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Organizadores

**SOCIAL LEARNING – DIALOGUES AND A  
PARTICIPATORY TOOLKIT FOR THE WATER,  
ENERGY AND FOOD NEXUS – LEARNING TOGETHER  
TO PROMOTE A BETTER FUTURE**

ResNexus – FSP/IEE – University of São Paulo



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# 1.

## INTRODUCTIONS: WHY A GUIDE?

Social Learning is related to the development of capacities and that implies the possibility of public actors of Civil Society participating in new collective ways of thinking and confronting problems related to the Urban Nexus. We emphasize: the sustainable use of water, reducing degradation, scarcity and unequal distribution articulated with lack of sewage, problems of malnutrition and alternative answers to promote better quality of life.

This Guide provides different tools to promote an improvement in social participation and the enlargement of the repertoire of practices to improve dialogues, engagement and co-responsibility, establish links of trust, manage and solve conflicts and jointly find socially and technically acceptable solutions. There is a special focus on the Participatory Geographic Information Systems (PGIS) approach, due to its high potential to attract and engage citizens on a multilevel scale and produce new local knowledge with new analysis and visualization possibilities. This approach is innovative and adaptable to a variety of fields such as urban sustainability, disasters, ecosystem services, mobility, perceived environmental quality, basic resources access, and so many others. It can also be applied on several scales, from the local to the regional. The important aspect is that such initiatives should be promoted through collective practices, sustained by participatory and cooperative dynamics within the community.

In this context, this guide provides skills to enhance social participation and to expand the repertoire of practices to improve dialogue, engagement and co-responsibility, building trust and aiming to solve conflicts. A special focus is given to the approach of Participatory Geographic Information Systems (PGIS), due to its potential to engage citizens in a multilevel scale and several applications with new possibilities for analysis and data visualization. This approach is innovative and adaptable to a variety of areas inside urban sustainability topic, such as disasters management, ecosystem services, mobility, perceived environmental quality, access to basic resources and so many others. Thus, this guide can be used by any organization interested in applying participatory methods for social and environmental assessments.

## 2.

# SOCIAL LEARNING – HOW TO PROMOTE DEMOCRATIC PRACTICES CONVERGENT WITH NEXUS THINKING – THE SUSTAINABILITY, PARTICIPATION AND SOCIAL LEARNING

### **Nexus thinking - what is the water-energy-food nexus?**

The water-energy-food (WEF) nexus is a new model for action, a key approach (the nexus approach) to address interconnectedness among three of the most important resource components of sustainability namely: water, energy and food. The main premise of the nexus approach is that in our hyper-connected world the three components of the nexus are increasingly interdependent, with impacts in one sector affecting the others. The relationships between water, energy and food can be described as follows: water is needed for the generation of energy; energy is needed for the supply of water; energy is needed to produce food; food can be used to produce energy; water is needed to grow food while food transports (virtual) water, usually through the use of energy (Stringer et al., 2014). Understanding and taking into account those interdependencies is vital for the adoption of decisions to achieve economic, environmental and social goals, connected to urban resilience (Hoff, 2011).

Water, energy and food are essential resources for human well-being and for sustainable development. According to forecasts the demand for fresh water, energy and food will increase significantly in the coming decades due to the pressure exerted by population growth, economic development, international trade, urbanization, cultural changes, technology and climate change (Hoff, 2011). It is expected that by 2050 the global population will reach nine billion

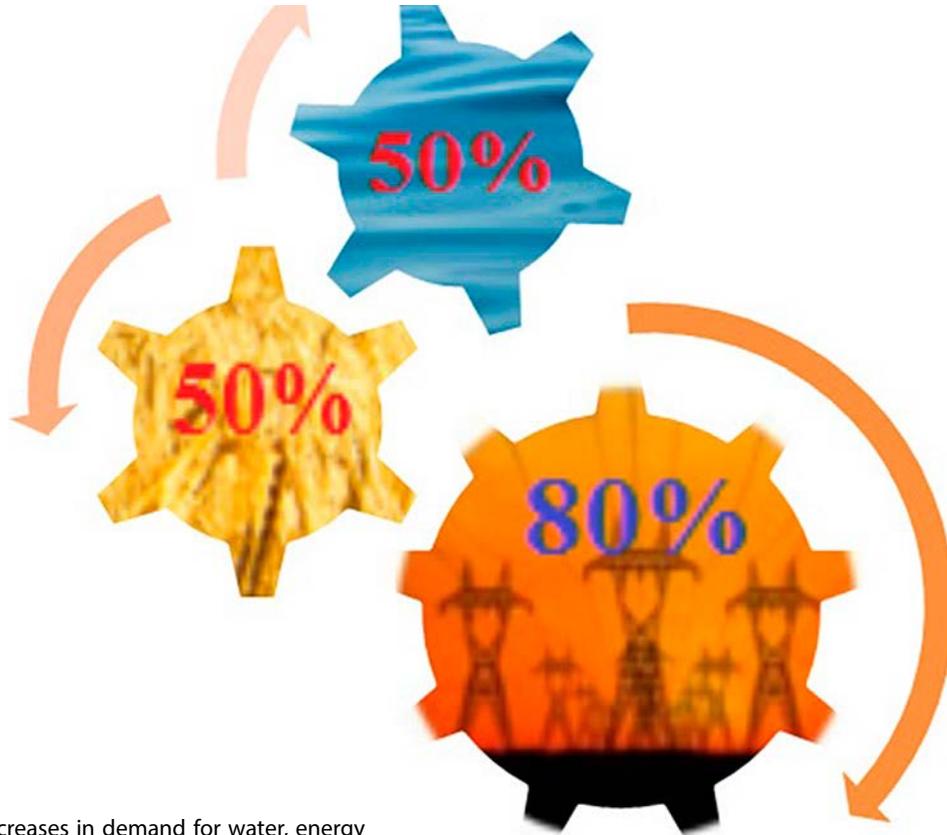


Figure 1. Expected increases in demand for water, energy and food by 2050. (Author: Lira Luz Benites-Lázaro)

and the demand for primary energy will almost double, while that for food production and water are expected to rise by more than 50% (as shown in Fig. 2) (IRENA 2015). The increase in demand leads to increased competition for resources among sectors (Benites-Lazaro et al., 2018).

