EDITORIAL

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Agroecology as necessary knowledge to transform the mutual determination nature–society

Introduction

AT FIRST GLANCE, agroecosystems are a specific kind of ecosystems organized towards the production from the land of useful goods for human beings. The study of agroecosystems is far from being simple. Just consider that even outside from the study of agroecosystems, the study of natural ecosystems has been challenging for ecology. As an answer to the task of studying the different levels of organization of biotic communities and their interaction with abiotic factors, Richard Levins (1966) stressed the need for a new research programme, later called *population biology* (Levins 2004; Lewontin 2004). Such a research programme should be able to simultaneously address the different levels of heterogeneity (physiological, genetic, and related to age structure) of systems in which many species interact with each other. In these systems demographic changes occur that affect the very structure of the communities and alter the pattern of environmental heterogeneity.

In the case of agroecosystems we have to face a *concrete totality* that includes another dimension to its complexity. Human labour becomes the key factor in the structure of the agroecosystems and determines the flows of energy and matter within it. So characterized, the agroecosystems would be distinguished from the rest of the ecosystems in nature in two ways: 1) the ends or *telos* that guide its existence (the reproduction of the material life of human beings) and 2) the historical process of its conformation (mediated by labour) as social–natural systems. Reminding that production is oriented by consumption and consumption is conditioned by production, we can say it is this mutual constitution that requires us to conceptualize agroecosystems as complex systems in which different levels (biological, physical, social, economic and cultural, to name a few) are intertwined and whose understanding demands an interdisciplinary approach.[1]

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1 "'Complexity' here is not determined only by the heterogeneity of its constituent parts;

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Different sources of agroecology

Agroecology, understood as a scientific discipline or, perhaps in a more precise way, as an *interdisciplinary field*, has a clear dominion: the study of those peculiar ecosystems where the dominant species is *Homo sapiens*, a species that structures the ecosystem's flow of matter and energy. The reciprocal determination between society and nature is what ultimately demands the engagement of multiple disciplines for agroecological analysis. This concurrence already has a travelled path, through which different *agroecological approaches* have been generated.

The understanding of the interactive dynamics among species from an ecological and evolutionary standpoint is not a new task for the biological sciences. Starting with the work of Nicolai Vavilov (1926), we can find examples in which the evolutionary and ecological knowledge were used to comprehend particular traits of agriculture (such as its origins and the keystones in the domestication process), as well as the exploration of the possibilities for transforming agricultural production. The work of Basil M. Bensin (1930, 1935), an agronomist, is usually recognized as pioneering the modern use of the term agroecology[2] (Wezel *et al*. 2013). He referred to agroecology as the application of concepts and methods of ecology to the study of agroecosystems, particularly for the study of commercial crops. Moreover, if agroecosystems are the domain of agroecology, a disciplinary approach to agroecology could be precisely "ecology of agroecosystems". Thus, agroecology as a science would study the composition, structure and function of those peculiar assemblages of species that occur in and around the agricultural fields of the world.

rather it is determined mainly by the *inter definability and mutual dependence* of the functions that they perform within a totality. An agrarian complex rarely has precise geographical limits and a well-defined number of components. Moreover, characteristics of its elements can hardly be registered and classified in an unequivocal way. What characterizes a complex is a particular behavior, that is, a certain number of activities that, together, make up the functioning of the 'totality'. The activities of the complex (the production of private crops, the importation of elements for production, the consumption of water and nutrients from the soil, the work of the peasants, migrations, economic income, trade credits, etc.) are interrelated in such a way that the whole works as an organized whole." (García 2006, 137; *fragment translated to english by LJB*).

2 From a historical stand point it is interesting to note that one of the pioneering works by Bensin was done precisely in the Mexican locality of Soto La Marina (Bensin, 1930). The diversity of management practices and the concomitant diversity of associated plants and animals demands its scientific comprehension and the abstraction of general patterns and processes. The central role of Mesoamerica (in broad sense) in the study of the origin of agriculture, of the domestication process and the necessity of the scientific study of the agroecosystems is indissolubly linked to the cultural diversity present in the region. This cultural diversity can be understood as a diversity of forms of production of the human material life in the nature–society interaction.

This agroecological domain includes a huge diversity of biotic factors, including microorganisms, animals, plants, and fungi, and different scales of integration, from backyards, to cultivated plots, landscapes, or even complete regions (Gliessman 2015). It is precisely in this concept of scale that agroecosystems and the science that studies them inherit from the ecology. In other words, agroecology also faces the problem of determining or defining the scale at which the interactions are sufficient and significant to define groups with generally shared properties. For example, depending on the scale at which they are defined, more or less contrasting patterns of diversity can be observed when comparing different agroecosystem units.

