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STUDY ENERGY INDICES OF TOBACCO PRODUCTION IN NORTH OF IRAN

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ABSTRACT

Energy in agriculture is important in terms of crop production and agro processing for value adding. This method in an agricultural product system is the energy consuming in product operations and energy saving in produced crops. In this article, evaluation of energy indices under rain fed farming tobacco in north of Iran (Guilan province) was investigated. Data were collected from 72 farms by using a face to face questionnaire method during 2011 year in Guilan province. By using of consumed data as inputs and total production as output, and their concern equivalent energy, and energy indices were calculated. The average yield of tobacco was found to be 1112 kg/ha and its energy equivalent was calculated to be 890 MJ/ha. Energy efficiency (energy output to input energy ratio) for seed in this study was calculated to be 0.03, showing the affective use of energy in the agro ecosystems tobacco production. Nonrenewable energy was 94.09% of total input energy that concluded that tobacco production needs to improve the efficiency of energy consumption in production and to employ renewable energy.

Keywords: tobacco, energy indices, Iran, yield.

INTRODUCTION

Tobacco is one of the most valuable agricultural and industrial crops which is cultivated in more than 100 countries all over the world with different climate and has a major role in of some of economy them (Tso, 2005). Although Tobacco is counted as an important industrial plant in the world, it has not been paid much attention by researchers because of its negative aspect in cigarette production. Nevertheless, tobacco has different other usage. For instance, nicotine extraction is carried out from this plant in a large scale and tobacco is also used as a model plant in biotechnology (Chawla, 2003). This plant will be able to have more application in production of different materials based on its transgenic parameters (Dimanov, 2001). Around 3.69 million hectares of the world's lands are under tobacco cultivation.

Energy has an influencing role in the development of key sectors of economic importance such as industry, transport and agriculture. This has motivated many researchers to focus their research on energy management. Energy has been a key input of agriculture since the age of subsistence agriculture. It is an established fact worldwide that agricultural production is positively correlated with energy input (Singh, 1999). Agriculture is both a producer and consumer of energy. It uses large quantities of locally available noncommercial energy, such as seed, manure and animate energy, as well as commercial energies, directly and indirectly, in the form of diesel, electricity, fertilizer, plant protection, chemical, irrigation water, machinery etc. Efficient use of these energies helps to achieve increased production and productivity and contributes to the profitability and competitiveness of agriculture sustainability in rural living (Singh *et al*., 2002). Energy use in agriculture has been increasing in response to increasing population, limited supply of arable land, and a desire for higher standards of living (Kizilaslan, 2009). However, more intensive energy use has brought some important human health and environment problems so efficient use of inputs has become important in terms of sustainable agricultural production (Yilmaz *et al*., 2005). Recently, environmental problems resulting from energy production, conversion and utilization have caused increased public awareness in all sectors of the public, industry and government in both developed and developing countries It is predicted that fossil fuels will be the primary source of energy for the next several decades (Dincer, 2001; Demirbas, 2003). Efficient use of resources is one of the major assets of ecoefficient and sustainable production, in agriculture (De Jonge, 2004). Energy use is one of the key indicators for developing more sustainable agricultural practices (Streimikiene *et al*., 2007) and efficient use of energy is one of the principal requirements of sustainable agriculture (Kizilaslan, 2009). It is important, therefore, to analyze cropping systems in energy terms and to evaluate alternative solutions, especially for arable crops, which account for more than half of the primary sector energy consumption (Sartori *et al*., 2005).

The main aim of this study was to determine energy use in tobacco production, to investigate the efficiency of energy consumption and energy indices analysis of tobacco in Guilan province of Iran.

MATERIALS AND METHODS

Data were collected from 72 farms by using a face to face questionnaire method during 2011 year in Guilan province (north of Iran). The random sampling of production agro ecosystems was done within whole population and the size of each sample was determined by using bottom equation (Kizilaslan, 2009):

$$n = \frac{N \times s^2 \times t^2}{(N-1)d^2 + s^2 \times t^2}$$

In the formula, n is the required sample size, s is the standard deviation, t is the t value at 95% confidence limit (1.96), N is the number of holding in target population and d is the acceptable error.

In order to calculate input-output ratios and other energy indicators, the data were converted into output and input energy levels using equivalent energy values for each commodity and input. Energy equivalents shown in Table-1 were used for estimation (Ozkan *et al*., 2004; Moradi and azarpour, 2011). Firstly, the amounts of inputs used in the production of tobacco were specified in order to calculate the energy equivalences in the study. Energy input includes human labor, machinery, diesel fuel, chemical fertilizers, poison fertilizers, electricity and seed and output include yield of tobacco. The energy use efficiency, energy specific, energy productivity and net energy gain were calculated according to bottom equations (Moradi and azarpour, 2011; Ozkan *et al*., 2004).

$$\text{Energy ratio} = \frac{\text{Output energy (Mj/ha)}}{\text{Input energy (Mj/ha)}}$$

$$\text{Energy production} = \frac{\text{yield (Kg/ha}}{\text{Input energy (Mj/ha)}}$$

$$\text{Energy intensity} = \frac{\text{Input energy (Mj/ha)}}{\text{yield (Kg/ha)}}$$

Net energy gain =
Output energy (Mj/ha) - Input energy (Mj/ha)

The input energy was divided into direct, indirect, renewable and non-renewable energies (Kizilaslan, 2009; Ozkan *et al*., 2004). Direct energy covered human labor, diesel fuel and electricity used in the peanut production while indirect energy consists of seed, chemical fertilizers, poison fertilizers, and machinery energy. Renewable energy consists of human labor and seed and nonrenewable energy includes chemical fertilizers, poison fertilizers, electricity, and machinery energy.

