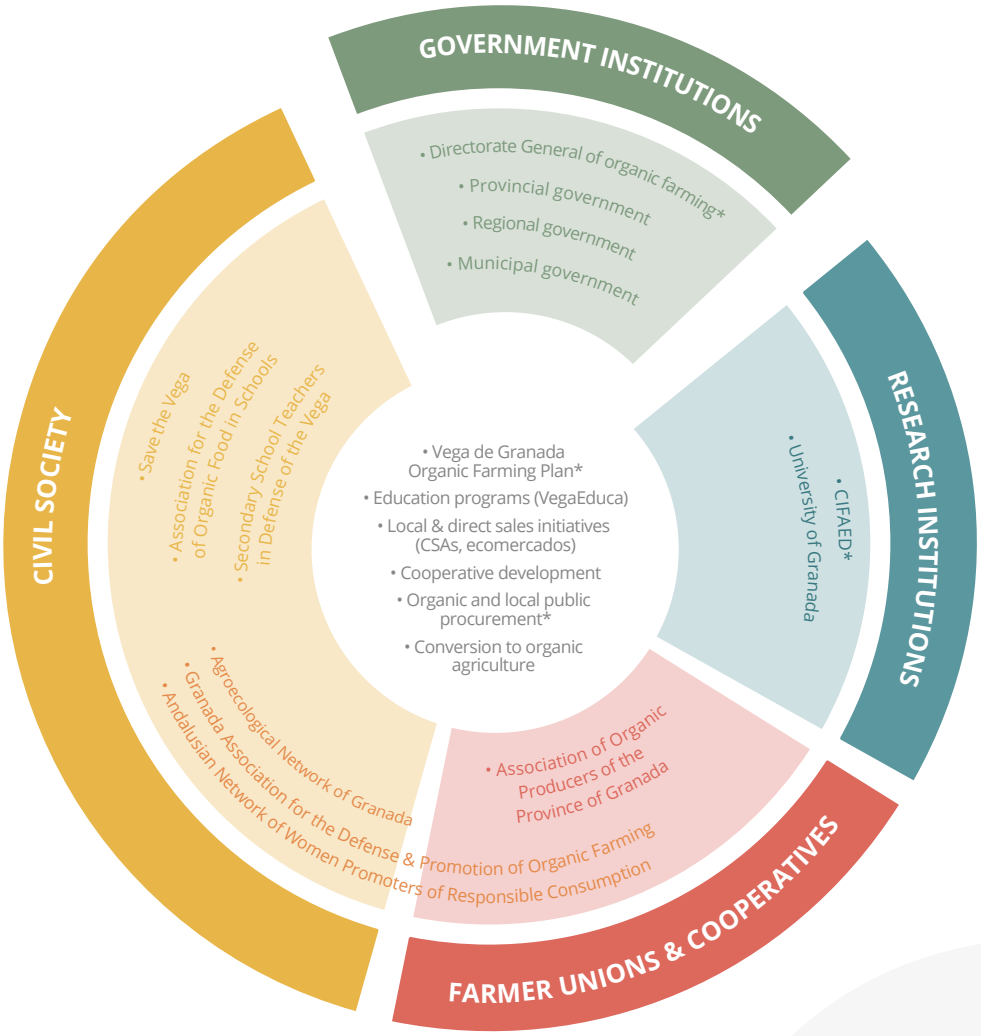
The participants of the *ecomercado* have created the Agroecological Network of Granada (RAG in Spanish), now an important political actor in negotiating with institutions to defend the interests of organic farmers. In 2017, the RAG opened another eco-market in the Vega and continues to support the growth of different organizations within the network. For example, one of the *ecomercado* sellers, El Vergel, has shifted from association to cooperative status, growing from 10 to 16 farmer families and extending its sales network to include deliveries to some 36 consumer groups, as well as organic shops and restaurants. The continued growth of small organic food shops, stocked with fresh products from local farmers, is another indicator of the sustained logistical and organizational capacity of food and farming actors in the district.

While pre-existing associations have continued to operate, new ones have also appeared, most notably the Association for the Defence of Organic Food in Schools and the organization of Secondary School Teachers in Defence of the Vega. In addition, projects supporting agriculture

58 PLANPAIS is a social science research project (Project of Excellence of the Junta de Andalucía) which aims to use local knowledge and context to describe: i) the ecological structures and multifunctionality of the Vega de Granada; ii) the policies and regulations of how the Vega functions; and iii) current conflicts in the Vega. This research lays the foundations to develop concrete policy proposals for the valuation, re-qualification, and reconstruction of the agrarian territory of the Vega as well as sustainable planning to support and promote it.

in the Vega have emerged in the University of Granada, through the PLANPAIS[58] (Matarán Ruiz, 2013a, 2013b; Torres Rodríguez et al., 2016). Meanwhile, the Andalusian Network of Women Promoters of Responsible Consumption and Organic Food has continued to carry out several projects, with financing from the Women's Institute of Andalusia.[59]

FIGURE 15 - A MULTI-ACTOR CHANGE PROCESS IN THE VEGA



** Terminated when government support was withdrawn in 2009*

59 For more information, see: https://reddinamizadoras.blogspot.com (in Spanish only)

3.6 VEGA, ANDALUSIA, SPAIN

Educational initiatives are proving particularly important in taking on the mantle of change. The VegaEduca project, involving 20,000 students and almost 100 secondary schools, supports agriculture and territorial integrity through various interactive activities without any institutional funding. Farmers (especially older ones) have proven to be important educational resources in regard to natural and social sciences. For example, farmers have helped to describe and interpret the changes that have taken place in the territory in the past 50 years.

These interactions have reminded students that the Vega still has the potential to generate economic resources and employment, in a context of high youth unemployment and out-migration (in 2016, Andalusian unemployment for the under-25s stood at 57.8%). Furthermore, the educational program helps to promote local organic food consumption. VegaEduca has also served to consolidate pre-existing entities such as Save the Vega, by making new actors aware of the agroecological transition, including parents and secondary school students.

CHANGES IN INSTITUTIONAL FRAMEWORK

The establishment of CIFAED is a clear example of how institutional conditions may open up a window of opportunity for transition. The research centre had broad-based political buy-in, in the shape of funding received from the Andalusian regional government and provincial councils, and the explicit mandate to foster agroecological transition in the Vega. Commitments were further enshrined in the Vega de Granada Organic Farming Plan, which the regional government committed to co-financing for three years (2008-2010).

Alongside the financial and logistical support for participatory research and learning activities, and the establishment of local market initiatives, the Organic Food for Social Consumption program was established by the Directorate General of Organic Farming (DGAE, in Spanish) of the Andalusian regional government.

The programme sought to i) promote organic consumption among children (as future consumers), parents, and the broader school community; ii) encourage the aggregation of production via groups of local farmers supplying a diversity of produce in line with the demands of public institutions; and iii) provide dedicated opportunities for small and medium-sized producers, thereby securing farm livelihoods through fixed prices and guaranteed payments (González de Molina and Guzmán, 2017).

In 2008-2009, during the operational phase of the Organic Farming Plan, 13 school canteens and one hospital in the province of Granada entered the public procurement program; the local government covered all costs of sourcing from local organic farmers for the hospital, and split the costs with parent groups for the schools. When the government cancelled the program, the school canteens sourcing local organic food in the Granada province dropped from 13 to one, and the participating hospital also switched back to conventional market sourcing. However, the Association for the Defence of Organic Food in Schools arose in response to cancellation of the programme, leading to the emergence of three new organic school canteens managed by parents' associations outside the premises of public schools.

Following the closure of CIFAED, another public research and agricultural training institution, IFAPA, continued to provide some advisory services to organic farmers in the

3.6 VEGA, ANDALUSIA, SPAIN

Producers and consumers interact at the *ecomercado*

Vega. However, as of 2014 there has been no further delivery of public support for organic farmers. Closure of the Directorate General of Organic Farming (DGAE) has also severed ties between the regional government and organic advocacy groups. Nonetheless, organic farmers' groups and cooperatives have survived and even expanded in size, and now use the Agroecological Network of Granada to lobby cities for direct access to consumers through the establishment of organic farmers' markets.

This case study was researched and initially drafted by Gloria I. Guzmán Casado, Director of the Master's Programme in Agricultura y Ganadería Ecológicas at the Universidad Pablo de Olavide, in Sevilla, Spain. She was director of the Centro de Investigación y Formación de Agricultura Ecológica y Desarrollo Rural de Granada (CIFAED) ("Granada Organic Farming and Rural Development Research and Training Centre") which was founded in 2002 and closed in 2009.


Photo: Patti Naylor

CUBA

Turning economic isolation into an opportunity for agroecological transition

3.7 CUBA

From the 1960s to the beginning of the 1990s, Cuban agriculture was focused on highly-mechanized, large-scale monocultures of export commodities, and dependent on large quantities of imported chemicals and fertilizers – in other words, emblematic of the Green Revolution (Burchardt, 2001; Machín Sosa et al., 2013; Rosset et al., 2011).

Although the sector was provided with capital, agro-chemicals, and additional inputs through the Socialist trading bloc, the yields of rice and other key crops began to decline in the 1980s (Machín Sosa et al., 2013; Rosset et al., 2011). The intensive and uniform agricultural model had left soils degraded and struggled to control pests over the long term (Ponce Palma et al., 2015). When the Socialist bloc broke down at the end of the 1980s, Cuba lost 85% of its trade flows and its food production and supply networks collapsed – a situation aggravated by the ongoing US trade embargo.

In response to this crisis, the small-scale agricultural sector in Cuba underwent what has been referred to as an "agroecological revolution" (Altieri, 2016; Machín Sosa et al., 2013). The Cuban peasantry was able to increase production despite a severe reduction in external inputs, while large-scale plantations of sugarcane and other commodity crops continued to struggle (Rosset et al., 2011). The transition accelerated through the 1990s building on a burgeoning *campesino-a-campesino* (farmer-to-farmer) movement.

Today, an estimated 300,000 small-scale farmers are said to be practicing agroecology in Cuba (Altieri, 2016). Studies suggest that agroecological practices are applied on 46-72% of small-scale farms, accounting for about 60% of the vegetables, maize, beans, fruits, and pork consumed in Cuba (Altieri, 2016). Evolving agroecological design and practices have contributed to a significant increase in the peasant sector's relative and absolute production levels, alongside increasing climate resilience and other benefits (Funes and Vázquez, 2016).

