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Self-Organization and the Bypass: Re-Imagining Institutions for More Sustainable Development in Agriculture and Food

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Abstract: In exploring the social dynamics of agrofood movements in Ecuador as examples of self-organization (i.e., locally distributed and resolved development), this article departs from a preoccupation with innovation by means of design and the use of scaling as a metaphor for describing research contributions in agriculture and food. The case material highlights that much development is contingent, unpredictable, and unmanageable as well as unbound to fixed spaces or places. In their study of people's daily practice, the authors do not find clear boundaries between dichotomies of internal–external, lay–expert, traditional–modern, or local–global organization, but heterogeneous blends of each. For the purposes of sustainable development, this highlights the need for attention to be paid to relationships (social, material, and biological), adaptation (the capacity to innovate), and responsibility (adherence to norms of sustainability). Far from romanticizing self-organization, the authors acknowledge that people and their institutions share varying degrees of complicity for the goods as well as the bads of their economic activity, such as mass soil degradation, agrobiodiversity loss, and poisoning by pesticides. Nevertheless, even under highly difficult conditions, certain actors effectively bypass the limitations of formal institutions in forging a socio-technical course of action (i.e., policy) for relatively healthy living and being. As such, the authors have come to appreciate self-organization as a neglected, if paradoxical, resource for policy transition towards more sustainable agriculture and food.

Keywords: agricultural research for development; agricultural innovation; food studies; self-organization; social movements

1. State of Agricultural Science and Development

1.1. Call for New Direction

Despite contributions that continue to be lauded (see, for example, the latest agenda for the Global Conference on Agricultural Research for Development), it is increasingly clear that in the long run agricultural modernization, also referred to as "modern food" [1], has become an influential force in environmental degradation across the globe, leading, for example, to major destruction of soil as a result of tillage regimes and reliance on synthetic fertilizers [2], loss of crop genetic resources [3], and ecological decline. Others have made ties between these developments and the subsequent international rise in non-communicable diseases, such as poisoning by pesticides and obesity [4,5]. Relationships between rural producers and urban consumers have suffered from creative forms of

market exclusion, such as usurious credit schemes and supermarket monopolies, as well as volatile fluctuations in global financial markets [6]. Further, climate change and rising rates of climatic variability have added new complexities and uncertainties to the already overwhelming challenges of meeting people's ever-growing food demands [7,8].

In the face of such challenges, there is increasing international consensus that the model of prescriptive agricultural development has reached a limit, leading to the need for fundamentally re-imagining and revising dominant institutional designs and purposes [9–12]. In particular, this has led to a call for institutional change towards more productive and sustainable agriculture [13] and major new policy directions at the Food and Agriculture Organization, Consultative Group of International Agriculture Research Centers (CGIAR), and beyond [14,15]. Yet decades of intransience in Agricultural, Knowledge, Science, Technology, and Development (AKSTD) raises questions over the expectation of change from within existing institutional frameworks [16]. Actors in the current social networks have a vested interest in maintaining the existing situation, such as in the perpetuation of harmful pesticide technology [17]. Institutional resistance to Integrated Pest Management [18] and agroecology [19] further illustrates this. So, regardless of curative claims, AKSTD institutions appear to be structurally tied to the same logic and value systems that induce and perpetuate the problematic qualities of modernization [20–23]. Aspects of a deep-seeded commitment to modern food are embedded in the present-day preoccupation with "going to scale" with expert-based knowledge and technology.

1.2. Re-Thinking Scale

Despite tremendous insights that both empirical and theoretical research on scale have marshaled, Marston et al. [24] convincingly argue, " ... there is today no consensus on what is meant by the term or how it (scale) should be operationalized". The authors point out that geographic scales are historically mutable and the product of social activity. For example, when placing spatial boundaries on social realities, AKSTD actors use scale without making a distinction between spatial size, social organization, and political control, thereby confounding spatial forms of struggle with social processes. When using scale to cover both hierarchies in spatial size as well as social power, they subsume social meaning to spatiality.

The local–global distinction is the spatial manifestation of an arbitrary micro–macro dichotomy. Marston et al. [24] provide a list of conflated binaries (e.g., local/global, place/space, difference/sameness, agency/structure, culture/economy, among others), with essentially all being carried over into agrofood studies, where the geographic metaphor is conflated to cover both social and spatial meanings and relationships. For example, "local" is understood as inter-personal and human–environmental interactions involved in the reproduction of food and agriculture, and transnational interactions are understood as "global" relationships. In addition, there is a notion that political status necessarily increases with geographic space. The erosion of the distinction between space and the social ultimately renders geographic metaphor indeterminate. A central problem that Marston et al. highlight is the tendency for self-reification—that the models of scale become conceptual givens, thereby giving qualitative attention to the contingency of political or conceptual boundaries over people's empirical reality.

As a result of such problems, Marston et al. [24] call for the elimination of scale as a concept in human geography. Similarly, we take issue with the use of a spatial metaphor in explaining socio-technical development and its alternatives in agrofood studies. Following Marston et al. [24], in this paper on informing new directions in development practice and research for sustainability, we apply their recommendation for a "flat ontology" of self-organization, "where the dynamic properties of matter produce a multiplicity of complex relations and singularities that sometimes lead to the creation of new, unique events and entities, but more often to relatively redundant orders and practices".

2. Self-Organization in Agrofood Studies

Empirically based agrofood studies focus on what Theordore Schatzki calls "practice as the site of the social", while seeking to manage a priori categorizations of food relationships [25]. An empirical perspective is based on the understanding that social change is fundamentally situated (not scalar), discontinuous, and, at times, quite radical. As experienced in food and agriculture in Latin America, change can be highly unpredictable, spatially mobile, and even unmanageable. Firstly, actor-oriented studies highlight how development experts and their public policy do not have control over local processes of social change, suggesting that ultimately change rests in the hands of consumers. In seeking to demythologize planned interventions as part of a technical–rational process, this perspective reveals how individuals and groups translate and integrate planned interventions into their daily lives. As such, societal contexts and structural conditions are understood as not only constraining but also enabling [26,27]. Secondly, communication and innovation studies speak about creating 'space for change' and self-organization as "the room for maneuver that exists and/or emerges in a network of interactions at multiple social interfaces" [28]. So if latent opportunities for more direct democratic change exist (even if unacknowledged), then there must be realistic alternatives to hegemonic AKSTD institutions. Where and what are they?

