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Energy Auditing and development of economical model for greenhouse cucumber production in Lorestsn and Markazi provinces

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ABSTRACT

The purposes of this study is analyzing energy consumption and investigational the influences of energy inputs and forms on yield of greenhouse cucumber production in Lorestan and Markazi provinces. Data used in this study were obtained from 64 greenhouses randomly during one period of plant cultivation season in 2011-2012. The total energy input of 1070966.3 MJ ha^{-1} was required for cucumber production. The portion of fuel by 78.4 % of the total input energy was the highest energy input. The energy use efficiency, specific energy, energy productivity and net energy gain were found as 0.14, 5.67 MJ kg^{-1}, 0.176 kg/MJ and -919867.9 MJ ha^{-1}, respectively, that indicated inefficient use of energy. The economic model estimation revealed that the impact of, human labor, fertilizer and chemical energy inputs that significantly showed a positive effect on yield that mean increase in quality of these inputs causes yield increases significantly. The results of sensitivity analysis of the energy inputs showed that the highest the MPP value of human labour. Econometric analysis indication of the benefit–cost ratio was estimated as 1.86

Introduction

Cucumber is one of the most popular greenhouse vegetable products worldwide[17]. In Iran, it was cultivated on 4675 ha and the production was 984825 tones in 2009[2].

Energy use in agriculture has become more intensive as the Green Revolution led to the increasing use of high yielding seeds, fertilizers and chemicals as well as diesel and electricity. Energy consumption per unit area in agriculture is directly related to the development of the technology in farming and the level of production. The energy inputs such as fuel, electricity, machinery, seed, fertilizer and chemical take significant share of the energy supplies in the production system of modern agriculture. The use of intensive inputs in agriculture and access to plentiful fossil energy has provided an increase in food production and standard of living [12].

It is realized that crop yields and food supplies are directly linked to energy[5].Calculating energy inputs of agricultural production is more difficult than the industry sector due to the high number of factors affecting the production[26].In the developed countries, an increase in the crop yield was mainly due to an increase in the commercial energy inputs in addition to improved crop varieties[9]. Generally, land productivity is measured as the total measure of crop productivity. In a number of recent researches, the yield that is the amount of crop produced per unit area (kg ha^{-1}), has been considered as the total measure of productivity[4].However, it is only a partial measure of agricultural productivity like other measures, such as labour, seed and diesel productivity. Similarly, the energy use efficiency (output energy to input energy ratio) and specific energy, i.e., input energy to yield ratio (MJ kg^{-1}) of farmers in crop production systems are indices, which can define the efficiency and performance of farms[1]. Technical efficiency (weighted output energy to weighted input energy ratio) is another way to explain the efficiency of farmers. Accordingly, mathematical function needs to be specified to obtain a relationship between inputs and yield. Some researchers investigated the functional relationship between energy inputs and yield. In general, two competing approaches for the measurement of efficiency are the parametric stochastic frontier model and non-parametric data envelopment analysis (DEA) [18].

Although many experimental works have been conducted on energy use in agriculture, there are few studies on the energy and economical analysis of greenhouse crops production [4,16,23]. Ozkan et al.[20] studied energy use for greenhouse vegetable (tomato, cucumber, eggplant and pepper) production in Turkey. Pashaee et al.[23] determined value of energy consumption for producing 1 kg tomato and determination of energy indices in cultivating tomato at greenhouse in 2006 for Kermanshah province of Iran. Hatirliet al.[12]investigated energy inputs and crop yield relationship to develop and estimate an econometric model for greenhouse tomato production in Antalya province. Heidari et al.[13] investigated Energy use patterns and econometric models of major greenhouse vegetable productions in Iran. Pahlevan et al determined economic modle and sensitivity analysis of energy input for greenhouse cucumber. mohamadi et al.[16].studied economical analysis and relation between energy inputs and yield of greenhouse cucumber production in Iran.

1-Determine of energy use and its form for greenhouse cucumber production.

2-Determine of energy use efficiency per hectar for greenhouse cucumber production.

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3-Specifying a relationship between input energies, yield and sensitivity analysis of the energy inputs on greenhouse cucumber yield in Lorestan and Markaziprovinces of Iran.