### **Why search for an integrative governance model?**

Traditionally, water, energy, and food concerns have been separately handled while neglecting their substantive consequences in terms of trade-offs, as for instance, the amount of water needed in all stages of biofuel production. The challenges involved in achieving integrated governance are particularly acute because sectors operate, and policies are executed in areas with differing institutional frameworks on different scales and through various actors (Benites-Lazaro et al., 2018; Weitz et al., 2017). Important decisions within each of those sectors are highly political and take place in arenas of unequal power relations; some sectors are more economically and politically important than others, and each one has different social, economic and environmental goals and interests (Benites-Lazaro et al. 2018).

However, since the 2011 Bonn conference on the water, energy and food security nexus, the nexus research agenda has drawn increasing attention and it is being used to express an 'integrative imaginary' with a belief that integration among various sectors is possible and desirable (Cairns & Krzywoszynska 2016). In keeping with that desirability, 'nexus thinking' emerges as a key concept focusing on integrative governance that takes into consideration interdependencies, tensions and trade-offs across different policy sectors and treats challenges as interconnected rather than separate (Fig.2). Nexus thinking presupposes non-restriction to the institutionalized and traditional spaces of decisions and emphasizes participation incentives among several stakeholders - public, nonprofit, and private alike, that motivate collective action, aiming for a more sustainable urban life.

Figure 2. Water-Energy-Food nexus connections.  
(Author: Lira Luz Benites-Lázaro)



## People's participation and sustainability

The term participation for sustainability summarizes the participatory governance model, which is the complex interaction between multiple actors in pursuit of common long-term goals (Benites-Lazaro et al. 2018). Since the publication of the Brundtland Report in 1987, which popularized the definition of sustainable development, there have been demands for an interactive process for social dialogue and public participation. The 1992 Earth Summit strengthened the participatory governance concept by establishing broad public participation in decision-making as one of the key prerequisites for achieving sustainable development. The Rio+20 Conference outcome document, the “Future We Want”, recognizes that public participation in decision-making and people voicing their concerns are fundamental to achieving sustainable development.

The identification and inclusion of a wide range of stakeholders, and high social participation rates can generate high-quality governance, which, in turn, would promote harmonious development processes for the benefit of the community. Stakeholder dialogue and participation processes bring together different perspectives and enable actors to jointly identify several solutions for different problems and goals (Fig.3) (Benites-Lazaro & Mello-Théry, 2018).

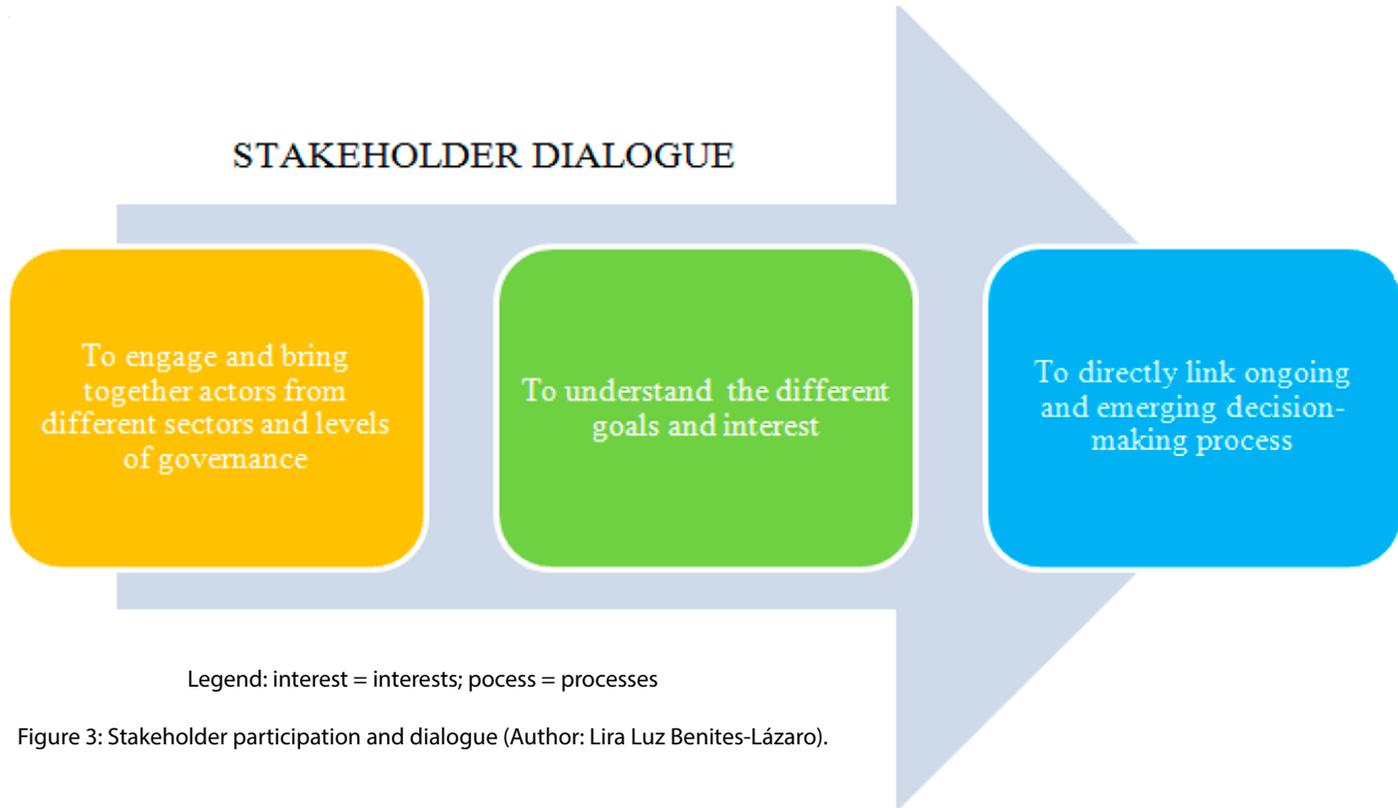


Figure 3: Stakeholder participation and dialogue (Author: Lira Luz Benites-Lázaro).