Concerned about the inability or unwillingness of AKSTD institutions to seriously engage with institutional change, different sets of studies seek a new debate in the proposals for re-imagining modern food towards enabling greater direct citizen involvement, if empirically, in bringing forth greater human health, productivity, and sustainability in food. In particular, these studies address questions such as how agriculture and food practices unfold outside the formalized, highly administrative processes of science, development, and government agencies [29,30], how no pure form of modernization exists at the household level, despite the arrival of a highly dominant regime of thought in agriculture and food [31], and how food movements are cosmopolitical rather than spatially rooted [25,32]. This body of research depicts development in agriculture and food as highly decentralized, emergent, and contingent, with scientists, government officials, transnational actors, and others having multiple influences—not just through their professional lives, but primarily through their activity as independent social actors—that are not commonly acknowledged or understood in the academic literature on AKSTD institutions.

3. Fix, Fit, and Flow: Models of Change in Agricultural Research and Development

3.1. Expert-Led Development as "Fix": Technology Transfer

The instrumental top-down, linear transfer of technology or pipeline agricultural research and development model is based on the idea that technology is developed by research institutes, transferred through intermediaries, and then adopted by users [28]. The ideology is the basis for the well-studied intensification of production, which subsequently has led to public investment across the world in deliberate mechanisms for positioning AKSTD as the champion of social change in agriculture and food [1,10]. Over the last century the work of this influential ideological movement has fueled the broad-scale establishment of academic disciplines, national and international research systems, and cooperative extension programs. Transfer of technology has its roots in the notion of change as a continuum of research–extension–education [33,34] for fixing [35] complicated agriculture and food problems.

Many have criticized the transfer of technology model [36,37]. According to Leeuwis [37], common problems with the expert-led approach include assumptions that: (1) specific technologies are universally applicable; (2) agriculture and markets are static; (3) socio-technical change is a linear process from researchers to extensionists to producers; (4) rural people largely are homogeneous; (5) locally progressive farmers and community leaders are capable of driving social change; and (6) farmers operate in isolation and were rational economic decision-makers. In practice, technologies put forward through science often are not adopted by users but adapted [35]. While the fix approach

continues, it has been complemented as a result of a call for further attention to social process, in particular with regard to hidden voices, interaction among stakeholders, and participatory processes of technology development.

3.2. Innovation Systems as "Fit": Participation

More recently, agricultural innovation system approaches have attempted to address the shortcomings of earlier transfer of technology approaches through new communication architecture and interactive platforms. This has included emphasis on strengthening Agricultural Innovation Systems [38–40], intermediation and brokerage processes [41], management of competing claims [42], design of multi-stakeholder platforms [43], as well as linking agriculture development to agribusiness and supply chains and private industry [44]. The innovation system approaches are applied as means of addressing issues holistically as well as taking into account the context. Much theorizing focuses on collective action and the importance of institutions as structures that constrain and enable desired action. In this line of thinking, decision-making is facilitated through trust, which is built by repetition of rule-shaped interaction and reinforced by the risk of sanctions when breaking the rules [45]. In terms of AKSTD designs and best practice, while the fix-the-problem approach continues in Ecuador, it has been complemented by a fit-in-context approach [35].

The literature shows that system approaches do not always lead to the desired move away from agricultural modernization. Diverse authors have pointed out that collective action, institutions, and the social norms do not lend themselves very well to design [45–47]. For example, while creative innovation system approaches show promise for improving existing management, they inevitably rely on actors to represent their organizations or constituencies and thus operate within the constraints of what is possible in the existing institutional environment. Inviting actors to participate in innovation systems as representatives limits the kind of change that they can bring about, and it can even lead actors to hold on to their interests during multi-actor negotiations to the extent that interactive, participatory processes reach a deadlock [48]. According to Cleaver and Franks [45], in general " . . . participation of stakeholders is likely to be uneven, shaped by power relations, and institutions are legitimated through a variety of processes including the use of symbolic resources, multiple authority structures and devices borrowed from the state". So in practice, agricultural reality is not always systemic but rather heterogeneous as well as highly fragmented [35]. While we find continued usefulness in working with agricultural innovation systems, such approaches necessarily run the risk of perpetuating some of the flaws of agricultural modernization and thus risk reproducing its institutional shortcomings [9]. Social scientists and students of development have called attention to the continued distance between AKSTD and realities that people experience in their daily lives, including those of researchers and public policy-makers.

3.3. Practice and Civic Movements as "Flow": Self-Organization

Interested in finding ways of achieving more substantial institutional change in agriculture and food, we chose to look outside of modernization for inspiration. Diverse authors argue that space for change does not come about only (or even mainly) through deliberate processes of planning and intervention [49–51]. Societal change arises largely from ongoing interactions among actors—people, acting as individuals and collectives outside the designs of formal institutional frameworks, even when this civic activity conflicts with enforced rules, regulations, and procedures [16]. So rather than being controlled and engineered, people in their roles as social agents—acting relatively free of external controls—perform societal change through their practices of daily living and being [52]. Self-organization, however, does not necessarily imply that change happens automatically in the absence of human intentionality. Rather, self-organization is often the contingent outcome of endless and infinitely dynamic intentional and purposeful activity [50,53–55]. Instead of a fix-the-problem approach or a fit-in-context approach, the unique relational dynamics of the "social wild" (i.e., the

largely informal, unrestrained, creative spaces of socio-technical emergence) can be characterized as a diving-into-the-flow approach [35].