Material and methods

Data used in this study were obtained from 64 farmers growing single crop cucumber in greenhouse in the Lorestan and Markazi provinces of Iran by using a face-to-face questionnaire performed in season 2011-2012. The average size of the studied greenhouses was found to be 0.25 ha. In addition to the data obtained by surveys, previous studies of related organizations such as Food and Agricultural Organization (FAO) and Ministry of Jihad-e-Agriculture of Iran (MAJ) were also utilized during this study.The number of operations involved in the cucumber production, and their energy requirements influence the final energy balance. The random sampling of greenhouses was done within whole population and the size of each sample was determined by[13]:

$$n = \frac{(\Sigma N_h S_h)}{N^2 D^2 + \Sigma N_h S_h^2}$$

where n is the required sample size, N is the number of holdings in target population, N_h is the number of the population in the h stratification, S_h is the standard deviation in the h stratification, S_h^2 is the variance of h stratification, d is the precision where $(\bar{x} - \bar{X})$, z is the reliability coefficient (1.96 which represents the 95% reliability), and $D^2 = \frac{d^2}{z^2}$.For the calculation of sample size, criteria of 5% deviation from population mean and 95% confidence level were used. The size of 64 was considered as sampling size. Thus, 64 greenhouses were selected randomly.

Auditing of energy

Energy inputs including human labour, machinery, diesel fuel & natural gas, electricity, chemical fertilizers, farmyard manure (FYM), chemicals, water for irrigation and output yield values of cucumber have been used to estimate the energy ratio. Energy equivalents shown in Table 1 were used for estimation.

Based on the energy equivalents of the inputs and output (Table 1), the energy ratio (energy use efficiency), energy productivity, specific energy, net energy and energy intensiveness were calculated.according to [22]:

Energy use efficiency= $\frac{\text{Energy output (MJ ha}^{-1}\text{)}}{\text{Energy input(MJ ha}^{-1}\text{)}}$ (1)

Energy productivity = $\frac{\text{Cucumber output (kg ha}^{-1}\text{)}}{\text{Energy input (MJ ha}^{-1}\text{)}}$ (2)

Specific energy = $\frac{\text{Energy input (MJ ha}^{-1}\text{)}}{\text{Cucumber output (kg ha}^{-1}\text{)}}$ (3)

Net energy = Energy output (MJ ha^{-1}) − Energy input (MJ ha^{-1}) (4)

For the growth and development, energy demand in agriculture can be divided into direct and indirect energies or renewable and non-renewable energies [22]. Direct energy (DE) covers human labour, fuel, electricity and water for irrigation, while indirect energy (IDE) includes energy embodied in fertilizers, Farm yard manure and chemicals used in the cucumber production. Renewable energy (RE) consists of human labour, Farm yard manure and water for irrigation, whereas non-renewable energy (NRE) includes fuel, chemical fertilizers, chemicals and electricity.

Developing economic models

In order to specify a relationship between input energies and cucumber yield aneconomical function were identified. For this purpose, Cobb-Douglass production function was chosen as the best function in terms of statistical significance and expected signs of parameters.

The Cobb-Douglass function has been used by several reaserchers to investigate the relationship between input energies and yield [13,16,22]. The Cobb-Douglass production function is expressed asfollows:

$$Y = f(x)\exp(u) \quad (5)$$

This function can be expressed as a linear relationship using the following expression:

$$\ln Y_i = a + \sum_{j=1}^{n} \alpha_j \ln(X_{ij}) + e_i \quad (6)$$

where Yi denotes the yield of the i'th farmer, Xij is the vector of inputs used in the production process, a is a constant, α_j represents coefficients of inputs which are estimated from the model and e_i is the error term. Eq.(6) can be expressed in the following form;

$$\ln Y_i = \alpha_1 \ln X_1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln X_5 + \alpha_6 \ln X_6 + \alpha_7 \ln X_7 + \alpha_8 \ln X_8 + e_i \quad (7)$$

where Xi (i = 1, 2, . . . , 9) stand for human labour (X_1), machinery (X_2), fuel (X_3), chemical fertilizers (X_4), FYM (X_5), chemicals (X_6), water for irrigation (X_7), electricity (X_8).

In addition the impacts of DE and IDE energies and RE and NRE energies on the yield were investigated. For this purpose the Cobb-Douglass function was selected and investigated as the following forms:

$$\ln Y_i = \beta_1 \ln DE + \beta_2 \ln IDE + e_i \quad (8)$$

$$\ln Y_i = \gamma_1 \ln RE + \gamma_2 \ln NRE + e_i \quad (9)$$

Where Yi is the greenhouse's yield, βi and γi are coefficient of exogenous variables. DE and IDE are direct and indirect energies, respectively, RE is renewable energy and NRE is non-renewable energy.