Thus, because of its origin as an application of ecology to the study of agricultural problems and regardless of whether it was developed from agronomy (Wezel points to the German case as an example of this) or it was from ecology, agroecology as a science can be located to a certain extent as part of technoscience in the sense of González Casanova:

> "Techno–science is a term that denotes the science that is made with technique, technique that is performed with science by researchers and that is both technical and scientific or scientific and technical, researchers that work at various levels of abstraction and concretion, taking into account their same or similar methods of posing or solving problems. Techno-science corresponds to the interdisciplinary work *par excellence*."(González Casanova 2004, 30).

Moreover, the recognized origins of agroecology as an interdisciplinary science coincides in time (1920s–1930s) with the time that González Casanova himself locates as a first boom of interdisciplinary approaches. This interdisciplinarity, promoted by Nation–States (González–Casanova 2004, 41), manifested itself in the most extreme forms of agronomic extension. But this was not, and is not, the only possible techno–science. Subsequent development in the postwar period was responsible for a unitary techno–scientific output to address two problems posed by capitalist production. The so–called *Green Revolution* as a model for the capitalization of the countryside gave way to surpluses in the world capacity for industrial production of nitrates (whose market for explosives suddenly contracted at the end of World War II). At the same time, techno–science was used to develop the widespread use of industrial inputs (including, but not limited to, synthetic ammonia derivatives). Discursively this approach sought to "solve the problem of hunger in the world" without ever mentioning the accumulation of capital as a source of the problem—a discourse that was very timely as national liberation movements emerged in Africa and Latin America.

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Perhaps the greatest irony is that the "solution of ammonia" tries to alleviate a metabolic rift caused by capitalism itself. In the case of soils, this was, and continues to be, manifested in the rupture of the flow of organic matter back to the ground. This flow had happened during the ~9,500 year history of agriculture and its rupture was originated by the demand of the capitalist cities of more and more organic matter. This metabolic rift, which was already established by Marx precisely around the fertility of the soil in the mid–nineteenth century,[3] has only deepened, to the point of jeopardizing the survival of humanity.

The fixation of atmospheric nitrogen (N_2) in ammonia (NH_3) through the Haber–Bosch process allowed the production of synthetic fertilizers starting in the 20th century. But the dependence on these fertilizers is perhaps one of the worst false solutions that capitalist industrial agriculture has generated for agriculture, relatedly resulting in massive application of herbicides and insecticides to further degrade agroecosystems. Approximately 40% of the proteins we consume today were produced thanks to the Haber–Bosch process (Smil 2002), a process that represents approximately 2% of global energy consumption and 2% of greenhouse gases. But only about half the mass of nitrates that are used as fertilizers are assimilated by plants (Cassman *et al*. 2002 report 37%, Liu *et al*. 2010 report 55%, Sebilo *et al*. 2013 report 60%). Sadly, the remainder of these reactive species flow to water bodies or are volatilized as nitrogen oxides into the atmosphere, increasing global warming.

According to Rockstörm *et al*. (2009), nitrogen extraction now exceeds the sustainable limit by four times, putting at risk the entire biogeochemical cycle (and human life with it). Meanwhile, on a local and regional scale, chemical fertilizers have not solved the problem of the disruption of the structure of the physical pores of the soil, causing collateral problems due to loss of water retention and ion exchange capacity. Ultimately fertilizers have not solved the problem of soil erosion. This sets a complete "lose–lose" scenario, which is rounded off when we consider that agricultural inputs circulate since a long time ago in the form of capitalist commodities. Until now, the best strategy for capital has been to squander the land and the labour force, but today it has the possibility of brutally and extensively eroding the the conditions necessary for the existence of agriculture.

3 "Capital rapidly forms an internal market for itself by destroying all rural secondary occupations, so that it spins, weaves for everyone, clothes everyone etc., in short, brings the commodities previously created as direct use values into the form of exchange values, a process which comes about by itself through the separation of the workers from land and soil and from property (even in the form of serf property) in the conditions of production." (Marx 1983 [1857-1858], 512).