Urban agriculture (virtually chemical free) has also flourished, and now supplies up to 70% of the consumption of fresh vegetables in larger cities throughout the country (Altieri, 2016), making Cuba a global leader in urban agriculture (Leitgeb et al., 2016). However, these trends are yet to translate into healthy and sustainable food consumption patterns for broad swathes of the Cuban population.

The following steps were key in driving the transition process forward:

1. Organizing horizontal exchanges between farmers in the field through farmer-to-farmer experience sharing and systematic knowledge exchange;
2. Making the farmers the 'experts' (through several methods of interaction);
3. Recognizing the need to adapt to local conditions (in the development of crop varieties and biological products); and iv) building institutional cooperation between stakeholders in the process.

Many of these steps were driven from the bottom-up by the Asociación Nacional de Agricultores Pequeños (ANAP or National Association of Small Farmers). State support grew in the wake of grassroots farmer-led change, as the strong potential of agroecology to support food production under difficult conditions became clear (Machín Sosa et al., 2013). Through the creation and redirection of research centres, the provision of biological inputs, and the development of advisory services for agroecology, Cuba has assembled what for many are among the world's most supportive policies for agroecology. The implementation

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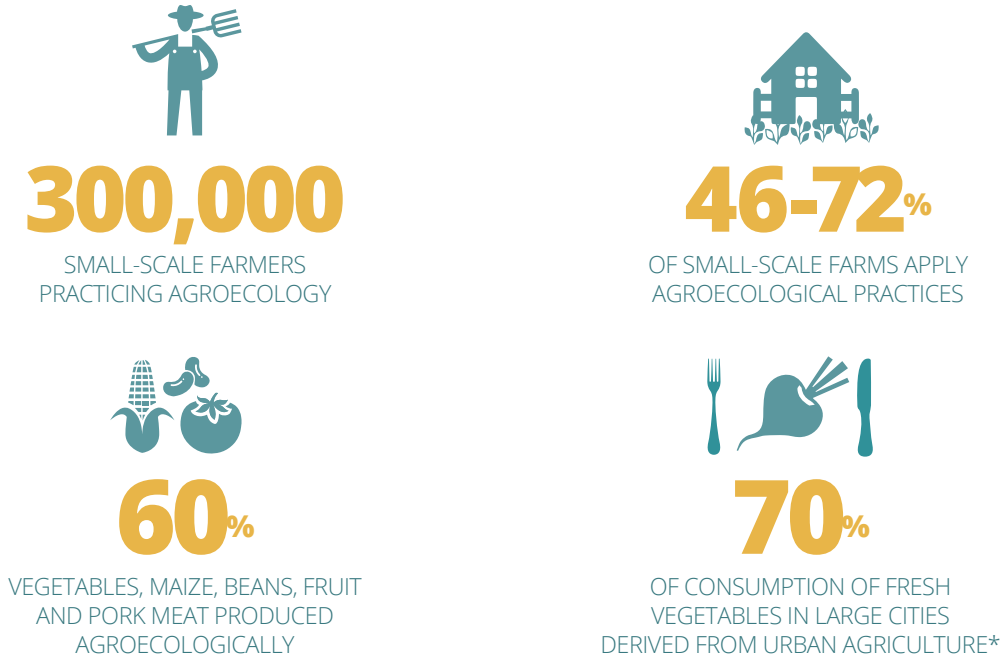
FIGURE 16 - KEY IMPACTS OF CUBA'S AGROECOLOGICAL TRANSITION
(data: Altieri, 2016)



** 77% of the Cuban population lives in cities (Companioni, 2002)*

of curricula based on agroecology, including both theoretical and practical learning in Cuban agricultural colleges and universities, has also helped to institutionalize the transition over the long-term.

However, policymakers displayed a willingness to back Green Revolution-style approaches once the national economy improved (Altieri and Funes-Monzote, 2012). Though many components of the food system are simultaneously undergoing change in Cuba, many others (e.g. food access, nutrition) have yet to experience significant shifts. While the Cuban experience might not be directly replicable, the case underlines the importance of supportive state policies, a highly organized peasantry, and the intentional and systematic use by a peasant organization of a social change process methodology.

CHANGES IN PRODUCTION PRACTICES

Before the supply shocks at the end of the Cold War, the average size of state-run sugar and citrus plantations was roughly 10,000 ha, while state livestock farms averaged about 20,000 ha and rice farms around 30,000 ha. Cuban agriculture had more tractors per person and per hectare than any other Latin American country, and during the 1970s its tractor density became comparable to that of developed countries (Febles-González et al., 2011; Rosset et al., 2011). Fertilizer use on a par with developed countries gave Cuba some of the highest grain yields in Latin American (Ponce Palma et al., 2015; Rosset et al., 2011) while leaving the country's production base highly reliant on imports – accounting for 94% of chemical fertilizers, 97% of herbicides, and 98% of feed concentrate (Febles-González et al., 2011; Funes, 2002).

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Cuba benefited from reasonably high levels of food security through this period (Rosset et al., 2011), with the state managing markets for staple foods and guaranteeing prices as part of Cuba's participation in the socialist trading bloc, the Council of Mutual Economic Assistance (CMEA) (Deere, 1997).

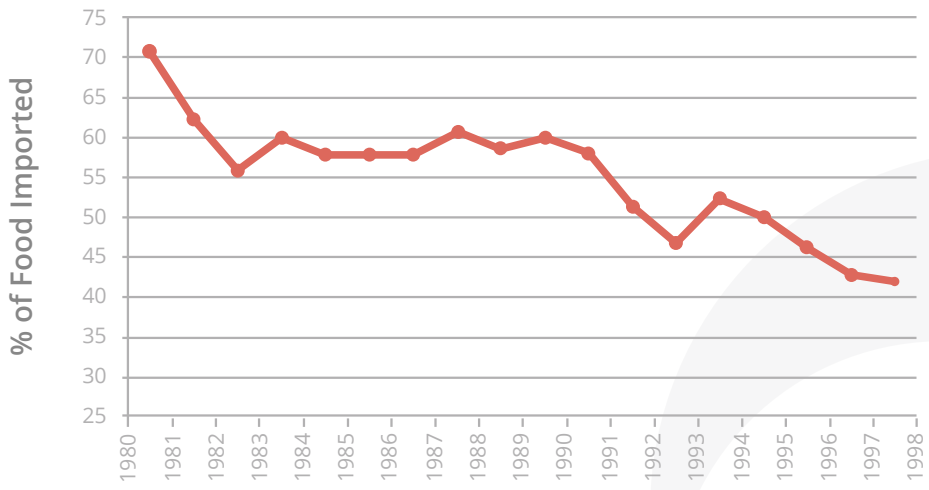
By 1989, when the Soviet bloc broke down, sugarcane was being grown on 30% of the agricultural land in Cuba, generating 75% of export revenues. Meanwhile, Cuban food import dependency stood at 57% (Rosset et al., 2011), and with the US-led trade embargo still in place, almost all of these trade flows were drawn from the Socialist trading bloc. The dissolution of the Soviet Union disrupted these trade relations. During 'the Special Period in Time of Peace', imports of food, oil, raw materials, and spare parts declined sharply and Cuba lost 85% of its trade flows (Nieto and Delgado, 2002; Rosset et al., 2011).

A food and farming crisis emerged. Cuban food production shrank by 5.1% per year from 1986 to 1995, in a context of stagnant production across Latin America. Vegetable production declined by 65% from 1988 to 1994 as the use of agricultural inputs fell to one fifth of previous levels, largely because imported inputs were no longer available. With distribution networks reeling, only one third of the agricultural harvest reached formal markets. Another third rotted in the fields, while the remaining third was distributed on informal markets. Agriculture became the economy's most subsidized sector (Burchardt, 2001; Rosset et al., 2011).

With the loss of conventional chemicals and fertilizers, and lacking tractor parts, Cuban agriculture began an ambitious transition process. A shift towards agroecology was kick-started by farmers themselves, based on innovative forms of farmer-to-farmer knowledge sharing (see below). In tandem, the government conducted a structural reorganization of the agricultural sector by decentralizing the state farm sector through new organizational forms and production structures. Land was redistributed to encourage diversification of production (Funes, 2002).

At the beginning of the 1990s, the Cuban Ministry of Agriculture (MINAGRI) officially initiated

FIGURE 17 - CUBAN FOOD IMPORTS 1980-1997
(Source: Alvarez, 2011)



an alternative model of agriculture. This model included implementation of an agroecological training programme on a large scale, including production diversification, replacement of machinery with oxen, and implementation of integrated pest management (IPM) techniques with a view to reducing dependence on pesticides.

The first initiatives to transform Cuban agriculture were based on input substitution via biofertilizers and biopesticides, in a context of low agro-chemical availability (Machín Sosa et al., 2013). The National Programme for Biological Pest Control began in 1982, and by 1991 had founded Centres for Reproduction of Entomophages and Entomopathogens (CREEs). The CREEs produce biological pest and disease-management solutions including predators, insect pathogens and disease antagonists, plants with insecticidal, fungicidal, bactericidal and herbicidal qualities, and parasitic nematodes (Funes, 2002; Perez and Vazquez, 2002).

The centres are spread around the country, allowing locally-tailored solutions based on locally available by- or waste products, to be delivered directly to the farmers with few transportation and storage requirements (Perez and Vazquez, 2002). The use of organic fertilizers, especially those produced with vermicomposting, the production of locally made biopesticides, and the raising of beneficial organisms for pest and disease control, were among the approaches taken up widely by Cuban farmers (Rosset et al., 2011).

In the early 1990s, the Agroecological Lighthouses Programme was initiated with support from the Sustainable Agriculture Networking and Extension (SANE) project of the United Nations Development Programme (UNDP). Agroecological concepts were applied at 'lighthouse farms' pertaining to different cooperatives in different provinces of the country (Funes, 2002).

It was only from the late 1990s onwards that the majority of Cuban farmers began a more widespread transition from Green Revolution techniques to production systems based on input substitution. This acceleration came on the back of expanding farmer-to-farmer knowledge sharing under the leadership of ANAP. Over time, production systems have become increasingly diversified, with more and more farmers undertaking soil conservation, crop rotation, green manure, polycultures and agroforestry, biological control of pests, integration of livestock with crops, and overall farm diversification (Mier y Terán Giménez Cacho et al., 2018).

