



Urban Metabolism in Protected Island Environments: A Multidimensional Analysis

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Abstract:

This study addresses urban metabolism in protected island environments, highlighting socio-territorial dynamics and their environmental interaction. Focusing on minor archipelagos such as the Galapagos Islands, we adopt a multidimensional approach that integrates biological, demographic, socio-economic, socio-cultural, and legislative variables (Acciarri et al., 2021; Gusev, 2021).

The fragility and complexity of these minor archipelagos, such as the Galapagos Islands, reveal a complicated interaction between human settlements and the environment (Yılmaz & Bakış, 2015). Our study emphasizes the importance of understanding these interactions to mitigate adverse environmental impacts and promote sustainability (Ragazzi et al., 2016).

Methodologically, this analysis focuses on five key variables to unravel the socio-territorial dynamics of settlements. These include territorial (biological) characteristics, the origin of settlements (demographic), the use of natural resources (socio-economic), historical memory and built physical space (sociocultural), and special regulations (legislative) (Hiernaux & González, 2014; Bueren et al., 2014). This comprehensive approach allows for an in-depth analysis of how human activities and policy decisions influence the urban metabolism of these environments.

Our research is based on theoretical models of urban metabolism, such as the Wolman City Metabolism and the Newman Extended Metabolic Model. These models are applied in the context of minor archipelagos, demonstrating their relevance and adaptability in protected island environments (Maxwell et al., 2020; Feng et al., 2019).

The study results indicate unique challenges in these environments, such as dependence on exogenous resources and the impact of tourism. These challenges are reflected in the alteration of urban metabolic cycles, highlighting the need for sustainable development strategies and environmental conservation. In addition, positive aspects are observed, such as learning sustainable building techniques and developing unique island cultures, which can serve as models for other similar environments (Watson et al., 2010; Santamarta et al., 2014).

Understanding urban metabolism in protected island environments is vital to designing effective sustainability strategies. This study provides a comprehensive view of how human and environmental interactions can be balanced to protect these unique and vulnerable ecosystems while promoting the well-being of their communities. The research emphasizes the urgency of adopting multidisciplinary approaches to urban planning and environmental management, especially in the Anthropocene era, where human impact on nature is more significant than ever.

Keywords:

Urban Metabolism, Socio-Territorial Dynamic, Protected Island Environments, Sustainability, Anthropocene

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Author Biography:

I am Juana Perlaza Rodríguez, an Urban Systems Modeling and Natural Resource Management specialist. I am passionate about urban sustainability and developing innovative technological solutions for the environment in built environments. As an architect, I have a deep technical knowledge of physical infrastructure and value integrating diverse perspectives to enrich projects. My continuing training in Geocomputing, Machine Learning, 3D Urban Modeling, Data Programming, Statistics, and Probability has equipped me with critical advanced technical skills to address complex challenges in multidisciplinary environments.

Recently, I completed my doctoral studies (Everything but Dissertation) at the University of Basilicata, Italy. My dissertation proposes the creation of a conceptual model technology tool 'ad hoc' (CMTT 'ad hoc') for the sustainable management of urban metabolism in Puerto Ayora, Galápagos. This project, which focuses on residential energy efficiency and the socio-cultural dynamics of small-scale protected island communities, seeks to examine the interrelationships between construction, the use of materials with specific energy properties, and the influence of sociocultural practices on the configuration of urban metabolism. This project stands out for its applicability and reliability; its results are presented through the Galapagos EnerBuilt Monitor board. It provides an interactive and detailed visual interpretation of energy and material flows, demonstrating my ability to generate technological solutions adapted to specific and complex contexts.

In my role as a researcher at the Matera Technology House (CTM), I developed an Integrated Semantic Method to analyze Urban Heat Islands in historical environments, contributing to the development of the digital twin of the city of Matera (2022-2023). This experience, together with my participation in various projects, such as the Sustainable Post-Earthquake Architecture Project in Manabí (2020-2022) and the construction of the Data Warehouse for SIS ECU 911 (2012-2014) in Ecuador, demonstrates my ability to contribute effectively in interdisciplinary teams, a relevant competence in scientific research.

Publications:

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Rapporteur at congresses and chair:

- 2023 Speaker International Congress on Architecture, Urban Planning, Territoriality, and Environment. Topic: Impact of Anthropogenic Incursions on Urban Metabolism: Addressing Flash Floods with 'Water Squares.' PUCE-I. Ibarra/Ecuador
- 2023 Speaker 5TH INTERNATIONAL CONGRESS ON BUILDING MANAGEMENT. Topic: BIM Methodology Based on Complex Systems and Biomaterials Applied to Urban Metabolism and The Decarbonization of Buildings. Case Studies: Jalisco And Querétaro Mexico. UPM Polytechnic University of Madrid/Spain
- Mexico Speaker IX National Innovation Congress: Innovation Towards Sustainable Development and A New Planetary Consciousness 2023. Topic: "Technological Innovation of Materials from Digital Prototyping of Biomaterials in Building in Fragile Environments." University of Guanajuato/Mexico
- 2023 Conference Speaker Workshop: "Decarbonization of Buildings - Passport of Materials." Topic: Decarbonizing Cities Through Intelligent Data Management: Smart Cities, IA, IoT, Remote Sensing", NATIONAL UNIVERSITY OF COLOMBIA, MANIZALES CAMPUS Master's DEGREE IN CONSTRUCTION. Manizales/Colombia
- 2023 Speaker: Building energy efficiency material life cycle and Green certifications. Masterclass Universidad San Gregorio de Portoviejo, Portoviejo Ecuador. Seventh, eighth, and ninth-semester students.
- 2022 (1 week) Seminar Speaker: Urban Metabolism of Habitable Ecosystems. Università Degli Studi Della Basilicata (UNIBAS), Bachelor of Science in Architecture A.Y. 2021/2022; Bachelor of Science Landscape, Environment, and Urban Greening A.Y. 2021/2022; Bachelor of Technology for the Environment and the Territory.
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