Agroecology as a movement (and indirectly its boom as a science) is a response to the production model that, driven by the self–named *Green Revolution*,[4] tends globally to homogenize and simplify agroecosystems, as well as to erode crop genetic diversity (first through use of hybrid seeds, later through introduction of transgenic seeds). Thus, when the disastrous environmental consequences of the generalized use of pesticides, herbicides and synthetic fertilizers began to be noted, a whole set of social and academic movements began to call themselves agroecological (the 1962 book by Rachel Carson, *The Silent Spring*, is usually placed as a breaking point in regard to the technological optimism of the postwar period). Wezel *et al*. (2009) point out that since the 1960s and 1970s the agroecological movements developed in relation (to a greater or lesser extent) to academic groups interested in alternatives to the agroindustrial model (see also Dussi and Flores 2018, in this issue). In the quest for these alternatives, both the scientific knowledge generated within ecology (in the case of USA and Western Europe ecology developed largely isolated from agronomy) and the ensemble of agricultural practices, sometimes called "traditional", become relevant. These practices have been maintained, modified and adapted through centuries by peasant communities, especially by indigenous communities not only, but notably, in Latin America (see Altieri 2002).

The negative consequences of industrial agriculture have driven the rise of agroecology as a discipline, as reflected on by one of the best–known agroecologists when reflectiong on the traditional polyculture systems:

> "The significance of biological diversity in maintaining such systems cannot be overemphasized. Diversity of crops above ground as well as diversity of soil life provided protection against the vagaries of weather, market swings, as well as outbreaks of diseases and insect pests. But as agricultural modernization progressed, the ecology–farming linkage was often broken as ecological principles were ignored or overridden. Numerous agricultural scientists agree that modern agriculture confronts an environmental crisis." (Altieri 2000, 77-78).

The relevance of such movements increased when the global capital accumulation model changed in the 1970s and 1980s. This implied going from a historical stage in which the Nation-States were the central reference for capital accumulation (and with that were key actors of the so–called *Green Revolution*) to an era, or model, in which the means of dispossession became a cutting edge

4 It is worth noting that this process also dislocated many relations between livestock production and agricultural production, making this two spheres to interact preferably through the market. For length reasons here we can't approach this in detail.

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with which life itself is reconfigured as a function of accumulation. The rate of loss of agrobiodiversity increased precisely in the moment in which it became the object of new forms commoditization. At the same time, biotechnology that uses recombinant DNA techniques tried to materialize the neoliberal desire to:

> "…overcome the ecological and economic limits to growth associated with the end of industrial production, through a speculative reinvention of the future. At the height of the high–tech euphoria of the 1990s, the biotech industry promised to overcome hunger, pollution, the loss of biodiversity, and waste in general, while the ecological and biopolitical problems associated with industrial capitalism only continued to worsen" (Cooper 2008, 11).

Agroecology as a science that studies agroecosystems and as a movement in search of recovering food sovereignty (this is understood not just as the quantitative capacity to produce food, but also as the political capacity to decide over the characteristics of said production according a certain necessities) becomes even more valid in an era that the Zapatistas have called the *Fourth World War*[5] (SCI Marcos 1997; 2004). This validity of agroecology requires a review of some of the material organization levels for which the agroecology as a science can provide relevant scientific information. This understanding can then be used to comprehend which of the subsystems within agroecosystem are mutually determined and the ways in which they are.

Biological levels of agroecosystemic organization

We have pointed out that even from a strictly biological standpoint, agroecosystems constitute complex systems that include different level of organization and specific species assemblages. These systems have elements of continuity

5 "Not only that, but the end of the "Cold War" brought with it a new framework of international relations in which the new struggle for those new markets and territories produced a new world war, the IV. This required, as do all wars, a redefinition of the national States. And beyond the re–definition of the national states, the world order returned to the old epochs of the conquests of America, Africa and Oceania. This is a strange modernity that moves forward by going backward. The dusk of the 20th century has more similarities with previous brutal centuries than with the placid and rational future of some science–fiction novel. In the world of the Post–Cold War vast territories, wealth, and above all, a skilled labor force, await a new owner." (Subcomandante Insurgente Marcos (SIM) 2017 [1997], 102).

This translation of this fragment has been taken from the English version available in the site: http://schoolsforchiapas.org/wp-content/uploads/2014/03/Sup-Marcos-Global-Jigsaw-Essay.pdf

and also elements of discontinuity regarding the structure of ecological communities traditionally studied by ecology. From some approximations derived from agroecology as a movement, to replicate as much as possible the natural ecosystem complexity[6] has even been proposed as a desirable horizon or objective to emulate, (Altieri 1999). This "equilibrium" approach is debatable from a historical point of view, since other disciplines, such as historical ecology have shown to what extent the transformative impact of human work has shaped ecological communities at a landscape scale, even in presumably pristine areas such as the Amazon basin (Erickson 2008). But leaving aside for the moment the issue of the existence or not of a pristine ecosystem, a fundamental question emerges: which aspects or themes of ecology and, in general, biology are relevant in the study of agroecosystems and which level or biological organization could be better comprehended in order to transform agriculture?

