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TOWARD A SEMIOTICS OF SYNTROPY: GRAMMATICALITY, EVOLUTION, AND SUCCESSIONAL DYNAMICS IN AGROECOSYSTEMS

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Abstract: Under the scope of Systems Theory — drawing on thinkers such as Edgar Morin, Ilya Prigogine, and Jorge de Albuquerque Vieira — and in conjunction with Charles S. Peirce's Semiotics, this article examines the dynamics underlying Ernst Götsch's Syntropic Agriculture, focusing on its successional cycles, evolutionary parameters, and regime of meaning or grammaticality. Developed empirically and pragmatically over decades, the syntropic agroforestry model stems from Götsch's attempt to understand how nature organizes itself to sustain and intensify life. His cultivation methodology is grounded in thermodynamic principles, transforming the management of entropy into the harvesting of syntropy, that is, life-promoting organization. We propose that this methodology operates as a stochastic and non-linear process that favours the emergence and singularity of living, stochastic systems in continuous creative evolution — *genesis* — enabling both the included species and the environments they inhabit to grow in resilience and complexity. Its triple rootedness — thermodynamic, eco-biological, and agro-cultural — constitutes the grammaticality of syntropic agriculture, or its regime of meaning. Within this framework, the physico-chemical dynamics of out-of-equilibrium systems drive species variability in successional cycles, fostering healthier, self-productive, and self-organizing ecosystems. The article concludes that Syntropic Agriculture positions *Homo sapiens* as an operator of semantic transformations within agroecosystems.

Keywords: Syntropic Agriculture, Ernst Göstch, Agro-ecosystem, Semiotics, Complexity.

Resumo: Sob a perspectiva da Teoria dos Sistemas — dialogando com pensadores como Edgar Morin, Ilya Prigogine e Jorge de Albuquerque Vieira — e em articulação com a Semiótica de Charles S. Peirce, este artigo examina as dinâmicas subjacentes à Agricultura Sintropia de Ernst Götsch, com foco em seus ciclos sucessionais, parâmetros evolutivos e regime de sentido ou gramaticalidade. Desenvolvido empiricamente e de modo pragmático ao longo de décadas, o modelo agroflorestal sintropico decorre da tentativa de Götsch de compreender como a natureza se organiza para sustentar e intensificar a vida. Sua metodologia de cultivo fundamenta-se em princípios termodinâmicos, convertendo o manejo da entropia na colheita da sintropia, isto é, da organização promotora da vida. Propomos que essa metodologia opera como um processo estocástico e não linear que favorece a emergência e a singularidade de sistemas vivos, estocásticos e em contínua evolução criativa — gênese — permitindo que tanto as espécies incluídas quanto os ambientes que elas habitam aumentem sua resiliência e complexidade. Sua triplo enraizamento — termodinâmico, eco-biológico e agro-cultural — constitui a gramaticalidade da agricultura sintropica, ou seu regime de sentido. Nesse enquadramento, as dinâmicas físico-químicas de sistemas fora do equilíbrio impulsionam a variabilidade das espécies em ciclos sucessionais, promovendo ecossistemas mais saudáveis, autoprodutivos e auto-organizáveis. O artigo conclui que a Agricultura Sintropica posiciona o *Homo sapiens* como operador de transformações semânticas nos agroecossistemas.

Palavras-chave: Agricultura Sintropica, Ernst Götsch, Agroecossistema, Semiótica, Complexidade.

Introduction:

In recent years, there has been growing academic interest in Ernst Götsch's Syntropic Agriculture (REBELLO & SAKAMOTO, 2021) (ANDRADE & PASINI, 2022), because his cultivation methodology, based on the development and maintenance of integrative processes between plant and animal species, not only produces food, but also has the capacity to restore forests and woodlands in different biomes, guaranteeing the survival of complex ecosystems and combating many of the problems we currently face related to climate change.

This syntropic agroforestry model has been developed in an empirical-practical way over the years, with the impetus of discovering how nature *works* to produce life. The observations of Götsch, a genetic scientist by training, were born within the forest and woodlands, when he realised that there was an evolutionary complexity in these ecosystems that guaranteed food for everyone in them. What's more, these ecosystems didn't need external inputs to achieve something fundamental to life: their autonomy and permanence. But how was this possible?

