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## Cost benefit analysis of aquaponic and hydroponic systems in barley production: A sustainable agriculture approach

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### Abstract

The primary objective of this study was to perform a comprehensive cost–benefit analysis of barley production within both aquaponic and hydroponic systems. This research provides a detailed economic evaluation of barley cultivation using aquaponic and hydroponic techniques, with a particular focus on their viability, productivity, and sustainability under controlled conditions. A locally adapted variety of barley was selected to assess production outcomes, operational costs, and overall efficiency associated with each cultivation system. Key performance indicators included tray net weight, dry matter percentage, and crude protein yield, which were systematically measured on the 7<sup>th</sup> and 14<sup>th</sup> days post-seeding to capture early growth and biomass accumulation. The results revealed that by the 14<sup>th</sup> day of cultivation, the aquaponic system produced the highest net tray weight of 11.80 kilograms, compared with 9.58 kilograms for the hydroponic system with nutrient solution and 9.27 kilograms for the hydroponic system without nutritive supplementation. Similarly, the dry matter percentage was higher in the aquaponic system at 17%, while both hydroponic treatments recorded 14%. Total crude protein output per tray further highlighted the advantages of aquaponics, reaching 387.44 grams, whereas hydroponic cultivation with nutrient solution yielded 332.15 grams and hydroponics without nutrient mixture produced 227.18 grams at the 14-day mark. The cost–benefit analysis indicated substantial profits for all systems, with the aquaponic system generating the highest net revenue. These findings emphasise the economic and practical benefits of integrating fish cultivation with plant production, confirming aquaponics as a sustainable and profitable method for barley production. By demonstrating its potential for enhanced yield, protein content, and financial return, this study establishes aquaponics as a promising approach to improving food security and sustainable agricultural practices, particularly in resource-limited settings.

**Keywords:** Aquaponic, Cost benefit analysis, Crude protein, hydroponic