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LIVING LAB TAPAJÓS: A MODEL OF LANDSCAPE AND URBAN PLANNING UNDER APPROACH OF OPEN AND COMPLEX SYSTEMS THEORY

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ABSTRACT

Designing an environmentally sustainable, economically and socially better productive territory in the Amazon region is possible through the implementation of a Living Lab, as a co-creation method, where users, companies and researchers idealize and perfect over time, a set of technologies capable of mitigating certain urban or rural problems in an interactive and intelligent way. This research aimed to theoretically model a Living Lab for the Tapajós micro region under the Open Systems Theory approach. The Living Lab Modeling methodology was developed in six (6) steps: 1st stage- Identification and characterization of Living Lab environment as an open and complex system; 2nd stage - creation of the structure, that is, the Living Lab subsystems; 3rd stage- Characterization of feedbacks between Living Lab subsystems; Stage 4 - Living Lab socioeconomic metabolism qualification; Stage 5 - Qualification of the Energy-material Efficiency of the Living Lab System; 6th stage - Proposition of the actions for Living Lab Tapajós. The results culminated in a Living Lab composed of 4 subsystems, the environmental, social, economic and technological co-creationwhere the interaction between them generated with a cluster of thirteen technologies (*inputs* to the system) for urban and forest / riverine environments and thirteen products (*outputs* of the system) related to environmental, productive, urban waste, energy and communication issues.

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INTRODUCTION

The Tapajós River basin region, in the Amazon Biome, as one of the Biomes of high biodiversity, inhabited by agro-extractive peoples, rich in culture and history, is still underdeveloped economically, with low Human Development Index and *per capita* income (IBGE 2017). Environmental disturbances with high rates of deforestation are now observed in the Amazon with climatic consequences already felt by local societies. Several studies of simulated climate change when reducing vegetation cover in the Amazon Biome have already been developed (Dickinson and Henderson-Sellers, 1988; Lean and Warrilow, 1989, Nobre et al., 1991; Henderson-Sellers et al., 1993; and Rowtree, 1993; Manzi, 1993, Lean et al., 1996), indicating a temperature increase between 0.6 and 2.0 ° C and a reduction of rainfall of 20 to 30% of the forest value. The environmental problems associated with the social and economic order in the Tapajós region stimulate the creation of new models of development and co-creation of technologies that mitigate such scenarios.

In this context, the necessary dialogue between traditional communities, companies, Science / Technology Institutions and State, which are indispensable actors or subsystems in the composition of development ecosystems and technological innovation, is accentuated as an alternative to the socioeconomic inclusion of Amazonian societies, holders of the biodiversity that surrounds them, thus arising, the possibility of installing Living Labs. Living Lab is a term that came into being in 1995, when MIT professor Willian Mitchell developed an experience that saw users in a smart home. Considering that a Living Lab structures itself from a process of co-creation of technologies by users, companies and researchers together, then the legitimacy of this process (Chesbrough, 2003) is to be expected. Livings Labs then grew up in Europe, creating the Livings Labs European Network (ENoLL), which promotes sustainable strategies where all Livings Labs have the idea of involving users in the process of innovation (co-creation) through experimentation in real life. In Brazil, there is a Living Labs network, such as those of Espírito Santo Digital Citizenship (Vitória, Espírito Santo)

Living Lab INdT - Well Being and Wealth Care LL (Manaus, Amazonas), Amazonas Living Lab (Manaus, Amazonas) and Habitat Living Lab (Vitória, Espírito Santo), which operate in different themes, such as energy efficiency, wellness, social and environmental innovation, among others. The Living Lab (LL) for the Tapajós region, theoretically proposed, is inserted in the theme of social technological innovations created from current problems both in urban and rural environments, which connected in IT platforms with smart meters and games, can indicate solutions and innovative technological adjustments in networks, such Living Lab (LL) will be approached from the Theory Of Open And Complex Systems.