When we talk about organic and permaculture, for example, we always see the need to cultivate using *ecologically correct* inputs such as compost and/or manure, natural herbicides and/or pesticides, etc. But in these processes, cultivation is still based on the maintenance of monocultures, such as vegetables and legumes, for example, and the constant injection of external agents to guarantee their survival.

There is a certain *artificiality* to these ecologically correct processes, because what is actually created are *bubbles* that simulate so-called *natural* systems. Syntropic agriculture goes the other way: it is part of the development of successional stochastic systems (VIEIRA, p. 65, 2008) that evolve in complexity until they reach ecosystem autonomy, but without the use of external inputs (artificial and/or ecological) to guarantee the historicity of this process.

To put it this way, such a methodology seems a little daunting, but let's use a little illustration here. Let's say that syntropic farming is a type of cultivation that is completely unknown to the reader. This degree of ignorance is homogeneous, because its representation sounds distant and null. Just as when we visit a city for the first time, we are totally unfamiliar with it. However, little by little, as we live in it, the city begins to be mentally mapped out and we begin to walk with a certain freedom along its avenues, streets and alleys, in fact we create our own routes, our places of reference, our information architecture, when we really get to know it.

This initial homogeneity – or lack of knowledge – we call the maximum degree of entropy. In the case of syntropic agriculture, for example, as we read about it, attend classes on the Götsch methodology, practise its principles and exchange ideas with other agroforesters, we stockpile information. This stock, or systemic memory, allows us to develop a knowledge of this cultivation, so that through our day-to-day experience, this know-how enables us to map it: to weave strategies, plans and guiding principles into our actions in agroforestry cultivation.

A degraded environment and/or even our large areas of monoculture, be it soya, maize, wheat, etc., can be listed here as examples of the maximum degree of entropy. For in both there is a systemic homogeneity: either artificially manufactured, or the result of actions harmful to the environment that has lost its capacity to regenerate. In thermodynamic terms, the homogeneity of both environments alerts us to the lack of information stock. Götsch noted that entropy does not serve as the place where we should grow our food, and this stage of homogeneity is just a moment of passage to another process: heterogeny.

In fact, the great driving force behind life on the planet is entropy, without which we *homo sapiens* wouldn't even be here (PRIGOGINE, 2002 p. 29). According to the Second Law of Thermodynamics, everything degrades, however, nothing remains homogeneous, everything tends, in the same proportion, towards heterogeneity, or the development of diversity and complexity[1]. However, in order to achieve this heterogeneous process, information needs to be stored over time.

Stochastic systems are called non-linear or out-of-equilibrium systems. In fact, many people confuse disorder with entropy, which is not correct. So, when we enter a forest, for example, that cacophonous disorder is not an index of entropy; on the contrary, everything that degrades there is driving a proportionally high volume of the possibility of life, or syntropy.

So, to summarise, what Ernst Götsch developed was a cultivation methodology based on thermodynamic principles, in which the management of entropy is transformed into the harvesting of syntropy, or life. This methodology takes the form of a stochastic process, i.e. a non-linear process that favours the emergence or singularity of living or stochastic systems, in constant creative evolution – genesis – which allows the species included in it and the very environments it develops to grow stronger.

To better understand this agricultural crop, its successional cycles, evolutionary parameters and regime of meaning or grammaticality, we have to analyse it under the scope of Systems Theory, with thinkers such as Edgar Morin, Ilya Prigogine and Jorge de Albuquerque Vieira, in conjunction with the Semiotics of Charles S. Peirce.

1. The Basics of Agroforestry: The Syntropic Cycles

System is a very recurrent term in the literature on syntropic agriculture, but what is a system? For Edgar Morin (2008, p. 175), a system is anything that demonstrates emergence and autonomy in relation to the external environment. Emergence can be seen as creativity's ability to evolve and find the means to remain. Jorge Vieira (2008, p. 34) observes the types of system: a) Open systems

[1] *Everywhere the main fact is growth and increasing complexity* (PEIRCE, 1992, p. 308).

are those that interact and exchange information with other systems and subsystems in such a way as to permeate their existence and permanence based on their ability to weave and/or build relationships, connections and integrations at different levels of associations, co-operations and mutual adjustments; b) Closed systems exchange energy and information, but not matter; c) Isolated systems, on the other hand, lose contact with their surroundings and tend to die.