In production, returns to scale refer to changes in output subsequent to a proportional change in all inputs (where all inputs increase by a constant factor). In the Cobb–Douglas production function, it is indicated by the sum of the elasticities derived in the form of regression coefficients. If the sum of the coefficients is greater than unity $\left(\sum_{i=1}^{n}(\alpha_i > 1)\right)$, then it could be concluded that the increasing returns to scale(IRS); if the function becomes less than unity $\left(\sum_{i=1}^{n}(\alpha_i < 1)\right)$, then it is indicated that the decreasing returns to scale(DRS); and, if the result is unity $\left(\sum_{i=1}^{n}(\alpha_i = 1)\right)$, it shows that the constant returns to scale [25].

Senesitivy analysis

Eq. (10) was estimated using ordinary least square technique. The Marginal Physical Product (MPP) technique, based on the response coefficients of the inputs, was utilized to analyze the sensitivity of inputs on cucumber yield. The MPP is the change of output produced by change of one unit of an input.

Table 1
Energy equivalents of inputs and output in agricultural production

Ref.	Energy equivalent (MJ unit^{-1})	unit	inputs
			A. Inputs
[22]	1.96	h	1.Human labour
[16]	13.06	h	2. Machinery
			3.Fuel
[2]	47.8	L	(a)Diesel fuel
[2]	49.5	M^3	(b)Natural gas
			4.Chemical fertilizers
[24]	78.1	Kg	(a)Nitrogen (N)
[24]	17.4	Kg	(b)Phosphate (P2O5)
[24]	13.7	Kg	(c)Potassium (K2O)
[24]	8.8	kg	(d)micro
[24]	303.1	ton	5. Farmyard manure (FYM)
			6.Chemicals
[24]	199	Kg	(a)insecticide
[24]	92	Kg	(b)fungicide
[24]	238	kg	(c)herbicide
[22]	11.93	Kw.h	7.Electricity
[22]	1.02	M^3	8.Water for irrigation
			B. Output
[22]	0.8	Kg	cucumber

Table 2
Amounts of inputs, output and energy inputs and output in cucumber production

percentage	Total energy equivalent (MJ ha^{-1})	Quantity per unit area (ha)	inputs
			A.Inputs
5.64	60423	30828	Human labour (h)
0	500	0.867	Machinery (kg)
78.4	839906	33310.68	fuel (l&m^3)
3.38	36190	1252.3	Chemical fertilizers (kg)
2.25	24047	307.9	(a) Nitrogen (kg)
0.24	2537	145.8	(b) Phosphate (P2O5) (kg)
0.67	7210.3	526.3	(c) Potassium (K2O) (kg)
0.22	2396.2	272.3	(d)Micro(kg)
1.3	13958.3	46051.9	Farmyard manure (FYM)
6.26	67009.4	595.3	Chemicals(kg)
4.15	44463.6	48.33	(a)insecticide(kg)
1.97	21094	10.6	(b)fungicide(kg)
0.13	1451.8	0.61	(c)herbicide(kg)
0.1	1043.9	1698.5	Water for irrigation(m^3)
4.9	52385.7	4391.09	Electricity(kwh)
	1070966.3		The total energy input (MJ)
			B. Output
	151098.4	188873	Cucumber (kg)
	151098.4		Total energy output (MJ)

Table 3
Energy output–input ratio and forms in cucumber production

Items	Unit	Quantity	%
Energy use efficiency	-	0.14	
Energy productivity	kg MJ^{-1}	0.176	
Specific energy	MJ kg^{-1}	5.67	
Net energy	MJ ha^{-1}	-919867.9	
Direct energy[a]	MJ ha^{-1}	953758.6	89
Indirect energy[b]	MJ ha^{-1}	117207.7	11
Renewable energy[c]	MJ ha^{-1}	75425.2	7
Non-renewable energy[d]	MJ ha^{-1}	995541.1	93
Total energy input	MJ ha^{-1}	1070966.3	100
Total energy output	MJ ha^{-1}	151098.4	