An urban agriculture movement also arose in response to the breakdown of food systems and trade flows at the end of the 1980s (Altieri et al., 1999). The movement has spread in cities and suburbs since the early 1990s and now sees the production of diverse fresh vegetables, spices, fruits, flowers, and livestock in mixed crop-animal systems; with 77% of the Cuban population living in cities, it has become an essential component of the food supply (Companioni, 2002; Altieri, 2016). In 1999, the urban sector produced more than 800,000 tons of produce, mainly vegetables (Nieto and Delgado, 2002). By 2012, urban farms or plots numbered 382,000.

While local markets have evolved alongside the agricultural shifts, this is yet to translate into clear impacts on consumption habits or nutrition.[60] Increasing knowledge on nutrition has been attributed to school and adult education. However, the most marginalized

60 In 2009, Cuba's first national food consumption survey showed that just 11% of the Cuban population consumed dairy products at recommended levels, while 16% and 17% consumed the recommended ammounts of fruits and vegetables, respectively. Excessive consumption of fat was found for 78% of the survey respondents while the same occurred for 59% regarding meat, 51% regarding sugar, 31% regarding cereals and 26% regarding dairy products. The survey results indicated poor nutritional quality and monotony in the diet (Porrata-Maury, 2009).

groups and lowest income groups continue to struggle to access healthy foods (Fernández and Hansing, 2008; Alcala, 2018).

CHANGES IN KNOWLEDGE GENERATION AND DISSEMINATION

In the late 1990s, the increasingly influential ANAP looked to kick-start the agroecological transition process by implementing a new methodology of decentralized farmer-to-farmer knowledge exchanges. This methodology was based on one farmer becoming a 'promoter' and sharing positive farming experiences and knowledge of successful innovations (including revival of traditional practices) directly with other farmers. Cuban farmers have proven willing to take up new approaches when seeing them successfully implemented on another farmer's land. This is in line with a Cuban saying, 'cuando el campesino ve, hace fe', which loosely translates to 'seeing is believing'.

Promoters receive no economic compensation, allaying farmers' fears that inaccurate knowledge might be passed along for economic gain. Information on different forms of experimentation is extensively documented, allowing farmers to be paired with the relevant promoters.[61] The farmer-to-farmer methodology thus stands in contrast to conventional top-down extension models (Larsen, 2016; Machin Sosa et al., 2010 and 2013; Rosset et al., 2011).

ANAP piloted a farmer-to-farmer programme in 1997 in the province of Villa Clara (Machín Sosa et al., 2013), arranging workshops to train local farmers in the farmer-to-farmer methodology. In 1999, it had spread to the provinces of Cienfuegos and Santi Spiritus, and one year later to Holguin, Ciego de Avila and La Habana. Though the farmer-to-farmer programme was well implemented in several provinces, the pace of progress frustrated ANAP. At the First Cuban National Gathering of the Campesino-a-Campesino (CAC) Programme in 2001, the ANAP president argued that farmer-to-farmer knowledge sharing should be a bottom-up movement, not simply a programme based on foreign project-based funding – although such funds would still be accepted. The Campesino-a-Campesino Agroecology Movement (MACAC) was thereby initiated, and by 2003 had spread to all Cuban provinces (Machín Sosa et al., 2010; Rosset et al., 2011).

This knowledge paradigm is now supported by institutional actors and programmes. Employees from various state institutions, research institutes, and NGOs regularly visit and learn from the farmers – who are repositioned as experts in a more equal exchange. Institutional actors also provide knowledge of their own and provide farmers with variety of seeds and biological inputs for free.

One example is a bus trip arranged by the Cuban Association of Agricultural & Forestry Technicians (ACTAF). The bus trip gathers employees from different associations and organizations who accompany ACTAF staff to various farms. Cooperation with a range of institutional actors – the Department of Soil, the National Institute of Research in Tropical Roots and Tubers (INIVIT), the National Institute for Fundamental Research

61 Facilitators' help to pair farmers in need of specific knowledge with relevant farmer promoters. The facilitators are employed by cooperatives. The coordinator oversees the process of knowledge sharing between farmers at the municipality or provincial level by developing and updating a list of problems (*banco de problemas*) and a list of farmers with solutions to those problems. Due to the growing complexity of organizing farm visits, and difficulties finding promoters with the relevant knowledge in the local area, the Banes method has been developed whereby cooperative members register successful experiences and problem areas in a matrix form. These matrices are then used for rapid identification of problem areas so that new promoters can respond to them when cross-referenced by cooperative facilitators and municipal coordinators.

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Photo: Patti Naylor

in Tropical Agriculture (INIFAT) – expands the scientific and professional competences put at the disposal of farmers (Larsen, 2016).

Similarly, in cooperation with the Ministry of Agriculture (MINAGRI), INIVIT conducts a national journey every three months to visit farmers in all provinces of the country. On these visits, INIVIT brings plant material, including the clones they produce, conducts inspections, identifies different problems at the farm level, assesses what crops are suited to local conditions,[62] and provides general technical assistance. INIVIT employees not only share their expertise with farmers in the field, but also obtain data on how their products function through inspections and the identification of problem issues by the farmers (Larsen, 2016).

Peasant farmers also obtain substantial information through the cooperatives to which the majority are affiliated. The cooperatives host monthly, well-attended assemblies, allowing a wide range of issues to be raised by farmers, with many promoters and at least one 'facilitator' of agroecology present in each cooperative. Some of the associations and organizations occasionally host debates and conferences at the field level, while ACTAF hosts debates on technical issues, important seasonal crops, and other issues proposed by the farmers (Larsen, 2016).

Books, brochures, magazines, and other materials are also widely-used communication channels (for example, see Funes and Vázquez, 2016). ANAP distributes a magazine four times a year that covers history, law, proceedings of

62 INIVIT invites a group of crop experts from around Cuba to attend. They control and check previous clones and by doing so, study the suitability of different crops in various provinces across the country.

Congress agreements, scientific events, and technical reports on farming. ACPA distributes a quarterly magazine and ACTAF publishes three times a year. These materials are physically and financially accessible to Cuban farmers throughout the country: all cooperatives have micro-libraries containing a selection of editions free of charge, while ACTAF and ACPA distribute their handbooks to the micro-libraries in all provinces in the country (Larsen, 2016). ACTAF also hosts radio programmes, including weekly broadcasts with weather forecasts, farmer advice, and practical information about the bus trips.

Agroecology has also been institutionalized in educational curricula. The Agricultural Polytechnic Institutes (IPAs), Cuba's rural vocational high schools, provide Cuba's future farmers and agronomists with their first formal introduction to the science and technology of agriculture. The IPAs are full-time live-in schools, which include research plots for student projects. The curriculum includes daily work in the fields as part of a broad-based learning approach that encompasses ecological and social sciences.[63] Farmers' fields serve as 'auxiliary classrooms' where the best agroecological farmers near the school teach directly on their farms. The schools also produce food for the students, based on diversified and integrated crop-livestock systems. Many of the schools also produce biological pest control organisms for their own use, sometimes working with CREEs to generate additional income.

CHANGES IN SOCIAL AND ECONOMIC RELATIONS

Social organization and activism have been essential ingredients in the spread of agroecology in Cuba (Mier y Terán Giménez Cacho et al., 2018; Rosset 2015; Rosset and Altieri 2017). In particular, farmer-to-farmer social process methodology has driven new knowledge dissemination practices while also building solidarity among farmers, and has shown the capacity to lead to rapid scaling of agroecology (Rosset et al., 2011). It would appear that agroecology has spread more rapidly in Cuba than in other parts of Latin America because of ANAP's greater degree of organizational development and promotion of the farmer-to-farmer methodology (Rosset et al., 2011). The number of farmers practicing agroecology grew quickly from just 200 farmers in 1999 to approximately 110,000 farmers in 2009, representing about one third of the small-scale farmers in Cuba (Rosset et al., 2011).

Social relations have also evolved through and in response to land ownership modalities under Cuba's Socialist regime. Most Cuban farmers privately own their land but cultivate it as part of cooperatives.[64] In 1977, farmers founded the Agricultural Production Cooperatives (CPA) or collectives, whereby privately-owned plots of land were pooled in order to benefit from supposed economies of scale, as well as common

63 The agroecological curriculum developed in the universities is based on an interdisciplinary approach (agricultural and ecological sciences, social sciences). The development of the curriculum has been based on exchanges between university researchers, professors, students and farmers. The Agrarian University of Havana (UNAH) offers comprehensive courses, practical training and a distance diploma programmes, as well as Master's and PhD programmes in 'Agroecology and Sustainable Agriculture' at the Centre for the Study of Sustainable Agriculture (CEAS), where students are prepared for future work as farmers, consultants and researchers. CEAS has designed and introduced an agroecological curriculum in universities throughout the country (García, 2002; Larsen, 2016).

64 Farmers in Cuba are divided into three categories: (i) farmers who have been given land in usufruct by the state, (ii) farmers with private ownership or parceleros, who are not a member of a cooperative (a minority of farmers, who are dispersed throughout the Cuban countryside mainly producing for own-consumption), and (iii) farmers with private ownership who are members of a cooperative – the vast majority (Alvarez, 2002).