The theory of Open and Complex Systems demonstrated by Illa Prigoginne for dissipative thermodynamic models is widely applied in other areas, such as sociology, natural sciences, agrarian sciences, administration, among others. According to Prigogine (1977), "science for the benefit of societies is only possible if a scientific attitude is deeply rooted in the culture. This certainly implies the better dissemination of scientific information as well as a better understanding of the problems of our time by the scientific community. " This leads us to think that science only has social and economic impact if such scientific results mitigate the problems of future societies, such as the Amazonian ones. In this context, the objective of this paper is to theoretically create a Living Lab model for the Tapajós region capable of mitigating the large socio-economic and environmental problems on a Territory scale from the Open System Theory perspective and may culminate in time as a first model of Smart City for the Tapajós region. Development & Technological Innovation in the Amazon: thinking of technologically developing the Amazon is invariably thinking about biodiversity and extractive populations. To equate, however, technology, biodiversity and extractives populations is a sensitive task, which must be based on the urgent need to improve developmentor Bio-business for those who are in the margin of economic process, that is, to think technology in a social way (Oliveira *et al* 2017 a; Oliveira 2017 b). However, not always thinking about social technologies means that they are inexpensive, since, for example, community-based factories for the processing of fruits, fish or oils, which would have a great social impact if they were in the Amazon, are not of low cost. Associated with this, understanding the space and time in which technological development and technological innovation are developed in the Amazon is fundamental. The movement that technological development tends to make is more horizontal than technological innovation itself.

This is because much of the territory is still underdeveloped, hence the horizontality of the movement. On the other hand, the technological innovation considered "the successful exploration of new ideas" tends to have a more vertical movement, since it is punctual and takes place on a scenario of technological development. Almost always, processes of agro (bio) technological innovation unfold after a process of technological development, although it is possible, innovation from undeveloped scenarios. To understand that technological development is urgent and precedes technological innovation in the Amazon, is to understand the contemporary socioeconomic and technological reality of agro extractives communities in the Amazon biome at the margins of the market, especially bio-businesses. Thus, the co-creation and evolution of ecosystems of development and technological innovation in the Amazon as Open & Complex Systems, have in space and time, the greatest challenges for its sustainability. The objective of this research was to analyze the structure and functioning of the theoretical creation of an ecosystem of technological innovation for the Tapajós region as a Living Lab. Open Innovation Ecosystem for the Tapajós region - The Living Lab proposed here for the Tapajós territory as an open ecosystem, presents the following specific objectives grouped between riparian and urban environments, as follows: A- Riparian environments: 1. Model Social technology to the production of drinking water in riverside environments in the Tapajós region; 2. Model Social technology aimed at the treatment of trash from the boats, local named *bajaras* and ships in the waterways of the Tapajós Basin; 3. Model Technological Package for use of renewable energy (solar or wind) by the boats, *bajaras* and ships; 4. Model Social technology for the treatment of sewage in riparian environments; 5. Model Technological Package, specifically in phitotherapeutics for riverside communities; 6. Model floating buildings (dwellings, medicinal gardens, fish processing factories) for riverine communities living in flooded environments; 7. Model water parks for intensive fish production, with an integrated structure for leisure and education; 8. Model the energy production from gasification of biomass residues such as açaí (*Euterpe oleracea*) stones for riparian communities in remote areas; B- Urban environments; 1. Model the afforestation of *hot spots* with high temperatures in the cities and thus create ambience for urban populations in the Tapajós, thus reducing their risks to the current critical levels of UVA and UVB; 2. Produce energy from urban waste through biomass gasification, enabling sustainable forms of energy use in urban environments and recycling of urban waste; 3.Introduce and diffuse Agrotechnologies for the construction of medicinal gardens.In order to obtain the objectives quoted and modeled in a *Living Lab* for Tapajós region, this research had the purpose of using and applying concepts of the Open and Complex Systems Theory, such as a system's boundary zone, subsystems, feedbacks, energy, material or information exchanges, inputs and outputs of the open system, emergency, suppression, socio-economic metabolism and energy-material efficiency.