According to Jorge Vieira (2008, p. 89), there are three fundamental parameters for classifying a system: its capacity for permanence, its environment and its autonomy. Permanence has a temporal character embedded in its process and often, in biology, this parameter can be synonymised with the term survival, i.e. the ability to maintain its existence over time. Environment is a system that involves another system; in fact, the environment allows the system within it to find the necessary resources for its emergence, development and maintenance. Morin warns us that in the same way that a system chooses its environment, or *Oikos*, the environment chooses the systems that will develop through it (MORIN, 2005, p. 68). There is a co-evolutionary aspect to the process, as environments and species co-produce and co-operate mutually for the permanence and evolution of both.

Autonomy, on the other hand, is related to the stock of information or systemic memory, i.e. the past connects the present, enabling possible futures. Thus, over time, in its process of permanence and exchanges with the environment, the system accumulates experience, evolves in mediation – or semiosis – internally – cells, organs, individuals – and externally – micro-systems, ecosystems and macro-systems – and transforms information into regularity, to the point of self-maintenance and self-generation: recursively (circuit) and retroactively (expansion) (MORIN, *ibid.*, p. 263). Maturana and Varela call this process as *autopoiesis*.

But why is the accumulation of information important for open systems? Because every open system, which is non-linear and out of equilibrium, has to deal with entropy, i.e. the degeneration of itself and/or its surroundings. Thus, the stock of information ensures that it can deal with crises, disturbances, hostilities, disputes, struggles, competition, etc. (VIEIRA, p. 66, 2008). That's why entropy is the driving force behind evolution, because it makes systems achieve what we call *homeostasis* or *non-equilibrium steady state* (PRIGOGINE, 2011, p. 69), which, above all, means an intermittent action to overcome entropy (PRIGOGINE, 2011, pp. 30-31), transforming it into systemic memory and transmitting it to subsequent generations, recursively and retroactively. What Morin calls auto-pheno-generativity (2005, p. 133).

As a stochastic, nonlinear system, syntropic agriculture is based on the succession of systems, i.e. going from the least complex to the most abundant. This is precisely because this methodology works on building autonomy, i.e. building a systemic memory (VIEIRA, 2008, pp. 34-35) that acts as a regulator of the system's creativity and permanence, or emergence, allowing the system to self-produce and find its own *homeostasis*.

So, in the beginning, what you see emerging in cultivation are fast-cycling species such as grasses, vegetables, herbs and tubers. Above all, what is established is a consortium of species that have the ability to thrive even in hostile environments. However, as the system evolves, the soils begin to have a microbiological activity that is more prone to harbouring species that are more demanding of nutrients. This is because plant roots begin to open up passageways, making the soil more porous and prone to physical and chemical exchange, thus accumulating information. At the same time, the biomass produced by these pioneer species is used as a cover for this soil that is undergoing the structuring of mycorrhizae.

In fact, mycorrhizae – the association between fungi, bacteria and plant roots – can be described as a communication network in the context of soil biocenosis (REBELLO & SAKAMOTO, 2021, p.28). It is therefore a system of interactions that allows for the maintenance and dissemination of information, strengthening the relationships, connections and integrations of species in the face of system degradation. It's no wonder that this process can also be referred to as restoring the *health* of the soil.

In the intermediate stage of syntropic cultivation, called accumulative, what we see emerging are species with medium- to long-term cycles, such as shrubs, trees and fruit trees. However, what is visible in this context is the emergence of *shading platforms*, because the sunlight, so intense and uniform in the initial stage, is now distributed in different steps within the system. Thus, some species serve as photosynthetic support for others, because many species produce better in the shade while others need to be exposed to the sun for longer. Above all, the same dynamic found in the construction of the soil biocenosis, i.e. the informational strengthening of the system, is now seen vertically, in layers, by a variety of steps: creeping, low, medium, high and emergent.

In this process, the layers of shading spread over different floors create: a) an environment that self-regulates in maintaining the temperature of the system; b) in protecting the soils, not exposing them to the abrasive action of the sun; c) in conserving the ambient humidity; d) in improving the photosynthetic metabolism strengthening the well-being of the individuals inserted in the system leaving them better able to deal with diseases and/or insect attacks; e) in the health of the system itself, i.e. with a more robust metabolism and a protective environment, all species benefit, since the metabolic surplus of the individuals is distributed by the roots via mycorrhiza, in a frank dialogue between soil and forest, favouring the information stock of the entire ecosystem and keeping it able to deal with the degradation of the system; f) last but not least, in the protection of the forest from the action of winds and storms.

