Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

Annals of Biological Research, 2012, 3 (8):3994-3997
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Energy Use Efficiency for Groundnut (*Arachis hypogaea* L.) Production in a Semi-mechanized Cultivation System

Saeed Firouzi* **and Hashem Aminpanah**

Department of Agronomy, Agricultural College, Rasht Branch, Islamic Azad University, Rasht, Iran

---

ABSTRACT

The aim of this study was to determine the energy requirement for a semi-mechanized production system of groundnut in Kiashahr region, north of Iran. Data were gathered from 62 groundnut farms using a face to face questionnaire method. Results showed that the energy input of the diesel fuel had the highest share (43.51%) in the total energy inputs followed by the chemical fertilizers (29.11%). Total energy input was found to be 20164.36 MJ/ha and total output energy was determined as 79252.02 MJ/ha. Energy output-input ratio, specific energy, energy productivity, and net energy gain were computed as 3.93, 4.74 MJ/kg, 0.212 kg/MJ, and 59087.66 MJ/ha, respectively. Renewable and non-renewable energy were 19.27% and 80.73% in the total input energy, respectively. The direct and indirect energy shares for semi-mechanized groundnut production also were found to be 53.80% and 46.20% MJ/ha of the total input energy, respectively.

Key Words: Groundnut, output-input ratio, Energy indices.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most important oil and food crop in the world. It is the third most important oilseed after soybean and cotton [1]. Groundnut seed consists of 25 to 32% protein (average of 25% digestible protein) and 42 to 52% oil [2]. Total groundnut production area in Iran is estimated to be 3000 ha. A semi-mechanized cultivation system is used for crop production in Iran. Tillage, opening furrows for manually planting of seeds, and inter-row weeding operations are mechanically carried out. Other operations are performed by hand. Groundnut growers in north region of Iran use a huge energy to prepare the soil for planting, weeding operation, harvest the crop, and pod shelling.

Energy input–output analysis is useful to assess the efficiency and environmental impacts of production systems. Review of reports showed that a lot of studies have been conducted to determine the energy use efficiency for various agricultural crops [3, 4, 5, 6-7]. However, there is no information regarding the energy indices in groundnut production in semi-mechanized systems. So, the aim of this study was to evaluate the energy use indices of groundnut production in semi-mechanized cultivation system in north region of Iran.

MATERIALS AND METHODS

This investigation was carried out in Kiashahr, the major groundnut production region in north of Iran. A semi-mechanized cultivation system is used for groundnut production in this region. Soil preparation is usually done by

moldboard plow following disk harrow and tractor drawn rotavator. Furrowing for planting, inter-row weeding operations are mechanically performed, but putting the seeds in furrows, intra-row weeding, digging groundnut, and pod separation are manually carried out. Shelling process of sun-dried pods are performed using vertical rubber-type groundnut huskers.

Data were gathered from the groundnut growers using face to face interview. A sample size of 62 farmers was randomly calculated using the stratified random sampling technique. The Neyman method was used for calculation of the sample size [8]. The acceptable error in the sample size was considered to be 5% for 95% reliability.

Different inputs and their energy equivalents used in groundnut production were presented in the Table 1. Total energy in each case was calculated by multiplying each mean by its special energy equivalent.

The main indices for evaluation of energy use were calculated by the following formulas [4-5]:
Energy ratio (ER): The ratio of output energy (MJ/ha) to the input energy (MJ/ha)
Energy productivity (EP): The ratio of crop yield (kg/ha) to the energy input (MJ/ha)
Net energy gain (NEG): Output energy (MJ/ha) minus input energy (MJ/ha)
Specific Energy (SE): The ratio of energy input (MJ/ha) to the total output (kg/ha)

The input energy was also evaluated as direct and indirect, renewable and non-renewable forms [9]. Each of the energy categories in this study was shown in Table 1.

RESULTS AND DISCUSSION

According to the Table 2, total energy input was found to be 20164.36 MJ/ha. Amounts of 1417.15, 554.69 MJ/ha energy were used throughout the human labor and machinery, respectively. These amounts are 7.02% and 2.75% in the total input energy, respectively. Results also showed that the diesel fuel had the biggest energy input share of 43.51% in the total input energy followed by the chemical fertilizer (29.11%). The highest energy input shares of diesel oil and chemical fertilizer may contribute somewhat to their higher unit energy equivalents.

Regarding the energy equivalent of 11.93 MJ/kWh for electricity, total energy input for groundnut pod shelling operation was determined to be 657.94 MJ/ha. This amount is about 3.26% of the total input energy. Total energy output also was calculated as 79252.02 MJ/ha for groundnut production.

According to the Table 2, energy usage ratio of 3.93 indicates the affective use of energy in groundnut production. This amount is more than those reported for canola, wheat, bean, lentil production in Iran (2.42, 1.97, 1.81, and 1.79, respectively) and cotton production in Turkey (2.36), [3, 4, 5-6]. Specific energy also was estimated to be 4.74 MJ/kg. This is less than those reported for canola and wheat production in Iran, cotton production in Turkey, bean, and lentil production in Iran (17.49, 10.43, 4.99, 19.45, and 20.26 MJ/kg , respectively), [3, 4, 5-6]. Energy productivity was computed to be 0.212

Kg/MJ). This shows that 0.212 kg of groundnut obtained per unit energy input (MJ). This amount is more than those reported for wheat and canola production in Iran and cotton production in Turkey (0.096, 0.057, and 0.20 kg/MJ) [3, 4-6]. Besides, the net energy yield was determined to be 59087.66 MJ/ha. This means that the output energy was more than the input energy for semi-mechanized groundnut production in north region of Iran.