RESULTS AND DISCUSSIONS

Analysis of input-output energy use in tobacco production

The inputs used in tobacco production and their energy equivalents and output energy equivalent are illustrated in Table-1. About 0.01 kg seed, 875 h human labor, 2 L poison chemical, 12 h machinery power and 110 L diesel fuel for total operations were used in agro ecosystems tobacco production on a hectare basis. The use of nitrogen fertilizer, phosphorus and potassium were 40, 50 and 175 kg per one hectare respectively. The total energy equivalent of inputs was calculated as 29012 MJ/ha.

The highest shares of this amount were reported for electricity (50.78%) chemical fertilizer (18.45%), diesel fuel (21.35%), respectively. The energy inputs of seed (0.00003%), poison (0.85%), human labor (5.91%) and machinery (2.59%) were found to be quite low compared to the other inputs used in production (Figure-1).

The average seed of tobacco was found to be 1112 kg/ha and its energy equivalent was calculated to be 890 MJ/ha (Table-1).

Table-1. Amounts of inputs and output and their equivalent energy from calculated indicators of energy.

Parameter	Unit	Quantity per hectare	Energy equivalents	Total energy equivalents
Inputs				
Human labor	h/ha	875	1.96	1715
Machinery	h/ha	12	62.7	752.40
Diesel fuel	L/ha	110	56.31	6194.10
Nitrogen	Kg/ha	40	69.5	2780
Phosphorus	Kg/ha	50	12.44	622
Potassium	Kg/ha	175	11.15	1951.25
Poison	L/ha	2	120	240
Electricity	Kwh	1237	11.93	14757.41
Seed	Kg/ha	0.010	25	0.01
Output				
yield	Kg/ha	1112	0.8	890

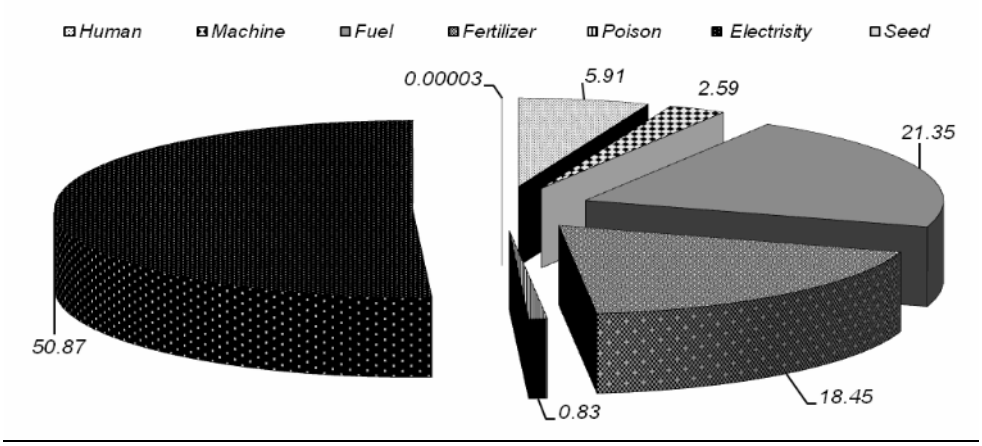

Figure-1. The share (%) production inputs in tobacco.

Evaluation indicators of energy in tobacco production

The energy use efficiency, energy production, energy specific, energy productivity, net energy gain, and intensiveness of tobacco seed production were shown in Table-2. Energy efficiency (energy output-input ratio) in this study was calculated to be 0.03, showing the affective use of energy in the agro ecosystems tobacco production. Energy specific was 26.09 MJ/kg this means that 26.09 MJ is needed to obtain 1 kg of tobacco seed. Energy productivity calculated as 0.04 kg/MJ in the study area. This means that 0.04 kg of output obtained per unit energy. Net energy gain was -28123 MJ/ha.

This means that the amount of output energy is more than input energy and production in this situation is logical. Direct, indirect, renewable and non-renewable energy forms used in tobacco production are also investigated in Table-2. The results show that the share of direct input energy was 78.13% (22667 MJ/ha) in the total energy input compared to 21.78% (6346 MJ/ha) for the indirect energy. On the other hand, nonrenewable and renewable energy contributed to 94.09% (27297 MJ/ha) and 5.91% (1715 MJ/ha) of the total energy input, respectively.

Table-2. Analysis of energy indices in tobacco production.

Item	Unit	Tobacco
Yield	Kg/ha	1112
Input energy	Mj/ha	29012
Output energy	Mj/ha	890
Energy use efficiency	-	0.03
Energy specific	Mj/Kg	26.09
Energy productivity	Kg/Mj	0.04
Net energy gain	Mj/ha	-28123
Direct energy	Mj/ha	22667 (78.13%)
Indirect energy	Mj/ha	6346 (21.87%)
Renewable energy	Kg/Mj	1715 (5.91%)
Nonrenewable energy	Mj/ha	27297 (94.09%)

CONCLUSIONS

Finally Energy use is one of the key indicators for developing more sustainable agricultural practices one of the principal requirements of sustainable agriculture, Therefore energy management in systems tobacco production should be considered an important field in terms of efficient, sustainable and economical use of energy. Using of combination machines, doing timely required repairs and services for tractors and representing a fit crop rotation are suggested to decrease energy consuming for tobacco in Guilan province.

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