The creativity and potentialities in people's practice and civic organization has gained the attention of researchers from highly different theoretical traditions, including cognitive, behavioral, cultural, social, and socio-biological systems literature, but we find people's self-organization so far to be largely unexplored in agrofood policy reform. We ask: where and how does self-organization emerge as an institutional counter-movement, thereby opening up new possibilities for continuation and change? Where do counter-movements encounter and interact with more formalized institutional processes of modern food? How can promising existing and imagined processes of self-organization be developed and strengthened, in favor of more sustainable agriculture and food?

4. Methods

Starting from the assumptions of multi-vocality and incommensurability in development, we look to people's practice as a means of describing and analyzing the activity of self-organization. Our analytical attention to practice de-emphasizes structures, systems, individuals, or interactions. Instead, here we view practice as embodied sets of activities that humans, simultaneously acting as individuals and in collectives, perform with varying degrees of commitment, competence, and flair. More than just routines, we view practice as a continual process of relationship-building, organization, and expression, as people, operating in situated socio-biological contexts of co-production, come to embody and assemble the present through resolving interfaces between desirabilities and possibilities as well as bring forth histories and futures. Contrary to the view of practice as the product of unidirectional rationality, we appreciate that the self-organization in people's practice can generate endless intensification in experience, nuance, and heterogeneity, leading to intentional and unintentional as well as desirable and undesirable outcomes.

Provided the limitations of this special edition, we ground our discussion about the relevance of self-organization in agriculture and food in our involvement in a quarter century of multi and transdisciplinary research in potato-based farming and agriculture modernization in northern Ecuador, as summarized in Crissman et al. [56], Yanggen et al. [57], Sherwood [58], and Paredes [31]. In addition, we refer to more recent studies on family-level nutrition [59] as well as the subsequent rise of food counter-movements and their influences in Ecuador's 2008 Constitution and subsequent public policies and debates [4,60].

As summarized in Sherwood [58], Paredes [31], and Gross et al. [59], the family and community-level practice-based studies involved key-informant interviews, household nutrition studies, and extensive participant observation in households, fields, and organizations during three periods: 1999–2003, 2004–2006, and 2010–2015. This body of ethnographic work took place in two interactive food contexts: (1) pesticide poisoning as a product of modernizing agriculture; and (2) how urban and rural people interact through individual and inter-relational activity (i.e., their co-productions) in generating diverse patterns of food production, distribution, and consumption. In addition, we draw on studies based on extensive reflexive research of the internal workings of AKSTD institutions in Ecuador, based on personal involvement as researchers at the International Potato Center (CIP) and Ecuador's National Agricultural Research Institute (INIAP) (1998–2003) as well as researcher–activists in the *Colectivo Agroecológico* (also referred to here as the Colectivo) (2005–present), which has involved diverse policy formulation processes around pesticide regulation [17], agroecology/food sovereignty, and, more recently, agrobiodiversity/seeds, nutrition, and responsible consumption [4,32].

5. Carchi: A Regional Model for Agricultural Modernization

Upon arrival as a researcher in Carchi in 1998, a farmer told Sherwood [58]: "I don't know if you believe in God, but I believe in pesticides". From a biophysical point of view, industrial-era technology enabled farmers to structurally break with nature, which was immediately impressive in its control

of crop pests. Eventually, however, it became apparent that the initial wave of impressive results was not durable and came at a high cost. Over time, the second-order consequences of mechanized tillage, synthetic fertilizers, and pesticides called into question the utility of the original innovations. Here, we summarize the unfolding of modernization as experienced in Carchi in three roughly 25-year phases: the rise and fall of technology transfer, the arrival of lay-science participatory platforms, and the growth of largely self-organized food practice and civic movements.

5.1. Phase 1 (1965–1990): Rise and Fall of Technology Transfer

In the latter half of the 20th century in Carchi, land reform formally ended the era of the large plantation hacienda and indentured servitude, providing a growing number of small-scale, family farmers with land ownership and high expectations for the future [61]. In its place, the Ecuadorian state formally instituted modernization through the Agricultural and Colonization Law of 1964, giving way to the progressive privatization of land, water, seeds, and other natural resources [62]. In Carchi, modernization was tied to a swift wave of land reform that was linked to the arrival of a new class of technicians (*técnicos* or *ingenieros*) and their state-supported agricultural intensification projects, built upon expert knowledge and technology [63,64]. Generally speaking, the highly arable land of the inter-Andean valley remained in the hands of large landowners, although the haciendas diminished in size and feudal labor was outlawed. An emergent class of smallholder family farmers was relegated to less fertile mountainsides, where the land was arable but the slopes made work difficult and land prone to erosion.

Given its rich natural resource base, a mostly literate rural population, and communication infrastructure for access to markets in both Ecuador and Colombia, Carchi has been identified as potentially one of the most productive agricultural regions in the Andes [56]. Nevertheless, the extreme environmental conditions of the Andean highlands, where most arable land rests at elevations at or above 2500 meters above sea level, limit commercial options to roots and tubers (especially potato) and pasture for dairy and beef cattle. In the 1960s, rural development experts and representatives from the Ecuadorian government focused on Carchi as a regional model of agricultural modernization [64]. Potato production in the province flourished during the 1970s, further developing until the crop supplanted the landscape and became the main source of income and wealth in rural areas [61]. By the early 1990s, Carchi had over 16,700 hectares dedicated to potato production, which produced over 198,000 metric tons per year—approximately half of Ecuador's national potato harvest, using up less than one-fourth of the national area sown to the crop [65].

Over time, however, the industrial model of potato production in Carchi began to show its social and environmental frailty. Eventually, market forces reduced on-farm potato biodiversity from an average of eight varieties per hectare at the start of land reform to fewer than two varieties per hectare 20 years later [58]. By the early 1990s, the majority of farmers produced a single, high-priced variety: superchola. Due to soil erosion rates of nearly 80 metric tons per hectare as a result of the introduction of mechanized tillage and the disk plough [66], farmers doubled their use of fertilizers simply to maintain earlier production rates [58]. Meanwhile, studies began to report serious adverse health consequences resulting from acute exposure to insecticides [67], to the point where neurological effects on the brain began to undermine farm economies [68].