## How to achieve this new governance model through participation and social learning

Education for Sustainable Development has become a critical component in achieving a sustainable life and protecting our planet and human habitats. According to Unesco (2008) “Education for Sustainable Development implies in including key sustainable development issues into teaching and learning and requires participatory teaching and learning methods that motivate and empower learners to change their behavior and take action for sustainable development”. Therefore, it has its roots in social participation.

As global society is becoming increasingly aware of environmental degradation and the significant risks that have been accumulating, it is visible that a number of scholars, practitioners, environmental activists, policy makers, teachers and others have been addressing problems and developed a multitude of sustainability practices in general and through education at various levels in particular. As the road to sustainability is based on the dissemination and application of social practices, the strengthening of premises of an education for sustainability has been to promote the wholeness and interdependence of life in all its forms (Jacobi, Toledo, Grandisoli, 2016).

The framework of Education for Sustainability is based on various themes in dialogue, representing different domains around a framework that aggregates ethical, cultural, historical, social, economic, ecological, spatial, design, and political aspects of sustainability, emphasizing various lenses.

Social learning embraces a diversity of issues, dialogues, empowerment and, above all, reflexivity in addressing sustainability challenges, particularly in the context of natural resource management. Considering that we are living in an era of uncertainty and multiplication of complex and perverse issues linked to necessary transformations in the use of energy, water and biodiversity and that in the last 50 years many wrongdoings have been part of the prevailing logic of society, there is an unquestionable need to think up alternative paradigms. There is a need for multiplying sustainable practices and, according to Wals (2015), a need to translate the

lessons learned into a re-thinking of actions as a system re-design and to do so within social innovation projects that demand multi-stakeholder interaction and learning perspectives (Jacobi, Toledo, Grandisoli, 2016).

That implies in active involvement within society, as it stresses the importance of social learning as “the collective action and reflection that takes place amongst both individuals and groups when they work to improve the management of the interrelationships between social and ecological systems” (Keen et al., 2005).

The main challenge is to develop anticipatory thinking, inter-personal skills and attitudinal changes associated with cooperation, solidarity and a leading role within a critical approach in a context where complexity and risk must always be considered (Keen et al., 2005). Social Learning can be considered as a component of multi-stakeholder engagement, increasingly seen as a multiplier of changing mindsets.

Social learning is a concept related to the capacity of societies and communities to be more learning-orientated in the way they tackle important problems and in particular sustainable development. There is a need to improve the way societies learn, and that challenges us to think about the role of civil society, the type of education we receive, and the relationship between science, innovation in applied technology and society (Jacobi 2012).

A social learning process takes place in a natural/ technical and a social (institutional, cultural) context with social involvement (interaction). The concept enabling social learning is that of relational practices: shared task-centered practices among different actors that enable interacting in a reciprocal way and/or reflecting on the interactions among the actors. Collective action and the challenge to confront and contribute to the resolution of environmental problems require that people recognize their interdependence and their differences, and learn to deal with them constructively.

The concept of social (or collaborative) learning refers to learning processes among a group of people who seek to improve a common situation and take action collectively. It emphasizes the better understanding of different points of view, and the processes for collective action and reflection over time. In that way, social

learning focuses on demonstrating a change or understanding that goes beyond individuals or small groups to become situated within wider social units or communities of practice. For social learning to occur, the ideas and attitudes learned by members of the small group must diffuse to members of the wider social units or communities of practice to which they belong (Jacobi, Toledo and Grandisoli, 2016). Participatory tools aim at proposing ideas and stimulating solidarity and proactive behavior. It is important that the challenges be worked out on the level of ideas, but also that the ideas be transformed into concrete actions.

### 3.

## PARTICIPATORY TOOLKIT – REPERTOIRE OF TOOLS

The preceding chapter presented a general view of nexus thinking, and what this approach can do to improve the governance model for a new level of urban sustainability through the social learning perspective. In this chapter we will present several tools to be used in participatory dynamics with stakeholders to help to build that new knowledge.

A perspective of combining different participatory tools aims at achieving a process with feedbacks, thereby enhancing the social learning processes, trust, and empowerment of citizens, searching for a more inclusive governance structures and providing reflection and the creation of alternatives in a context of nexus thinking. Therefore, participatory tools can include:

**Photovoice:** a method whereby people can identify and represent their community through photographs and discussion. As a practice based on the production of knowledge, photovoice has three main goals: (i) to enable people to record and reflect on their community's strengths and concerns, (ii) to promote critical dialogue and knowledge about important issues through large and small group discussion of photographs, and (iii) to reach policymakers.

## How to do it:

- ✓ Set goals and define topic;
- ✓ Prepare resources - such as cameras, cardboard, colored pens;
- ✓ Take photos in a chosen area in the community;
- ✓ Promote discussion sessions based on the photos and related experiences;
- ✓ Present photos and results;

**Focus group:** The focus group is widely used to explore people’s views and opinions on different subjects. It is useful for gathering information that broadens perceptions, beliefs, and attitudes about a theme, product, or service. There are different ways of holding a focus group, but the main guideline should be for the participants to be open to new opinions and points of view and even to strategies to achieve a goal. Speaking and listening are fundamental to achieving good results. After it is over, outcomes can be discussed and presented to all groups.

### **How to do it:**

- ✓ Organize a brief script;
- ✓ Organize needed material: cardboard and colored pens;
- ✓ Select participants and organize groups;
- ✓ Choose one or more moderator to be responsible for launching questions for the group;
- ✓ Record the dialogue – in writing and/or audio.



Figure 4: Focus group developed in Novo Recreio, Guarulhos, Brazil. (Author: Resnexus Team)

**River of Life:** The construction of a river of life makes it possible to retrieve the oral history of a neighborhood or region, among others, through the memories of the people of a community. The River of Life can facilitate the understanding of spatial, temporal and organizational patterns of the community in the face of events.

**How to do it:**

- ✓ Explain the methods to the participants and gather material, such as cardboard and colored pens;
- ✓ Ask participants to use the supplies and their drawing skills during the exercise;
- ✓ Allow 15 minutes for participants to create their pictures/the group-picture;
- ✓ If you have a larger group, you might want to consider dividing it into smaller units so that everyone has a chance to share.