MATERIALS AND METHODS

The present theoretical research was demonstrated in the Amazon Biome, Tapajós River Basin, which is located in the central part of the Amazon basin (west-east direction), through extensive aquatic-forest ecosystems, from the high reliefs of the Mato Grosso to the low latitudes and altitudes of the wetlands (floodplains) of Santarém city. Its main rivers are the Tapajós and its tributaries, the rivers Jamanxim, Teles Pires and Juruena. It is the fifth largest hydrographic basin (490,000 square kilometers), responsible for 6% of the discharge of freshwater in the Amazon River (Latrubesse et al., 2005). Its extension is of 650 kilometers considering only the stretch after the union of tributary rivers, almost all navigable (Goulding et al., 2003; Latrubesse et al., 2005; Hales & Petry, 2013). This Tapajós Basin was considered here as the Open and Complex System to be modeled theoretically for a Living Lab. The work was developed in six (6) stages: Stage 1- Identification and characterization of the Living Lab environment in the Tapajós region: in an Open and Complex System it is necessary to identify the limits of the Living Lab with its surroundings, i.e. Living Lab with its surroundings, it is seen, this is an important area for the maintenance of the physical and functional integrity of the system; Stage 2 -

creation of the structure of a Living Lab as an Open and Complex System adapted from Prigogine (1977) for the Tapajós region, from the identification and description of the subsystems: in this stage it was identified what would be the subsystems to compose an Open System (Living Lab), as well as their descriptions; Stage 3 - Characterization of the feedbacks among the subsystems of Living Lab: in this stage the information, energy and matter exchanges (feedbacks) were characterized between the subsystems that composed the Open and Complex System called Living Lab, such feedbacks are indicators of sustainability; Stage 4- Qualification of the proposed Living Lab socioeconomic metabolism: from the characterization of the feedbacks between the subsystems, the profile of the socioeconomic metabolism of Living Lab was delineated, that is, the social and economic issues in the Living Lab were observed as social and economic equity levels; Stage 5 - Energetic-Material Efficiency Qualification of the Living Lab System: in this stage the energy and matter that enter and leave the open and complex system were analyzed in order to observe the trends of evolution of them; Stage 6 - proposition of the actions for *Living Lab*operation in the Tapajós region.

RESULTS

The results about creation of 6 stages described in the methodology for building a Living Lab in the region of Tapajós under of Theory of Open and Complex Systems and focused on the bioeconomy was: 1st stage: in this stage the *boundary zone* between the open and complex system is delimited; 2nd stage- Creation of the *structure* of a Living Lab as an Open and Complex System for the Tapajós region focused on Bioeconomy; 3rd stage Identification of the *Feedbacks* between all subsystems; 4th stage- Qualification of the Living Lab socioeconomic metabolism; 5th Stage – Qualification of Energy-Material Efficiency of the Living Lab System;6th stage: Proposition of actions for LIVING LAB operation in the Tapajós region. After this process we create a Mandala of a *Living Lab* as an Open and Complex System in the Tapajós Basin and for last we create the *inputs and outputs* of *Living Lab Tapajós*.