Meanwhile, markets began to work against farmers. In the 1990s, real prices for inputs steadily rose, while the commercial value of the potato became increasingly volatile, with an overall tendency towards decline [69]. These events made potato farming a high-risk enterprise. Following the adoption of the U.S. dollar as Ecuador's national currency in 2001, the price of agricultural imports increased sharply, including a rise of 300 percent in agrochemicals. Together with the aforementioned production challenges tied to environmental decline and the proliferation of pests, these events combined to undermine the viability of potato farming. Crissman [31] found that in the early 1990s, potato farmers in Carchi lost money on about 45 percent of their plantings. By 2004, that rate had increased to two-thirds [31].

In summary, after the initial growth brought by modernization, the degradation of agro-ecosystems and the volatility of prices in distant commercial markets led to a drop in the profitability and sustainability of commercial agriculture in Carchi. According to data from the Third National Census from 2002, the total area planted annually with potatoes in the province dropped from a high of nearly 17,000 hectares to 7000 hectares. Faced with rising debt, farmers experienced growing frustration with modernization. One early adopter seemed to represent many when he declared [58], "We have done everything the extensionists have told us to do, and look where we are. We are broke." Three decades after integration into the markets and modernization, a considerable number of rural families began to abandon agriculture and migrate to urban centers in Ecuador as well as emigrate in search of opportunities abroad. Youth from rural communities repeatedly joined armed insurgent groups in nearby Colombia. At the turn of the century, agricultural modernization in Carchi was marked by the growth of three sectors: the landless laborer, the urban migrant, and the guerrilla fighter.

5.2. Phase 2 (1985–2010): Lay-Science Collaborative Platforms

Growing awareness of the shortcomings of agricultural modernization fueled efforts to overcome the limitations of technology transfer, in particular with regard to furthering the uptake of scientifically prescribed best practice. In Ecuador, this led to three substantial institutional innovations: participatory technology development, the greening of technology, and farmer–researcher collaborative platforms.

In the 1970s, CIP began to employ anthropologists to strengthen its economics based "on-farm research" [70]. The explicit objective was to increase technology adoption through heightened understanding of farmer constraints, thereby narrowing the geographic distance between the experimental station and the field. Despite further understanding of the financial and logistical contexts of rural families, studies showed little progress in adoption, opening the doorway for further experimentation. In the 1980s and 1990s, CIP's anthropologists worked with national research institutes to advance the cultural fit between science and farming. This involved a concerted effort to include farmers in collaborative and collegial decision-making, "where users of the technology are actively involved with scientists in developing new technology" [71]. The strategic purpose of this "participatory approach" was to integrate the lay knowledge of farmers with the expert knowledge of researchers, thereby finding a way to align farmers and their farming with the scientifically informed priorities of experts as well as to improve the questions and products of research itself.

In the 1990s, CIP and INIAP began to emphasize participatory research in safer, more target-specific pesticides as part of a large Swiss-funded program that was tied to similar initiatives in Peru and Bolivia. This included interactive farmer–scientist experimentation on late blight-resistant potatoes as well as earlier maturing varieties that could break the life cycle of the Andean weevil. In addition, researchers began to work with the agrochemical industry to test a new generation of safer, less toxic, target-specific insecticides. Rather than conduct trails at the experimental station in Santa Catalina in Quito and later seek to transfer them to the field, INIAP's staff of "action-researchers" identified "farmer innovators" in different highland regions to conduct collaborative research in group plots located in farming communities. They argued that the interactive process allowed farmers to be more closely involved in problem assessment and prioritization as well as aspects of research design and impact evaluation.

Initially, the focus was on pest control through the judicious use of pesticides, but over time researchers proposed the inclusion of biological, non-pesticide management practices and non-pesticide, organic production. Interest in the empowerment of farmers as well as the greening of technologies led to the introduction of Farmer Field Schools (FFS)—a group learning, knowledge-based approach that the FAO in Southeast Asia originally developed for Integrated Pest Management in rice [72]. For CIP and its partners in the Andes, the approach was radical in that FFS sought a departure from science-based technology development to the promotion of "ecological literacy" (i.e., fundamental biological knowledge of crop–soil and crop–pest relationships and the ability to "read" the environment) and farmer-led experimentation.

In 1998, a group of scientists at CIP and INIAP teamed up with the FAO's Global IPM Facility to develop FFS (in Spanish, *Escuelas de Campo de Agricultores* or *ECAs*) in Integrated Pest Management for the potato, demanding substantial changes in research agenda setting, process design, and facilitation as well as evaluation [72]. Following the implementation of over 125 FFS in Ecuador, independent ex-post studies found that the approach deepened and broadened biological and ecological knowledge in rural families in ways that unlocked creativities and new subjectivities [73]. For example, experience in FFS enabled substantial fine-tuning of social and agronomic nuances in potato production that led to improved production economies and decreased exposure to neurotoxins [74], with measureable improvements in productivity and human health [75].

As part of a strategy to "scale up" the experience, the researchers released FFS into the hands of other independent AKSTD actors [30]—from farm organizations, government, universities, NGOs, as well as private industry, permitting FFS to reach seven Latin American countries over a period of five years. Most immediately, this led to a diversification in its thematic platforms to include new crops and even animals, such as cattle, chickens, and guinea pigs. Others developed FFS to address the themes of family nutrition and breastfeeding. In terms of technology development, the objectives of FFS were generally centered around decreasing financial outlays in purchased products (for example, through more efficient use of chemical fertilizers and the production of botanical pesticides) as well as the "greening" of production through limited to no use of agrochemicals. Following Ecuador's financial collapse of 2001 and ensuing inflation, an additional objective became decreasing dependence on farm inputs and externally based technology. In practice, however, the overall agenda and interactive qualities of the FFS experience largely remained in the hands of technicians—be they from CIP, INIAP, the Ministry of Agriculture (MAG), development agencies, or the agrochemical industry. In particular, when MAG made FFS a national program in 2008, government staff strategically changed the name of the Farmer Field Schools to Schools of the Agrarian Revolution (a shift in the Spanish acronym from ECAs to ERAs) and eliminated the defining features of ecological literacy and farmer-led experimentation to the point where the approach became indistinguishable from the priorities of technology transfer. In the hands of the Ecuadorian government, FFS arguably scaled up in name, but not in meaning [30].