Figure 5: River of Life application in Novo Recreio, Guarulhos, Brazil. (Author: Resnexus Team)

**World Café:** is a participatory process that has a phenomenal ability to handle the diversity and complexity in the group. It is a process of group dialogue that can take from a few hours to a few days, in which participants are divided into several tables, and talk about a central question. The intense interaction among the participants and the complex and non-linear relationships can bring impressive systemic and emerging results.



Figure 6: World Café activity in the Resnexus project meeting, at the School of Public Health, University of São Paulo, Brazil. ([www.resnexus.org](http://www.resnexus.org)). (Author: Resnexus Team)

### How to do it:

- ✓ Form groups of about 4-6 participants furnished with cardboard and pens;
- ✓ All tables must have a 'table host';
- ✓ The 'table host' welcomes new participants and informs them about the results of the previous discussion at the table;
- ✓ Each table has a different set of questions;
- ✓ After 15-20 minutes participants move to another table to discuss other topics.

**Sketch Maps;** a graphic representation of reality from the reading of the participants. It combines popular knowledge and technical information. From the map, important points are identified for collective action. The activity enables the definition of priority sites for the intervention, as well as the most urgent actions, facilitating the elaboration of a schedule of actions and responsibilities.

### How to do it:

- ✓ Divide participants in groups from 4-6;
- ✓ Material; cardboard and colored pens;
- ✓ Propose a topic to be represented by participants on the cardboard;
- ✓ Discuss results among the groups;



Figure 7: Sketch map developed by the urban garden group, in Nazira Abboud municipal school, Novo Recreio, Guarulhos, Brazil. They are planning how the urban garden will be. (Author: Simone Ley Omori Honda)

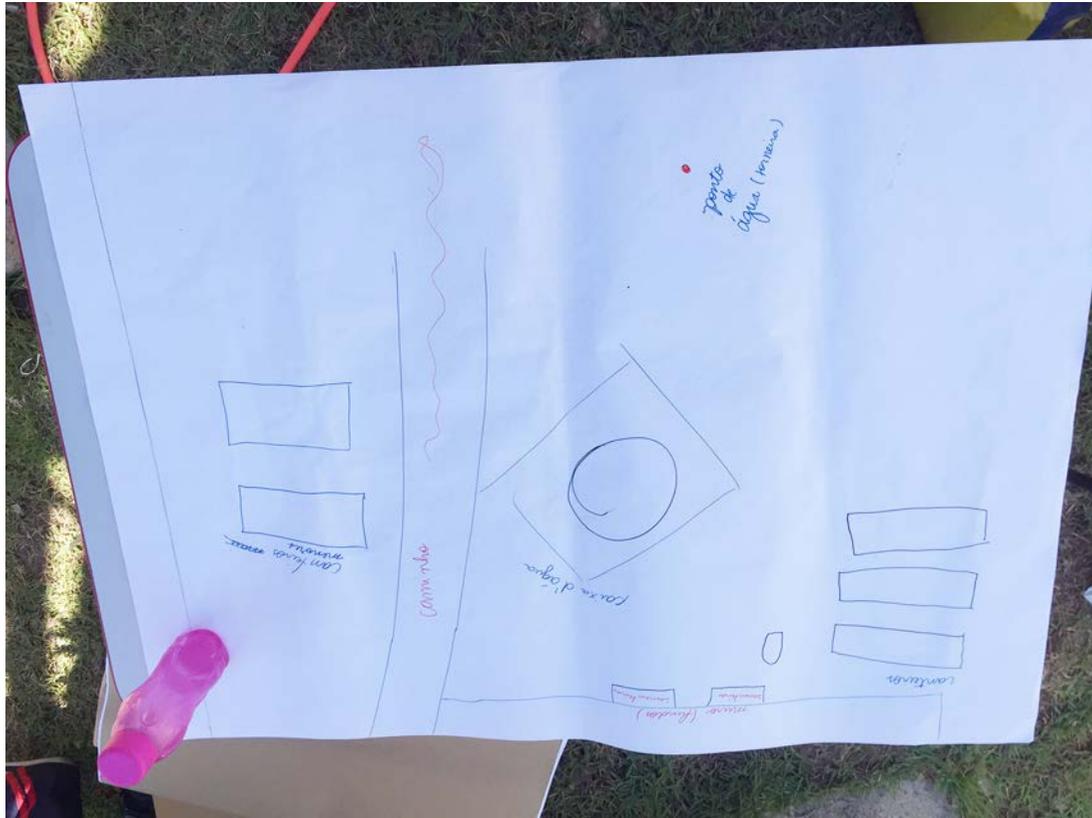


Figure 8: Final sketch map showing the final plan. (Author: Simone Ley Omori Honda)

Combining participatory tools helps to break down and reframe the silos separating the water, food and energy elements of the nexus — and at the same time can be used to map and reframe social practices and the relations among social practices. Furthermore, the participatory tools support the PGIS building process and enrich the information gathering and analysis.

## 4.

# USE OF TECHNOLOGICAL DEVICES, SOFTWARE AND INTERNET RESOURCES: PARTICIPATORY GEOGRAPHIC INFORMATION SYSTEM (PGIS): APPLICATION IN VULNERABLE COMMUNITIES AND URBAN PLANNING

Geographic Information Systems (GIS) are computer systems for the management of spatial and georeferenced data, with the main purpose of providing support for decision making through bidimensional and tridimensional maps production. The focus of this guide is environment and urban planning-orientated, addressing nexus thinking through the use of Participatory GIS, which is a combination of traditional GIS with local knowledge provided by the Community and through the participatory approaches detailed in the Chapter 3 of this Guide.

To apply PGIS in an urban context, a few main steps are needed. According to McCall (2003), the most important issue is social participation and not only the map production. This guide describes the PGIS application case in Novo Recreio, a vulnerable community of Guarulhos city, in the São Paulo Metropolitan Region, Brazil. To achieve that, we followed these main steps that can be reproduced in any other community or neighborhood.

### *Novo Recreio background*

Guarulhos, an intensely urbanized and industrialized city, with about 1.3 million inhabitants, suffers from several social and environmental impacts. The city is bordered by the Cantareira State Park, a natural reserve and environmental preservation area that has an important storage of water resources. Urban development has

dramatically degraded forest resources, leaving only about 30% of native vegetation remaining (GRAÇA et al., 2007). According to official data (National Water Agency - ANA), the whole municipality has low water security.