[a]Includes human labour, fuel, electricity and water for irrigation
[b] Includes fertilizers, Farm yard manure and chemicals
[c] Includes human labour, Farm yard manure and water for irrigation
[d] Includes fuel, chemical fertilizers, chemicals and electricity

Table 4
Economic developing results of inputs

Endogenous variables	variable: yield Exogenous	Coefficient	t-ratio	MPP
Model I: ln Yi = a1 ln X1 + a2 ln X2 + a3 ln X3 + a4 ln X4 + a5 ln X5 +a6 ln X6 + a7 ln X7 + a8 ln X8 + ei				
1. Human labour		0.655	14.155*	2.08
2. Machinery		-0.025	-1.337	-.125
3. Fuel		-0.003	-0.144	0
4. Chemical fertilizers		0.133	3.079*	0.72
5. Farmyard manure		0.103	3.160*	1.47
6. Chemicals		0.065	2.536**	0.21
7. Water for irrigation		0.007	0.295	1.37
8. Electricity		0.001	0.03	0.004
R^2		0.97		
Return to scale		0.94		

Table 5
Economic developing results of direct, indirect, renewable and nonrenewable energies

Endogenous variable: yield Exogenous variables	Coefficient	t-ratio	MPP
$\ln Y_i = \beta_1 \ln DE + \beta_2 \ln IDE + e_i$ (8)			
Direct energy	-0.137	-2.592**	-0.003
Indirect energy	0.663	8.742*	1.09
R^2	0.76		
Return to scale	0.526		
$\ln Y_i = \gamma_1 \ln RE + \gamma_2 \ln NRE + e_i$			
Renewable energy	0.982	19.611*	2.45
Non-renewable energy	0.048	1.618	0.001
R^2	0.93		
Return to scale	1.03		

Table 6
Economic analysis of cucumber production

Cost and return components	Unit	Value
Yield	kg ha^{-1}	188873
Sale price	$ kg^{-1}	0.7
Gross value of production	$ ha^{-1}	132211.1
Variable cost of production	$ ha^{-1}	9223
Fixed cost of production	$ ha^{-1}	61761
Total cost of production	$ ha^{-1}	70984
Total cost of production	$ kg^{-1}	0.38
Gross return	$ ha^{-1}	122988.1
Net return	$ ha^{-1}	61227.7
Benefit to cost ratio	-	1.86
Productivity	kg $^{-1}$	2.66

Assuming that no other inputs to production change, the MPP of the various inputs was computed using the αj of the various energy inputs as[25]:

$$MPP_{X_j} = (GM(Y))/(GM(X_j))\,(\alpha_j \quad (10)$$

where MPP_{X_j} is marginal physical productivity of *j*th input, α_j, regression coefficient of *j*th input, $GM(Y)$, geometric mean of yield, and $GM(X_j)$, geometric mean of *j*th input energy on per hectare basis.

Basic information on energy inputs of cucumber production were entered into Excel 2010 spreadsheets and SPSS 16.0 software program.

Results and Discussion

Auditing of energy

Table 2 shows the energy inputs in cucumber production and their energy equivalents with output energy rates and their equivalents in the studied area. The results revealed that 30828hours of human labour were required per hectare of cucumber production. The majority of human labour in the greenhouses was used in the harvest and transportation operations. Additionally, 33310.68l unit of fuel was consumed for the heating. The amount of chemical fertilizers, electricity and chemicals used for cucumber growing were 1252.3 kg ha^{-1}, 4391.09kW h and59.53kg, respectively.

The energy consumption of fuel and electricity due to their low cost was very high in the studied area. In order to improve the greenhouse environment as well as reduction of fuel consumption, it is strongly suggested that the heating system efficiency is raised or replaced with alternative sources of energy such as solar energy, etc. The last column gives the percentage of each input of the total energy input. Total mean energy used in various greenhouse steps during cucumber production was 1070966.3MJ ha^{-1}. In another study Banaeian et al. [4], total energy inputs for greenhouse strawberry production in Iran was reported to be 805376.3 MJ ha^{-1}.