In fact, this intermediate stage, or accumulative system, prepares for the forest's dialogical path that will be fully realised in the next cycle, called the abundance system. This last stage of syntropic cultivation is characterised by a change in the microclimate in the region where the agro-ecosystem is located, to the point where we see a greater volume of water circulating: a) in the soil, through the restoration of springs; b) within the agroforestry, through transpiration from the trees; c) as rain, through large-scale evaporation by the trees and plants in the consortium. Because of this emerging peculiarity, Götsch became known for the phrase: *Water is planted!*

Thus, in the system of abundance, what is harvested is everything that has been stored over the previous stages. The soils are healthy and the available nutrients are plentiful, the species complement each other synergistically and the whole ecosystem re-establishes itself as a forest. Here we see that species with long cycles – centenaries – and emergent species – very tall – are the ones that stand out most in the system. This doesn't mean that fruit-bearing species aren't in the landscape, on the contrary. We can see cocoa, coffee and citrus trees under these large woody trees that provide them with a more protective environment. It can be said that this process is made up of synergistic layers of systems that complement each other.

Another important factor is the return of medium and large species to the ecosystem. While in the first cycle we see many insects and small animals, in the intermediate and final cycles, medium and large species return to their original habitats, as there is an abundance of food in the system. At the same time, these species contribute to population regulation and, consequently, to the maintenance and evolution of the agroforestry, by transporting seeds and favouring spontaneous planting.

2. Evolutionary Parameters: The Synergy of Complexity

So far we've seen that an open system such as an agroforestry is characterised by exchanges of information, matter and energy. At the same time, we presented the fundamental parameters for

the consolidation of this system – permanence, environment and autonomy – projecting them onto the successional process of Ernst Götsch's syntropic agriculture. We now need to understand the evolutionary parameters of a system so that we can then address its semantics or grammaticality.
According to Jorge Vieira (2008, pp.35-42), for a system to consolidate itself as such, there are so-called hierarchical or evolutionary parameters, i.e. those that depend on the time factor to establish themselves, outlined as follows: composition, connectivity, structure, completeness, functionality and organisation, all permeated by a parameter that can arise from the first stage: complexity.
The first parameter called composition deals directly with diversity, i.e. the more diverse the system, the more information there is circulating, and the more information, the better the system will be able to deal with entropy. Therefore, information is difference and difference is autonomy. Composition is what we can observe in the *muvuca*. An indigenous method of planting widely used in syntropic agriculture that is characterised by a considerable volume of seeds from different species being planted together. In fact, this ancestral planting method promotes a wealth of germination possibilities right from the start. But the composition is not restricted to this initial evolutionary stage; in fact, this process accompanies agroforestry management throughout the three syntropic cycles.
From this initial abundant variety of *muvuca*, the farmer observes the growth of the consortium species and the development movements of each individual in the system. It is in this kinetic flow that the farmer is trimming, intervening, selecting, in other words, composing the agroforestry. In this way, the species that are left behind provide the biomass needed to maintain and/or enrich the soil biocenosis and are deposited at the feet of the plants that remain in the system. In this movement, the composition of the strata appears in the landscape like chords in a great symphony whose conductor is the farmer.
Therefore, information density becomes the key to the evolution of agroforestry, because it is through this abundance of possibilities that the farmer finds the resources necessary for the evolution and maintenance of the agro-ecosystem. Finally, composition deals with this arrangement that takes place over time and becomes connectivity.
Connectivity, the second evolutionary parameter, means weaving links, relationships, strengthening the interlinking of complementary processes, whether in the soil biocenosis or in the stratification of the system. Connections can vary over time, as species can leave the system and open up other possibilities for connectivity with those that emerge in the sequential processes. In

this way, the species that leave the system prepare the environment for strengthening the links between those that remain. One cycle closes and another opens, but each cycle has its own form or structure.

Structure is the third evolutionary parameter and means the shape of the system. Obviously, the structure of the systems – pioneering, accumulative and abundant – are different. When you come across each of these cycles, you notice the difference in the landscape. This configuration of the landscape is the structure or design of that moment in the agroforestry. However, this structure changes because it evolves due to all the multi-processes at play in the system, but noticing the change in the landscape is fundamental to recognising its completeness.