Novo Recreio is located in a region of mountains, prone to erosion and landslides, characterizing an area of environmental and social risk. It is home to approximately 4,500 families. Most of residents are not aware of the risk situation in which they live (UZAN, 2008). In order to map the main current socioenvironmental problems of Novo Recreio related to the WEF nexus, PGIS methodology was applied, through an extension course offered to 14-17 year old students, between April and June 2017, hosted by a local NGO (*Clube de Mães*). The course's main steps are described in the next pages

## A) Introduction to the mapping process

### *Required material*

- Base map (satellite image, google earth image, etc)
- Colored pens
- Transparent sheet of paper

Here, an introduction to the basics of the mapping process is developed with the participants. With a local base map, the first activity is to observe the surroundings of the neighborhood, and draw in the main rivers and roads, as well as other familiar features, such their homes and relatives' homes, for example. With that done, they start to develop spatial and environmental awareness.

The base map is the 'basis' for all the project developments. This can be a topographic map, a satellite image or any kind of map that can represent the studied place where you can at least distinguish streets and blocks. This is our base map:



Figure 9: Base map used in Novo Recreio, Guarulhos, provided by the local Primary Health Care Unit (Unidade Básica de Saúde - UBS). (Author: Carolina Carvalho).





These previous activities give participants a first glimpse about their real environmental conditions and the problems that should be studied and discussed more in depth in the next mapping phase.

## B) Participatory Mapping

### *Required material*

- Base map
- Transparent sheet of paper
- Colored pens
- Geoprocessing Software (e.g. QuantumGIS, ArcGIS, etc.)

Based on the preliminary socioenvironmental diagnosis provided in the first step, with SM and base map practice, and related outcomes, the participatory mapping process can start. It contributes to developing the diagnosis of local reality, as well as a reflection on the residents' quality of life, georeferenced.

Here some examples of indicators and variables that can be mapped at this stage:

- water courses,
- green and public areas,
- housing areas,
- landfills and inadequate waste disposal spots,
- hazardous areas,
- paved streets and roads,

- health services,
  - leisure areas,
  - water supply and sewage networks,
  - commercial buildings,
  - schools
- ...and any other desired features....

To start the mapping process, a base map of the community should be used, and over it, a transparent sheet of paper must be placed. Participants should be orientated to mark over this transparent paper, spots related to the proposed features to be mapped (the above-mentioned features, for example).

This can be done in groups, and the formed groups can discuss where to place a mark and why. This is an important part of the social learning process and awareness raising. The manual participatory mapping can be called Analogic PGIS (Santos, 2011). In our case, the following topics related to the urban nexus were mapped: water and energy scarcity places, access to food, inadequate waste disposal spots, paved streets and flooding/landslide areas. Finally, with all map layers produced, it was possible to develop the PGIS data base. Maps were posteriorly integrated and digitalized in geoprocessing software and compiled to one map. The following picture shows the geoprocessing software screen with all layers mapped.



When access to internet is possible, other online tools can be used, such as Maptionnaire ([www.maptionnaire.com](http://www.maptionnaire.com)), a PGIS online survey where citizens can answer questions regarding their environment, or Open Street Map (OSM). Several European cities use Maptionnaire for urban planning. It is a tool developed by a group of researchers from Aalto University, Finland; a questionnaire associated with a map, where the participant can make comments of their perceptions and opinions regarding several elements of the city onto the map, answering the questions elaborated by urban planners.

In the case of Novo Recreio, Maptionnaire could be used and it was applied to plan the future of the community. It is an online platform that allows participants to respond to a survey, and the responses are located in a map. For this case, a survey was developed with 10 questions. There were 16 participants and 144 responses marked on the map. The questions were as follows:

*Where could a new school be built? (There is no high school in the community).*

*Where could a cinema or theater be built? A sports club and court? (Students complain about lack of leisure options).*

*Where could a recycling cooperative be implemented? (Recycling is the main income source of several families).*

*Where is it appropriate to set up a shelter in case of heavy rain and landslides? (The area is prone to landslides and floods in the rainy season, therefore it is important to have a place where the local people can go in case of disaster occurrence)*

*Where would you like to have a street market? (There is no street market currently in Novo Recreio, and residents need to walk long distances to buy fresh food)*

*Where should a new Primary Health Care Unit be implanted? (A new Unit is needed because the current is not big enough to handle the Novo Recreio population)*

*What do you think should be done to make these changes real? This was an open question, aiming to ask what the students think the next step to implement changes should be and the answers were:*