As in the case of mass poisonings with highly toxic pesticides, research found that scientific documentation and public demonstration of the success of an alternative approach was not enough to provoke institutional change in science and development practice [57]. Rather than continue to engage in political conflict over FFS/ECAs and the ERAs, the CIP-led Papa Andina network joined an international coalition of scientists from the CGIAR and elsewhere in calling for linking farmers to institutional contexts through Participatory Market Chain Approach (PMCA) and stakeholder platforms [43,76,77]. Similar to the work in Africa, Asia, and elsewhere, this ideological shift led to an initiative to create collective learning alliances in Ecuador (and elsewhere in the Andes) and sought to strategically bring together smallholder producers, market agents, and agriculture service providers. The explicit objective was commercial, technological, and institutional innovation through the opening of niches in high-value markets, which in turn enabled new interactions among stakeholders and investments in their common interests and technical skills. In Ecuador, the process led to the creation of the Consortium of Smallholder Potato Producers (CONPAPA), which aspired to take over many of the functions associated with providing services in quality seed production, agrochemical inputs and potato processing, marketing, and trade.

Ex-post studies on these innovations found that farmers substantially increased use of inputs, but that gross margins improved by nearly a factor of four, in large part due to yield increases and better prices for products [78]. Based on indicators of modern-day potato biodiversity, the use of pesticides and fertilizers, in terms of environmental and health impacts, it was argued that participating farmers experienced no negative consequences from this production intensification in relation to the practices of their neighbors. Nevertheless, concerns were raised over the advantages for medium- and larger-scale farm operations as well as a number of conflicting activities in the platforms, for

example with regard to self-certification, problematic legal ownership, and alliances with profit-seeking private companies. Smaller-scale operations struggled to overcome the margins of benefits from input investments. The studies concluded that donor return on investment was positive and dependence on subsidies was limited, suggesting a degree of long-term financial viability of the market chain platform model as per the one-off experience of CONPAPA. Nevertheless, the evaluations raised questions over the ability to independently replicate and scale up the model outside of new investment.

5.3. Phase 3 (2005–Present): Rise of Civic Movements and Self-Organization

After decades of multiple failed attempts to shift national policy away from agricultural modernization, in particular through the institutionalization of agroecology (which the Colectivo Agroecológico actors in Ecuador view as a more regenerative farming practice based on low external inputs), many civil society organizations came together to seek radical change [4,32]. An informal network of over 400 organizations dedicated to ideals of agroecology, the Colectivo joined force with urban-based consumer groups, in particular the Social and Solidarity Economy Movement of Ecuador (MESSE), farmers, and first nations to intervene in favor of a pioneering constitutional mandate for "food sovereignty", understood as a radical democratic movement: "food of the people, by the people, for the people". Due to the ongoing emergence of this phase and the absence of time-critical research, the data reported here is based on the authors' narrative accounts, as per their activity as social actors in Ecuador's civic food movements.

As per the resulting 2008 Constitution, the official proposal for food sovereignty was based on the multidimensional context of agricultural production, emphasizing the social purpose of land as a means of equitable, democratic social development and natural resource conservation in favor of biodiversity (articles 276, 282, 334, and 400), equitable food distribution and commercialization (article 335), and ample access to culturally appropriate food and a healthy diet, in particular by means of native crops, animals, and indigenous food resources (articles 13 and 281) [79]. In 2009 this activity led the National Assembly to create the Plurinational and Intercultural Conference on Food Sovereignty (COPISA)—a government-supported, civil-society-led entity mandated with the task of putting food sovereignty into motion.

Following approval of the Constitution, the Colectivo Agroecológico dedicated itself to putting food sovereignty into practice through the drafting of legislation that led to the Food Sovereignty Regime Organic Law (LORSA by its Spanish acronym) [80]. Beginning in 2009, the Colectivo and its partners worked with COPISA to critically assess farming experience and to hold public debates and consultations over 18 months, involving over 500 organizations from every province of the country. This work led to a highly consultative and nuanced proposal for a Law on Agrobiodiversity, Seeds, and the Promotion of Agroecology—an ambitious bill espousing family- and community-based enhancement of agricultural resources. Ecuador's agricultural science community responded with antagonism, represented by the National Director of INIAP addressing a detailed 28-page letter to the President of Ecuador [81]. The Director single-handedly disqualified the law, declaring it "unscientific" and arguing that INIAP, and presumably not civil society, was the "ultimate authority" on food and agriculture in the country. He argued that the seamless integration of agro-biodiversity, seed management, and biologically based production "violated scientific categorization" and that the country's food security depended on authoritative scientific control and certification of crop genetic resources, their utilization in production, and the determination of "valid farming practice". In large part due to the protest of the scientific community, the bill was stopped in its tracks.

In April 2016, a revised version of the "seeds" bill surfaced in the National Assembly, in which scientific and state authority was reestablished and key provisions of public ownership over genetic resources and farming systems were re-drafted in the name of biosafety and state regulatory control. In particular, the proposed legislation demanded the registration of crop genetic resources, and it prohibited the planting or exchange of seeds that were not duly registered and certified. As outlined in the subsequent government response to food sovereignty in the 2015–2025 10-year agricultural

development plan, the central justification for these provisions was the priority of "enabling Ecuador to compete in the international agriculture market".