Again, it is within the context of a specific mode of production, with its corresponding contradictions, which has posed the need for a specific form of science, a different science that can overcome the limitations imposed by the agroindustrial model. Facing the agroecosystem over–simplification associated to monoculture, the study of community ecology, of ecology focused on biotic and abiotic interactions, and of the impact of different agricultural practices on diversity in agroecosystem communities became central to understanding the functioning of polyculture systems. Whether in the form of a challenge (derived from the homogenization and pauperization produced by capitalist agriculture) that demands a deeper understanding of the structure and function of agroecosystems, Engels' affirmation (1883) remains valid and *is infinitely more what science owes to production*.

In this way, one of the needs within agroecology emerge. It is a need to comprehend how, and in which forms, specific agricultural practices allow the emergence and permanence of certain biodiversity patterns (at genetic, physiological organismal, or ecological community level) associated to agroecosystems with their own structural and functional networks. In line with the agroecology as a social movement, but more importantly with the persistent presence of peasant practices around the world,[7] it is still possible to compare

6 In conventional agriculture, the natural tendency towards complexity is stopped using agrochemicals (Savory 1988). By planting polycultures, the agricultural strategy accompanies the natural tendency towards complexity; the increase of the biodiversity of the crop both above and below the ground *imitates the natural succession* and thus requires less external inputs to maintain the crop community" (Altieri 1999, 58-59, *translation to English and italics highlight by LJB*).

7 Towards the end of the XX century John Berger wrote: "whether they grow rice in Java, wheat in Scandinavia or maize in South America, whatever the differences of climate, reli-

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patterns of α and β diversity associated with different regimes of agrocosystemic management.[8]

In this sense, a relevant task of agroecology as a science, is to account for the biological processes that underlie the agricultural management practices that even today continue to maintain diversity that historically has been at the basis of the food cultures of the world. This task is sometimes minimized when trying to claim or assess other forms of popular knowledge (for example, the rich empirical knowledge of the peasant communities; see Hecht 1999). Nevertheless, this scientific understanding of the agroecosystems is of crucial importance in order to build collective strategies that allow for *in situ* conservation of agrobiodiversity. Above all, the role of agroecology as generator of scientific knowledge (sometimes erroneously equated with academic knowledge) is fundamental for survival in a moment in which global climatic change may make it difficult, if not impossible, to outlast the structural crisis of capitalism using just the traditional knowledge.[9] But what emerges immediately is the need to distinguish the nature of agrobiodiversity, not only through a static description of it, but as part of the quest to comprehend the *interdefinibility* of the components of the agroecosystems and these as part of evolutionary process (which again brings history to the fore).

From the ecology of communities, Perfecto and collaborators (2009) highlight the distinction between *planned* and *associated* agrobiodiversity, where the former would correspond to those plants and animals effectively introduced, planted or raised by the peasants and the latter to the array of biodiversity that "spontaneously arrives to the agroecosystem" (Perfecto *et al*. 2009). The usefulness of these concepts lies not only in its capacity to distinguish the

gion and social history, the peasantry everywhere can be defined as a class of survivors. For a century and a half now the tenacious ability of peasants to survive has confounded administrators and theorists. Today it can still be said that the majority in the world are peasants. Yet this fact masks a more significant one. For the first time ever it is possible that the class of survivors may not survive." (Berger, J., *Pig earth*. p. 15. Vintage books).

The interest in studying and understanding this agrobiodiversity cannot be separated from the interest in understanding the factors and strategies that have allowed this social class to survive, especially at a time when the survival of humanity is put at risk by capitalist accumulation .

8 In very broad terms the first, α diversity, would refer to the richness and diversity of species present within a unit of area, while the second or diversity β, would refer to replacement, to differences in composition, for example, of plant species between two or more area units present in a given system.

9 "2. All modes of discovery approach the new by treating it as if it were like the old. Since it often is like the old, science is possible. But the new is sometimes quite different from the old; when simple reflection on experience is not enough, we need a more self–conscious strategy for discovery. Then creative science becomes necessary" (Levins 1996, 101-112).

presence of a high planned diversity within the peasant managed agroecosystems where several crops coexist intentionally and where a large part of the associated agrobiodiversity has a use value (as in the case of the *quelites* and other arvense plants,[10] such as husk tomato, present in crop fields of the Mexican plateau). Its full *heuristic power* would lay in being a conceptual scafold from which it is possible to build a way to analyze the mutual determination between agroecosystem structure and use value production within them.

Thus, beyond the agroecosystem description in terms of its diversity and of the pertinence or not of certain agroecological approaches that try to imitate natural ecosystems complexity, it appears the question of the meaning for the agricultural workers of that diversity either as planned or associated diversity. In the answer to this question the possibility that agrobiological diversity produces specific *use values* in its different configurations is important, while the use value production itself emerges as a relevant evolutionary factor (Jardón Barbolla 2017).