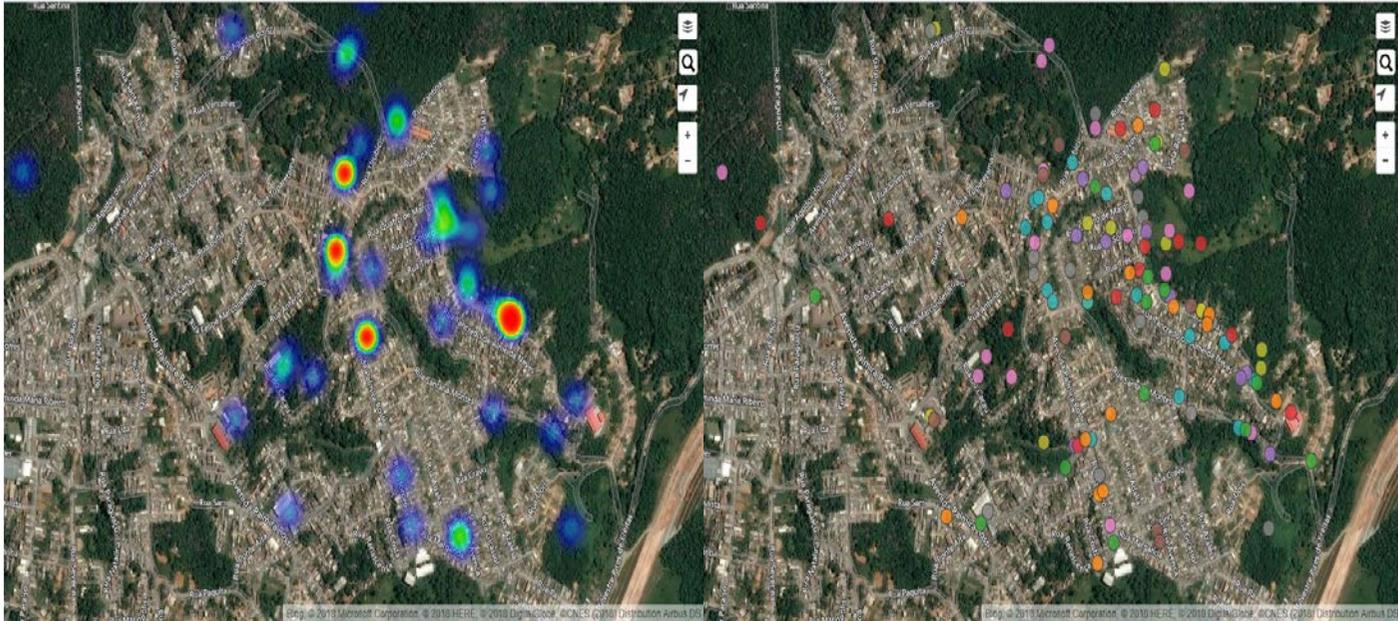


Figure 14: a) Total of marks made with Maptionnaire survey. b) Marks with street Market places suggestions. The red spots correspond to the higher number of marks made by the young students (Author: Carolina Carvalho).

The mapping process is an important instrument for social participation since it provides a collection of information and knowledge of the local reality and therefore expresses the demands and perceptions, as well as subsidizing the elaboration of new proposals for the solution of problems diagnosed and also the planning of actions to improve the quality of life and access to resources (Santos, 2011).

Finally, based on these dynamics, a closure of the process could be made.

### **C) Development of new proposals and strategies to change local urban life**

#### *Material required*

- Cardboard
- Colored pens and pencils
- Sheet of paper

In this final step, the mapping process and outcomes can be discussed with participants in order to build proposals and suggest actions to achieve the new demands and needs. Other participatory approaches can be applied to promote reflection about the mapped features, such as:

*Community journal*

*Integrated panel*

*Focus group*

In the Novo Recreio case, the Community Journal was chosen as a first activity for communication purposes. Five community journals were produced (Figure 15), and several suggestions and problems were discussed in them.

The main goal was to develop an editorial project to be used to communicate with the community about the findings of the PGIS process and also to raise awareness about them. One of the suggestions was to set up a website for people to find places that sell fresh food. The students also included in the paper some mentions of climate change and the Greenhouse Gas effect (GHG). Natural disasters in Novo Recreio (mainly landslides and flooding) were also discussed. Water scarcity was a highlight, while issues about waste of water were also discussed, pointing to an inadequate use by some residents. Energy was discussed in depth in one journal, including options of clean and renewable energy, also for the neighborhood. The possibility of installing solar panels was suggested, discouraged however by the high cost.

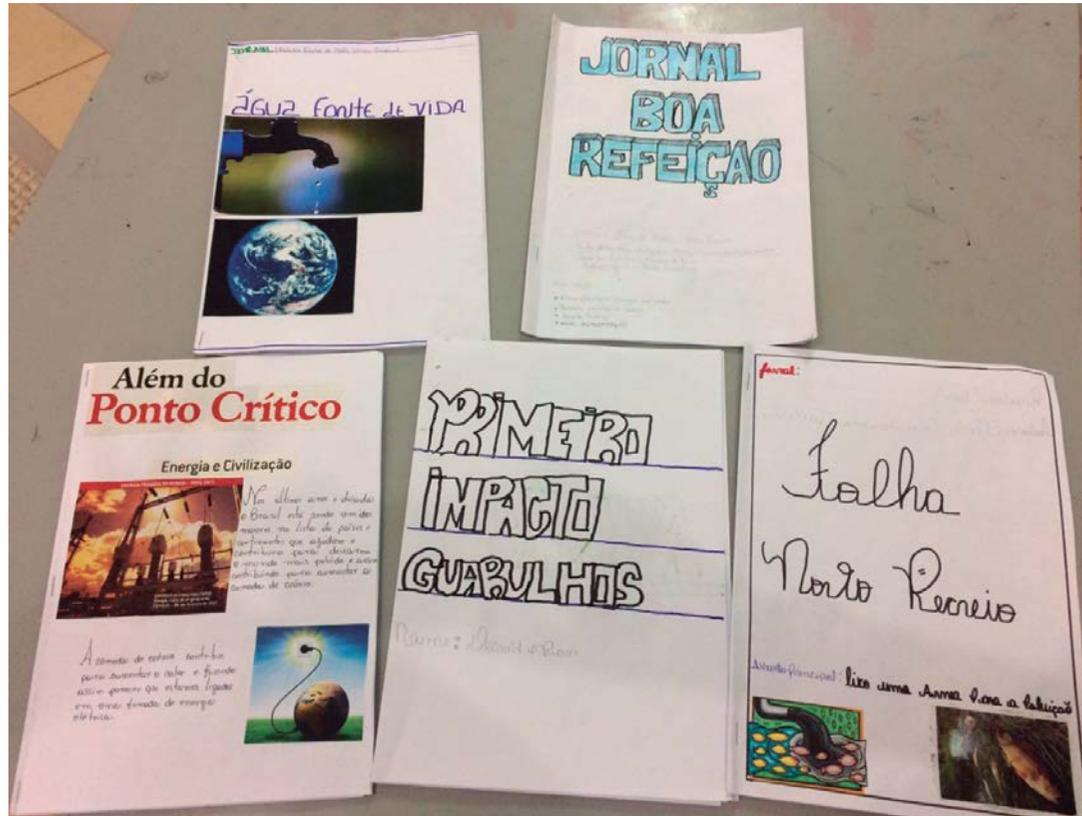


Figure 15: Produced Community Journals (Author: Carolina Carvalho).

Afterwards, the Integrated Panel was also developed. With this, the goal was to suggest more possible solutions to address the previously identified problems. Participants were again divided in groups and had to answer the following questions. Any kind of questions can be applied in this activity.