The Colectivo and MESSE's encounters with science and the state over the constitutional mandate for a shift from agricultural modernization to food sovereignty began years earlier. Following the constitution's groundbreaking prohibition of Genetically Modified Organisms (GMOs) in agriculture, on 1 September 2012 President Correa unexpectedly announced that, in the name of the constitutional mandate for food sovereignty, he intended to change the constitution in favor of introducing transgenic seeds and crops. "They (GMOs) will not belong to Monsanto or DuPont", he declared. "They will belong to us", explaining that the technology would be placed in the hands of Ecuadorian scientists working at a new biotechnology center to be constructed in the north of the country [82]. After cautioning against opposing agricultural modernization, he explained that biotechnology was the key to a better future for the country. The Ecuadorian experience of the enthusiasm and tenacity of the biotechnology industry shows that support for the intensification of modern food does not necessarily render the social world more transparent. In fact, the state came to redefine nationalism as a highly ambitious project, to date determined by the successful entrepreneurship of elite technocratic interests rather than globalizing sensibilities over ecology, territory, and rights. Interestingly, it was the public (i.e., the "consumer–citizen") and not the government that became organized in defense of Ecuador's constitution and arguably the interests of the public good [4,32].

Five years after the ambitious 2008 Constitution and emboldened by the recent audacity of its former collaborators in the state, the Colectivo Agroecológico and MESSE abandoned its political project to inform and guide public policy through formalized legislative processes [32]. During its 2016 Annual Meeting, instead of continuing to seek policy change through government, civic counter-movements strategically shifted attention to the streets, houses, and neighborhoods—i.e., the space where people operated outside the formalized institutional lives of their offices and bureaucracies and where they could be reached as unguarded fathers and mothers, siblings, and neighbors. Leaders in the Colectivo argued that, regardless of where one may work, "Home is where we are simply vulnerable people".

Following a series of internal discussion, the Colectivo analyzed the wealth in family-level food expenditures. Drawing on government census data, the USDA estimates that roughly $20 billion circulate in Ecuador's food and drink industries, including the economies of agriculture, transport, processing, sale, cooking, restaurants, and associated leisure and tourism [32]. In the context of declining international cooperation, the Colectivo membership has become focused on recruiting a growing share of the existing investment in food for its cause: "food that is safe, healthy, and from my own land". This led to the *Que Rico Es*! (How Good It Is!) campaign. The academic literature commonly describes agroecology and food sovereignty movements as composed of indigenous or mestizo peasant farmers "fighting against the system". Nevertheless, influential actors working in non-governmental organizations (NGOs), scientific organizations, government, and private businesses commonly have made important contributions in building capacities, calling attention to experiences and mobilizing resources. In Ecuador, participants come from all walks of life, including a growing number of urban middle- to upper-class consumers.

By organizing around the "people who eat" (i.e., consumers, understood not just as urban people, but potentially everyone, including farmers), the Colectivo and MESSE have made the radical step of reframing "agriculture as production" to "agriculture as food", meaning food production, but also the procedures, relationships, and economies involved in food processing, circulation, and consumption. In so doing, the Colectivo members have created space for the arrival of new actors to its cause, in particular urban-based food activists, chefs, storeowners, and restaurateurs. These people bring with them new possibilities, leading up to the "250 thousand families" campaign that focuses on flavor and eating as well as taste and responsible consumption as means of gaining access to the wealth of urban-based resources invested in food [83]. Along the way, these actors are effectively collapsing

dichotomies of AKSTD institutions of rural/production and urban/consumption, leading to a new interactive social space: food as rural–urban co-production.

6. Discussion: Reflexivity in Food and Agriculture

Based on the experience of fix–fit–flow in Ecuador, we identify a number of discontinuities. Despite the common resistance from the scientific community to the possibilities of opening up technology development to end users, between land reform in the 1960s and the growth of supermarkets in the 20th century, numerous rural families have taken part in ambitious pilot projects involving participatory technology research, ecological literacy, and the creation of multi-actor commercial platforms. Yet, the unequal power relations between experts and peasants, usually at the root of this kind of intervention, have undermined not just farmers' ownership of the end products of technology development, but also their control over resources (financial, natural, and social), thereby preserving the role of scientists and technicians as mediators of technology as well as social relationships. In terms of institutional practice, there was very little progress; in fact, even though technologies became greener and interaction was enhanced, expert culture is at the heart of perpetuating the central features of modernization: commoditization of rural life, use of currency to intermediate relationships, distancing of markets, and dependence.

In its venture into fix, the AKSTD in Ecuador has made substantial changes to its way of working. The fit solutions narrowed certain distances between AKSTD and practice, but nonetheless perpetuated institutional dichotomies, dividing expert-based knowledge and the practice of rural families. In the process, both fix and fit can disconnect farmers from their own agriculture [22]. In summary, it is not the tractors, pesticides, genetically modified organisms, or processed food that degrades the environment and harms people's health. It is technology linked to science- or state-based regulation that forms the basis of power. In this way, the regulations against harmful technologies become complicit, sustaining the continuation of that very technology. The shadow effects of regulation are not mere "externalities" of the system, but intrinsic elements of it [17]. What first appeared to be a success turns into a problem of its own making. Beck [84] describes this worrisome, self-destructive feature of industrial-era society as "organized irresponsibility".

In seeking the environmental and social fit-ness of technology and its development, the research shows that the involved AKSTD institutions were faced with substantial innovation in the form of a search for greener technologies, better means of participatory technology development, and farmer–researcher collaborative platforms. This required the introduction of new administrative procedures (increased beneficiary involvement in project development) and process management (involvement of intended beneficiaries in agenda setting, project design, and implementation as well as new roles of professionals—from "capacity-builders" to "facilitators"), thereby changing the roles and activities of professionals. At CIP, INIAP, and the FAO, this was far from a clean process, with many of the new generation of professionals dedicated to Farmer Field Schools, for example, dependent on soft money and needing to abandon ship when project-based resources dried up. Arguably, enhanced farmer participation increased the presence and voice of intended beneficiaries, but it also legitimized the position of the expert as the judge of valid experience and thus the gatekeeper to the future.

