

## **Abstract**

Nehbandan is one of the date producing regions in Iran; however, within the last 20 years, date production has been substituted by pistachio production. To analyze the reasons behind this conversion, the productivity and sustainability of date and pistachio production systems are examined using energy, emergy, economic and water footprint techniques. Emergy analysis uses wider spatial and temporal flows of energy and matter based on the equivalent unit (solar emjoules or sej) by multiplying them in corresponding transformities. The emergy indices computed in this study include; transformities, renewability factor, emergy yield ratio, emergy investment ratio, emergy loading ratio and emergy sustainability ratio. Total emergy supporting the systems was estimated to  $2.26E16$  and  $2.97E16$  sej ha<sup>-1</sup> yr<sup>-1</sup> for the date and pistachio production systems, respectively. The purchased nonrenewable resource accounts for 50.11% and 61.9% of total emergy flow for the date and pistachio production, respectively. This shows that both studied systems are an extremely open system influenced strongly by inputs purchased from economy. The compositions of purchased emergy inputs for both date and pistachio systems are similar to a great extent. Manure and phosphorus fertilizer have the highest contributions to emergy inputs, respectively. Economic analyses indicate that the output/input ratio and the net profit in pistachio production are higher than that of date. In terms of energy, indices such as energy efficiency, energy productivity, energy effectiveness, energy value added (net energy), energy intensity of consumption, energy intensity of production, energy intensity of streaming were calculated for both pistachio and date production systems. Energy efficiency were 1.738 and 0.235, energy productivity were 0/12 and 0/025 kg/MJ, energy effectiveness were 8/33 and 40 MJ/kg, net energy were 27494 and -31840 MJ/ha, energy intensity of consumption were 1/269 and 4.16 MJ/m<sup>2</sup>, energy intensity of production were 4.018 and 0.976 MJ/m<sup>2</sup> for date and pistachio production system, respectively. Net incomes for pistachio and dates production systems were 3338403 and 15972 Thosand Rials per hectare, respectively. The profit to cost ratio for pistachio and date production systems were 12.43 and 1.614, respectively. The productivity index for pistachio and date systems was 0.049 and 0.040, respectively. As a general outcome, the higher economic income from pistachio production is the reason for orienting from date production systems to pistachio production. However, energy and emergy assessments indicate that date production is more sustainable in the long term. The emergy, energy and economic techniques are different but complement each other; each considering a specific aspect of one system. A combined use of these techniques not only shows the reasons behind the current status of systems but also provides methods to adjust them towards a more sustainable status.

**Keywords:** Environmental sustainability, System analysis, Soil loss, Organic fertilizer, Natural resources



University of Zabol  
Graduate School  
University Campus  
Department of Agronomy  
**Thesis Submitted in partial Fulfillment of the Requirement  
for the Philosophy degree (PHD) in Agroecology**

Title

**Analysis of pistachio and date agroecosystems of Nehbandan using  
integrated evaluation of energy, economy, emergy and water footprint**

Supervisors

**Dr. M.R. Asghari poor  
Dr. M. Ramroodi**

Advisors

**Dr. M. Galavi  
Dr. GH.R. Haderbadi**

By

**Mehdi Jafari**

**January 2019**