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Evaluation of Energy Balance and CO_2 Emissions of Wheat (*Triticum aestivum* L.) Production

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Introduction

Climate change is a global concern. In wheat production, agricultural operations such as plough, applying fertilizers, pesticides, planting, irrigation, harvesting, processing and transformation, need some forms of energy. In a study to investigate the energy input in wheat production in Gorgan region, Iran, it was observed that among all the direct energy inputs, fuel consumed in agricultural operation had the highest place with an average of 3390 MJ ha^{-1} and the second place belonged to supplying electricity with an average of 309 MJ ha^{-1}. The amounts of energy input in the low input and high input planting system for wheat were 9354.2 and 45367.6 MJ ha^{-1}, respectively. Therefore, optimizing the agricultural operation is seen as a strategy to alleviate climate change effects. The purpose of this research was energy assesment and carbon dioxide emission in wheat production.

Material and Methods

The study area included three central cities of Mazandaran province (Jouybar, Sari, and Ghaemshahr), and was visited to investigate the target population through statistics and scientific planting method. To do the research, at first, six fields for conventional planting of the wheat for each city were identified in 2015. Then, they were compared with the improved planting method (according to growing low-input wheat developed by the researchers). In order to collect information from the fields, all agricultural practices were divided into eight parts as preparing the field, planting, fertilizing, preserving the plants, controlling the weeds, irrigating, harvesting, and transportation. Then, with the beginning of every operation, according to temperature fluctuations, information on various production methods and different amounts of input use by farmers of the region was collected. Moreover, in the improved planting method, the researchers were seeking reduction of input use, environmental damage and also increase in efficiency and its comparison with common methods of planting wheat in the same region. The identification of the fields was in a way that covered all main production methods in each city. After that, the improved and conventional methods of planting in the three cities were investigated as four planting methods. To estimate energy consumption and CO_2 emissions, the fields with improved planting method were taken as conventional methods in four systems.

Results and Discussion

The results showed that the mean total input energy in four planting methods was 11811.6 MJ.ha^{-1}. Nitrogen energy input with 38.03 % got first rank. The highest output energy was obtained in improved method as 36.34% of that belongs to grain and 63.66% belong to straw. Mean renewable and non-renewable energy in four planting methods was 3071.28 and 8740.33 MJ.ha^{-1}, respectively. Mean energy efficiency in four planting methods was equal to 14.57. Mean energy productivity in four planting methods was 0.37 kg MJ^{-1}. Mean GWP of wheat production in the four planting methods was 798.56 kg CO_2 per ha^{-1} with the maximum CO_2. Mean GWP per grain weight in the four planting methods was equal to 184.2 kg CO_2 per ha^{-1}. Mean GWP per input and output energy in the four planting methods was equal to 66.75 and 4.94 kg CO_2 per GJ^{-1}. Improved method with 4.35 kg CO_2 per GJ^{-1} had the least GWP per output energy. In a study to investigate the energy input in wheat production

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in Gorgan region, Iran, it was observed that among all the direct energy inputs, fuel consumed in agricultural operation had the highest place with mean of 3390 MJ ha^{-1} and the second place belonged to supplying electricity with mean of 309 MJ ha^{-1}.

Conclusion

According to the finding, the amount of GWP per energy input unit was the maximum in conventional method in Sari and minimum in improved planting method. Furthermore, the improved scenario had the lowest GWP per energy output unit and in conventional method in Jouybar achieved the first rank. In general, the amount of GWP has a direct relationship with the method of field management and input consumption.

Keywords: Climate change, Envirinment, Global warming, Improved planting system