Integrality, the fourth evolutionary parameter, means establishing systems within other systems, that is, forming subsystems that nourish each other through the links and connections established. In this way, the agro-ecosystem becomes less rigid and more flexible to withstand disturbances, because there is no one command centre, but a plurality of dispersed centres acting interdependently. That's why when a clearing opens up in the forest, it doesn't suffer, because within the forest itself the possibility opens up for other forests to emerge autonomously.

Integrality therefore means fostering emergencies. In a way, integrality can be synonymous with syntropy. Thus, the landscape is transformed because there is an interdependence of processes, as they co-evolve through several layers in a recursive and retroactive manner. This kinetic, multi-process synergy stimulates the full functionality of the consorting species within the syntropic cycles.

Functionality, the fifth evolutionary parameter, means providing the conditions for the properties of each species to act in such a way that they all benefit. In fact, each intercropped species has a function in the system, i.e. its specific place of action. Some are just to guarantee biomass, such as grasses, others to provide shade for the initial cycle of species that will only mature in sixty years' time. On the other hand, in multi-processes there is also the flow of functionalities in the system, because these functions can change over time. Thus, at one moment a species provides shade for another, but in the next cycle it becomes the biomass of another chosen to remain in the system.

Integrality stimulates the emergences – qualities – of species, allowing them to specialise. That's why Ernst Götsch doesn't call invasive plants *pests*, but rather auxiliaries or co-operators of the system, because these plants are specialists in pointing out problems, whether it's a lack or excess of some nutrient, for example. Even insect attacks can be read as indices of system problems, because degrading systems are easily afflicted by this stress, unlike healthy systems that manage to contain and overcome it.

This containment of degeneration is a reflection of the organisation of the system, as each part has a function in the whole, i.e. each species, with its speciality, complements each other in space and time. Diversity therefore favours this organic process, which is above all semantic, i.e. the system is cohesive and coherent. In fact, the parameters of cohesion and coherence are also parameters for consolidating a system. Cohesion deals with the syntax between species in terms of their joint, complementary and interdependent actions. Coherence deals with semantic completeness or the convergence of meaning that resonates throughout the system. In fact, the last evolutionary parameter is organisation, which means an elaborate form of complexity.

To summarise, the evolutionary parameters of system consolidation deal with the temporal movement of growth and development of complexity. Thus, in the syntropic agro-ecosystem, species are: composed in such a way as to create connectivity, structuring co-evolutionary landscapes and integrating complementary and interdependent multi-processes that foster specific functionalities, in a cohesive and coherent way, consolidating an organisation, the aim of which is the convergence of meaning, i.e. the system's *homeostasis*.

3. Grammaticality: The Convergence of Meaning

In the first part of the text, we look at the fundamental parameters of a system – permanence, environment and autonomy – and how these are intertwined with successional cycles in syntropic agriculture. In the second part, we analysed the evolutionary or hierarchical parameters within this cultivation matrix elaborated by Ernst Götsch. Now let's look at the semantics of the system, or rather its grammaticality.

Grammaticality (VIEIRA, 2008, pp. 44-51) means the system's regime of meaning, i.e. we can understand its systemic evolution through its historicity. Historicity, on the other hand, is the path along which the system has evolved through a chain of events that have taken place over time and that we can translate iconically by means of a map. However, every event is procedural, meaning that it is not isolated in time and space, but is the result of a previous contextual history.

In syntropic agriculture, *homo sapiens* becomes an operator of semantic transformations or historical intentions. Thus, it is through his/her interventions in the system, producing a chain of events, that the agro-ecosystem circles and evolves. There is therefore a semiotic character to syntropic cultivation, i.e. there is a coordinated action of interpreting signs that mediate the successional evolution of this crop. We mustn't lose sight of the fact that the term culture is embedded in the word agriculture, because growing food is a primarily semiotic process. We cultivate in accordance with what we believe and put into practice what we are.

Charles S. Peirce's theory of interpretants can provide us with important analytical tools for understanding the grammaticality of the syntropic agro-ecosystem and its process of managing meaning. Firstly, the interpretant is a sign resulting from the mediation of the sign (*representamen*) in relation to the object. The object determines the sign which, consequently, produces another sign, already mediated, which brings with it information about the object, but not just the qualities of the object, because the interpretant is a sign capable of activating the action of the sign: *semiosis* (PEIRCE, 1998, p. 290).