DISCUSSION

1st stage: in this stage the *boundary zone* between the open and complex system, called Living Lab in the Tapajós region with its external environment was delineated. Thus, the Tapajós Hydrographic Region, which comprises 493,986 ha, is formed by the hydrographic regions of the Xingu River (512,279 ha) to the right, by the Madeira River (551,429 ha) to the left by the Madeira-Tapajós Inter basin (95,596 ha) and the Xingu-Tapajós Inter-basin (45.129ha), Figure 1. Once the area surrounding the Open And Complex System is considered, in this case the Living Lab in the Tapajós, then this zone of intersection with the adjacent basins now has the structural function, in the sense of keeping the structure of the SYSTEM intact, but also of maintain the healthy exchange characteristics (material, energy or information feedback) between the SYSTEM and the environment. Considering that there are 23 municipalities in the Xingú Basin, 49 in the Tapajós and 70 in the Madeira River, and associated with this, an expressive rural population, which uses the rivers as a source of labor, income and transportation, then this context, coinciding with the surrounding area is an area sensitive to nature disturbances: 1. Environmental Disturbances-such as, high pressure by aquatic resources; pollution of water resources; deforestation; erosion of marginal soil to water; threat on the support capacity of these flooded environments, among others; 2. Social Disturbances- conflicts over territories; poor health for riverine populations; absence of sanitation adaptable to rural flood environments; partial education in remote areas; unsustainable housing in the face of constant and severe floods in the Tapajós, Madeira and Xingu Hydrographic Units; 3. Economic Disturbances- low income of the riverside communities; financial dependence of riverine populations on federal government grants; low technological level in the productive processes of the agroextractivism; absence of processingof the majority products of biodiversity. Thus, the positive feedbacks in this boundary zone of the Open and Complex System called Living Lab Tapajós (Figure 2) should promote scenarios of structural and functional

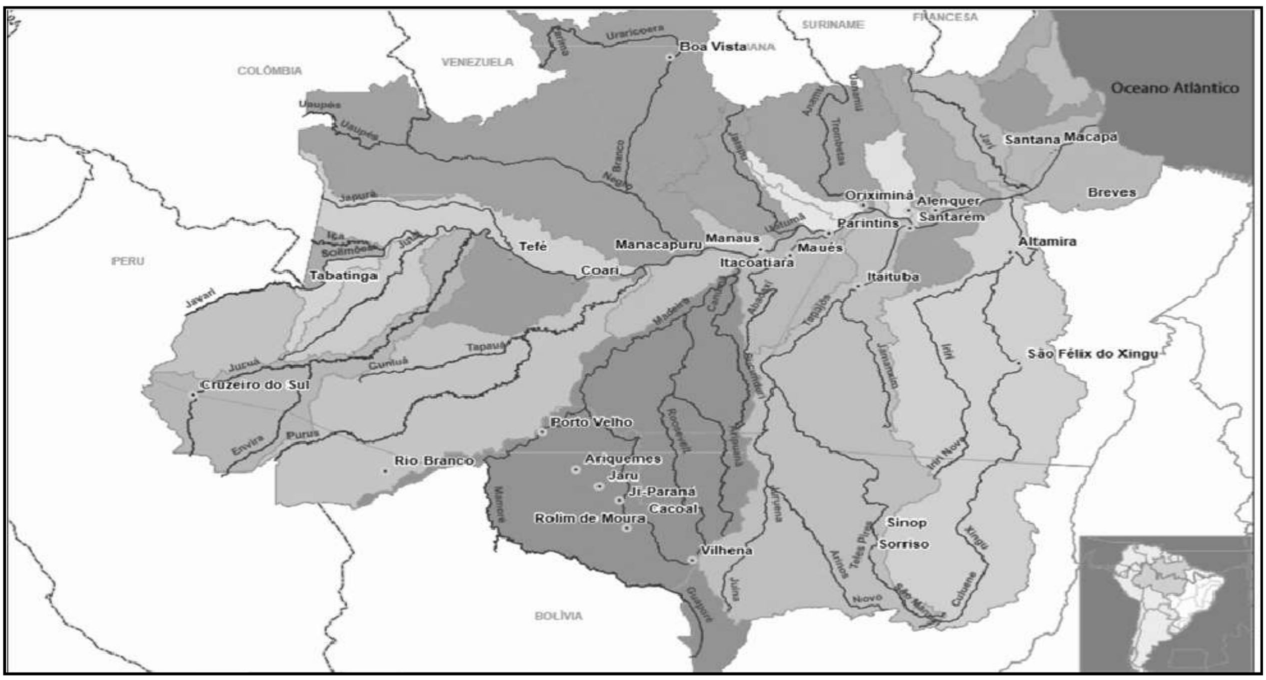

Figure 1. The Amazon Basin with the Hydrographic Unit (UH) of Tapajós River (indicated by the arrow) and its limits to the right by the UH of the Xingu River and to the left by the UH of the Madeira River

stability under the environmental and +socioeconomic aspects mentioned above, otherwise the system may evolve to a context of unsustainability.