**Table 1: Integrated Panel with questions and answers.**

<b>Questions</b>	<b>Answers</b>
How could food habits and availability in your community be improved?	<ul style="list-style-type: none"> <li>• street markets closer by selling</li> <li>• vegetables without pesticides.</li> <li>• urban gardens kept by local residents.</li> <li>• Lower prices (food suggestions whose prices should drop down are: chocolate, beans, coca-cola, rice and banana).</li> </ul>
What are the main difficulties you face with lack of water and electricity? How do you solve them? Examples?	<p>Main difficulties:</p> <ul style="list-style-type: none"> <li>• We can't bathe, wash clothes or dishes.</li> <li>• Not possible to do professional activities, even reading and writing, or use computers.</li> </ul> <p>Solutions:</p> <ul style="list-style-type: none"> <li>• Ask for water from neighbors.</li> <li>• Save water for these days, and</li> <li>• Buy gallon jars of water at least to drink.</li> <li>• Purchase solar panels or power generators (but they are expensive)</li> </ul>
How could landslides and floods be avoided? Examples.	<ul style="list-style-type: none"> <li>• Avoiding throwing waste on the street, as it can clog the drains causing the floods.</li> <li>• Trash cans for adequate waste disposal</li> <li>• Avoid deforestation.</li> <li>• Rivers should be cleaned.</li> <li>• Government should not allow the occupancy of risk areas and should relocate the people who are already in such places to appropriate regions.</li> </ul>

*PGIS addressing a new urban governance model and the Sustainable Development Goals (SDG) connection*

PGIS enables the collection of data specifically related to the urban nexus (water, energy, food and their impacts on the environment, as well as other related ones such as health, waste, etc.), providing a more complete urban analysis and showing the exact locations that need intervention. Furthermore, PGIS stimulates social participation by developing maps and other products together with participants. The empowerment provided by the PGIS comes from the social learning that is generated by the dialogue process and from the development of local knowledge. Finally, the possession of information and use made of it and the products generated by the PGIS also imply in empowerment and power of decision over the use of the data. All of those elements boost the aforementioned Social Learning process and bring about concrete changes in governance.

To sum up they are consistent with the main contributions of the PGIS to other studies related to the urban nexus: integration of marginalized groups and minorities through the promotion of equity in access to information and the production of a new knowledge; creating more information to support improvements in urban governance; spatialization allowing for new analysis, supporting more data integration. Besides that, PGIS fosters social mobilization, engagement and perception of the environment.

The Sustainable Development Goals - SDG were created by a UN agenda, aiming to address the problem of achieving sustainable development, especially in cities, since urban management and especially vulnerable communities have become one of the most important challenges of the century.



# SUSTAINABLE DEVELOPMENT GOALS



Figure 16: The 17 Sustainable Development Goals (Source: UN website)

PGIS can provide support directly to the following SDG's: 3, 6, 10, 11, 13, and 17; and indirectly to the others, since it is a method that can be used for any sector and almost any type of research such as social, economic, urban and gender research and others.

Specifically, in relation to SDG 3, PGIS supports the mapping, analysis and monitoring of health indicators, including cases of epidemics such as the dengue fever epidemic in Brazil. Likewise, it supports SDG 6 through water and sanitation indicators. PGIS allows mapping and spatializing of indicators, and with that, it is possible to delimit problematic areas.

This mapping and social learning process allows the participating citizen to take charge and assume a greater role. Empowerment contributes to reducing social inequalities, as envisaged in SDG 10. Improvement of environmental and urban planning creates a more sustainable urban reality (SDG 11). Therefore, it is possible to develop proposals for actions and strategies that mitigate the impacts of climate change (SDG 13).

## 5.

# CONCLUSION – THE IMPORTANCE OF COLLECTIVE CO-PRODUCTION AS A METHOD OF DIALOGUE, BASED ON ACTION RESEARCH

In recent years social inclusion practices have been developed involving learning and dialogue, in keeping with the concepts of Social Learning. Social Learning embraces educational and socioenvironmental practices developed by facilitators together with civil society that are intended to contribute to decision-making processes. Social Learning fosters better collective decisions, builds trust among the social actors and constitutes a shared body of knowledge by means of participatory reflection and practices.

Adopting instruments such as participatory approaches and PGIS methodology could bring about changes in the governance models through action-research. It would mean that the society's opinions, knowledge and practices, as well as its demands, would be taken into account in decision-making processes, raising the level of sustainability of urban environments, especially vulnerable communities and peripheries, by considering nexus thinking as the core of the process. For the Novo Recreio case, PGIS proved to be an efficient tool with potential to improve urban planning and governance since it is based on local knowledge provided by the citizens and is therefore a more inclusive methodology.

To that end the practices and concepts would have to be widely applied in society as a whole and not merely applied in isolated situations, as is usually the case. Technical support will be needed to make it feasible to broaden the outreach of practices and change the current panorama.

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## References

- Bonham-Carter, G. F. (1994). *Geographic Information Systems for geoscientists: Modelling with GIS*. 416p. Pergamon, Ottawa. ISBN: 9780080424200.
- BENITES-LAZARO, L. L.; GIATTI, L.; GIAROLLA, A. (2018). Topic modeling method for analyzing social actor discourses on climate change- energy and food security. *Energy Research & Social Science*. <http://doi.org/10.1016/J.ERSS.2018.07.031>
- CAIRNS, R.; KRZYWOSZYNSKA, A. (2016). Anatomy of a buzzword: The emergence of ‘the water-energy-food nexus’ in UK natural resource debates. *Environmental Science and Policy*, 64, 164–170.
- Chelleri, L., Kunath, A., Minucci, G., Olazabal, M., Waters, J. J., & Yumalogava, L. (2012). *Multidisciplinary perspectives on urban resilience*. Workshop Report. 1st edition. BC3, Basque Centre for Climate Change, Bilbao, Spain. ISBN: 978-84-695-6025-9.

FAO - Food and Agriculture Organization of the United Nations. (2014). *Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative*.

HOFF, H. (2011). *Understanding the Nexus*. Background paper for the Bonn2011 Nexus Conference: *Stockholm Environment Institute*, (November), 1–52.

GRAÇA, B.A. Condicionantes geoambientais no processo histórico da ocupação territorial do município de Guarulhos, estado de São Paulo, Brasil. *Revista UnG – Geociências*, 2007, v.6, n.1, 163- 190 pp.

