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Energy storage in field operations of sunflower production using data envelopment analysis approach

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Abstract

This study applies a Data Envelopment Analysis (DEA) approach to analyze the technical and scale efficiencies of farmers with respect to energy use for oilseed sunflower production in Golestan province, Iran. This study also helps to segregate the efficient and inefficient farmers, identify the wasteful usage of energy by inefficient farmers and to suggest reasonable saving of energy. The results revealed that total operational energy of 6771.1 MJ ha^{-1} was consumed for sunflower production and the irrigation operations had the highest share. About 64% of farmers were technically efficient and the mean efficiency of farmers was found to be 0.85 and 0.94 under constant and variable returns to scale assumptions, respectively. The results also revealed that, by raising the performance of inefficient farmers to the highest level, on average, about 9.3% of total operational input energy could be saved. Moreover, energy saving from irrigation operation had the highest share (76.9%). From this study improvement of timing, amount, and reliability of water applications and utilization of new irrigation systems with high efficiency is suggested to improve the energy use efficiency and to reduce the environmental impacts.

Keywords: Energy storage; Operational energy; DEA; Sunflower production; Environmental impact.

1. Introduction

Sunflower (*Helianthus annuus L.*) is one of the most widely cultivated and important oilseed crops in the world [1]. Its common uses include food, medicine, and dyes; but the sunflower seed is often pounded into flour and used in cakes, mush, and bread [2]. Sunflower seeds contain a high amount of oil (40%–50%) which is an important source of polyunsaturated fatty acid of potential health benefits [2].

Energy, economics, and the environment are mutually dependent [3]. There is a close relationship between agriculture and energy. Agriculture itself serves a dual role as an energy user, but also energy supplier in the form of bio-energy. At the present time, the productivity and profitability of agriculture depend upon energy consumption [4]. Energy consumption in agriculture is directly related to the development of technology in farming and the level of mechanization. Efficient use of energy in agriculture will minimize environmental problems, prevent destruction of natural resources, and promote sustainable agriculture as an economical production system [5]. There are several parametric and non-parametric techniques to measure the efficiency in agricultural production. In some studies the econometric approach has been used to identify the relationship between energy consumption from different inputs and yield values of crop productions [6,7]; this method is parametric and estimates the parameters of the production or cost functions statistically. Similarly in a number of recent researches, the indicators of energy output to input ratio and energy productivity in crop production systems have been used to evaluate the energy efficiency and performance of farmers [8-10].

On the other hand, Data Envelopment Analysis (DEA) is a non-parametric approach that uses a linear programming (LP) based technique of frontier estimation to assess the relative efficiencies of a number of decision making units (DMUs) on the basis of multiple inputs and outputs [11]. DEA can be applied to measure the technical efficiency in details by examining both the scale and management (non-scale) factors [12]. The main advantage of non-parametric method of DEA compared to parametric approaches is that it does not require any prior assumption on the underlying functional relationship between inputs and outputs [13].

In recent years, DEA has been used in agricultural enterprises: In an earlier study, Fraser and Cordina [14] applied DEA to evaluate the technical efficiency of input use for irrigated dairy farms in Australia. They reported that DEA was a useful tool in helping to benchmark the dairy industry, which is continually striving to improve the productive efficiency of farms. Subsequently, DEA was used to investigate the efficiency of individual farmers and to identify the efficient ones in citrus production in Spain [15]. In another study [16] the technique was applied to benchmark the productive efficiency of irrigated wheat area in Pakistan and India based on three inputs of irrigation, seed and fertilizer. Nassiri and Singh [17] applied the DEA technique to the data of energy use for paddy production in India. They assumed energy equivalents of different inputs as input variables and the paddy yield as output variable. Finally, Omid et al. [18] employed this technique to analyze the technical and scale efficiencies of greenhouse cucumber producers in Iran.

The previous studies are focus on efficiency estimation of farmers in terms of input consumption from different sources. The energy usage analysis in terms of different operations of crop production provides a closer insight into the pathways to reduce energy inputs by targeting improvements in specific production operations for agricultural crops [19]. Energy consumption in various operations can also be considered for a DEA type study. Such a study will help to pinpoint more precisely the agricultural practices at the operation level that make a farmer efficient [20].

The present study employs a non-parametric DEA technique to optimize the energy consumption in different field operations of sunflower production in Golestan province of Iran. This study also helps to discriminate efficient farmers from inefficient ones and to identify the wastage of energy in different operations.

2. Materials and methods

2.1 Data

Data used in this study were collected from 95 sunflower farms in Golestan province of Iran in the production period of 2009-2010. Golestan province is the main centre of oilseed production in the country. Data were included the amount of all operational energy inputs and output as well as socio-economic structures of farms. The information about sampling and energy balance analysis methods has been presented in our previous study [21], in which, the energy use pattern for sunflower production was investigated.

2.2 Data envelopment analysis technique

In this study, the DEA technique was employed to estimate the efficiencies of individual farmers. So, each farmer called a DMU and the energy consumptions in different operations, including tillage, sowing, irrigation, weeding, fertilizer and chemical applications, harvesting and transportation were defined as input variables; while, sunflower yield was the output variable.