The results showed that the most energy consuming input for cucumber production in the different greenhouses investigation was fuel (78.4%).Similar results were found in the literature that the highest energy item was diesel fuel in agricultural crop production (Cetin and Vardar. [6]; Esengunet al. [8]; Yilmazet al.[27]; Ozkanet al. [19]).Banaeianet al.[4], determined that 78% of total energy in greenhouse strawberry production is diesel energy inIran.Djevic and Dimitrijevic [10] determined that 92% of total energy in greenhouse lettuce production is diesel energy in Yugoslavia. High percentage of fuel consumption in the greenhouses of the studied region could be attributed to use of heaters with low efficiency, greenhouse holders do not attention to amount of fuel consumption and thermal management of greenhouse and also low price of fuel in Iran.The total energy equivalent of Chemicals consumption placed second among the energy inputs and constituted 6.26% of the total energy input, Human labour(5.64%), Electricity(4.9%) , chemical fertilizer (3.38%). Average annual yield of greenhouses investigated in one period was 188873kg ha^{-1}, and calculated total energy output was 151098.4MJ ha^{-1}.

The energy use efficiency, energy productivity, specific energy and net energy of cucumber production were shown in Table 3.Energy use efficiency or energy ratio was calculated as 0.14, showing the inefficiency use of energy in the greenhouse cucumber production. It is concluded that the energy ratio can be increased by raising the yield and/or by decreasing energy inputs consumption. Other results in different crops such as cotton of 0.74 for cotton reported by Pahlevan et al. [22], 0.27 for cucumber, Yilmazet al.[27], 0.76 for cucumber, 0.61 for eggplant, 0.99 for pepper (Ozkanet al. [21]) and 0.99 for tomato (Pashaee et al.[23]).

The average energy productivity of greenhouses was 0.176 kg MJ^{-1}. This means that 0.176 units output was obtained per unit energy. Calculation of energy productivity rate is well documented in soybean of 0.18 units DE et al.[7] and cherries of 0.51 units (Kizilaslan.[14]).The specific energy and net energy of cucumber production were 5.67MJ kg^{-1}and -919867.9 MJ ha-1, respectively. Net energy is negative (less than zero). Therefore, it can be concluded that in cucumber production, energy is being lost. High negative value for the net energy gain in greenhouse cucumber production has several reasons, traditional structure of greenhouses, low level technology of ventilation such as high consumption of diesel motors for heaters, lack of thermostat controller in suitable place of greenhouse make this negative value, reasonable.

Total mean energy input as direct, indirect, renewable and nonrenewable forms is given in Table 3. The total energy input consumed could be classified as direct energy (89%), indirect energy (11%), renewable energy (7%) and non-renewable energy (93%). Several researchers found that the ratio of direct energy is higher than indirect energy, and the rate of non-renewable energy was greater than renewable energy consumption in cropping systems as reported byBanaeian et al. [4], Esengun et al.[8], Kizilaslan. [14] and Ozkanet al. [19].

Economic model developing of cucumber production

Relationship between the energy inputs and yield was developed using Cobb–Douglas production function for the cucumber on different categories of greenhouse. Cucumber yield (endogenous variable) was assumed to be a function of human labour, machinery, fuel, chemical fertilizers, FYM, chemicals, water for irrigation, electricity and (exogenous variables). In validating the models I, II and III (Eqs.(7)–(9), respectively).The impact of energy inputs on yield was also investigated by developing Eq. (7).The coefficient of determination (R^2) was 0.97 for this model. Regression resultfor this model is shown in Table 4.

The contribution of human labour energy is significant at the 1% level. This indicates that with an additional use of 1% for human labour energy would lead, to 0.655% increase in yield. Also chemical fertilizer and FYM energies are significant at 1% level. Chemical energy is significant at 5% level.(Table4).Hatirli et al.[12] estimated an econometric model for greenhouse tomato production in Antalya province of Turkey. He concluded that among the energy inputs, human energy was found as the most important input that influences yield. Singh et al. [25] concluded that in zone 2 of Punjab, the impact of human and electrical energies were significant showed the productivity at 1% level.

The MPP value of model variables is shown in the last column of Table 4. The MPP of human labour and machinery inputs were found to be 2.08 and -0.125, respectively. This indicated that an increase of 1 MJ in each input of human labor and machinery energy, would lead to a change in yield by 2.08, -0.125 kg ha-1, respectively. The value of return to scale (RTS) for the Model I was calculated by gathering the regression coefficients as 0.94. The degree of returns to scale less than one implies decreasing returns to scale(DRS). These results indicate that 1% increase in all the energy inputs would result only by 0.94% increase in the cucumber production; so, the cucumber farmers were not operating at an optimal scale and for considerable changes in yield, technological change is required.