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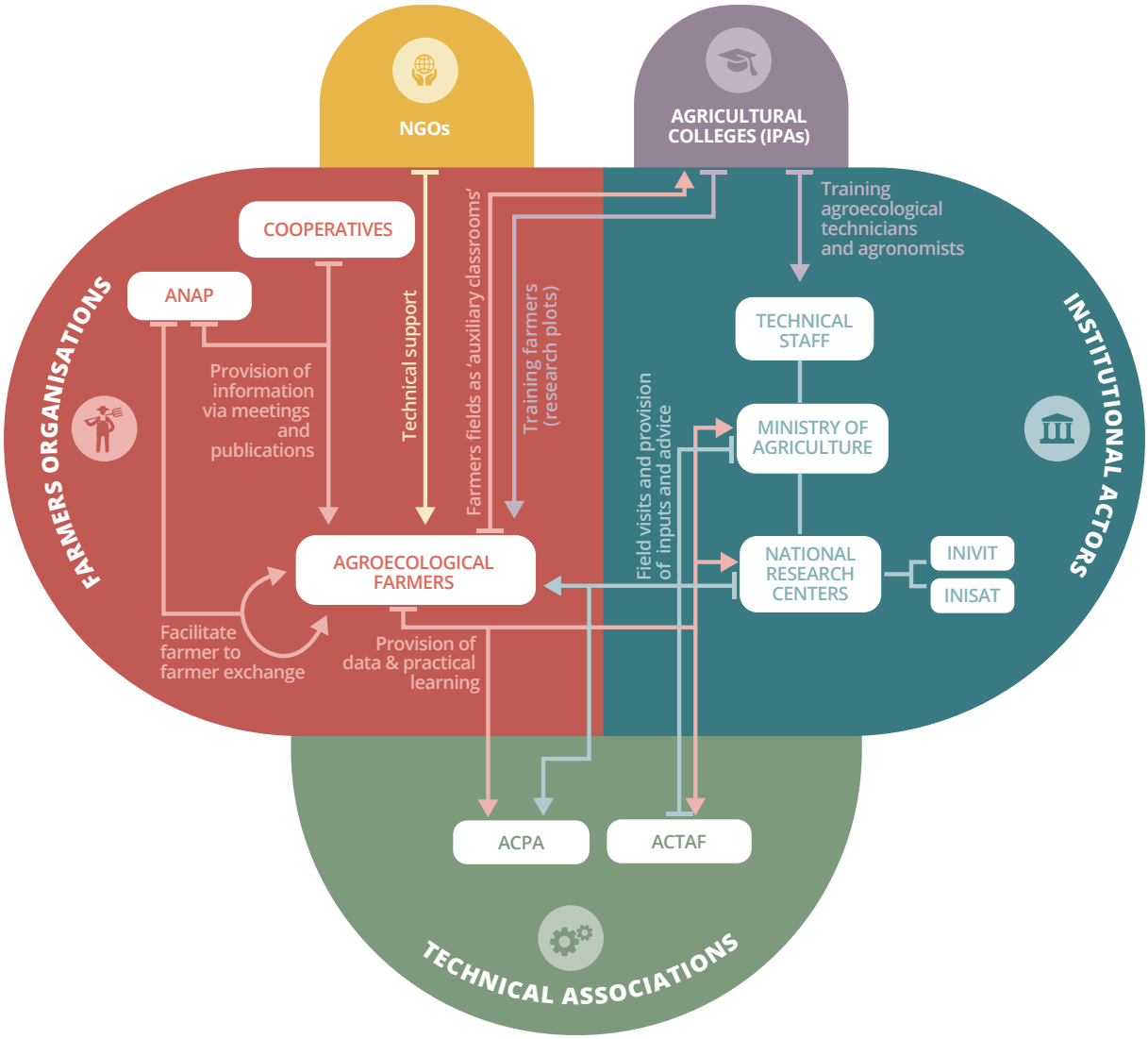
FIGURE 18 - AGROECOLOGICAL KNOWLEDGE CYCLES IN CUBA



services, credit, and bulk input purchasing (Martin, 2002). Land, machinery, and warehouses in these cooperatives are owned collectively and CPA members receive payments based on the number of days they work. Profits from production are divided annually between the members (Alvarez, 2002; Rosset et al., 2011).

The majority of land-owning farmers can also be members of a Credit and Service Cooperative (CCS). CCS members own their farms and farm individually but obtain services and credit collectively, while sharing machinery and marketing activities (Rosset et al., 2011). Because agroecology and farmer-to-farmer approaches spread much more rapidly in the CCS coops than in the CPAs, part of ANAP's strategy was to adapt their methodology over time to better address the needs of CPAs (Machín Sosa et al., 2010; Rosset et al., 2011).

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CHANGES IN INSTITUTIONAL FRAMEWORK

Cuba's agroecological transition has also been aided by the institutionalization of agroecology in public policies, government bodies, research institutes, and NGOs (Nelson et al., 2009). These steps built on the momentum created by the farmer-led agroecology movement that had already built strong roots in Cuba. The political weight and influence of the peasant organization ANAP helped to drive transition forward in Cuba, both in terms of spreading agroecology at the production level, and influencing governmental institutions in the process.

As a result of the economic crisis in the early 1990s, the government conducted a structural reorganization of the agricultural sector by decentralizing the state farm sector, and officially began to embrace an alternative model of agriculture. In 1993, agrarian reforms saw the dismantlement of the large state sector. The following year, restrictions were lifted on sales channels for agricultural produce (Deere, 1997). On the back of chronically low prices on global sugar markets, former sugar plantations were divided up and usufruct rights granted to more than 75,000 new farmers, many of whom moved towards agroecological production (Funes, 2002). Benefiting a wide array of farmers, these policies likely served as a precondition for agroecology to take root at the farm level.

The government also removed constraints on urban, family, and community farming movements, and formally lifted restrictions on farmers' markets (Funes, 2002). The ministry also began to promote cooperation amongst farmers and to support research and development into new sustainable techniques. In a context of increasing urbanization, incentives were provided for rural populations to remain in or return to the countryside with a view to ensuring the availability of farm labour (Nelson et al., 2009).

MINAGRI's agroecological support programmes were introduced with the involvement and support of various ministries;[65] a range of government agencies became important allies of the farmer-to-farmer movement (Mier y Terán Giménez Cacho et al., 2018). NGOs and universities have provided research, technical, and other types of support. Groups including the Cuban Association of Agriculture and Forest Technicians (ACTAF), the Cuban Animal Production Association (ACPA), and the Programme for Local Agricultural Innovation (PIAL) played similar roles.

However, while support for agroecology by government policies expanded considerably in the 1990s in the wake of economic shocks, the state currently appears to be undergoing a "cyclical return" to conventional agriculture (Altieri and Funes-Monzote, 2012). Recent years have seen major influxes of industrial agricultural technologies, fertilizers, oil, and GM maize varieties through cooperation and exchange with Venezuela, Brazil and other partners (Montalván, 2010; Altieri and Funes-Monzote, 2012; Patel, 2012b). The Cuban government is also investing heavily in biotech research (Altieri and Funes-Monzote, 2012). In 2012, dedicated areas for intensive production of staple crops including potatoes, rice, maize and soy still made up less than 10% of cultivated land, though invest-

65 The Ministry of Science, Technology and Environment (CITMA) (founded in 1994 during the Special Period) which prepares and implements state policy concerning scientific, technical and environmental issues with major implications for the agricultural sector; the Ministry of Education (MINED) which includes a network of Agricultural Polytechnic Institutes (IPA); the Ministry of Higher Education (MES) which includes all agricultural universities, several research institutes and experimental stations as well as all university and post-graduate teaching (Funes, 2002).

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Photo: Patti Naylor

ments in these systems may be on the rise (Altieri and Funes-Monzote, 2012).

Political and economic changes in Cuba may also be exacerbating poverty and affecting the quality and availability of social services – with serious implications for food security and access (Fernández and Hansing, 2008). Following Cuba's new border policies with the US, an influx of tourists caused a surge in the demand for food by the hospitality industry, resulting in a spike in food prices (Ahmed, 2016). Around the same time, the government proposed to discontinue support for the 50 year-old 'family ration booklet' policy, which provides a subsidized basket of basic foodstuffs on which millions of Cuban citizens still rely.

Cuba's agroecological transition therefore remains in the balance. While agroecology has been institutionalized on various levels, joined-up policies to promote sustainability and food security across the food system are yet to take shape, and agroecology continues to coexist with competing priorities and paradigms.

This case study is based on the findings and original insights of several researchers, in particular the Master's Thesis of Mille Renée Larsen (*'We are a system' - Towards a sustainable agriculture. The transition process into agroecology - learning from Cuba*), and Peter Rosset, Center for the Study of Rural Change in Mexico (CECCAM), who has reviewed initial materials and provided further insights.

04 Conclusions

The case studies profiled in this report have several limitations. Information on some aspects of these transition processes was more readily available and more easily documented than others. In particular, question marks remain about how actors were convinced to change course, how existing power relations were overcome, and to what extent communities will be capable of sustaining transitions if lead actors step back. The various impacts of the initiatives (on productivity, on environmental resilience, on labour, etc.) are also unevenly captured. These case studies, like the transitions themselves, are ultimately works in progress and have not yet fully captured what are complex change processes.

Nonetheless, the seven case studies provide in-depth examples of how transition can occur despite the mechanisms locking food systems into an industrial paradigm, and help to complement existing understandings of agroecological transition and how it can be taken forward. In Section 4.1, the key findings of each case are summarized in table form, with reference to the four dimensions of change. Subsequently, key entry points and leverage points for agroecological transition are identified by looking across the cases, with particular attention to the potential for unlocking transition at the intersections between different types of change. In Section 4.2, conclusions are drawn in regard to what can be done by various actors to promote agroecological transitions moving forward.

4.1. INSIGHTS FROM THE CASES: KEY LEVERAGE POINTS FOR AGROECOLOGICAL TRANSITION

The case studies show that it is possible for communities, regions, and whole countries to fundamentally redesign their food and farming systems – from a variety of different entry points. The change process does not always begin on the farm with input substitution. Transition can also be kick-started by community-building activities, farmer-researcher partnerships, participatory scientific assessments, and even by external shocks that make people question the status quo.

Often a single entry point for transition is hard to identify: **these transitions are characterized by the coexistence of a series of parallel shifts from the outset**. For example, the Vega and Drôme projects had a dual focus on shifting practices and developing new marketing/retail networks from the start. In Chololo and San Ramón/Veracruz, the questions of *how* the communities should farm and *who* should be involved (as farmers and decision-makers) were addressed in parallel from the outset. In Santa Cruz, a robust farmer-researcher partnership was established alongside the first production shifts and endured throughout the transition. In Puhan, changes in production practices initially stalled, and only accelerated after major changes in social relations (via community-building activities) had helped to break the deadlock. Where production shifts played an important role early on, they extended beyond increasing the productivity of commodity crops, and entailed a broader focus on diversification of production and/or livelihood activities (e.g. Chololo, San Ramón/Veracruz).