• 2nd stage- Creation of the *structure* of a Living Lab as an Open and Complex System for the Tapajós region focused on Bioeconomy: the structure of an open system, whatever, has an increase in its complexity as the number of subsystems increases from this, it is seen, that increases the number of *feedbacks* in the system as a whole. This scenario of high complexity is healthy to sustainability of the system (Living Lab), since the more diverse the system (different *subsystems*), the more strategies it must react to external disturbances. Systems with less complexity by analogy, have less alternatives to react to a given disorder (entropic phases). Thus, in *open systems* of development and co-creation of technological innovations, such as the Living Lab proposed here for the Tapajós region (Figure 2), the same happens. However, the high diversity of *subsystems* observed in the composition of this Living Lab, *per se*, already delineates a profile with many survival strategies to the disturbance conditions, such as deforestation, flooding, problematic land use planning, poor health and sanitation among others. Thus, the proposed model of a Living Lab for the Tapajós region as an environment for co-creation of agro and biotechnological innovations that promote Bioeconomy in the region is basically composed of 4 subsystems, the environmental, the social, the economic and the technological co-creation according to Figure 2.

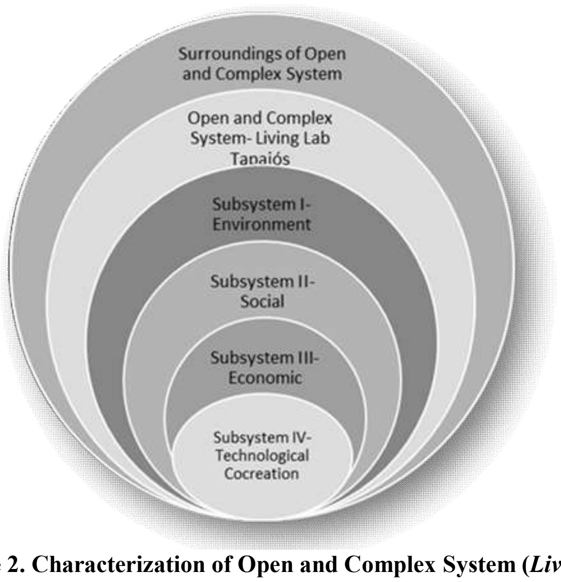

Figure 2. Characterization of Open and Complex System (*Living Lab Tapajós*) with surroundings, four subsystems and respective exchanges of material, energy or information (feedbacks) between them, represented by the arrows