Table 3 shows the direct, indirect, renewable and non-renewable energy inputs in semi-mechanized groundnut production. The results revealed that the direct and indirect energy input shares were 53.80% and 46.20% in the total energy input, respectively. This implies that the energy inputs of human labor, diesel fuel, and electricity was more than the total energy input of machinery, fertilizers, chemicals, and seed. The renewable and non-renewable energy input shares also were determined as 19.27 and 80.73%, respectively. This result shows that energy input of machinery, diesel oil, electricity, chemical fertilizers, and insecticide was more than the energy input of human and groundnut seed. Similar trends were obtained for renewable and non-renewable energy input shares in wheat, bean, lentil, and chick pea production in Iran and cotton production in Turkey [4, 5-6].

Table 1: Main energy categories of groundnut production in north region of Iran

Energy category	Items
Direct Energy:	Human, diesel, electricity
Indirect energy:	Seed, fertilizers, chemicals, machinery
Renewable energy:	Human, seed
Non-renewable energy:	diesel, electricity, chemicals, fertilizers, machinery

Table 2: Energy use and input-output energy indices for groundnut production

Input	Quantity per unit area (ha)	Energy equivalent (MJ/unit)	References	Total energy equivalent (MJ)	Percentage of total energy input (%)
Human labor (h)	723	1.96	[10]	1417.15	7.02
Machinery (h)	8.56	64.80	[10]	554.69	2.75
Chemical fertilizer (kg)					
-Nitrogen	68.39	60.60	[11-12]	4144	20.55
-Phosphorus	104.48	11.10		1159.73	5.75
-Potassium	84.5	6.70		566.15	2.81
Chemicals					
-Insecticides	1.52	278	[13-14]	422.56	2.10
Seed (kg)	132.50	18.63	[15]	2468.48	12.21
Diesel Fuel (l)	155.81	56.31	[10]	8773.66	43.51
Electricity (kWh)	55.15	11.93	[10]	657.94	3.26
Total energy input (MJ)				20164.36	
Yield (kg)	4254	18.63	[15]	79252.02	
Energy usage ratio					3.93
Specific energy (MJ/kg)					4.74
Energy productivity (kg/MJ)					0.212
Net energy gain (MJ/ha)					59087.66

Table 3: Different main energy categories in groundnut Production

Indicators	Unit	Quantity
Direct energy	MJ/ ha	10848.75 (53.80%)
Indirect energy	MJ/ ha	9315.61 (46.20%)
Renewable energy	MJ/ ha	3885.63 (19.27%)
Non-renewable energy	MJ/ ha	16278.73 (80.73%)

CONCLUSION

Results of this study showed that the total energy input for semi-mechanized groundnut production in north region of Iran was 20164.36 MJ/ha and the total energy output was 79252.02 MJ/ ha. Results also revealed that the level of diesel oil energy (8773.66 MJ/ha) was one of the major determinants of the total energy input, followed by chemical fertilizer (5869.88 MJ/ha). The least energy share (2.1%) was related to the level of insecticides, followed by machinery (2.75%) in the total input energy. The energy output-input ratio was also calculated as 3.93, specific energy as 4.74 MJ/kg, energy productivity as 0.212 kg/MJ, and net energy gain as 59087.66 MJ/ha. Renewable energy and non-renewable energy were calculated as 3885.63 and 16278.73 MJ/ha, respectively. Results also revealed that the direct and indirect input energy shares were 53.80% and 46.20% of the total energy input, respectively.

Acknowledgement
Authors are grateful to Islamic Azad University, Rasht branch for the scientific support of the present research.

REFERENCES

[1] FAO Food Outlook **1990**, Rome, Italy.
[2] LG Woodroof, Peanuts, processing, products. **1983**, Third edition. AVI Publishing, Connecticut.
[3] A Dehshiri, *ARPN Journal of Agricultural and Biological Science*, **2011**, 6(11): 54-61.
[4] S Shahan, A Jafari, H Mobli, S Rafiee, M KarimiEnergy, *Journal of Agricultural Technology*, **2008**, 4(1):77-88.
[5] A Koocheki, R Ghorbani, F Mondani, Y Alizadeh, R Moradi, *Int. J. Energy Economics and Policy* **2011**, 1(4): 95-106.
[6] E Dagistan, H Akcaoz, B Demirtas, Y Yilmaz, *Afric. J. Agric. Res*., **2009**, 4 (7):599-604.
[7] H Akcaoz, *Afric. J. Agric. Res.* **2011**, 6(25): 5618-5624.

[8] T Yamane. Elementary Sampling Theory. Prentice-Inc., Englewood Cliffs, N. J., USA. **1967**.
[9] H Singh, AK Singh, HL Kushwaha, A Singh, *Energy*, **2007**, 32: 1848-1854.
[10] JM Singh, On farm use pattern in different cropping systems in Haryana, India. Master of Science. Int. Inst. Management, Univ. Flensburg, Germany. **2002**, pp. 118.
[11] KG Mandal, KP Saha, PK Ghosh, KM Hati, KK Bandyopadhyay, *Biomass and Bioenergy*, **2002**, 23: 337-345.
[12] I Mani, P Kumar, JS Panwar, K Kant, *Energy*, **2007**, 32: 2336-2339.
[13] KJ Hülsbergen, B Feil, S Biermann, GW Rathke, WD Kalk, W Diepenbrock, *Agriculture, Ecosystems and Environment*, **2001**, 86:303-321.
[14] M Meul, F Nevens, D Reheul, G Hofman, *Agriculture, Ecosystems and Environment*, **2007**, 119:135-144.
[15] J Sales, PJ Britz, *Aquaculture*, **2002**, 207(1–2): 113–123.