In the future, that consideration may enrich the study of the patterns of crop genetic diversity. Since the pioneering works by Vavilov (1926, 1931) and Harlan (1975) up to the contemporary advances in genomic studies (see for example Meyer and Purugganan 2013), the study of genetic diversity among and within landraces cultivated in milpa systems, backyards and orchards has been relevant both for the understanding of the basic nature of the domestication process as well as for scientific disciplines that have looked for crop adaptations to specific environmental conditions. Of course, it must be recognized that adaptation to local environments is a very important factor in the diversity present in local varieties of crops. But the study of genetic diversity as a record of use value production, as a result of the reciprocal interplay between *planned* and *associated* diversity in the agroecosystem will not only allow to better understand the nature of the evolutionary processes involved in domestication (Jardón Barbolla 2015, 2016; Mercer and Perales 2010; Mercer 2018, in this issue), but it will enable to generate another space of convergence and interaction for the conformation of the interdisciplinary field of agroecology.

There are other topics in which an evolutionary perspective is very relevant for the strengthening of agroecology. About this Kristin Mercer writes in this issue, focusing its contribution in the necessity to complement the social component —agroecology as social movement and as recovery of peasant practices—

10 Arvense: from latin *arvum*, cultivated field. Literally, arvense plants are plants "that belong to the plowed field". In scientific Spanish the term denotes plants that grow spontaneously within the crop fields, being not always weeds, but many times useful plants for traditional peasants.

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by means of incorporating the evolutionary perspective as a useful element in the practical improvement of productive systems. From another perspective, Mariana Benítez collaborates discussing the contributions of ecological evolutionary developmental biology and its possible implications in topics such as the germplasm conservation strategies. With complementary views, in both works is manifested the possibility that the relationship with other subjects within and outside the academic space, may transform the scientific activity and open new avenues in the agreocological studies.

It is not the objective of this issue on *Agroecological approaches* nor that of this editorial essay, to make an exhaustive presentation of all the schools within agroecology and even less to present all its themes of study. Much has been written about that. However, what does interests us is to show some of the possible intersection points and above all, to locate some of the generating questions that appear within the interdisciplinary field and its possible implications beyond the academic space.

The agroecosystems as product of human labour

All living organisms are capable to modify a greater or lesser extent the surrounding exterior environment; today we know that these modifications can have trans-generational effects in living conditions of different organisms and that such effects may be either positive or negative and impact organisms' evolution to some degree; this suit of processes is called *niche construction* (Lewontin 2000; Ondling–Smee *et al*. 2003). The very fact of niche construction would allow, from the onset, to leave behind the notion of "equilibrium" between organisms and its environment: such equilibrium doesn't exist and hasn't existed because both environment and organisms are continually and reciprocally transformed. In this sense, there's a continuity between the niche construction process that exists within ecosystems and the specific process through which human beings participate in the conformation of agroecosystems. Nevertheless, there are different elements of discontinuity, being central the emergence, specific in *Homo sapiens*, of a new mediation in its interaction with nature, in its *niche construction*: the appearance of human labour (Vandermeer 2011; Jardón Barbolla y Gutiérrez Navarro 2018, in press). Given this, the so called *human niche construction* corresponds to *purpose–oriented activity* (i.e. *praxis* in the sense of Sánchez Vázquez 2003). Labor as socially organized mediation in the nature–society relationship makes human niche construction behave in unique and sometimes contradictory ways with the rest of niche construction processes occurring in nature (for some examples of this see Vandermeer 2011).

In parallel an interesting phenomenon can be appreciated. One of the great contributions of niche construction theory (Levins 1968; Levins and Lewontin 1985; Lewontin 2000; Odling–Smee *et al*. 2003) has been to identify cases and mechanisms though which processes that belong to the *ecological time* can influence the *evolutionary time*. Even more, the application of niche construction theory to the study of domestication and agriculture (see Piperno 2017) has brought the possibility of making mutually intelligible the *historical time* and *ecological time*, making the agroecosystem as a sort of double hinge that articulates different temporal scales at which living beings evolve.

Then agroecosystems are part of a peculiar assemblage of ecosystems, that results interesting in its structure and the speed and intensity with which evolutionary processes occur within them (for example, that linked to the speed at which soils are enriched or degraded, depending on the way agriculture is carried out). But also, agroecosystems as such, imply a form of *specifically human activity*, that is the *productive praxis* (in the sense of Sánchez Vázquez 2003) and therefore imply the active subjects of that praxis. Both Altieri (1999) and Gliessman (2015) point the existence of additional energy and matter inputs as the distinctive feature of agroecosystems, energy and matter introduced by humans and domestic animals. Vandermeer names it with its specific name and problematizes extensively the *labour* as an emergent property that alters ecological processes, starting with niche construction.