The fix and fit work overlooks the fact that farmers and scientists have an agenda and are heterogeneous in their motives and interests in ways that can fragment the norms of their respective organizations. People, operating as social actors, organize in networks of belief systems and discourses that can cut across formal administrative, spatial, and organizational boundaries. In fact, earlier research highlights how groups of farmers and scientists came together over a common cause, such as concerns over the proliferation of pesticide technology, market-oriented production, or agroecology [17]. Far from objective, fact-seeking researchers, in Ecuador we find that scientists are involved in the country's lively actor networks that are organized through processes of translation, where like-minded people from different walks of life work together to problematize experience, normalize behavior, enroll new actors, and mobilize resources.

The research on agricultural modernization exposes a long history of activism lying at the margins of dominant regimes of farming practice that is commonly overlooked, neglected, or excluded from the official record [58]. From an institutional perspective, we have seen that more fix (i.e., more specialized knowledge and externally based solutions) or greater fit (institutional innovation, more participation, and multi-actor platforms) has resulted in a bypass of the different constructs of modernization into the flow of self-organization (see Table 1).

Table 1. Contrasting periods of development practice in Ecuador: fix (information provision), fit (process facilitation), and flow (being and becoming).

	Fix	**Fit**	**Flow**
Period	**1965–1995**	**1985–2015**	**2005–Present**
Dilemma	Uninformed practice and organization—a need to inform and educate.	Exclusive, undemocratic organization—a need to deliberately involve hidden voices and manage externalities.	Organized irresponsibility—a need to internalize social and environmental externalities.
Assumptions on reality	Single, tangible reality.	Multiple perspectives that are socially constructed.	Multiple realities that are individually and socially constructed.
Interaction with bodies of knowledge	Discipline-based, limited interaction with other perspectives.	Multidisciplinary, on-going interaction and transformation of perspectives.	Transdisciplinary, need to overcome arbitrary dichotomies of modernization (abstraction and practice; expert and practitioner; internality and externality; local and global; personal and professional).
Scientific method	Reductionist and positivist. Complexity can be best described through independent variables and cause–effect relationships. The perception of the researcher is central.	Holistic and post-positivist. Local and global categories and perceptions are mutually acknowledged. Differences between subject and object: methodology and data are poorly defined.	Reflexive. Objectivity is questioned: a need to be explicit about influences and manage them.
Strategy and context of research	Professional knows what he or she wants. Designs are pre-established. Information is the product of universal knowledge. Context is controlled and independent.	Professional does not know where processes will go. Themes emerge as a result of learning-action. Focus and understanding emerge from interaction.	Professional seeks coherent daily practices in families, neighborhoods, communities, and offices. Performance and public accountability in context is fundamental.
Who sets priorities?	Researchers and practitioners give priority to problems and activities.	Communities, practitioners and researchers prioritize together.	People, through their daily living and being.
Relationship with intended beneficiaries	Researchers and practitioners control and motivate clients from a distance. Tendency to distrust local people, who are principally research objects.	Researchers and practitioners maintain close dialogue with constituents. Construct trust through joint analysis negotiations.	Direct and immediate, as a member of communities, the researcher lives the consequences of his and her activity.
Intervention modality	Unidirectional and project driven: time and theme bound.	Interactive and deliberative: unbound, working in teams based on long-term commitment.	Socially embedded and contextualized: working within defined social change contexts.
Political position	Inappropriate: threatens objectivity.	Appropriate and necessary: managing social role of science and development.	Essential: professional understood as a person first, intricately involved in intentional and unintentional communicative products.

As the contradictions of modern food in Ecuador became increasingly apparent, a flow of self-organized initiatives (i.e., farmer, agroecology, and consumer food movements) have risen outside of the formalized spaces of institutions to confront modern food and challenge the existing order. Over the last decades, these social movements have grown in size, diversity of activity, and influence to the point where they have begun to inform and shape public policy, with varying degrees of success—from drafting elements of the constitution and framing public debates around the need for

alternative human organization, including the recent seeds legislation, to seeking to shape the flavors and tastes of family-level food consumption [85].

7. Conclusions: Self-Organization and the Bypass

7.1. A Landscape of Practices

In this article, we have described agricultural science and development as a practice, which in turn signifies the determination of the social course of action. Viewed thusly, agricultural science and development are not just the exclusive enterprise of formal institutions, but also is a product of the daily activity of people operating as individual and collective actors in social networks. In particular, we have called attention to the promising alternative forms of social organization that have emerged in response to different harmful consequences tied to modern food.

The problematic history of agricultural modernization in Ecuador reveals how AKSTD agencies endlessly spin off technologically induced risks that can undermine their own institutional legitimacy [61], thereby opening space for self-organization and the arrival of emergent counter-movements organized for overcoming, undermining, or bypassing everyday politics. Over time, these forms of self-organization have grown to challenge, change, and, we find, even become an alternative to seemingly overwhelming institutional frameworks.

In making public the rural experience in Carchi, actors forged relationships through the confrontation of similar circumstances over agricultural modernization, and in particular the harmful health effects of pesticide technology, in Ecuador and beyond. In addition to working locally, actors became part of what Beck [23] describes as "the new constellation of global sub-politics". Marginalized and estranged by country-level bureaucracy, the emergence of global sub-politics appeared to represent a growing liberalizing and emancipating force, forging new spaces of social interaction (e.g., in food sovereignty and responsible consumption) and making alternative realities visible. New possibilities for change were envisioned that previously could not be imagined. What began as merely a belief system has now become a new reality, as illustrated by what has become a politically viable local–global agroecology movement capable of transcending and re-drawing organizational boundaries.

The institutional change that we have observed in agriculture and food is quite different from that of the international calls for transition in AKSTD [9–11], which prescribe adjustment either from within existing institutions or the involvement of these institutions as a necessary prerequisite for corrective change. The AKSTD literature assumes that amendments can be deliberatively guided through careful planning and intervention. On the contrary, in Ecuador we find that the forms of self-organization had the following characteristics: (1) they came from outside of formal institutions; (2) they were the main (or even the only) force that brought transformative change in agriculture and food; and (3) changes were only partially intended and anticipated, for example, with regard to the 2008 Constitution and ensuing legislation. Consistent with Wagemans [16], this experience shows that existing institutional frameworks were questionable points of departure when searching for fundamental transition out of modernization.

