

Participatory Mapping of the Water-Food-Energy Nexus in the Brazilian Semiarid Region to meet the SDGs

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Abstract:

The concept of the water-food-energy nexus (WFE) was initially configured from the Bonn Conference in 2011, in Germany, under the theme “The water, energy and food security nexus - Solutions for the Green Economy” in which it sought to contribute directly to the United Nations Conference on Sustainable Development (Rio +20), held in 2012, in the city of Rio de Janeiro (Hoff, 2011). The Nexus, according to Karlberg et al. (2015), emphasizes the interconnections between the environment and human development, and the need for integrated and intersectoral coordination, management and governance. Thus, the WFE nexus approach analyzes the interconnections between the uses of these resources in the environment, essential for social well-being, sustainable development and the preservation of biodiversity (Albrecht et al., 2018). However, such studies are incipient and based on mostly top-down quantitative methodologies, with few examples of participatory and local-scale approaches. Water, food and energy problems tend to increase due to the scenario of the COVID-19 pandemic, especially in the most socio-environmentally vulnerable communities. Furthermore, world population growth has direct consequences on the demand for natural resources, meaning that growing numbers of people will continue to depend on and impact on these elements. Thus, studying the nexus directly implies eradicating poverty and reducing social inequalities, in addition to meeting energy security, combating hunger and malnutrition, increasing access to water and sanitation, as set out by the Sustainable Development Goals (SDGs) of the 2030 Agenda of the United Nations (UN).

Therefore, the objective of the research was to analyze the WFE nexus on a local scale, through cartography participatory approaches, having as study area the rural communities present in the Brazilian semi-arid region, in the municipality of Forquilha, located in the State of Ceará (Northeast region) (small municipality with about 20,000 inhabitants, 250 km from the capital, who basically earn their living from family farming, commerce and rural retirement), whose objective was to apply participatory cartography methodologies to show and encourage the cohesive use of natural resources, subsidizing the improvement of the quality of life of the inhabitants, prioritizing the idea of food sovereignty, access to treated water and stable energy source, guiding the preservation of the environment in which they are inserted.

The methodology used in the research uses the bottom-up approach from the SWOT matrix and participatory mapping. The activities were carried out at the Union of Rural Works of Forquilha (Sindicato dos Trabalhadores Rurais) in August, September and October 2018 for the preparation of the SWOT matrix and November 2018 for the elaboration of participatory cartography. In 2019, 2020 and 2021, during the COVID-19 pandemic, specific technical visits were also made to Forquilha to complement the data acquired in 2018, when topics related to the SDG water, energy and food were exhaustively discussed, in different workshops using these topics. Monthly activities were attended by an average of 25 adults from communities in the municipality and the municipal headquarters. In addition, the research had a team of 15 students from multidisciplinary areas and geographer professors from the Federal University of Ceará (UFC) and the Federal Institute of Education, Science and Technology of Ceará (IFCE). The SWOT matrix (Strengths, Weaknesses, Opportunities, Threats) was used as a participatory socio-environmental diagnosis to qualitatively understand the problems and potentialities of the WFE nexus, based on the discussion and problematization of guiding questions, produced considering the SDGs of the 2030 Agenda and the scientific bibliography, which encouraged the public to discuss access, availability, adequacy, stability, investment, acceptability, human development and sustainability. For the construction of the matrices, the focus group was subdivided into groups with about five participants in order to provide better deepening of the discussions, these groups elaborated partial matrices that, then, were aggregated in a final SWOT matrix that integrated and hierarchized the data discussed in smaller groups. The elements inserted in the SWOT matrix

fostered the spatialization of the data obtained in a participatory mapping (Figure 1), using them in the previous construction of the subtitles of the water, food and energy security and insecurity maps. For the participatory mapping workshop, the municipal map of Forquilha, datum SAD69, under UTM projection was used. In addition to this vectorial cartographic base, a satellite image of the municipality of Forquilha was also printed on A0 sheet, at a scale of 1:10,000, acquired through the Google Earth Pro Software, reprojected in SIRGAS 2000 datum, UTM 24S.



Figura 1. Participatory Mapping Workshop for spatialization of the WFE nexus (2019).

Details of spatial data were obtained (with the bottom up method) that would be impossible to capture with national statistics or the application of questionnaires (with the top down method): (a) food security map: 16 legends that portray from homes with incidence of hunger to slaughterhouses clandestine; (b) food insecurity map: 10 legends showing different elements, including hunting and fishing sites and agricultural community associations; (c) water security map: 12 legends that, among other things, identify deep wells with desalination plants and stores that sell mineral water; (d) map of water insecurity: 18 legends that reveal, among other problems, the places where garbage accumulates in rivers and the areas where native vegetation is burned for agriculture and charcoal; (e) map of energy (in)security: 12 legends that add the positive and negative points of electric and thermal energy in the municipality, such as charcoal production sites and homes that have solar panels. Through the participatory mapping of the sectors of the WFE nexus, it was possible to observe interconnections in water-food, energy-food, water-energy and water-food-energy in the community way of life. In the maps of the water sector, places of pollution or poor conservation of river sources, food produced with pesticides, animal husbandry on the edge of the dam and clandestine slaughterhouses, which are directly related to the food sector, were delimited. In addition, the map of the food sector identified fishing in the Forquilha dam, also related to the water sector. Some elements of the energy map are intertwined with the food sector, as the rural communities of Forquilha extract wood from native vegetation to serve as thermal energy, replacing kitchen gas in cooking food, in addition to using plant remains as a method of preparing soil before planting.

It is concluded that the water, food and energy sectors in Forquilha are increasingly interconnected, and it is possible to observe that the impacts in one sector affect the other sectors. The data obtained in the research converge in support tools for effective intervention actions through public policies, environmental education and social technologies, emerging the need to establish alternatives and structures that seek to stimulate the rational use of water, sustainable family agriculture and food sovereignty, and the production of clean energy at low cost, contributing to the eradication of poverty and the reduction of social inequalities, in line with the targets set out in the SDGs. Furthermore, this study deals with the nexus from a systemic approach, interrelating the sectors, in which it assists in the integrated planning of the WFE nexus and decision-making for the strategic use of natural resources that improve the quality of life and guarantee water security, energy and food at the community level in the semi-arid region. It brings innovation by developing a qualitative approach on a community scale, understanding the way of life, practices and issues involving rural communities in the Brazilian semi-arid region.

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