The four dimensions of change represent the basic preconditions for agroecological transition. The case studies underline that, regardless of the initial entry point, change must spread to other dimensions in order to drive transitions forward and sustain them over time. The four dimensions of change – in production practices, in knowledge generation and dissemination, in socio-economic relations, and in institutional framework – were not equally important in all

SUMMARY OF FINDINGS FROM THE CASES

	CHANGES IN PRODUCTION PRACTICES	CHANGES IN KNOWLEDGE GENERATION & DISSEMINATION	CHANGES IN SOCIAL & ECONOMIC RELATIONS	CHANGES IN INSTITUTIONAL FRAMEWORK	KEY ENTRY POINTS & LEVERAGE POINTS FOR TRANSITION
Santa Cruz	Stepwise conversion from input substitution through to system redesign & re-diversification; Push-pull methods	30-year farmer-researcher partnership with dynamic research questions; Farm as learning centre	Long-term solidarity purchasing via UC Santa Cruz, CSAs & farmers' markets; Organic and food justice certifications; Consolidation in large farms & erosion of markets by mainstream organic	Methyl bromide ban; Uptake of organic practices by mainstream; Double-edged impacts of organic certification frameworks	Long-term farmer-researcher partnership; System redesign away from monoculture; Durable alternative markets; Long-term change vision held by lead actors
San Ramón Veracruz	Agroecology used to tackle short-term disease threats & build longer-term resilience through diversification, home gardens; Stabilization of production & food availability through the year	Participatory Action Research cycles responding to positive & negative results; Horizontal farmer-to-farmer & coop-to-coop learning exchanges; Nutrition/ cooking education to maximize home garden benefits	New coffee export brand; Dedicated women's activities and coffee fund; Dedicated youth programs	New price-setting process for coffee exports; Cooperatives becoming political actors; Multi-level cooperatives to divide functions and aggregate power	Dual focus on diversification & high-value exports; Building capacity & change mentality among local orgs & coops; Empowerment of women as decision-makers
Chololo	Package of agroecological technologies; Focus on optimal planting times; Promotion of agro-forestry & resource conservation across community	Technical guidance through technology groups & farmer-to-farmer demonstration approaches; Participatory appraisal of problems & solutions	Community-building through awards, celebrations & visibility of pioneering farmers; Women's empowerment in selecting & pursuing new livelihood activities	Conscious alignment with national climate adaptation policy; Visits from national policymakers & involvement of local policymakers	Multi-sectoral focus (ag., livestock, water, energy, resources) & multi-disc. project team (university, govt. ag. research institute, local authority & NGOs) for wide buy-in; Politically-sellable climate adaptation model
Puhan	Gradual steps to reduce chemical inputs & shift to agroecological practices; Production in cooperatives	Training sessions organized by cooperatives; Focus on technical knowledge & policy awareness; Intergenerational knowledge transfer to keep youth on farms	Community-building over profits & productivity; Wide array of services provided by cooperatives; Women-focused initiatives building ownership; Equal shares of produce for community, CSAs, & formal markets	State policies failing to stem rural decline; Community-led parallel institutions & services provision; Emerging policy support for cooperatives & ecological transition	Development of cooperative-led rural development & rural livelihood approach; Community activities to build basis of solidarity & common interest; Balancing of local consumption, CSAs & formal markets
Drôme	(Re-)adoption of organic farming practices (especially elimination of agrochemicals and upscaling of organic fertilizer production and use); Whole-farm organic conversion	Dissemination of info. on organic production techniques through trade journals, input providers & "neo-rural" environmentalists; Agricultural knowledge centres bridging organic/ conventional divide	Organic farmers taking on leadership positions; Establishment of new logistical and marketing channels through grassroots organizations; Two-speed transition in upper and lower valley	Support through 'communities of municipalities'; Adoption of region-wide 'Biovallée' plan; Access to national and EU-level funding; Modest opening of 'Chambres d'agriculture' to organic shift	Connection of bottom-up organic movement with political rural development agenda; Gradual mainstreaming of organic via interactions between organic & conventional farmers and between grassroots & institutional actors
Vega	Redesign of regional agroecosystem & management practices in line with organic principles; Focus on re-establishing nutrient & resource flows, local input sourcing	Transdisciplinary historical reflections on local farming system & rural decline through the lens of Agrarian Metabolism; Stakeholder engagement to co-design Organic Farming Plan	Multiplicity of civil society groups defending organic food & farming (women-led, education-based; environmentally-focused); movement consolidation through ecomercados & Agroecological Network of Granada	Establishment of research centre with regional & provincial funding; Regional govt. support for three-year plan (inc. public procurement schemes) but withdrawn after breakdown of political coalition	Broad alliances across producer/consumer divide forged in negotiation of Organic Farming Plan; Broad base of civil society activism to maintain momentum despite withdrawal of political support
Cuba	Input substitution followed by adoption of agroecological techniques such as diversification, crop rotation, agroforestry & crop-livestock integration; Urban agriculture	Farmer-to-farmer knowledge exchange; Provision of biological inputs via state research centres; Circular knowledge flows between farms & govt. agencies via 'bus tours'; Knowledge spread by coops & Agricultural Polytechnic Institutes	Highly organized peasant agroecology movement driven by national small farmers' association with social process methodology; Land, machinery, & credit pooling through cooperatives	Decentralization of state farm sector; Institutionalization of agroecology in state & research institutions; Supportive policies (e.g. land reform) alongside continued support for industrial agriculture	Forced adjustment due to external shocks; Gradual alignment of various orgs. & govt. institutions around agroecology; Rapid spread of new practices via farmer-to-farmer approach

of the cases. However, as shown in the table above, they are broadly present throughout. This reinforces the insights from the literature on the relevance of these dimensions in driving and sustaining agroecological transitions.

Indeed, the case studies reviewed in this report suggest that some degree of change is likely to be required in all four dimensions in order to spark a meaningful and durable shift in food and farming systems. It is when these different types of change combine and reinforce one another that transitions are truly unleashed. Simple dichotomies – between top-down / bottom-up transitions, or farmer-led / community-led transitions – do not accurately capture how change occurs.

Furthermore, the case studies make clear that **the lock-ins of industrial food systems**[66] **need to be confronted head-on, through mutually-reinforcing actions on multiple fronts**. For example, *export orientation* could not simply be reversed in San Ramón/Veracruz by selling to local markets, given ongoing reliance on coffee revenues and weak local demand. Ultimately, steps were required to diversify production and build viable alternative livelihoods (i.e. addressing *path dependency*), while a new bottom line for coffee exports based on long-term solidarity-based purchasing had to be negotiated in parallel (i.e. addressing the lock-ins of *short-term thinking and the expectation of cheap commodities*[67]). Similar dynamics can be observed in Santa Cruz, where steps to diversify and redesign production systems went hand in hand with steps to build more equitable strawberry supply chains. In the Drôme, Vega, Puhan and Chololo, transitions gained traction when actors started to pull on multiple levers of change, with equal attention to production-based, market-based, knowledge-related, and political obstacles – and a focus on anchoring the transition in new *narratives*.

The Cuban transition arose from a sudden change in geopolitical realities, meaning that *export orientation and path dependencies* (i.e. reliance on chemical inputs and commodity monocultures) were forcibly broken. However, these ingredients alone were not sufficient for transition, and could simply have mired the country in food insecurity and poverty. Indeed, agroecological transition only flourished once peasant organizations and cooperatives had reappropriated knowledge systems and rebuilt them around agroecology, allowing *compartmentalized thinking* to be challenged. The only-partial promotion of agroecology by the Ministry of Agriculture suggests that the lock-ins of industrial food systems are still exercising a pull, holding back and limiting the potential impacts of the Cuban transition.

The *concentration of power* was confronted across the cases, often requiring multiple, creative steps, and ultimately the creation of new markets, knowledge systems and governance structures in order to circumvent highly-entrenched power relations (see Section 4.2).

These examples reflect the findings of the broader literature on agroecological transition, i.e. that **the different dimensions of change are overlapping and mutually-reinforcing over time** (see for example Pimbert, 2010). While the case studies are organized according to the four dimensions of change, in reality many of the developments did not fit easily into one category. In particular, agroecological production shifts are strongly influenced by the adoption and implementation of more democratic and communication-oriented knowledge dissemination (for

66 The eight lock-ins of industrial agriculture, as identified by IPES-Food (2016), are: path dependency; export orientation; the expectation of cheap food; compartmentalized thinking; short-term thinking; 'feed the world' narratives; measures of success; and concentration of power. See explanation and diagram on page 9.

67 This lock-in is originally formulated as 'the Expectation of Cheap Food' in IPES-Food's 2016 report, From Uniformity to Diversity. However, the same logic applies to coffee, a non-food commodity, in this case study.

instance through farmer-to-farmer approaches). These shifts reinforce and are reinforced by changes in socio-economic relations that allow consumers and other value chain actors to communicate their preferences, e.g. through the establishment of short, local supply chains, and alternative marketing arrangements (Duru et al., 2015). Meanwhile, changes in social and economic relations may engender changes in institutional frameworks, if citizen inclusion and democratic deliberation procedures are meaningfully included in the policy-making process. This in turn can lead to changes in knowledge generation, as diverse forms of knowledge are accommodated in more open policy-making processes, and it is recognized that knowledge cannot be separated from values. This is when the transition process of change becomes a transformation in thinking, believing, and acting.

The case studies in fact show that **the greatest leverage points for transition sit at the intersection between different dimensions of change**. It is at these intersections, as hybrid structures and actors emerge, that power can be reconfigured and reliance on the existing brokers of inputs, knowledge, and market access can be drastically reduced. Across the case studies, seven key leverage points[68] emerge at the intersection between different dimensions of change, and are explored below:

1. **Building new community-led governance structures and economic systems between the state and the market** (at the intersection of social & institutional change). Several transitions were driven forward by the emergence of hybrid, informal, community-led institutions and governance structures – rather than relying on change happening within formal institutional frameworks. In some cases, the transition process was tantamount to a civil society-led rural development strategy, entailing steps to relocalize food systems, to reserve productive capacity and resources for supplying local communities, to provide a range of services to rural populations, and to reinvest profits into the community when selling into formal/distant markets (e.g. Puhan, San Ramón/Veracruz). In the Drôme and the Vega, the transitions were built on self-organizing, civil society-led platforms and regional plans that were later taken up and endorsed by state actors. In San Ramón/Veracruz, new multi-stakeholder price-setting processes for coffee were instituted. In other words, fertile terrain for transition was found by occupying spaces between the state and the market, and building a member-owned economy for goods and services.

2. **Developing hybrid roles for key actors** (at the intersection of social, knowledge & institutional change). Change can be unlocked when actors take on hybrid roles, allowing new brokers of knowledge, inputs, and market access to emerge. In particular, the cases show that politicized farmer/peasant organizations and cooperatives can be highly influential, particularly if they combine cooperative functions such as joint marketing, farmer-to-farmer knowledge sharing, community-building activities, and political advocacy (e.g. ANAP in Cuba; the Puhan Rural Community cooperatives; the UCA San Ramón cooperatives in Nicaragua; the Agroecological Network of Granada and other farmer-civil society platforms in the Vega). In some cases, farmers took on political leadership roles in the community (e.g. Drôme) and became important political actors through the transition process (e.g. San Ramón/Veracruz), reinforcing their ability to drive change forward. Cooperatives played a variety of crucial roles across the cases. Taking on more classical functions at the outset

68 The order of these leverage points reflects how strongly and how systematically they emerged across the cases. However, it is not intended to imply that one factor is more important than another in supporting agroecological transition; the various leverage points are overlapping and mutually-reinforcing.

of transitions (i.e. aggregating production and adding value in specific supply chains) did not prevent parallel steps to diversify production – and to diversify the activities of the cooperatives – over time.