Peirce divides the interpretant into three types – the Potential or Immediate, the Dynamic and the Final (SANTAELLA, 2000, p. 69). The Immediate or Potential Interpretant is associated with an internal property of the sign, i.e. its possibility in the abstract, not yet realised, contained in the sign itself, to be interpreted as such. Therefore, it is linked to the power of the sign to produce a certain effect as soon as it finds the necessary conditions for the desired action.

A seed is an example of a potential interpretant, because the seed represents only a possibility, in the abstract, of a future. However, when placed in the right conditions, this seed awakens and contains all its potential for development. In the same way, syntropic cultivation, at its inception, is only a possibility in the abstract, an agroforestry project.

This project is abstract at first, but it already makes the farmer visualise it: the possibilities of intercropping, the lines of cultivation, the sequential cycles, the projections of the strata, the maintenance of the system, the economic viability of the venture and the evolution of each part of the farm or site in syntropic cultivation. At the outset, the project still requires attention to the evaluation of the soils, rainfall and light, as these factors play a part in the projection, which can often be translated into a map containing the entire cultivation plan.

The Dynamic Interpretant is associated with the real effect of the sign when in direct contact with the interpreting mind. "It corresponds, finally, to what can be called the meaning of the sign in concrete, that is, the empirical fact of apprehending the sign, a particular realisation of the meaning (...)" (SANTAELLA, *ibid.*, pp. 72-73). Thus, the dynamic interpretant in syntropic agriculture is related to this moment when the project leaves the paper, enters the field of reality and is put to the test.

However, there is a lot of instability, variables and possibilities in the configuration and activation of a process as complex as that observed in syntropic agriculture. Ernst Götsch emphasises in his courses and lectures that each syntropic agro-ecosystem has its own history. This is largely due to various factors such as: the biome, the topology of the region, the ecosystem, the individuals and species that are intercropped in a given location and, of course, the farmers involved. It is not a technical science to be used in a generalised way, without mutual observations and/or adjustments to the characteristics of each environment. Syntropy has to be built in accordance with and respecting the time, space, incidence of light, relief and socio-economic and ecological characteristics of the place.

A farm, for example, is not something undifferentiated, on the contrary. Certain parts of a single property can have such different soil, light and water supply characteristics, for example, that placing them on the same undifferentiated level of action would mean accelerating their degradation, leading to the degeneration of the system, not its syntropy.

This is why syntropic agriculture requires a type of learning that has long been forgotten: ancestral learning. By socialising with syntropic farmers like Ernst Götsch, Fernando Rebello, Namastê Messerschmidt, Juã Pereira and Antônio Gomides, for example, you can learn the principles of syntropic farming by listening to them, walking with them through the agroforestry and watching them manage the system. Thus, it is through orality, through sharing their previous procedural experiences that we improve: a) our sensitivity to perceiving the processes underway in the agroforestry; b) our actions in the system with regard to pruning, thinning and the choice of individuals and/or species that stay and/or leave; c) our knowledge of syntropic cultivation. These three semiotic moments represent exactly the three stages of the dynamic interpretant.

According to Santaella (*ibid.*, pp. 78-87) the dynamic interpretant is internally divided into three instances: the emotional interpretant, the energetic interpretant and the logical interpretant. The emotional interpretant deals with our sensitivity, the energetic with our actions and the logical with our habits, beliefs and thoughts.

With the advance of technology and agribusiness, sensitivity is perhaps the cognitive capacity that has been most neglected in agriculture. This is because sensitivity requires a bond with the cultivation ecosystem, strengthening ties with the countryside and turning it into *agriculture*.

However, in syntropic cultivation, this ability becomes fundamental to the perception of the system's circular-evolutionary processes. Perceiving the evolution of the intercropped species, the strata and their shading, the timing of pruning and how to carry it out in a way that favours the whole system requires, above all, sensitivity. Thus, walking through the fields, observing the species interacting, smelling the soil, the textures of the fruit, the incidence of light on the topology, makes us better suited to agroforestry management.