Certainly, the techno–science[11] linked to the hegemonic power hasn't attained a comprehension of the agroecosystem's social dimension and even less has been able to comprehend the social, cultural and historical determinations that have made the often called *traditional* agroecosystemic management practices persist. The link between techno–science and the big agro–industrial corporations makes impossible to pose from there the answers and questions that enable to really overcome the socio–environmental crisis. Facing this limitation of fault in the dominant techno–science, a possible answer is to deny the agroecosystem as an analytical and practical category for agroecology and, as part of this, to reject the *western* approach to knowledge (see Lugo and Rodríguez in this issue). However, there are other possibilities that may result more fructiferous methodologically, conceptually, scientifically and politically. If instead of renouncing to the agroecosystem category we approach to it in a dialectical way, trying to find the significant

11 "Inter–discipline appears as an academic phenomenon and is much more than that. Actually, it is linked to techno–science, which by itself corresponds to the link between scientific and technological disciplines. Inter–discipline and techo–science have received the maximum support from political–business or industrial–military complex that has dominated in the USA and in the whole world at least since WWII". (González Casnova 2004, 30).

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relationships that conform the agroecosystem and consider the process of social conformation of labour, then we can enrich the agroecosystem concept or, using the notion of García (2006) we permit ourselves to modify the margins of the piece of the reality in the proper course of research (and action). Thus, without losing the scientific rigor, we will be able to build an agroecology that instead of closing itself (either as the power–linked agronomy or as the epistemological relativism of "everything is worth"), will give better explanations about and, in last instance, transform reality. In political terms, we cannot forget that the *occident* and the called *western thought* has had also a *bellow* and an *above*.

Let us consider then that for the full understanding of agroecosystems it is indispensable to understand that form acquired by this human activity, that *productive praxis*, which is always a socially determined form. Human labour is then constitutive part of agroecosystems as much as is constitutive the biological matrix which in turn is product of the long–time (evolutionary and geological) and societies interpenetrate with that matrix through labour. This interpenetration is the material basis of human history.[12] This why agroecology has the need to dialogue with or to actively incorporate those who carry out the *productive praxis*: peasants, agricultural day labourers, small farmers, cooperative workers, etc. It is from this dialogue that another way of orienting this *praxis* can be constructed, this implies to modify not only its cognitive moment but also its teleological moment. But at the same time, incorporating field workers as subjects of agroecology allows, at least potentially, to solve the problem of scale, since the relevant unit to study in agroecosystems would be at least partly determined by the land extension, whose interactions biological are relevant to the subjects of labour, be these peasant communities, small farmers, etcetera.

12 Pablo González Casanova expresses this concept very clearly by pointing out that the conformation of interdisciplinary fields requires to distinguish the existence of different kinds of *complex systems*: "ones that are natural, others that are human artefacts built for determined purposes and third kind that are combinations of the former two and come into historical systems of matter, life and humankind. The artificial complex systems ate product of technological, techo–sicentific, political, artistic, economic, social and cultural constructs, constructs that utilize the natural laws, tendencies and structures to achieve its objectives, In the historical complex systems of our time appears the impact of complex systems built by humans and by the classes or groups in which they divide." (2004, 99; *translation of the fragment to English by LJB*).

The key factor in the comprehension of agrocosystems is precisely the presence of human historicity, as an interplay between deterministic and stochastic elements along the time, but above all a historicity that results from the *praxis* and therefore of action oriented by socially built ends. In the case of biological systems the historical dimension makes already impossible their reduction to mere systems of simple self–organization, and this property is exacerbated in agroecosystems, where evolutionary change takes place vertiginously within the framework of human historicity, marking a classic case of quantitative change that becomes qualitative.

This dialogue cannot start form the abandonment of scientific knowledge under the accusation of being western or a mere product of colonialism. The task is, in any case, to recognize that the realism and precision of knowledge about the agroecosystem that hat rural workers usually develop and the generality and realism that scientific knowledge achieves can complement each other. But this dialogue of knowledges (using the expression by Mariela Fuentes and collaborators in their article in this issue) requires the development of a critical thinking on the sciences in their relationship with peasant empiric knowledge. In word of Richard Levins:

> "When pretending to solve a problem, each group varies its own knowledge and ignorance. The first step when we try to unite groups of different social origins is to question: 'Which is the kind of typical error that you are going to incur and which are the typical errors I'm going to incur in?' Once they are over the table, we can go with the self-awareness of a science that is critical of itself." (Levins 2015, 25-26, *translation to English of this fragment by LJB*).

