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Ph.D. Program in Management,  
Production and Design (XXXIII Cycle)

# **Design and microalgae**

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**A self-produced system to grow  
Spirulina for food use**

## **ABSTRACT**

**Doctoral Dissertation by  
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## Abstract

The global population is exponentially growing, and it is estimated that more people will be living in metropolitan areas in the next decades. Considering the finiteness of agricultural lands, finding alternative sustainable ways to produce food is imperative. Microalgae have many properties – including the capacity of fixing carbon dioxide – and some particular strains like Spirulina are gaining in popularity as a superfood mainly due to their high amount of protein, and high consumer acceptance. This design research studies the integration of microalgal production in urban contexts. The work is an innovative attempt to utilize microalgae as a driving force to foster environmental sustainability and economic profitability. The most recent design and architectural projects that have entailed the use of microalgae are analyzed, and their limits and possibilities are traced. Afterward, two innovative products and the related service-systems are presented. The practice-based work outlines the transversal role of design and emphasizes multidisciplinary approaches from the fields of biology, economics, and sociology. Finally, new potential open-source design applications and guidelines are defined to be used as a basis for future research and projects.

**Keywords:** Microalgae; Future Superfoods; Product-Service System Design; Sustainability; Urban Contexts.

## Contribution to knowledge

Design culture and practice are undergoing radical transformations. Designers are embracing more inclusive and multidisciplinary approaches to respond to binding needs urgently. For instance, new conventions linked to biological sciences are emerging in the world of design and architecture. In recent years various pioneering projects have involved the use of living organisms and biomaterials, including microalgae. The media interest in these projects is high. Although publications about microalgae are numerous and continuously growing in number in many scientific disciplines, studies in the field of design are still quite limited, and the approaches to these projects are highly diverse and uneven. The contributions to the knowledge offered by this doctoral dissertation revolve around the topics of Design for Sustainability, Product-Service System Design, Systemic Design, and Biodesign, by answering two research questions: ‘*How can design researchers contribute to microalgal studies?*’ and ‘*How to design products, services, and systems involving microalgae that are beneficial and sustainable for the society?*’ The questions have been answered through theoretical abstraction and practical work: in-depth multidisciplinary literature review, case study analysis, surveys and workshops, and demonstrative products and services. This study is a relevant academic product useful for designers who want to experiment with microalgae, but not limited. It paves the way for further technical and humanistic researches and raises interest in a new branch of study.