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**Ph. D. Dissertation**

# Assessing the Sustainability of Tropical Crop Production using the Eco-efficiency Index in Sistan and Baluchistan Province

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**Abstract**

The present study evaluates the sustainability of tropical crops' production systems in Sistan and Baluchestan Province located in the southeast of Iran. Hence, the most common tropical crops of the region such as banana, mango, jujube, guava, and sapodilla were considered. LCA was used to indicate the environmental impacts of production systems, while economic-environmental efficiency index, cumulative degree of perfection (CDP), and renewable index (RI) were utilized to assess the sustainability of crop production. In order to model and optimize input usage, artificial neural network and genetic algorithm methods were employed respectively. The study of economic indices showed that the net income for banana, mango, jujube, guava, and sapodilla was 1791.42, 1258.27, 55.62, 560.83, and 467.48 million Rials per hectare, whereas the mean values of cost-to-revenue ratio of these crops were 8.37, 8.70, 1.32, 4.29, and 4.19 respectively. These two indices revealed the higher profitability of banana and the lower profitability of jujube crop. The life cycle assessment showed that the global warming rate was the highest for jujube (545.20 kg CO2 eq) and the lowest for mango (181.99 kg CO2 eq). Sustainability indices revealed that the value of the economic-environmental efficiency index for mango was the highest, with 53.99 thousand tomans per kilogram of CO2 eq, confirming that using inputs in mango production had the highest economic-environmental efficiency regarding the production of tropical crops. Also, CDP and RI values for banana was the highest with 1.21 and 0.68, respectively, approving that the banana had the lowest exergy losses. The optimization results revealed that the optimal use of inputs significantly increases sustainability indices. The increase rate regarding the economic-environmental efficiency index was the highest for mango with 90.58 thousand tomans per kilogram of CO2 eq, and the increase rates regarding the CDP and RI indices were the highest for banana, with 2.72 and 0.89, respectively. The results may contribute to improved planning, protection, and management of influential and practical strategies and measures to improve the sustainability of the region. Based on the results, some policy suggestions are offered for agricultural sustainability, environmental protection, and further research.

***Keywords:*** *optimization, exergy analysis, sustainability, economic-environmental efficiency, tropical crops*