This has the virtue of opening paths to walk by. If the agroecosystems are the product of human labour and the management practices undertook by peasants are one of the sources or agroecology as a social movement while also a research task for agroecology as a science; this is, if the *concrete totality* necessarily includes its social dimension, then other problems become open and some of them are treated in the works presented in this INTERdisciplina issue (Fuentes *et al*. 2018; Krohling and González 2018; Lugo and Rodríguez 2018; see also the interview to John Vandermeer published here). In one side, there is the consideration of the social forms and determinations that takes the labour that makes agrobiodiversity possible. From there comes the necessity to reflect about forms of new knowledge construction in dialogue with the subjects of rural labour. From this topic also arises the need to meditate and execute new participatory research practices, being this the central theme of the book *Agroecology: A transdisciplinary, participatory and action–oriented approach* whose review we publish in this number of INTERdisciplina (Gutiérrez–Navarro 2018).

Agroecosystem and socio–environmental crisis

This issue of INTERdisciplina attempts to joint different approaches to the study of agroecosystems, assuming that the conformation of agroecology as an interdisciplinary field has been and will be a product of the continued interaction among the different disciplines involved in it. But the urgency of agroecology to *understand in amore integral way the ecological and social factors that inter-*

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twine in the structure, function and in la instance in the coevolution of the agricultural productive systems, with special emphasis in the peasant agricultural systems (Altieri 1999, 2002) doesn't come simply from an academic interest. It arises in a moment in history marked by the socio–environmental crisis, manifested among other thing in global warming, a high rate of biodiversity loss and ocean acidification, and this crisis is part of a global war of capitalism against humankind. This makes that every serious attempt to discuss the nature-society relationship has to name and problematize capitalism, which has been a "forbidden category for natural sciences, including the mainstream within the sciences of complexity (González Casanova 2011).

We need to relocate the role of agroecological knowledge to face a new, more dangerous stage of capitalism. We have said that the origins of agroecology as a movement are rooted in the dichotomy between diversified productions systems (like milpas and other polyculture systems) still oriented towards *use value* production on one hand and high input monoculture systems oriented by *exchange value* production in the other. This is to say, agroecology as a movement arose from the confrontation against industrial agriculture model and its consequences at different levels. In the current moment, the *value–use value* contradiction expresses in its most developed way in the preponderance of financial–speculative capital in the world capitalism (see for example Husson 2009; Rodríguez–Lascano 2017). This brings the consequence or "non–collateral damage" that the determinants of monoculture agroecosystems composition are not only outside of the needs of the rural workers, but even outside of the usual domain of the productive capital, being overdetermined in the sphere of speculation and in the incorporation of "cheap nature" (Moore 2016) into the global process of accumulation of capital.

Lewontin (1998) is right at pointing out that in the "classic" industrial agriculture model (i.e. that developed through the *green revolution* until the 1970–1980 years) what is relevant for capital is to control the agricultural process, including production and sell of inputs as well as the commodity circulation of agricultural goods. In this scheme, the direct property over land wasn't a mandatory requirement for accumulation. But today we face a different stage, in which the character of *total* that takes the war of capitalism against humankind makes that some of the secular tendencies of agriculture capitalization become sharpen, while there are some breakpoints with respect those previous tendencies.

The restructuring of agro–food capital impacts not only in the processes of circulation of the agriculture commodities, but also transforms the social relations of production, altering in last instance the agroecosystem itself through the transformation of the rural labour (Garrapa 2017; Garrapa, in this issue). The development of transnational corporations, the modification in the structure of

commercial capital in this stage of capitalism and the concomitant acceleration of the circulation process, bring with them traits of the production under real–time demand to the crop fields: this happens from perennial fruit trees in the Mediterranean basin to the ephemeral strawberries and blueberries of the California and Baja California valleys. Today, the change in the mediations between commercial and productive capital in the production of crops for export market introduces scenarios in which the decision making on the composition of the vegetal community is sometime even beyond the reach of the landlords that relentlessly exploit the day labourers in northwest Mexico. The power lies now in other place and it os not in the old National–State and its agriculture policies.

