

## Extended exergy, energy and economic approach as integrated indicators of sustainability for two canola production systems in Lorestan province, Iran

### Abstract

In direction of demonstrating suitable strategies for the purpose of cultivation expansion, increasing sustainability and productivity in production systems of canola as a strategic crop, in agricultural year 2017-2018, were done 2 traditional and commercial systems of canola with usage of thermodynamics techniques of expanded exergy analysis (*EEA*), in the mold of a new manner in evaluating of agricultural ecosystems, energy and analysis in Khorram Abad-Iran. With the employed biophysics methods, was demonstrated comprehensive picture from situation of deliberated agricultural systems sustainability in this research. The *EEA* of these two systems showed that the exergy of the environmental remediation cost ( $EE_E$ ) for the traditional system was less than that of the commercial system by  $2.69 \times 10^4$  MJ ha<sup>-1</sup>. Accordingly, the ecological sustainability of the traditional system was found to be two times higher than the commercial system. In contrast, the values of thermodynamic indicators such as the capital conversion factor of the annual monetary value of product sales ( $K_{cap}^{EEA}$ ), the extended exergy efficiency ( $D_{EEA}$ ), and the cumulative degree of perfection (*CDP*), respectively, indicate the higher economic value, the higher thermodynamic efficiency and the greater optimality of the commercial system compared to the traditional system. The high consumption of inputs led to increased cumulative exergy consumption (*CExC*) in the traditional system. also The calculated values of the *ESI\**, %*R*, *ELR*, and *ELR\** indices showed the higher ecological sustainability of the traditional farming system compared to the commercial system of canola production. According to these indices, the main reason for the lower sustainability of the commercial canola production system was the large amount of soil organic matter that was lost per unit input of nonrenewable resources used. A large energy exchange ratio in favor of the buyer, the increased environmental sustainability when the market impact is considered, the lower energy consumption per unit of output and the higher productivity of the production factors all reflect the relative advantage of the commercial system based on the indices of *EER<sub>y</sub>*, *EISD*, *UEV* and total factor productivity (*TFP*), respectively. Hence, our findings revealed that in the commercial canola production system, the ecological sustainability can be improved drastically by employing scientific approaches for the comprehensive management of the production ecosystems, especially through the amelioration of soil organic matter and prevention of its loss. Besides improving the farmers' technical knowledge, the integration of small lots into the production system is recommended for improving the economic sustainability of the traditional production system.

**Keywords:** Canola production, Thermodynamic indexes, Ecological sustainability, Economic productivity.



University of Zabol  
Graduate School  
Faculty of Agriculture

Department of Agronomy

The thesis submitted for PhD Degree

On Agroecology

**Extended exergy, emergy and economic approach as an integrated  
indicator of sustainability of two canola production systems in  
Lorestan province, Iran**

**Supervisor:**

Dr. M.R. Asgharipour

**advisors:**

Dr. D.E. Campbell

Dr. M. Armin

**By:**

Zahra Amiri

Summer 1398