Food, water and energy security in urban areas – case of study in Angra dos Reis, RJ, Brazil

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With increasing urban expansion, especially in developing countries, it is necessary to search for methodologies to show the impact of soil use in food, water and energy security.

These are fundamental elements for the welfare of human populations, poverty reduction and sustainable development (FAO 2014).
This work aims to propose an integrated methodology of nexus food-water-energy and ecosystems evaluation, showing the impact of urban expanding areas in the sustainability, providing subsidies for making decision about the use and occupation of these areas.
Study area—Itinga (Bracuí)

- Ribeira Bay (II Municipal district – Cunhambebe).
- Approximately 18 miles from the center of the city.
- Second major hydrographic basin (Bracuí-Paca Grande basin).
This region encompasses important traditional territories, such as the Guarani Sapukai village and the Quilombo of Santa Rita do Bracuí.
The region has an intense occupation dynamics that involves the appropriation of extensive coastal areas by the real estate capital, invasions, constructions in preservation areas and landfill on mangrove.

The most intense conflicts of land, with deep socio-spatial transformations – deterritorialization.
The Itinga emerged, as the result of a process of invasion and squatter started in the 70's, under a settlement approved in 1954, but only partially implemented.
Currently, Itinga has approximately 10,000 inhabitants, with approximately 2,650 buildings.

The community lacks public services and is still exposed to all kinds of risks.

Conflicts over land intensified in the 1990s, when villagers organized an association and fought for recognition and guarantee of their rights.
A Participatory Environmental Diagnosis was carried out in 2016, which involved bibliographical surveys, interviews, records and field trips.

- 53 interviews were collected from September to October 2016
- It provided an overview of ecosystem services, territorial potentialities and conflicts.

IMPORANT FOR DECISION MAKING
A set of indicators of water, food and energy security, available in official bases, were proposed.

Four dimensions were considered: availability, accessibility, utilization and stability.

The availability is related to a roll of indicators accessible to the study area, present in official bases (municipal or regional data).

Indicators of accessibility and utilization allow evaluation at local level, as they refer to the individual and household scale.
• The local indicators were obtained through interviews, applied during August 2018.

• Some areas, however, were difficult to be covered, due to local urban violence – the importance of residents participation.

• The data were tabulated using the Sphinx iQ2 software.

• The indicators were correlated with some environmental services evidenced by the Participatory Environmental Diagnosis.
The proposed questions were translated into variables - parameters and indicators of the WEF security.

- 12 indicators of Food Security.
- 14 indicators of Water Security.

**Energy security indicators have not been organized yet.**

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Bracuí-Paca Grande basin has 92% of preserved area and high precipitation (orographic rainfalls) (FRANCISCO, 2004; SOARES et al., 2014) - high water availability.

Terrain formed by natural pools, which contribute to hydrodynamism and also serve as refuge sites for insects, amphibians and birds.
• High richness of fauna (107 species) and flora (96 species) – presence of endemic species, such as black-hooded antwren (*Formicivora erythronotos*) – pollinization and dispersion of seeds.

• Problems with exotic species - the black-marmoset (*Callithrix penicillata*), the white-tufted-marmoset (*C. jacchus*), the toco-toucan (*Ramphastus toco*) and the african snail (*Achatina fulica*) – prey native species, also compete with them, destroys native and cultivated plants.

• Presence of crops in the households (70% ) – Food security

• Culture and ancestry – relationship with the ancient africans slaves of the old Santa Rita do Bracuí farm, evidenced by historical references, traditional knowledge and family kinship.

• 60% of villagers are unsatisfied with Itinga natural environment. The main problems identified were sewage pollution and deforestation.
Pequenino ainda, tem muitos na região. Quando maior, mais se confunde com galhos.

Tem razão, esse ainda é pequenino... Uma ninfa (filhote) de bicho-pau... Phibalosoma phyllinum.
The preliminary results of Water and Food assessments shows a low consumption of fruits and vegetables (1F) between the dietary food items – they are only present in 14.3% of the answers.

The consumption of fresh food (3F) shows the majority of respondents consuming only 1 to 2 portions per day (28.6%).

Among the reasons for non-consumption (4F), 75% of respondents indicated economic reasons.

The fresh food is obtained, for the most part, in the local market, although 22.2% of respondents have claimed to obtain it in local production (5F).

76.2% of respondents had ceased to consume some food recently (6F). The main foods affected by ceasing are meats in general (62.5%).

The main reasons for non-consumption of food are related to economic aspects (7F).
• Organic consumption (8F):

- 50.0% claimed to obtain organic food from their own family production;
- 9.1% ignore the concept = conceptual gap – improve methodology;

• Consumption of local food plants (9F):

- Between the species found (10F), taioba (Xanthosoma sagittifolium), is consumed by 40.9% of the residents.
• The main difficulties pointed (12F) were the lack of integration between people and the incidence of pests, mainly *Achatina fulica*.

Urban farming model (11F):

- 45.5%
- 27.3%
- 22.7%
- 4.5%
• 77.3% of respondents show perception of high water availability (1W)

• 50% relate this high availability to the Bracuí waterfall, a symbolic local landmark.

• The water supply Indicator (2W): public service, fountain spring and artesian wells
• Quality of water (3W):

• Organoleptic changes in water (8W): strong smell and taste of chlorine (89.5%) and dark color ("muddy water"), with 42.1%.

Domestic treatment: buy water (31.8%) or drink it from fountain spring, without any treatment (31.8%).
• Sewage (4W): septic tank, public service and rudimentary sump.

• Itinga does not have a public sewage service – some residents do not know exactly how the sewer treatment in their residences is.

• Adequacy of sewage treatment (5W):

• Main problem: overflow of the sewer and the stench when time is rainy or when the tide is full.
• Period exposed to lack of water (6W): 3 days – the maximum period.

• Impact of the lack of the water in the routine (7W): mainly affecting food preparation (40%).

• Use water pumping (12W):
• Reuse and water economy (13W):

- 50% reuse of the water of washing clothes, to wash balconies and sidewalks.
- 42.9% make some type of water economy, without specifying which one.
- 14.3% reported collecting rainwater, in buckets and reservoirs.

• The greatest difficulties for the implementation of alternative solutions for the water supply were financial, technical aspects and need for incentive and government support.
• Interdependences of Food, Water, Energy and Ecosystem

- Considering urban areas (SÁ, 2013 adapted from DE GROOT, 1992).
Conclusions

- Deforestation contributes to fragmentation of the mangrove and wetlands, affecting the hydrological cycle, intensifying flooding.

- Disappearance of native species and the proliferation of harmful species invaders as *Achatina fulica* – destroying crops.

- The absence of adequate sanitation contaminates the groundwater and soil, affecting food and water securities.

- The implementation of urban agriculture, would promote a connection with the agroecological modules of the Quilombo de Santa Rita do Bracuí.

- Even preliminary, the data is promising to show the potential of participatory environmental diagnosis and local perception for the assessment of WEF security.
• Local food plants, in particular the taíoba (*X. sagittifolium*), shows as an important source of food.

• To Identify and cultivate these species would be a relevant measure for food safety in the neighborhood, especially considering the lower income families.

• This paper describes the close relationship between the natural environment and local knowledge, important for conservation.