- 3rd stage - *Feedback*: There are interrelationships, that is, feedbacks, between all subsystems, as well as between the system as a whole and its surroundings, adding up to 6 feedbacks at this macro level. As for the feedbacks among the four subsystems of the General System called Living Lab, these can behave as follows: 1. Positive feedback: when exchanges between subsystems are harmonious or sustainable, whether they are exchanges of matter, energy or information between them. Examples of these positive feedbacks between the environmental and social subsystem are the agroextractivism activities practiced by rural populations (SOCIAL SUBSYSTEM), which inhabit both flooded and non-floodable environments and their removal of matter (fish, fruits, wood, oils, game, seeds, agricultural crops) of the ENVIRONMENTAL SUBSYSTEM (rivers, lakes,forests, floodplains). Such a relationship is historically sustainable, since there is no over exploitation in the socioeconomic practice of agroextractivism in the Tapajós Basin and in the Amazon as a whole, and thus the support capacity of the exploited environment is empirically respected by Amazonian forest populations. Another example of positive feedback now between the SOCIAL and ECONOMIC SUBSYSTEM is characterized when the relations of buying and selling products, processes or services between urban / rural populations in the different market niches in the Tapajós develop in a non-exploratory way among those that produce and those who consume, the product of this relationship would be non-poverty, or average Human Development Index (HDI). From the perspective of the Open and Complex Systems Theory this positive feedback scenario characterizes a balance or homeostasis in the interaction of the Social and Economic Subsystems. Unfortunately, this is not the case in the Tapajós region, which further justifies the proposition of a Living Lab that corrects this entropic (chaotic) scenario as will be seen below. Finally, the interaction between the ECONOMIC SUBSYSTEM and the proposed TECHNOLOGICAL COCRIATION SUBSYSTEM, to be positive, must be harmonious regarding the exchange of agro (bio) technological information mainly among the subsystems considered, given that the nature of such information will tend to leverage the economic Subsystem of the SYSTEM (LIVING LAB) as a whole. If the Tapajós region, here seen as an Open and Complex System has in its Agro (bio) technological subsystem, innovative actions that will be absorbed during feedback with the economic subsystem, then the trend is toward sustainability. For example, information on agro-technologies capable of increasing the productivity of certain agricultural crops, or biotechnologies capable of identifying high added-value bioactives are examples of positive feedback among the subsystems mentioned above. In general, if the feedbacks are mostly between the main subsystems (4) are balanced and maintain the homeostasis of these interactions, then the Living Lab Tapajós tends to sustainability in time, or in other words, the urban and rural environment model which arises from the technological co-creation, of a developmental or innovative character on the part of all the actors involved, tends to evolve towards sustainability, according to Figure 3, although there is only a probability of the evolution of the system, but not certainty, according to PRIGOGINE (1997) already described, which would be typical of open and complex systems.

2. Negative feedback: when interactions or feedbacks of matter, energy or information between the different subsystems of the Open and Complex System, called Living Lab Tapajós, are not harmonious and therefore characterized by entropy (chaos), then the system tends to evolve into unsustainability, both structurally and functionally. An example of negative feedback between the surroundings of the system and the Living Lab TAPAJÓS system itself exists when there is a drastic intervention such as the damming of Xingu River (bordering the Tapajós) and the consequent implantation of Belo Monte Hydroelectric, a reality with great environmental and socioeconomic disturbances for people who lived on fishing and agroextractivism in the area flooded by the project, but which could have been implemented in a sustainable way. These disturbances regarding the exchange of

matter and energy between the surroundings and the Tapajós region can alter the ichthyofauna, the ichthyoplankton, can cause genetic erosion of certain species, loss of plant diversity, migration of people among others. Regarding the negative feedbacks between the subsystems that make up the Open System called Living Lab several examples are even real ones.

Between the ENVIRONMENTAL and SOCIAL SUBSYSTEM there can be negative feedback when the exchange of information, energy or matter, for example between them can generate a disturbance (entropic state). A real example of what is currently happening is the federal government plans to construct five hydroelectric units - São Luiz do Tapajós, Jatobá, Cachoeira dos Patos, Jamanxim and Cachoeira Caí - with installed capacity of 10,680 MW in the Tapajós Basin. Considering the local, regional and national energy needs, but also the socio-economic right to the use of biological diversity (forest resources, aquatic resources and animals) by traditional populations, then, it is almost always a difficult scenario to consider both. Thus, *entropy* (environmental-social chaos) in this context is predicted if they do not change the form of intervention. However, studies and reports of environmental impacts, mandatory instruments in the installation processes of hydroelectric units are important inputs (information) in the Open and Complex System, here considered Living Lab in the Tapajós region. Such inputs in the Open and Complex System can change the quality of the system, either positively or negatively. Another case of negative feedback among economic subsystem and the technological co-creation subsystem, when for example the technological innovations to be created with Living Lab do not meet the economic demands of urban and rural populations in the Tapajós Basin. However, what is observed today is that the insipient or absence of agro and biotechnological innovations in the Tapajós region already brings negative feedback among the subsystems considered here. In this context the Living Lab emerges as a strategy or point that emerges from the Open and Complex Systemin order to attenuate the technological gaps in the Tapajós region.