JACOBI P.R. (2012). Governança ambiental, participação social e educação para a sustentabilidade. In: Philippi Junior A, Sampaio CAC, Fernandes V. (eds.). *Gestão da Natureza Pública e Sustentabilidade*. São Paulo: Manole, pp. 343-361

JACOBI, P.R.; TOLEDO, R. F.; GRANDISOLI, E. Education, sustainability and social learning: conceptual challenges and innovative practices. *Brazilian Journal of Science and Technology* 20163:3 <https://doi.org/10.1186/s40552-016-0019-2>.

KEEN M., BROWN V.A., DYBALL R. (2005). *Social Learning in Environmental Management: Towards a Sustainable Future*. London: Earthscan.

McCall, M. K. (2003). Seeking good governance in participatory-GIS: A review of processes and governance dimensions in applying GIS to participatory spatial planning. *Habitat International*, 27, 549–573. doi:10.1016/S0197-3975(03)00005-5.

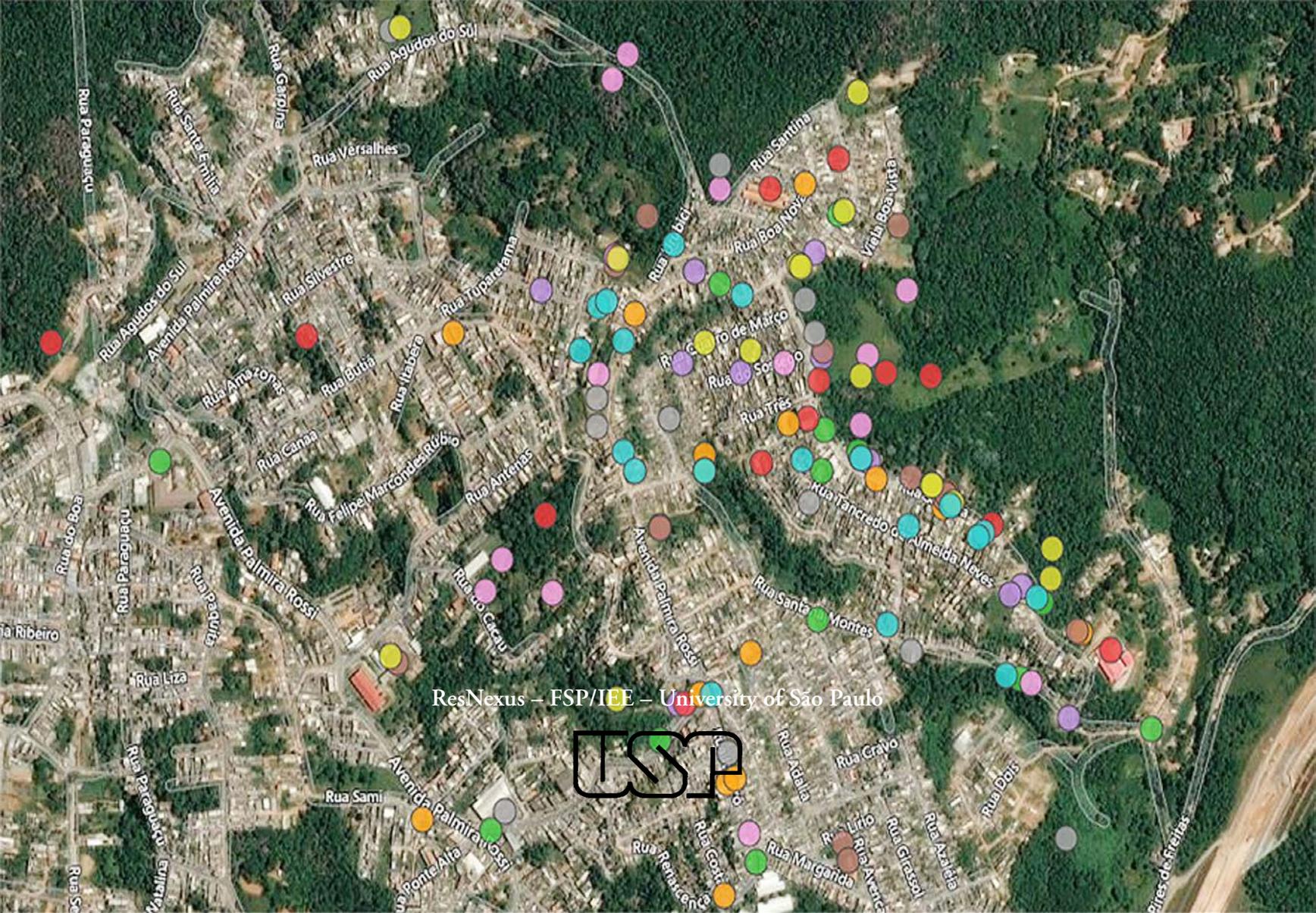
UNESCO. (2008). *EFA-ESD Dialogue: Educating for a sustainable world*. Education for Sustainable Development Policy Dialogue No.1. United Nations Educational, Scientific and Cultural Organization.

STRINGER, L; QUINN, C; BERMAN, R.; LE, H.; MSUYA, F.; ORCHARD, S.; PEZZUTI, J. Combining nexus and resilience thinking in a novel framework to enable more equitable and just outcomes. Centre for Climate Change Economics and Policy Working Paper No. 193, *Sustainability Research Institute Paper No. 73*, October, 2014.

UZAN, E.F. Questao de moradia. Area de riscos naturais no Recreio Sao Jorge e Novo Rdecreio, Guarulhos, SP. Dissertacao de Mestrado. Pontificia Universidade Catolica de Sap Paulo. 2008. 133p.

WALS, A.E.J. (2015). Social Learning-Oriented Capacity-Building for Critical Transitions Towards Sustainability. In: Jucker R, Mathar R (eds.) Schooling for Sustainable Development in Europe, *Schooling for Sustainable Development 6*. doi 10.1007/978-3-319-09549-3\_6.

WEITZ, N.; STRAMBO, C.; KEMP-BENEDICT, E.; NILSSON, M. (2017). Closing the governance gaps in the water-energy-food nexus: Insights from integrative governance. *Global Environmental Change*, 45, 165–173.



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