The literature on institutional change endlessly draws on designs and metaphors that emphasize rationality, pre-planning, universality, and thus coherence [15]. Experiences in Ecuador reveal a process of self-organization that is not fully rational, designed, or planned; it also is not entirely situated or singular and thus not necessarily coherent. So instead of thinking about institutional change as a unidirectional process, our research finds that it is a messy and highly unpredictable process, which no method, however sophisticated and refined, will manage to completely master or even guide.

In light of the concerns over the limitations of metaphors in describing the social, we examined how new institutional possibilities for more sustainable agriculture and food emerge and take social hold in seemingly closed and intractable circumstances. As summarized at the onset of this article, our experience has led us to re-think the metaphor of scale and scaling. Instead we prefer to think of self-organization as what Wenger-Trayner and Wenger-Trayner [85] describe as a "landscape of

practices"—a metaphorical territory that consists of a multiplicity of interrelated practices. Social differentiation within a landscape of practices is a matter of commitment to it: one needs to be more than just a visitor or tourist, in this case to alternative food, to become a knowledgeable practitioner and an actor capable of nuanced application, public performance, and opening up space for new expressions. S/he must have made the necessary investment in the activity to move beyond its mere reproduction. In other words, self-organization involves learning and appropriating a practice to the point where development of that practice becomes a possibility. In the example of food movements in Ecuador, the arc of agroecology moved from the exclusive activity of radical farmers and hybrid farmer–development practitioners to the everyday activity of urban-based consumers, who in turn have translated food into a lifestyle of alternative living and being. Today, the accepted landscape of practice of alternative food in Ecuador has come to include the co-production of direct purchasing, the use of alternative currency and barter, biodegradable soaps, recycling, bio-construction, as well as the reclaiming of urban space for bicycling. In this sense, alternative food is not merely limited to class-based categories, but rather processes of recruitment to and activity within particular ideals and interrelated communities of practice. The self-organization inherent in flow involves both construction of knowledge in a landscape of practices and the creative processes of constitution and social differentiation.

7.2. Implication for Agricultural Science and Development: The Bypass

If AKSTD lies at the center of present-day agrofood predicament [86], can we reasonably expect it to lead us out? In the creation of policy around technology, groups of researchers creatively organize around common interests and open up new pathways, moving networks along particular trajectories of interaction with members, third parties, and artifacts. Nevertheless, our findings show that AKSDT actors are greatly constrained by the norms and expectations placed upon them by their institutions. As in the case of the utilization of FFS for the advocacy of a particular technological package at the cost of ecological literacy and independent decision-making, the pathways that AKSTD actors forge are not understood as merely the product of rational, evidence-based analysis. Instead, AKSTD is also a political practice, and AKSTD actors strategically communicate as a means of both self-expression and social organization. As a result, we question whether it is realistic to expect institutions to substantially change beyond the logic that governs their present identity. What's needed is further attention to what we view as the bypass.

A central problem of agricultural science and development in general and modern food in particular lies in the process of institutionalized science—its social distance from the public that depends on its products and processes and that benefits or suffers from its unanticipated and unpredictable, but nonetheless very real and enduring consequences [23]. Steeped in 17th-century thinking, science depends on solutions based on knowledge and power that are in a constant state of growth and advancement, supplanting the ignorance and impotence of the commoners—people conceived as committed to particular society-determined categories as producers, middle people, or consumers [87]. In order to overcome the modern predicament of our pressing food and ecosystem challenges, much of which is deeply rooted in science itself, there is a growing consensus that a more promising future depends on taking a new direction.

We live in a period where AKSTD is necessary, but it is not enough for enabling the required socio-technical change. For us, the first step towards a more promising future depends not on bridging the gap between centuries-old notions of science and society, but by altogether bypassing it. Any reform will need to be part of a general reform of the way people see and act with regard to agriculture and food. As per the experiences summarized here, we find hope that in many ways AKSTD has never existed outside of society, in the sense that scientists are denizens of households, communities, and social networks that reach and connect into other parts of life (and death), including food embodiments and their consequences. We find hope in the ways that researchers who break with their normative practices and ranks can make important contributions, not necessarily in an official or professional

capacity. Whenever researchers interact with policymakers, industry representatives, or farmers, their communication is not only carried out through words, but also by deeds—the practices involved in the research process itself, which includes continual interactions with other stakeholders, but, more so, involves researchers becoming vulnerable, being open to new practices and social relationships, and ultimately taking on roles as actors in social networks. Stepping outside of their formal activity as scientists can free up energy and generate creative new social arrangements and entanglements. This is evident in their at times catalytic contributions in social movements.

7.3. Moving Forward

As an alternative to the model of prescriptive agricultural development, we call for a shift away from a preoccupation with the end products of agricultural science and development (i.e., the technological artifact) to the productive activity of agricultural science and development itself: the social space of knowledge production. With regard to the activity of researchers, we feel that it is important to engage with existing alternatives to dominant institutional frameworks. If the world is heterogeneous, then we are moved to the conclusion that different social practices coexist, intersect, and interact. Shedding light on neglected or hidden practices is a potentially important responsibility for researchers because it enables them to imagine different futures that have, so far, been deliberately denied or even forbidden and thus remain outside the scope of permitted institutional practice. This implies that researchers need to go looking for gaps and subaltern realities [88]. It requires engagement with difference, to make a difference.

We concur with Law [88] that instead of acting on notions of a norm and commonality, we need "to start looking for social deviances and their disjunctions—the cracks!" We need to search out a rich diversity of performances and practices in distinct situations, places, and contexts, and support new possibilities and desirabilities. If different practices sustain different realities, then we may hope to make a political difference by making such heterogeneity visible in the articulation of more sustainable futures, thereby rendering normativities discussable and contestable in ways that constitute new realities in agriculture and food.

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