• 4th stage- Qualification of the Living Lab socioeconomic metabolism: in this stage it was observed that from a theoretical point of view the qualification of the socioeconomic metabolism of the LIVING Lab Tapajós occurs in two ways, with social and economic equity or without equity. When there is harmony or balance between the subsystems, then the socio-economic equity, guided by a uniform distribution of technologies aimed at health, education, housing, security, sanitation, agriculture, extractivism and others, and in this case, the metabolism is said to be efficient in the General and Open System. When, however, there are disturbances between subsystems (social, economic, environmental, technological co-creation), then there is no socioeconomic equity and, therefore, deficiency of the metabolism in question. This occurs, for example, when agroextractivists people in the Amazon, extractors of vegetable oils, sell their seeds and oils in natural way, receiving low values, when, due to lack of technology (no factories), they lose economically in this process , characterizing a low metabolism of Open and Complex System. Here, in this stage of socioeconomic qualification of Living Lab metabolism, it is necessary, when in practice, to consider group users rather than isolated users, who will experience the Living Lab.According to Pallot (2009), the groups bring the social-emotional element in the process of living.

- 5th Stage - Energy-Material Efficiency Qualification of the Living Lab System: a system is said to be open because it exchanges matter, energy and information with its surroundings, such an exchange may be adequate or not; the first case is characterized when the *output* of energy or matter of the system must be the same of energy or matter *input* in quantity and quality. In this case there is energy-material efficiency in the system. Otherwise, when there is a gap of matter or energy within the Open System Tapajós; that is, when the *out puts* of matter or energy are greater than the *inputs*, then the metabolism becomes deficient. A real example of this is the deforestation in the Tapajós River Basin, where there is actual biodiversity, carbon and water loss, but the input of the same materials in quantity and quality will take in many years and thus, or the system becomes resilient or degrades in structure and shape. This context characterizes a suppression of qualities of the Open and Complex System.

• 6thstage: Proposition of actions for LIVING LAB operation in the Tapajós region: the actions for a fair and efficient socioeconomic metabolism for forest populations, riverside communitiesand urban societies runs through a set of technologies to the different subsystems (social, economic, environmental, technological) already cited according to Figure 3:

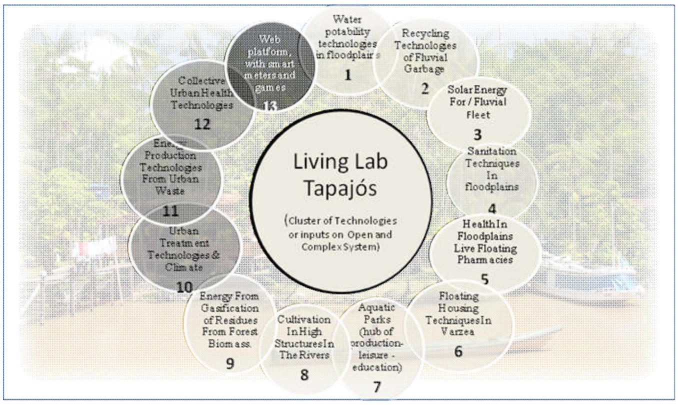

Figure 3. Mandala of a *Living Lab* as an Open and Complex System in the Tapajós Basin - Lower Amazon Territory with a set of thirteen (13) technologies co-created. (dark gray circles = urban environments, light gray circles = forest/riverside environments, black circle =transverse to all others)

