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Estimation of greenhouse gas (GHG) emission and energy use efficiency (EUE) analysis in rainfed canola production (case study: Golestan province, Iran)

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ABSTRACT

Increasing the use of energy inputs in agricultural section has been led to numerous environmental concerns such as greenhouse gas (GHG) emissions, high consumption of non-renewable resources, loss of biodiversity and environment pollutions. The study was aimed to analyze the energy use efficiency (EUE) and estimation of GHG emissions from rainfed–based canola production systems (RCPSs) in Iran. In this study, data were collected from 35 farms in Golestan province (northeast of Iran) by a face to face questionnaire performed and statistical yearbooks of 2014. The amount of GHG emissions (per hectare) from inputs used in RCPSs was calculated using CO_2 emissions coefficient of agricultural inputs. Results showed that the EUE and net energy (NE) were as 3.44 and 35,537.81 MJ ha^{-1}, respectively. The value of these indices for the study area indicated that surveyed fields are approximately efficient in the use of energy for canola production. The highest share of energy consumption belonged to nitrogen fertilizer (42.09%) followed by diesel fuel (39.81%). In production of rainfed canola, GHG emission was estimated as 1009.91 kg CO_2 equivalent per hectare. Based on the results, nitrogen fertilizer (44.15%), diesel fuel (30.16%) and machinery (14.49%) for field operations had the highest share of GHG emission. The total consumed energy by inputs could be classified as direct energy (40.09%), and indirect energy (59.91%) or renewable energy (2.02%) and nonrenewable energy (97.98%). These results demonstrate that the share of renewable energies in canola production is very low in the studied region and agriculture in Iran is very much dependent on non-renewable energies. In this study, the energy use status in RCPSs has analyzed and the main involved causes have been interpreted.

1. Introduction

Agriculture is becoming more dependent on energy use in forthcoming days, so as to produce sufficient nutritional material for the ever-increasing population of the world. Energy sources are limited and furthermore, the effects of excessive use of energy on the environment are drastic [1]. Effective energy use in agriculture section is one of the conditions for sustainable agricultural production, since it helps to save financial resources, conserve fossil fuels and reduce environmental pollutions [2]. Thus, identifying agricultural practices which maximize crop productivity, energy use efficiency (EUE) and minimize greenhouse gas (GHG) emissions is essential [3].

Agriculture uses energy directly as diesel fuel or electricity to operate machinery and equipment on the farm and indirectly to produce chemical fertilizers, machinery and biocides that are produced off the farm [4]. Field operations like seed-bed preparation, sowing, harvesting, transport, pumping water, grain drying and also production of chemicals require energy [5]. Increasing the use of energy inputs in agriculture had led to numerous environmental concerns such as high consumption of non-renewable energy resources, loss of biodiversity, pollution of the aquatic environment by nitrogen and phosphorus as well as by pesticides [6]. These concerns are serious in different spatial scales from single fields to

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