



## Energy flow analysis for rice production in different geographical regions of Iran



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### ABSTRACT

Rice (*Oryza sativa* L.) is an important primary crop in Iran. In this study, energy use pattern for rice production was analyzed and compared in different geographical regions, Golestan, Mazandaran and Guilan, northern provinces of Iran. There is a significant difference among the three provinces in respect to input energy and agronomical managements such as crop rotation, transplanting date and land preparation. Data were collected from 50 farmers using a face to face questionnaire-based survey. The data collected belonged to the production period of 2012–2013 with the following results obtained. The energy use efficiency varied from 1.39 for Golestan to 1.67 for Guilan provinces. The research results revealed the main difference between energy consumption in three provinces comes from diesel fuel, chemical fertilizers and electricity. The net energy for paddy production was approximately higher in Guilan (36,927.58 MJ ha<sup>-1</sup>) than other provinces. Also, the values of energy productivity (kg MJ<sup>-1</sup>) for Golestan, Mazandaran and Guilan provinces were found to be 0.064, 0.059 and 0.070, respectively. On average 84.70% of total energy input used in rice production was non-renewable, while the contribution of renewable energy was 15.30. The results showed that the total energy input for rice production in Golestan province was 64,158.78 MJ ha<sup>-1</sup> which was higher than other provinces, due to high energy consumption in diesel fuel style (46.44%).

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## 1. Introduction

In the developing countries, energy consumption has risen rapidly as a result of economic growth and with the introduction of high-yielding varieties and mechanized crop production practices. The relation between agriculture and energy is very close. Agriculture is an energy consumer and energy supplier [4,27].

Energy is one of the important elements in modern agriculture as it heavily depends on fossil and other energy resources. Energy consumption in agriculture has been increasing in response to the limited supply of arable land, increasing population, technological changes, and a desire for higher standards of living [18,34]. Agriculture uses energy directly as fuel or electricity to operate machinery and equipment, to heat or cool buildings, and for lighting on the farm, and indirectly in the fertilizers and chemicals produced off the farm [38].

In recent years, the relationship between agriculture and the environment has changed, and concerns regarding the sustainability of agricultural production systems have come to the fore. This had led to tension between production vs. conservation. Conservation systems are understood as sustainable production systems, while production first oriented practices imply production should take place, without considering the environmental and energetic effects. Conservation practices, however, balance environmental and energetic effects with production [22]. It is important to note the current agricultural production is not sufficient. Due to land limitation and environmental impacts, crop yield increase is the main source of growth in agricultural production. Thus, more agricultural inputs, mainly fertilizer, will be needed in future to increase agricultural production [35].

Many studies have been conducted to determine the energy efficiency in crop production. Eskandari et al. [14] considered the energy consuming process and factors influencing rice production in semi-mechanize and traditional systems in Mazandaran province located in north of Iran. They found irrigation and fertilizer energy use are the most energy consumers in rice production. A research was carried out by Iqbal [17] to find the

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