Such technologies (*inputs*) in the *System*, are interlaced or connected to each other due to the existing close relationships and, therefore, with *feedbacks* operating between them, making alive the *Open and Complex System*, called Living Lab - Tapajós. Nine of the thirteen proposed technologies are for forest / riparian environments, which alleviate serious economic and environmental problems, or in the language of Open and Complex System theory, such technologies mitigate entropy points in the forest / riparian environment studied in the Tapajós Basin. Associated with the 13 technologies discussed, three other technologies from Living Lab are proposed for urban environments, which tend to reduce the *chaos* of urban trash, climate and health in these niches. The thirteenth proposed technology is the one that computes all the observations, experiences and suggestions of users (rural and urban communities) about the technologies they use in the Living Lab, culminating in the improvement of the Open, Complex and Smart System in a process of co-creation (users, researchers, companies) that will evaluate and interact through web platforms and games that metering the efficiency of the 12 technologies. It should be noted that the proposed ninth technology of energy production from biodiversity residues ends up converging with other biotechnologies from the same residues, which Golembiewski (2015) called a convergence model from Bioeconomy. On the other hand, such *inputs* in the open system called Living Lab Tapajós will generate a set of products which correspond to the *outputs*according to the Figure 4:

Figure 4. List of 13 *Outputs* and 13 Inputs in a Theoretical Model of Living Lab Tapajós

Technologies *(inputs on Living Lab)*	Products from Technologies (*outputs of Living Lab*)
1	1. Sustainable Floodplain's house 1 (Technological kit for water filtration)
2	2. Sustainable boat 1 (Technological kit for processing boat's trash)
3	3. Sustainable boat 2 (Technological kit with sun energy)
4	4. Sustainable Floodplain's house 2 (Technological kit for sanitation in riparian communities' houses)
5	5. Sustainable health service (Floating *Live pharmacies* in floodplains environments)
6	6. Sustainable Dwellings that accompany the water column variation of river between dry and full seasons.
7	7. Water Parks in riverside communities.
8	8. High gardens in lowland ecosystems.
9	9. Energy Factories in remote communities.
10	10.Forest urban *Cluster*.
11	11.Biofuel urban Factory.
12	12. Medicinal Urban Garden
13	13.Database about Living Lab from web interactive platform

The above proposed Living Lab outputs are capable of technologically innovating at the territorial level, and meet the major challenges of the Sustainable Development Objectives (ODS), especially the ODS 6 - Ensure Availability and Sustainable Management of Water and Sanitation for all ; ODS 7- Ensure Reliable, Sustainable and Modern Access to Energy for all; ODS 8- Promote Sustainable, Inclusive and Sustainable Economic Growth; ODS 9- build resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation; ODS 12- Ensure sustainable production and consumption patterns, ODS 15- Protect, Recover and Promote the Sustainable Use of Terrestrial Ecosystems and Sustainable Management of Forests. Thus, the *outputs* will be the points of emergence of new structures and functions in the Open and Complex System called *Living Lab Tapajós*, while the points of constraint will be those that disappeared from the system and, therefore, correspond to the problems solved by the outputs.

Conclusions

The theoretical model proposed here by *Living Lab for The Tapajós*region according to the Open and Complex Systems Theory can be a contribution tool for the development of *Smart Cities* in the Amazon. The proposed model with 13 technologies can guarantee the resolution of the main problems in urban and forest / river niches regarding environmental, energy, productive, communication and climate issues. The input of information and matter in the Living Lab as an Open System proposed, tends throw technologies alter the socioeconomic metabolism and material energy efficiency of the Tapajós Basin. The Living Lab Tapajós outputs tend to shape a new structure and function in the territory, that is, socially more egalitarian and with less environmental impact. The interdisciplinary and intersectoral approach becomes essential in the construction of a highly complex Living Lab such as Tapajós. Finally, it is possible to design intelligent cities in the Amazon region, specifically in the Tapajós River Basin using the Living Lab methodology, which can be replicated in the other micro regions of Pará state.

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