The energetic interpretant is associated with an act in which some energy is expended. In fact, this interpretant is linked to the effort, muscular or mental (PEIRCE *apud* SANTAELLA, *ibid.*, p. 78), of the mind in the face of the physical objects that act on us and on which we act. A syntropic agro-ecosystem is something dynamic and keeping it in a constant circle of evolution depends on managing, that is, acting on the different temporal/informational flows of the system. Managing means promoting conscious disturbances, i.e. with a pre-established meaning, in order to keep the system always active. Remember, we are always managing entropy in order to harvest syntropy.

This clash between what is projected and what is executed demands energy and effort from us which, on the one hand, alerts us to the fact that physical phenomena are independent of us, and on the other, this resistance warns us about our existence and identity, since we respond to them in accordance with our beliefs (PEIRCE, 2000, p. 195). Therefore, acting demands reflection and reflection based on how we interpret facts in accordance with what we believe and know. In fact, this is the semiotic role of the logical interpretant.

The logical interpretant has the effect of the thought or general understanding produced by the sign. To think "(...) is to make inferences, to establish consequences of certain premises, to move according to a general rule" (SANTAELLA, *ibid.*, p. 79). Being a syntropic farmer implies not specialisation, but poly-functionality (MORIN, 2001, p. 345-346), i.e. a multifaceted view of the ecological and complementary interrelationships in and through which successional cultivation is immersed.

This means that such a farmer travels through the cycles, knowing how to activate them in the way s/he wants, not being a specialist in one of these processes, but having the ability to stitch them together, weave them and, above all, connect them. Therefore, their virtue lies in establishing and developing systemic connectivity, i.e. being immersed in diversity, being able to explore, foresee and articulate the links between species, strata and their circle-evolutions, promoting co-operations and associations that are built and consolidated in and by the whole, the agroforestry. In this way, the history of the system (VIEIRA, 2007, p. 110) becomes supported, determined or biased towards the farmer or farmers involved. This is why syntropic cultivation is primarily semiotic cultivation. The ultimate goal of the logical interpretant would be to change habits or beliefs, in other words, to change the general rules that mould our way of interpreting the world. This is because entering, interacting, walking and staying in a syntropic agro-ecosystem requires the farmer to take the time to acquire a certain amount of knowledge – systemic memory – about the active system they are travelling through. It implies understanding its integrality in order to be in the same intersymbolic range (VIEIRA, *ibid.*, p. 58) of ecological interpretation.

Being on the same intersymbolic track requires an interpretative re-education, or better said, a dilation of the biological Umwelt (VIEIRA, 2007, p. 26-28) towards an ecological Umwelt, that is, towards an expansion in the way we interpret the agro-ecosystem. Thus, through daily experiences – collaterality (PEIRCE, 1998, p. 409) – and immersed in this environment of sign exchanges, the farmer becomes able to dialogue with the culture of that developing agro-ecosystem, understanding its dimensions of information (VIEIRA, *ibid.*, p. 58) and interpreting them in accordance with the multiple needs of the ecosystem.

This semiotic movement is based on a decentralisation of communication as coming exclusively from *homo sapiens*, and opens up space for an understanding that ecosystems produce languages, signs, beauty, information, meanings, exchanges, mediations, interpretations, habits, behaviours, stories, knowledge, in short, culture. In fact, this semiotic process is reflected in so-called *popular knowledge*, where these manifestations are translated into various forms, whether through a playful artistic approach, a variety of narratives – storytelling – and/or a cosmology or worldviews (VIEIRA, 2008, pp. 54-58).

Every human action implies the action of signs or *semiosis*. Not only do we interpret our surroundings, but we mould them in our image and likeness. Therefore, we act in accordance with what we believe. Our intention permeates everything around us (PEIRCE, 1998, p.139), which means that our culture is not only what we inherited when we arrived here, but also what we propagate to future generations. While the Dynamic Interpretant is a finite event, the Final Interpretant is associated with a tendency and direction of the sign in generating interpretations. In other words, it serves as an *in abstracto* guiding principle for a continuous journey towards renewals of these interpretations realised over time (SANTAELLA, *ibid.,* pp. 75-76). In fact, the Final Interpretant is no longer associated with an individual, but with the collective, because the interpretant has a social nature (SANTAELLA, 2000, p. 76), i.e. it depends on its evolution in people's minds and in the generations that follow.

