University of Zabol

Graduate School
Faculty of Agriculture
Department of Agronomy
Thesis Submitted in Partial Fulfillment of the Requirement for the degree of Ph.D in Agroecology

Evaluation the sustainability of some agricultural production systems using ecological footprint, emergy analysis and emergy footprint

Supervisor

Dr. Ahmad Ghanbari

Advisors

Dr. Mohammad Reza Asgharipour

Dr. Esmaeel Seyedabadi

By

F. Fartout Enayat

January 2023

Abstract

Agricultural ecosystems are natural systems that have been modified artificially to produce a product with economic value. However, establishing a logical relationship between methods of increasing performance and maintaining ecosystems for production sustainability has been discussed for some time. This resulted in the development of techniques for assessing the sustainability of production systems. Among these methods are the ecological footprint, emergy analysis, and emergy footprint, which in the present study aid in determining the sustainability of grape, wheat, and fish production systems in the Sistan region during 2018-2019. This study determined that the emergy input to the grape production system was 1.92E+16 sej/ha, which is the sum of the environmental and economic inputs to the region's vineyards, of which 64.31 and 35.69 percent, respectively, were estimated. The result of the EYR index (2.80) substantiates the importance of environmental inputs in grape production. By examining the system's interaction with the environment using the environmental load ratio index, it was determined that these systems exerted moderate stress. The total environmental and economic inputs to the region's wheat fields were 5.35E+16 sej/ha, of which 34% were renewable and the remainder were nonrenewable. The proportion of nonrenewable inputs in the production process, which was roughly double that of renewable inputs, caused these systems to have an average environmental impact. The production of fish in concrete ponds in the region required the least amount of emergy support. The emergy yield ratio calculated for all three fish farming systems revealed that production in semi-natural ponds is highly dependent on natural resources, whereas production in concrete ponds is highly dependent on purchased resources. All three production methods have a significant impact on the environment. The results of the emergy footprint indicated that the three systems of grape, wheat, and fish rearing in the semi-natural pond have an ecological surplus due to their high emergy tolerance capacity in comparison to their emergy footprint. The opposite occurred in concrete and steel ponds. This resulted in the production in these ponds exerting pressure on ecological resources, demonstrating the insecurity of these systems and the strain they impose on the regional ecosystems. In all production systems, improper management practices have resulted in the loss of a substantial amount of renewable environmental inputs; therefore, agricultural experts must hold briefings for producers in order to alter the way the systems are managed. Additionally, optimal economic input utilization can reduce economic and ecological costs.

Key Words: Production sustainability, Environmental carrying capacity, Outstanding production systems, Economic and ecological costs