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The Evaluation of Energy Balance of Wheat under Rainfed Farming in West Azerbaijan

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Abstract: Agricultural ecosystems are related to economical and society condition widely, that there are in world. The major target of agricultural ecosystems management is maximum energy flow and human service materials. Energy cycle is a subject of agricultural ecology and in different locations of world, input and output energy are calculated in different agricultural ecosystems. A way of estimation agriculture development and product stability in agricultural location in using of energy flow method. In this consideration, energy flow at agricultural ecosystem of wheat under rained farming was evaluated with using of statistics and information related province agricultural organization (preparation of questionnaire from province farmers). The related data of inputs and outputs are become equivalent values of input and output energy, than was calculated energy efficiency. Energy value of used factors and inputs of this type cultivation was 3906663.848 kcal ha^{-1} and output (production) energy value of wheat grain yield 4068475.6 and 3118380.72 kcal ha^{-1}, respectively. Also, energy efficiency value (output: Input ration) was 1.84 that energy efficiency value of grain and straw were 1.04 and 0.8, respectively.

Key words: Energy balance, input, output, wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important cereal crop in Iran and ranks first in the world cereal crops production. It is a staple food of ⅓ of the world's population and a principal source of carbohydrates and nutrition both for human being and animals.

Agricultural ecosystems are connected by two different completely stored of energy (cultural and ecological energy). Source of ecological energy is radiant energy that it used to environment temperature control, photosynthesis and to create of atmospheric currents and to make rainfall.

Completely, request of energy to tiller in farming depends on degree of change that making in natural ecosystem (Haidar and Hassanzade, 2003).

The increased production of foodstuffs during recent decades is based upon research and technological development. The predominant feature, however is the used of large amounts of energy either directly or indirectly in the form of oil, electricity and fertilizers. Agriculture depends strongly on energy especially fossil fuels (Pimentel *et al*., 1990). Fossil energy input in corn production has increased more than 100-fold during the past 75 years (Pimentel *et al*., 1990). There is a worldwide trend towards increasing consumption of fossil energy in the production of necessary foodstuffs. This energy use creates 2 problems related to agricultural sustainability. First, fossil energy is a limited resource and will eventually be exhausted. The other problem is that serious environmental impacts are related to energy use, such as acidification, higher levels of CO_2, loss of biodiversity, soil losses, mining of water and pollution (Schroll, 1994).

Analysis of biophysical and energy in an agriculture ecosystem is necessary to make benefit production and competency. Inevitable energy should be having mind to produce different material in farming. Because artificial fertilizer production costs are very noticeable.

Evaluation of energy efficiency is available in different production systems if energy of plant yield and other output of agricultural systems were determined and was compared with input energy (Haidar and Hassanzadeh, 2003). Peterson *et al*. (1990) described that increase of energy efficiency in consumption of

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nitrogen related to kind of previous crop and amount of primary nitrogen in soil. Many kind of energy input are available that caused increasing on crop yield or energy protection from outcome of production. This energy can be used in animal and plants production systems (Pimentel *et al*., 1990). There has been increasing use of fertilizers, chemical pesticides and new crop varieties and this is the main reason for the increase in the yield per hectare.

Energy flows are an important component of agricultural ecosystems and many serious environmental problems are related to fossil energy utilization. Internationally, many calculations of energy output/input ratios of different agricultural ecosystems have been made (Bansal and Kshirsagar, 1988; Phipps and Mulvany, 1976). On computation of the energy efficiency (energy output/input), it is revealed that prior to the use of machines and fossil fuels.

MATERIALS AND METHODS

The study was conducted during 2006 in the West Azerbaijan province in the northwest, Iran.

In this consideration, the energy flow in the agricultural ecosystem of winter wheat was evaluated with the use of static and information derived from the local agriculture government organization. A detail inventory of average different inputs (seed, labor, chemical fertilizer, pesticide, machinery, nitrogen, phosphorus, potassium, herbicide and oil) and output (grain yield) was prepared). In the studied region usually use Massey Ferguson tractor (model 285) and this machine has 75 h power (HP) in average, at this analysis noticed percent of power transmission efficiency and among of useable fuel calculated as follow:

$$\text{PTO (HP)} \times \text{(power transmission efficiency)} \times 0.73 \times 0.6 = \text{useable fuel (Gallon/hour)}$$

(Shroll, 1994).