3. **Forging new alliances across disconnected domains** (at the intersection of social & institutional change). In some cases, change was unlocked by creating improbable alliances that brought together farmers, consumers, and environmental groups (e.g. Vega), and brought institutional actors into contact with more radical actors (e.g. Drôme). Avoiding organic/agroecology becoming closed niches and facilitating ongoing exchanges with mainstream actors appears to have played a key role in maintaining momentum and building powerful alliances over time. This took the shape of integrating organic with conventional farmers in various organizations (e.g. Drôme); allowing risk-averse farmers to shift later after seeing the results of early adopters (e.g. Chololo); or bringing together small-scale farmers at all levels of transition (e.g. Puhan). Participatory evaluations/appraisals helped to forge broad alliances and establish common ground at the outset of transition processes (e.g. Vega, Chololo, San Ramón/Veracruz). Across the cases, agribusiness actors were consulted and included in the transition process, but without being able to set the terms (e.g. the decision by the Puhan cooperative to limit the land dedicated to supplying a large-scale buyer; consultation of agribusiness actors in the evaluation and planning stages of a research, farmer and civil society-led process in the Vega; negotiating coffee prices with all actors in the commodity chain, from farmer to roaster, San Ramón/Veracruz).

4. **Anchoring transitions in counter-narratives and theories of change** (at the intersection of knowledge & social change). Narratives and theories of change matter, and can help root transitions in local identity and culture, as well as allowing people to differentiate themselves from the dominant model and embark on a new course. Examples of this ranged from the emergence of influential opinion-forming media (e.g. Nature et Progrès in the Drôme); to the use of cultural media like song and dance to make sense of the transition and strengthen community ties (e.g. Chololo, Puhan); and critical historical reflections to build a basis for transition (e.g. Vega).

   Furthermore, transitions appear to be sustained and driven forward when underpinned by a clear theory of change, while allowing space for adaptation along the way. This was visible in the intentional and systematic use by ANAP of a social change process methodology in Cuba; through the application of the 'five levels' approach and Participatory Action Research (PAR) cycles as a long-term change process in San Ramón/Veracruz; and in the deliberate, stepwise methodology underpinning the farmer-researcher partnership in Santa Cruz, as well as Swanton Berry Farm's commitment to realizing an ever-broader sustainability paradigm. Across the cases, agroecology itself appears to have provided a unifying narrative to capture the change process underway. Furthermore, a commonality of these experiments is the focus on increasing the social capital and adaptive capacity of communities, building transitional mindsets, and creating the conditions for ongoing transition. Mier y Terán Giménez Cacho et al. (2018) identify the "social organization and intentional social process" at the heart of agroecological movements in Central America, Cuba, Brazil, and India as a crucial driver of their growth and expansion.

5. **Relocalizing food and farming systems** (at the intersection of production & social change). Some degree of reconnection to local markets, culture and community proved crucial across the cases. This included a focus on home gardens (e.g. San Ramón/Veracruz), farmers' markets, CSA schemes and other forms of direct sales (Santa Cruz, Vega, Puhan), local public procurement (e.g.

Vega, Drôme, Santa Cruz), as well as steps to source inputs within the farming communities (e.g. Vega, Chololo). The case studies and the broader literature underline the importance of alternative customer bases and particularly short supply chains and direct sales in order to break free of the industrial model (ARC2020, 2015; European CSA Research Group, 2016).

In several cases, the process of connecting to local markets proved an important step in consolidating agroecological production models. Although priorities had to be carefully balanced and community food security came first, the focus on relocalized or territorial markets did not come at the expense of outside trade. Indeed, strategies to access national markets (e.g. Puhan) or international markets (e.g. San Ramón/Veracruz) were strengthened by the new organizational capacities developed through the respective projects, whereby farmers had expanded options and did not have to resort to bulk sales at any price. With its own infrastructures, extension agents and retail circuits, organic agriculture appears to have played a key role in reconnecting producers to local markets, as well as paving the way for new regional/national markets to be accessed (e.g. Puhan, Vega) and external funding opportunities to be secured (e.g. Drôme). Across the cases, a clearly defined and deeply held commitment to transition was embedded in lead organizations and actors. This helped to ensure that the change process did not stop at organic certification (see further discussion in Section 4.2).

6. **Promoting farmer-to-farmer knowledge sharing** (at the intersection of production & knowledge change). Farmer-to-farmer knowledge sharing, farmer-field schools, and demonstration farms emerged across the case studies as powerful drivers of transition – succeeding where linear extension models have failed. In several cases, they helped to bring a large number of farmers on board and build solidarity between them (e.g. Chololo, Cuba). Allowing pioneering, risk-taking farmers to take a strong lead role as 'promoters' appears to have been impactful (e.g. Chololo, Cuba). Supporting farmers to go beyond the community to share experiences and extend their learning was also key (e.g. Puhan, Chololo, Cuba). Simply showing benefits on one farm to another farmer did not suffice; to be effective, such systems needed to be deeply embedded and integrated with the broader change process (e.g. Veracruz/San Ramón).

The case studies and the broader literature underline the benefits of farmer-to-farmer approaches vis à vis linear extension models. For example, farmer-based systems allow micro-regional agroecological knowledge to persist in the face of standardization and rationalization pressures coming from dominant agri-business paradigms in the wake of absent state extension services (e.g. Puhan). Mier y Terán Giménez Cacho et al. (2018) identify "constructivist teaching-learning processes" as a central driver for bringing agroecology to scale. As Meek (2016, p. 285) observes, conversely, a lack of mutual understanding between extension agents and the local community can create barriers to agroecological transitions.

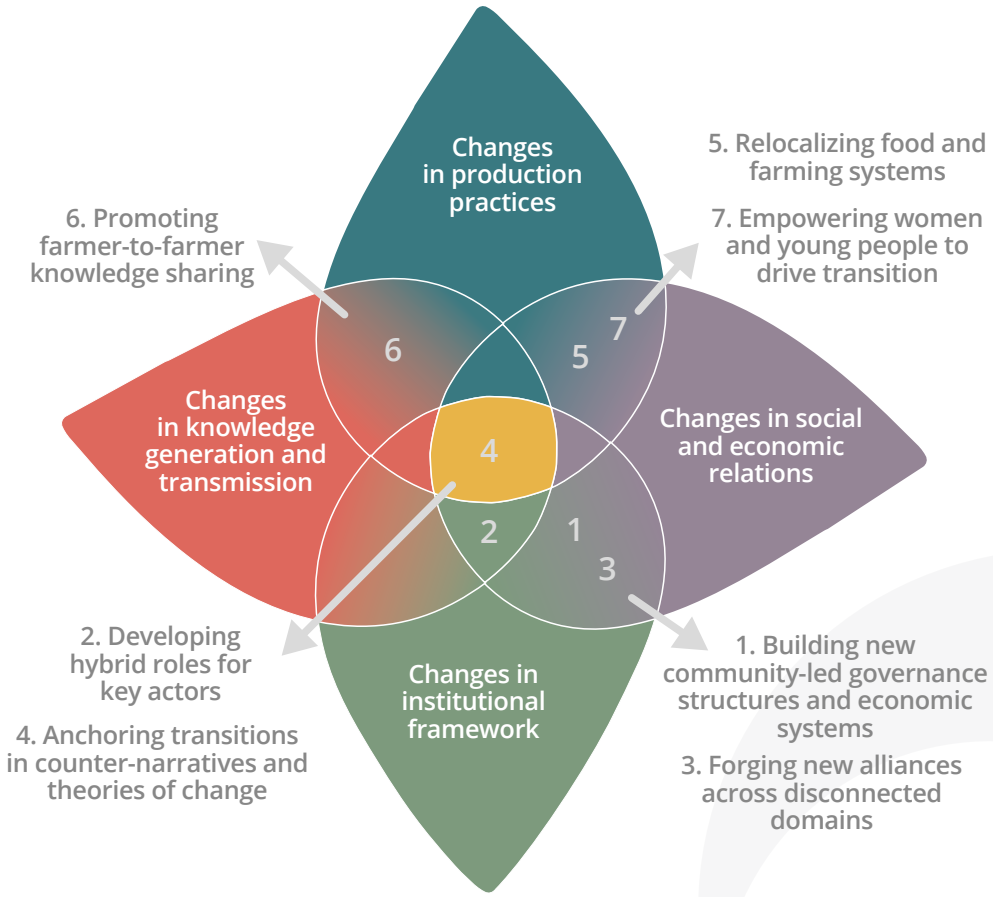
A focus on farmer-to-farmer knowledge paradigms reinforces the importance of peasant farming organizations with a wide remit and clear transitional mindset (see Leverage Point 2). Referring to Cuba, Rosset et al. (2011, p. 186) highlight that "to scale up agroecology requires a peasant organization and a socially dynamic methodology like [farmer-to-farmer training]", warning that "conventional agricultural extension from the state, NGOs or the private sector is no substitute". However, several of the cases show fruitful interaction between farmer-led systems, government research centres and other state institutions in order to amplify the spread of agroecological knowledge.

7. **Empowering women and young people to drive transition** (at the intersection of production & social change). In several cases, dedicated steps were taken to expand

women's livelihood options, and to allow women to play a meaningful role in decision-making regarding their activities (e.g. Chololo, San Ramón/Veracruz, Puhan). Initial steps in this direction appear to have led to sustained engagement of women in the projects, helping to drive positive impacts for women and for the community more broadly. These observations confirm insights from the literature indicating that women's empowerment is an essential ingredient for 'food sovereignty' (Machado Brochner, 2014; Patel, 2012a), and underline the overlaps between food sovereignty and agroecology-based approaches. In some of the cases, women's empowerment was closely associated with the adoption of small-scale farming activities in specific sub-sectors (e.g. chicken rearing in Chololo) or with dedicated funding and activities (e.g. women's coffee funds in San Ramón/Veracruz). Questions remain about the relative benefits and transformative potential of dedicated domains of activity for women, versus approaches whereby women become lead stakeholders in broader community decision-making around primary income-generating activities – and whether the two are mutually supportive.