The regression coefficients of direct and indirect energies (Model II) as well as renewable and non-renewable energies (Model III) on yield were also investigated through Eqs. (8) and (9), respectively. The regression coefficients of indirect and renewable energies were all statistically significant at 1% leveland regression coefficient of direct whereas theNon-renewable energies was found insignificant (Table 5). The impacts of direct, indirect, renewable and non-renewable energies were estimated as -0.137, 0.663, 0.982 and 0.048, respectively. Similar result was reported by Heidariet al. [13] that stated the impact of renewable energy was more than non-renewable energy and indirect energy was more than direct energy. The R^2 value was 0.76 for estimated Model II and was 0.93 for Model III. The RTS values for the Models II and III were 0.526 and 1.03, respectively, implied DRS for Model II and IRS for Model III.The MPP values of indirect and renewable energies were 1.09 and 2.45, respectively (Table 5). It indicated that an additional use of 1 MJ in each of the indirect and renewable energies, would lead to an additional increase in yield by 1.09 and 2.45 kg ha^{-1}, respectively.

Economic analysis of cucumber production

The costs of each input used and calculated gross production values for cucumber production are given in Table 6. Fixed and variable costs within total production costs were calculated independently. The gross value of production (132211.1$ ha^{-1}) was found by multiplying the cucumber yield (188873 kg ha^{-1}) by cucumber price (0.7 $ kg^{-1}). The total cost of production was 70984$ ha^{-1}.About 87% of the total cost was fixed costs, whereas 13% was variable expenditures. Based on these results, the benefit–cost ratio from cucumber production in the surveyed greenhouses was calculated as 1.86 .These results are consistent with the findings reported by other authors, such as 2.37 in orange, 1.89 in lemon and 1.88 in mandarin (Ozkanet al.[21]), 1.83 and 2.21 in greenhouse and open-field grape (Ozkanet al. [15]) and 1.10 in soybean, 2.03in wheat, 1.98 in mustard and 2.30 in chickpea (Mandal*et al.*, 2002). The gross return of 77362 $ ha-1 was calculated by subtracting the variable cost of production per hectare (9223$ ha-1) from the gross value of production. The productivity (2.66kg $\$^{-1}$) was obtained by dividing cucumber yield (188873 kgha^{-1}) by total production costs (70984 $ ha^{-1}).

Optimization is an important tool to maximize the amount of productivity which can significantly impact the energy consumption and production costs. Optimization of energy usage in agricultural systems is reflected in two ways:- an increase in productivity with the existing level of energy inputs or conserving energy without affecting the productivity. In practice, a farmer has limited resources for the total cost of different inputs (chemicals, fuel, etc.)

Since each unit of cucumber production makes the same amount of profit, then the farmer would reasonably locate available resources to maximize the number of products it produces. This problem can be expressed in mathematical form as a linear programming. So, this study can be extended to identify efficient farmers from inefficient ones, determined wasteful uses of energy inputs by inefficient farmers and suggested necessary quantities of various inputs to be utilized by each inefficient farmer from every energy source.

Conclusions

In this study, the energy balance between the input and output for cucumber production was investigated. The total energy consumption in cucumber production was 1070966.3 MJ ha^{-1}. The energy input of fuels (diesel and natural gas) gave the biggest share within the total energy inputs followed chemicals, electricity and chemical fertilizer, respectively. High percentage of fuels and consumption in the greenhouse of the studied region are due to use of heaters with low efficiency and also low price of fuels and electricity in Iran (about 0.02 $ L-1 for diesel and 0.002 $ kWh^{-1}for electricity in agricultural section). On average, 89% of total energy input used in cucumber production was direct affected, while the contribution of indirect energy was 11%. Also the shares of renewable and nonrenewable energy inputs were 7% and 93%, respectively. The impact of human labor, Chemical fertilizers and Farmyard manure energy inputs was significantly positive on yield. The MPP value of human labor was the highest. Energy management becomes more important when the required energy should be economical, sustainable and productive. It is concluded that reduce fuels, electricity consumptions are important for energy saving and decreasing the environmental risk problem in the area. Since electric pumps are old, high level of electricity energy is used. Reducing diesel fuel consumption, important for energy management. Saving in fuel by improving heating performance may be possible introduced. The benefit cost ratio was found to be 1.86, in the result of economic analysis of cucumber production. The mean net return from cucumber production was obtained 61227.7$ ha^{-1}.

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