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Chapter 10
Water integration applied to microalgae-based systems

Abstract: Microalgae-based systems have emerged as a promising solution for sustainable production of food, feed, and biofuels. However, water stress and scarcity are major challenges that limit the viability and scalability of microalgae production. To address this challenge, water integration has been proposed as a means to optimize water use efficiency and reduce the environmental impact of microalgae-based systems. This chapter reviews the current state of knowledge on water integration in microalgae-based systems, with a focus on different types of microalgae cultivation systems, process integration for water optimization, and Life Cycle Assessment (LCA) of microalgae-based systems. The chapter concludes with research gaps and future directions in water integration and LCA of microalgae-based systems.

Keywords: microalgae, water stress, water scarcity, process integration, water footprint, sustainability, Life Cycle Assessment, acidification, eutrophication, ecotoxicity

10.1 Introduction

Microalgae-based systems have gained increasing attention in recent years as a promising solution for sustainable production of food, feed, nutraceuticals, and biofuels (Acién Fernández et al., 2021; Chua et al., 2022). Microalgae are photosynthetic microorganisms that can grow rapidly and efficiently using sunlight and carbon dioxide, while producing a range of valuable products such as fine proteins, such as phycocyanin as pigment, fine lipids such as omega-3 highly polyunsaturated fatty acids (EPA, DHA), and carbohydrates (Acién Fernández et al., 2021; Siddiki et al., 2022). However, the intensive water consumption and associated environmental impact of microalgae production pose a significant challenge to the sustainability and scalability of this technology (Acién et al., 2017). To address this challenge, water integration has been proposed as a mean of optimizing water use efficiency and reduce the environmental impact of microalgae-based systems.

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