In Chololo, Puhan and San Ramón/Veracruz, the projects also included youth-focused activities. This appears to have been a key factor in sparking and sustaining transition, particularly where young people were encouraged to remain in the countryside and take up agroecological farming (e.g. Puhan). In cases like these, more needs to be known about how sustained youth engagement was, and whether young people remained in rural communities and in agriculture over the longer term.

FIGURE 19 - COMBINING DIFFERENT TYPES OF CHANGE TO DRIVE TRANSITION FORWARD



4.2. THE WAY FORWARD

Collectively, the case studies show that **overcoming the lock-ins of industrial food systems may require communities to construct what are effectively parallel systems of production, marketing, retail, values and governance** – alongside and layered into mainstream food systems. In other words, some degree of 'delinking' from mainstream food systems may be necessary, before considering whether and on what terms to re-establish connections to these systems. Communities have essentially developed institutions of their own. This underlines the need for a fluid understanding of institutions,[69] which exist at multiple levels and take different forms, as has been highlighted in the literature on rural development (cf. Van der Ploeg, 2008) and beyond (Lauth, 2015; Ostrom, 1990; Teubner, 1997). In their bid to reappropriate spaces from industrial food systems, agroecological transitions are characterized by institutional creativity and hybridity.

Formal institutional and political support also matters, and tended to materialize and accelerate change once bottom-up transitions were underway. For example, the Vega de Granada Organic Farming Plan was developed by researchers, farmers and civil society and then endorsed by state authorities; political support bolstered emerging farmer-to-farmer knowledge programmes in Cuba; the Biovallée programme came decades after the emergence of the organic movement in the Drôme, while support had previously been limited in the lower valley; and new layers of local political support and mainstreaming came after the first phase successes in Chololo. Some form of small-scale public funding often predated outright political support and created institutional footholds for the development of transition initiatives, e.g. the funding of the CIFAED research centre in the Vega; small research grants for alternative farming practices in Santa Cruz; the part-funding of training sessions by the local government agricultural bureau in Puhan. In other cases, there were windows of opportunity to exploit political entry points for promoting agroecology, e.g. climate adaptation as a new and 'uncoopted' niche in Chololo/Tanzania.

The case studies also underline how strongly current industrial paradigms are locked in place at the political level, and the ongoing challenges in demonstrating the benefits of alternative approaches. The case studies highlight the challenges in retaining support over time, and in the face of competing priorities, e.g. withdrawal of state support in Vega, and continued support for industrial agriculture by the Cuban agriculture ministry and Chinese central government. More generally, bottom-up, agroecological approaches to knowledge dissemination have not been mainstreamed into public research and extension programmes. The case studies therefore confirm the findings from the broader literature, in terms of the importance of supportive policy environments, and how often these conditions are lacking (see Section 2).

This draws attention to lock-ins within the policy process. According to Pimbert (2010, p. 11), "a policy is the result of numerous interactions among the social actors who, directly or indirectly, shape its content, interpretation and implementation. In general, thus, a 'policymaking process' reflects the power relations that exist in society." Within this process, power-knowledge relationships are able to frame practice, recast political issues and choices in the neutral language of science, and shape dominant narratives and discourses that underline the importance of industrial agriculture and exclude alternative interpretations (Pimbert, 2010; IPES-Food, 2016).

69 A broad understanding of institutions and their relevance to agroecological transitions is reflected in the decision to use 'institutional framework' as one of the four dimensions of change, rather than referring only to formal governance structures or policies.

Furthermore, **political prioritization responds to hard evidence of success or impact, based on a limited repertoire of indicators.** These tend to be focused on increasing productivity of individual crops per hectare or per worker, i.e. the things that industrial agriculture is designed to deliver, and the logic that agroecology seeks to challenge (IPES-Food, 2016). The initiatives profiled in this report have achieved and documented some impressive impacts in terms productivity and income gains – and have earned the interest of policymakers as a result (e.g. Chololo). More systematic documentation of these impacts would be useful to put cases like these firmly on the radar of policymakers.

However, broader change is required in terms of measuring what matters. **Agroecology delivers broader and mutually-reinforcing benefits that the prevailing *measures of success* in food systems fail to capture** (IPES-Food, 2016). Some of the most impressive impacts of these transitions – greater resource efficiency, improvements in community livelihoods and nutrition, increased resilience to shocks, biodiversity enhancement – tend to be overlooked at the political level. And while undervaluing these benefits, prevailing policy incentives continue to allow the social and environmental costs of industrial agriculture to be externalized.

Moreover, agroecological transitions tend to be evolving and ongoing, making it difficult to gauge whether they have reached the intended landing space, let alone whether they have definitively 'succeeded'. In some instances, transition initiatives may be delivering positive impacts simply by keeping land in (sustainable) agricultural production and keeping people in rural communities, in the face of unfavourable macro-economic and political conditions. In other words, breaking away from the industrial pathway and sustaining a transition over time is in itself a major achievement with positive implications for sustainability. All of these factors make agroecological transitions conducive to case studies (as in the present report) and similar forms of narrative documentation – a form of evidence that may itself be undervalued by policymakers.

Globally, the policy environment may now be shifting. The crises in food systems are deepening and the limits of productivist approaches are becoming clear, alerting actors not only to the need to change course, but also to adopt new metrics of success, and to think holistically about the different dimensions of sustainability. Landmark studies such as the 'IAASTD' Global Agriculture Assessment have underlined the need for a paradigm shift, galvanizing action at multiple levels in support of agroecology (IAASTD, 2009). The FAO's increasing receptiveness to agroecology, following the 2nd FAO International Symposium on Agroecology (April 2018) and the recent adoption of the 'Scaling Up Agroecology' initiative (FAO, 2018a), testifies to this policy opening. The African Union's EOA initiative is also highly significant (see Section 2). Various governments around the world are putting policies in place that explicitly support agroecology[70] and are cracking down on some of the most harmful industrial practices, e.g. the US ban on methyl bromide in strawberry production (see Case Study 1).

The risks of dilution and co-optation are nonetheless high, as interest arises in bringing experiments to scale and large-scale actors enter the playing field. The Santa Cruz case study highlights the risks of co-optation and the threats to sustainability as major agrifood companies take up organic strawberry

70 These positive developments have been recognized by the World Future Council's Future Policy Award. In 2018, the Award focused on identifying and highlighting policies that promote agroecological approaches. In partnership with the FAO and an international jury, the Council shortlisted legal frameworks and policies from Brazil, Denmark, Ecuador, India, the Philippines, Senegal, and the US, including some regional and local-level initiatives. For more information, see: https://www.worldfuturecouncil.org/p/2018-agroecology/

production. Indeed, organic farming organizations have also sounded the alarm on these risks, and are now seeking to reappropriate organic agriculture, reassert core values, and ensure convergence with the agroecology and food sovereignty movements –'organic 3.0' (Arbenz et al., 2016). The inclusion of farmers in export-oriented organic value chains is frequently presented as an example of agroecological transition (Henderson and Casey, 2015; Mier y Terán Giménez Cacho et al., 2018; Oakland Institute, 2018) despite the underlying tension between agribusiness-led export-oriented chains, holistic organic, and agroecological principles (c.f. Anderson et al., 2015; Isgren and Ness, 2017).

As political support grows, debate must be refocused on 'scaling out' agroecology. Steps are required to promote agroecological transition at various scales. In all cases, it will be crucial to ensure a focus on 'scaling out' agroecology, i.e. seeking to replicate success by designing transitions with local communities – not imposing change from the outside based on a one-size-fits-all model. The focus until now in the initiatives profiled here has been to *scale out* rather than to *scale up*, i.e. to roll out similar approaches, including the participatory ideas phase, in different communities (e.g. San Ramón/Veracruz, Chololo, Puhan). Most authors highlight the importance of localized contexts and conditions, which need to be taken into account for tailored solutions, and help to predict both the transferability and potential for successful experiments to be rolled out elsewhere (Moraine et al., 2017; Wezel et al., 2016). Scaling tends to be seen as part of a continuous process of fine-tuning, adaptation, and translation of existing innovations. This approach aligns with socio-ecological system frameworks that view "management interventions as experiments from which successive interventions can be adapted to more effectively manage socio-ecological systems" (Foxon et al., 2009, p. 3) and underscore the role of learning and adaptation as key criteria of successful, resilient systems.

More evidence on transitions occurring at large scales with strong political support will be useful to complement the case studies gathered here. While the Cuban example includes some elements of top-down, nation-wide transition, the case studies in this report are primarily community-led transitions occurring at modest scales. Indeed, small sub-regions emerge from the case studies as a particularly viable scale for galvanizing communities around sustainability challenges, spreading knowledge, promoting shifts in practice, and creating a sense of identity around food and farming transitions (e.g. Vega; Drôme; Puhan). However, ambitious experiments are occurring at a variety of scales, e.g. widespread conversion to 'zero-budget' farming in Andhra Pradesh, India.

In other instances, significant shifts in food systems are being driven by changing patterns of mass consumption. These shifts may not entail the same breadth of change or the same degree of individual/community engagement as the agroecological transitions documented herein. However, they can be significant in scale, and represent another important piece of the puzzle in terms of understanding how different trends can coincide on the path to sustainable food systems.

Detailed documentation of all of these transitions will be of primary importance in the coming years. Finding synergies between different bodies of transition literature, and between the different actors underpinning those transitions, is a major opportunity to be explored. For example, urban food initiatives offer a range of different entry points for food system transition, while yielding some similar findings in terms of the need for institutional hybridity and the power of alternative food systems (c.f. IPES-Food, 2017c).

While different analytical approaches must continue to cross-fertilize, it will be important to **converge on common approaches that capture the multiple dimensions of change**, in order to make the case for holistic agroeco-

logical transition in the policy spaces that are now opening. Scientific and civil society groups must increasingly document and communicate the potential of diversified agroecological systems to reconcile productivity gains, environmental resilience, social equity, and health benefits; to strengthen yields on the basis of rehabilitating ecosystems (not at their expense); to build nutrition on the basis of access to diverse foods; and to redistribute power and reduce inequalities in the process (IPES-Food, 2016, 2017b). Referring systematically to the four dimensions of change helps to capture the breadth of agroecological transitions, and to focus attention on documenting and measuring what matters - including but not limited to shifts in production practices. This report therefore provides a basic analytical framework that could be useful for future compendia of case studies.