In parallel, the current stage of capital accumulation makes the confrontation in the countryside to acquire new edges and modalities. As Elkisch Martínez warns us in its article the conflict lines that express in the context of agricultural production have also determinants within the speculative–financial capital sphere. Through finances the current production is tied to future prices of agricultural commodities indexes, worsening the old capitalist contradiction in which production is subordinated to the logic of the valorisation of value, now reaching levels unseen before. At the same time, the expansion of accumulation by dispossession towards the social interstices that operated as an inner frontier to capitalism accentuates its struggle against natural and peasant economies that subsisted (using the expression of Rosa Luxemburg); this expresses in a harsh process of territorial disposession. Even more, by the opening of the technological possibility of controlling and commoditizing parts of nature that resulted impractical before (air, biodiversity, carbon uptake, etc.), capital is launches in an almost desperate race for differential rents. All of this obliges that the study of agroecosystems understands or at least considers the emergent forms of conflict. This raises a challenge, because these new determinants of what is lived and happens within a growing plot weren't present 40 or 50 years ago, when the agroecologcial discourse started to shape academically.

This is the context in which the current socioenvironmental crisis occurs. The environmental deterioration at a planetary scale must be named with its own proper name, *capitaloscene* (Moore 2016) because it has been at this epoch of humanity history in which the rift of biogeochemical cycles has occurred and because the main driving force of devastation has been the accumulation of capital. As an algid point of capitaloscene, the current socioenvironmental crisis is manifested in key aspects for agriculture, such as climate change or the genetic erosion, and is also manifested in the increase of land and natural resource dispossession across the globe, in a process through which capital tries to palliate the decreasing trend in the profit rate. This without forgetting that every day the war of capital against the capacity of communities to reproduce their lives and against

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the cultural reproduction of the indigenous peoples gets more intense. This means that the very sources of agroecology (agroecosystems and management practices that go hand in hand with cultural diversity) are being destroyed.

All of this speeds up the global change, and the new cannot be treated as the old (i.e. as a continuation of the classical forms of confrontation between industrial and traditional agriculture) so it is necessary that as part of its self–aware practice (*sensu* Levins 2007), agroecology problematizes the capitalism and take a stand in front of him. Without such a reflection, the risk is not only one of epistemological shortness of sight, but it is the risk of agroecology becoming a new brand, a new fashion to commercialize or another technological package (Giraldo and Rosset 2016; Fuentes *et al.*, in this issue). For capitalism devastation or destruction is always and in any case an opportunity to broaden its control, reconstructing in this case, its own version of the agroecology–based echnological packages that may be commercialized, sold as an answer to the crisis.

Our horizon: to transform the world

As González Casanova (2006) has showed, a science or an interdisciplinary field that aims to study the complexity cannot afford to leave politics at the doorstep of the whole, so it is necessary to take a stand against capitalism system. To achieve this, rather than conceptualizing agroecology as a movement in itself, it is necessary to look at its relation as a scientific practice with the social movements. It is in this relationship where agroecological knowledge becomes a tool in the process of recovering the collective control of production, a tool to shape the spaces and territories that those social movements snatch away form capital. In this relation with the social movements, the knowledge of agroecosystems can help to transform the production of material life, while participating of the process of production of the own human social life.

That's why the category "traditional agriculture" may result insufficient to describe the melting pot of practices that appear opposed to the agroindustrial model. In this number, we can approach through the work by Krohling and González to the experience, genuinely *poietic* of the Borborema Sindical Pole and the *Cooperativa de Produção Agropecuária União da Vitória* in Brazil. Both cases illustrate how in the *value–use value* contradiction, the struggle of the social movement to recover use value as the axis of production can be fruitfully articulated with agroecological knowledge. At the same time, this work highlights the relevance of collective action to transform the nature–society relation.

In summary, we are interested in understanding the agroecosystems as a *cognitive moment* of a praxis, that is, as necessary knowledge to transform the world, to transform our mutually determined relation with nature. Until today

the dominant form of such nature–society relation has been oriented not by the ends or objectives of humanity, but by the fundamental *telos* of valorisation of value. In order for this relationship to be controlled by humanity both extremes are required: that of the collective action beyond the academy and that of a scientific knowledge that overcomes its own condition of alienation —which until today has limited the action of the natural Sciences—.

Having said that, we hope that this issue will raise problems that in turn contribute to the constant conformation to the interdisciplinary field of agroecology. And we hope this not so much or in any case not only because it's a nice academic exercise. The expectation is that the knowledge that can be generated from the interdisciplinary field of agroecology help us to achieve *the coincidence in the change of the circumstances and human activity or the self–transformation*, then we are interested in this as *revolutionary praxis* (Marx, 3rd thesis on Feuerbach). Let's just note that the transformation of the mutual determination between society and nature will overflow the academic work and cannot even be circumscribed to the role of agroecological knowledge on its own. We present this issue of **INTER**disciplina in a moment in which in face of capitalism, we fight as humankind for life in a collective, no more, no less. That is the political position from which I write these lines.

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