Thus, in its relationship with the idealised purpose of the sign, this triad, internal to the dynamic interpretant, will dialogue directly with the limiting possibility of projection and intentionality associated with the final interpretant. Thus, Peirce proposes three patterns (values or ideals) that guide the movement of sign transformation or self-correction of interpretations: the conjectural, the propositional and the argumentative.

Therefore, the final interpretants deal with the formatting and expansion of the so-called *ancestral knowledge* that guides an enormous diversity of knowledge that jointly channels the aesthetics, ethics and logic that permeates the agriculture of various crops – semiotic and ecological – integrated into these in different biomes.

The final interpretant, whose impetus promotes and praises the qualities of the sign, what it has that is unique, singular, different and admirable, is associated with the production of qualities of feeling (SANTAELLA, *ibid.*, p. 85), which Peirce called rematic or conjectural, precisely because this interpretant acts mainly at the level of suggestion (PEIRCE, *ibid.*, p. 192). This interplay between a dynamic interpretant – the semiotic place of the interpreter – and a final interpretant at the level of the conjectural has its semiotic effect geared towards playful exercise, i.e. the experience that allows the mind to visualise possibilities for associations of ideas through the free play of similarities.

Primarily aesthetic, this conjectural interpretant is responsible for the dances, music, popular arts, handicrafts and also gastronomy of the forest and countryside. In it, the ecosystem fosters the playful game of immaterial suggestions that manifest themselves in countless ways through the popular imagination and its diverse artistic manifestations.

Next, the propositional final interpretant is primarily concerned with events, facts, evidence, conflicts, efforts, actions-reactions and resistance. Therefore, its purpose is ethical-practical (SANTAELLA, *ibid.*, p. 85), i.e. to enable the observation of behaviour which, above all, deals with the attitudes and choices of individuals in the face of events.

We are in the field of narratives, of the transmission of teachings through the telling of stories that permeate experiences in the fields, woods and forests. Thus, through stories and their characters we can extract wisdom for dealing with events that permeate the lives of individuals. And because of the change in perspective, from anthropological to ecological, other species become relevant and are examples of ethical teaching through legends and myths. Above all, orality becomes the means of integrating and expanding these stories and circulating them between generations.

The final argumentative interpretant, on the other hand, which guides its course over time through a set of consistent logical interpretants that are put up for evaluation, debate and validation or refutation, has a critical-pragmatic nature as its guiding thread (SANTAELLA, *ibid.*, p. 85). It includes mythologies, religions, rituals and their systematisations, and even science and technology within this critical-pragmatic framework. There is, in fact, a coexistence between scientific-technical and mythological-magical knowledge, because both are nourished by what Morin calls uniduality (MORIN, 2008b, p. 172), i.e. the imaginary-symbolic-mythical is integrated, i.e. it feeds and is fed by empirical-logical-rational life (MORIN, *ibid.*, p. 169).

Beliefs are nourished by various crops that are interconnected and intertwined in cultures. In this process, we cultivate not only our food, but also our cultures, traditions, gastronomy, arts, ideas, ideals, concepts, thoughts, including our prejudices, ignorance and mistakes.

Conclusion

Its triple rootedness – thermodynamic/eco-biological/agro-cultural – becomes the grammaticality of syntropic agriculture, or rather, its regime of meaning. In it, we see the physical-chemical dynamism of out-of-equilibrium systems driving the variability of species in successional cycles, fostering healthier, self-productive and self-organized ecosystems.

However, this process only occurs because there is a paradigm shift, that is, there is a change in the way farmers think about growing food and their semiotic and systemic dialogue. This change occurs along three inseparable axes: through a renewed sensibility (aesthetics), through a new behaviour (ethics) in dealing with the environment and through the formatting of a new knowledge (logic) (PEIRCE, 2000, pp. 197-209) or worldview. These processes are transformed into actions – or interpretants – that will initiate the whole synergy of the multi-process chain, in other words, the historicity of the agro-ecosystem.

This regime of meaning – or grammaticality – does not remain with the farmer, alone. In fact, this semiotic and ecosystemic movement fosters and strengthens the cultures of the countryside, the woods and the forests in a process of perpetuating agroforestry knowledge to subsequent generations, but in a circular-evolving spiral, so that the end of one cycle becomes the beginning of another, in *continuum*, never being the same at each beginning and always transforming them.

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