Ultimately, agroecological transition must be articulated as part of a broader transformation of society. According to Gliessman's Five Levels approach (see Annex), the next step is to promote change that is global in scope and reaches beyond the food system to the nature of human culture, civilization, progress, and development. The depth of change is more than mere conversion or transition, and enters into the realm of full reform or transformation. The important role that food systems can and must play in mitigating and adapting to climate change as a global issue is one example of the value of Level Five thinking. The growing food justice movement, where everyone in the food system enjoys the benefits of equity, justice, security, and sustainability, is another. The expanding awareness that is part of this process then extends to other facets of environmental and social relationships beyond food. This awareness can underpin a paradigm shift that questions how the food and farming systems of the future can help reduce our ecological footprint, recognizes that there are limits to growth, and asks what it really means to live sustainably.

Annex. The Five Levels Transition Framework

TRANSFORMING FOOD SYSTEMS WITH AGROECOLOGY

(Adapted from Gliessman, 2016)

Agroecology is a way of redesigning food systems from farm to table, with the goal of achieving ecological, economic, and social sustainability. Through transdisciplinary, participatory, and change-oriented research and action, agroecology links science, practice, and movements focused on social change. But what are the steps that must be taken to achieve sustainable food system transformation? And how can food systems divest from the negative socio-economic and environmental impacts caused by modern industrial agriculture?

Gliessman (2016, 2015) proposes a framework for classifying "levels" of food system change based on agroecology. The first three levels describe the steps farmers can concretely take on their farms to convert from conventional (e.g. industrial) agroecosystems. The next two levels go beyond the farm to encompass broader societal and food system changes. Taken together, all five levels can serve as a stepwise framework to transform entire food systems:

Level 1: Increase the efficiency of industrial/conventional practices in order to reduce the use and consumption of costly, scarce, or environmentally damaging inputs.

The primary goal of change at this level is to use industrial inputs more efficiently so that fewer inputs will be needed and that the negative impacts of their use will be reduced. Most conventional agricultural research has taken place at this level, generating considerable amounts of modern agricultural technologies, inputs, and practices. This research has helped farmers maintain or increase production through practices including improved seeds, optimum planting density, more efficient pesticide and fertilizer use, and more precise application of water. 'Precision agriculture' is a recent focus of research at Level 1. Although this kind of research has reduced some of the negative impacts of industrial agriculture, it does not address the dependence on external inputs and monoculture practices.

Level 2: Substitute alternative practices for industrial/conventional inputs and practices.

The goal of this level is to replace external input-intensive and environmentally-degrading products and practices with those that are more renewable, naturally-based, and environmentally-sound. Organic farming and biodynamic agriculture are examples of this approach. They employ alternative practices that include the use of nitrogen-fixing cover crops and rotations to replace synthetic nitrogen fertilizers, the use of natural controls of pests and diseases, and the use of organic composts for fertility and soil organic matter management. However, at this level, the basic agroecosystem is not usually altered from its more simplified form, and thus many of the problems that occur in industrial systems persist despite input substitution.

Level 3. Redesign the agroecosystem so that it functions on the basis of a new set of ecological processes.

At this level, fundamental changes in overall system design eliminate the root causes of many of the problems that endure at Levels 1 and 2. The focus is on prevention of problems before they occur, rather than trying to control them after they happen. Research on whole-system conversions has provided an understanding of key yield-limiting factors. Agroecosystem structure and function is better understood, and ap-

propriate changes in design can be implemented. Problems are recognized and adjustments made by using internal site- and time-specific design and management approaches, rather than through the application of external inputs. Reintroduction of diversity in farm structure and management through ecologically-based rotations, multiple cropping, agroforestry, and the integration of animals with crops are examples of these changes.

Level 4. Re-establish a more direct connection between those who grow food and those who consume it.

Food system transformation occurs within a cultural and economic context, and must thus promote the transition to more sustainable practices. At a local level, this means those who eat must value food that is locally grown and processed, and support the farmers who are attempting to move through Levels 1-3 through their food purchases. This support becomes a kind of "food citizenship" and can be seen as a major force to drive food system change. Communities of growers and eaters can form alternative food networks around the world, creating a new culture and economy of food system sustainability. Food must once again be grounded in direct relationships. An important example of this change is the current food "re-localization" movement, including its growing networks of farmers' markets, community supported agriculture schemes, consumer cooperatives, and other more direct marketing arrangements that shorten the food chain.

Level 5. On the foundation created by the sustainable farm-scale agroecosystems achieved at Level 3, and on the new relationships developed through Level 4, build a new global food system based on equity, participation, democracy, and justice, that is not only sustainable but helps restore and protects earth's life support systems.

By thinking beyond Levels 1-4, Level 5 involves change that is global in scope, reaching beyond the food system to transform the nature of human culture, civilization, progress, and development. The depth of Level 5 change is more than mere conversion or transition, it is a process of reform or transformation. Through Level 5 thinking and action, agroecology provides ways to build on farm-scale and farmer-driven change processes to engage in a full re-thinking of how we relate to each other and to the earth that supports us. Basic beliefs, values, and ethical systems change. The expanding awareness that is part of this process then extends to other facets of environmental and social relationships beyond food, bringing about a paradigm shift focused on how the agriculture and food systems of the future can help reduce our ecological footprint, recognize that there are limits to growth, and what it really means to live sustainably. The important role that food systems can and must play in mitigating and adapting to climate change as a global issue is one example of the value of Level 5 thinking. The growing food justice movement, where everyone in the food system enjoys the benefits of equity, justice, security, and sustainability, is another.

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Panel members

Olivier De Schutter is co-chair of IPES-Food. He served as UN Special Rapporteur on the right to food from May 2008 until May 2014 and was elected to the UN Committee on Economic, Social and Cultural Rights in 2014.

Olivia Yambi is co-chair of IPES-Food. She is a Senior Consultant on Nutrition and Sustainable Development who served as UNICEF Country Representative in Kenya (2007-2012) and has held other senior roles in the UN system.

Bina Agarwal is former president of the Int. Society for Ecological Economics, and an expert on land rights & food security who has published award-winning books on gender and land issues and received the Padma Shri prize from the President of India.

Molly Anderson is a specialist in hunger, food systems, and multi-actor collaborations for sustainability who has led inter-disciplinary academic programmes and participated in regional food system planning.

Million Belay, founder of the MELCA-Ethiopia NGO and the Alliance for Food Sovereignty in Africa (AFSA), is an expert and advocate for forestry conservation, resilience, indigenous livelihoods and food and seed sovereignty.

Nicolas Bricas, Director of the UNESCO Chair on World Food Systems, is an expert in the socio-economics of food systems, namely the effects of urbanization, industrialization and liberalization on consumption practices in Africa and Asia.

Joji Carino, Senior Policy Advisor and former Director of Forest Peoples Programme, is a campaigner, advocate and educator on indigenous peoples human rights at the community, national and international levels.

Jennifer Franco is a scholar-activist, specializing in rural democratization, agrarian mobilization, global governance and the politics of natural resources. She is a research associate at the Transnational Institute (TNI).

Emile Frison is an expert on conservation and agricultural biodiversity who has headed global research-for-development organisation Bioversity International for ten years, after holding top positions at several global research institutes.

Steve Gliessman founded one of the first formal agroecology programs in the world, and has more than 40 years experience of teaching, research, publishing and production experience in the field of agroecology.

Mamadou Goïta, Executive Director of the Institute for Research and Promotion of Alternatives in Development (IRPAD), is a development socio-economist and expert in education and training systems, working with farmers' organizations in Africa and around the world.

Hans Herren is a World Food Prize (1995) and Right Livelihood Award (2013) Laureate, and has managed international agriculture and bio-science research organizations as well as playing a leading role in global scientific assessments.

Phil Howard is an expert in food system changes and the visualization of these trends. He has authored prominent contributions to the public debate on concentration, consolidation and power in food systems.

Melissa Leach is Director of the Institute of Development Studies (IDS) at the University of Sussex and founder of the ESRC STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre.

Lim Li Ching is a leading NGO researcher with expertise on sustainable agriculture, biotechnology and biosafety who served as regional lead author in the international IAASTD process and has contributed to several UN reports.

Desmond McNeill is a political economy and global governance expert who has led the Centre for Development and the Environment at the University of Oslo, and chairs the Independent Panel on Global Governance for Health.

Pat Mooney is the co--founder and executive director of the ETC Group, and is an expert on agricultural diversity, biotechnology, and global governance with decades of experience in international civil society.

Raj Patel is an award-winning writer, activist and research professor at the University of Texas. His publications on the economics, philosophy, politics and public health implications of food systems have been widely translated and taught.

Satheesh P.V. is an development and communication expert, recognized for his use of participatory methodologies and work in gender, food security and food sovereignty. He is a founding member of the Deccan Development Society (DDS).

Maryam Rahmanian is an international consultant on issues related to biodiversity and agroecology. She was a Research Associate at the Centre for Sustainable Development and Environment (CENESTA), an Iranian NGO from 2001 to 2014.

Cécilia Rocha is Director of the School of Nutrition at Ryerson University (Toronto), and a leading authority on food and nutrition policies in Brazil, including the successful experiments in the municipality of Belo Horizonte.

Johan Rockstrom is a leading global expert on resilience, global sustainability and sustainable development who spearheaded development of the 'Planetary Boundaries' framework to identify key environmental thresholds.

Ricardo Salvador is Director and Senior Scientist of the Food and Environment Program at the Union of Concerned Scientists. He has worked as an agronomist in academia, philanthropy and advocacy to support sustainable and socially equitable food systems.

Laura Trujillo-Ortega is an expert in the political ecology & economy of global food networks. She has taught in the US, Spain and several Latin American countries, as well as co-founding two NGOs for agroecology.

Paul Uys has 40 years of global retail experience specializing in brand creation, product development and sustainable sourcing, and now advises several bodies on sustainability issues, including the Marine Stewardship Council.

Nettie Wiebe has combined social activism, political engagement, research & farming throughout her life. An organic farmer in Canada, she was the first female president of the Canadian National Farmers Union and contributed to the creation of la Via Campesina.

Hairong Yan is a specialist in rural-urban migration, labour, gender, and collective and cooperative rural economy in China. She is Associate Professor in the Department of Applied Social Sciences at Hong Kong Polytechnic University.

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