Daily work time by tractor in a hectare on all period of planting, protection and harvesting are 11.25 h. Each gallon is equal 3.78 L. Thus, amount of useable fuel per liter in hour is as follow:

$$2.13 \times 11.25 \times 3.75 = 90.56 \text{ L ha}^{-1}$$

In the studied province, average of grain and straw yields were 1175.86 and 1411.032 kg ha^{-1}, respectively. Total weight's of machinery (tractor, drill, harvester and others) in the all production process was calculated 63 kg ha^{-1} (Table 1). Various inputs and output data's were converted to their equivalent values in input and output energy (Table 1). Than the degree of energy efficiency (or the ratio of output to input) was calculated using the following formula (Haidar and Hasanzade, 2003; Hulsbergen *et al*., 2001; Kuchaki and Hoseini, 1995):

Table 1: Energy equivalents for different inputs, outputs and energy efficiency in wheat production in west Azerbaijan province

Input and output energy	Amount/ hectare	Unit energy (kcal)	Kcal ha^{-1}
Input energy			
Labor	30.48 h	465.0	14173.200
Machinery	63.00 kg	20712.0	1304856.000
Oil	90.56 kg	9583.3	867863.468
N	57.00 kg	17600.0	1003200.000
P	38.00 kg	3190.0	121220.000
K	0.340 kg	1600.0	544.000
Seed	131.26 kg	4200.0	551293.000
Herbicide and insecticide	1.80 L	24175.0	43515.000
Total			3906664.668
Output energy			
Grain yield	1175.8600	3460.0	4068475.600
Straw	1411.0320	2210.0	3118380.720
Energy efficiency			1.840

$$\text{Energy efficiency for seed product} = \frac{\text{Energy produced by seed}}{\text{Total energy}}$$

$$\text{Energy efficiency for straw product} = \frac{\text{Energy produced by straw}}{\text{Total energy}}$$

$$\text{Biological yield energy efficiency for (seed + straw)} = \frac{\text{Total produced energy}}{\text{Total energy}}$$

RESULTS AND DISCUSSION

Result of investigation showed energy value of used factors and inputs of this type cultivation was 3906663.848 kcal ha^{-1} and output (production) energy value of wheat grain yield were 4068475.6 and 3118380.72 kcal ha^{-1}, respectively. Also, energy efficiency value (output: Input ration) was 1.84 that energy efficiency value of grain and straw were 1.04 and 0.8, respectively (Table 1). The greatest energy input was related to the fuel of machinery (Fig. 1). Reducing this energy is environmentally vital because the world today is short of fossil fuels and also because fossil fuels cause pollution in the environment. Reducing the energy will also be very effective in reducing costs (Alam *et al*., 2005; Stout, 1990). Accordingly, the following points can be taken into account in a wish to achieve this purpose (Alam *et al*., 1999).

- Integration or reducing tillage operations.
- Choosing a proper time for preparing seed bed (when the soil is dry enough).

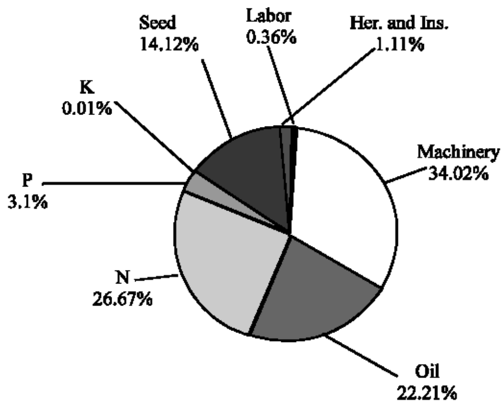

Fig. 1: Percentage of different inputs for production of wheat under rain fed condition in the west Azerbaijan

- Increasing the soil's organic matter.
- N-fertilizer alone enters for about 89.17% fertilizer energy expenditure and for 26.67% of the total energy requirement (Table 1).

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