In DEA an inefficient DMU can be made efficient either by minimizing the input levels while maintaining the same level of outputs (input oriented), or, symmetrically, by reducing the output levels while holding the inputs constant (output oriented). Sunflower production similar to other crop productions [16,18] relies on finite and scarce resources; therefore, the use of input-oriented DEA models is more appropriate to reduce inputs consumed in the production process.

In order to analyze the efficiencies of farmers, the technical, pure technical and scale efficiency indices were investigated [17].

2.2.1 Technical efficiency (TE)

TE can be defined as the ability of a DMU (e.g. a farm) to produce maximum output given a set of inputs and technology level. The TE score (θ) in the presence of multiple-input and output factor can be calculated by the ratio of sum of weighted outputs to the sum of weighted inputs or in a mathematical expression as follows [22]:

$$\theta = \frac{u_1 y_{1j} + u_2 y_{2j} + \ldots + u_s y_{sj}}{v_1 x_{1j} + v_2 x_{2j} + \ldots + v_m x_{mj}} \qquad (1)$$

Let the DMU$_j$ to be evaluated on any trial be designated as DMU$_o$ (o = 1, 2, . . ., n). To measure the relative efficiency of a DMUo based on a series of n DMUs, the model is structured as a fractional programming problem as follows [23]:

$$Max{:}\ \theta = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \qquad (2)$$

S.t:

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1 \qquad j = 1, 2, \ldots, n$$

$$u_r \ge 0,\ v_i \ge 0$$

where n is the number of DMUs in the comparison, s the number of outputs, m the number of inputs, u_r (r = 1, 2, …, s) the weighting of output y_r in the comparison, v_i (i = 1, 2, …, m) the weighting of input x_i, and y_{rj} and x_{ij} represent the values of the outputs and inputs y_j and x_i for DMU$_j$, respectively. Eq. (2) can equivalently be written as a LP problem as follows [23]:

$$\text{Max}{:}\ \theta = \sum_{r=1}^{s} u_r y_{ro} \qquad (3)$$

S.t:

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1, 2, \ldots, n$$

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$u_r \ge 0,\ v_i \ge 0,$$

In reality, the dual linear programming (DLP) problem is simpler to solve than Eq. (3) due to fewer constraints. Mathematically, the DLP is written in vector–matrix notation [23]:

$$\text{Min}{:}\theta \qquad (4)$$

S.t:

$$Y\lambda \ge y_o$$

$$X\lambda - \theta x_o \le 0$$

$$\lambda \ge 0$$

where x_o is the $m \times 1$ vector of the value of original inputs and y_o is the $s \times 1$ vector of the value of original outputs produced by the o^{th} DMU. Y is the $s \times n$ matrix of outputs and X is the $m \times n$ matrix of inputs of all n units included in the sample. λ is a $n \times 1$ vector of weights and θ is a scalar with boundaries of one and zero which determines the technical efficiency score of each DMU. Model (4) is known as the input-oriented CCR DEA model. It assumes constant returns to scale (CRS), implying that a given increase in inputs would result in a proportionate increase in outputs.

2.2.2 Pure technical efficiency (PTE)

In DEA, the TE can be divided into SE for scale factors and PTE for non-scale factors; the PTE is the TE that has the effect of SE removed. The model for calculating the PTE was introduced by Banker et al. [24], which was called BCC model. The BCC model is provided by adding a restriction on λ (λ =1) in the model (4), resulted to no condition on the allowable returns to scale. It assums variable returns to scale (VRS), indicating that a change in inputs is expected to result in a disproportionate change in output.

2.2.3 Scale efficiency (SE)

SE relates to the most efficient scale of operations in the sense of maximizing the average productivity. A scale efficient farmer has the same level of technical and pure technical efficiency scores. It can be calculated as below [17]:

$$SE = \frac{TE}{PTE} \tag{5}$$

SE gives the quantitative information of scale characteristics. It is the potential productivity gained from achieving optimum size of a DMU. The information on whether a farmer operates at constant or variable returns to scale status is particularly helpful in indicating the potential redistribution of resources between the farmers, and thus, enables them to achieve to the higher output [20].

The results of standard DEA models divide the DMUs into two sets of efficient and inefficient units. The inefficient units can be ranked according to their efficiency scores; while, DEA lacks the capacity to discriminate between efficient units. A number of methods are in use to enhance the discriminating capacity of DEA [25]. In this study, the bencmarking method was applied to overcome this problem. In this method, an efficient unit which is chosen as the useful target for many inefficient DMUs and so appears frequently in the referent sets, is highly ranked.

In this study, the Microsoft Excel spreadsheet and the Frontier Analyst software were employed to analyze the data.

3. Results and discussion

In Table 1 the descriptive statistic for the variables used in this study are presented. Also, the percentages associated of energy use in different operations are illustrated in Figure 1. As it is seen from Table 1, a wide variation in both the energy inputs and output is noticeable. Such a variation in the levels of inputs being used represents a mismanagement of resource usage between the farmers, indicating that there is a great scope for improving the efficiency of energy consumption in farming practices for sunflower production.

Table 1. Descriptive statistics of variable used in the models

Item	Average	Max	Min	SD
A. Inputs (MJ ha^{-1})				
1. Tillage	1715.8	3396	447	604
2. Sowing	349.6	585	72	127
3. Irrigation	2451.5	16580	0	5807
4. Weeding	77.9	310	0	74
5. Application	208	709	0	164
6. Harvesting	1276.3	3838	110	917
7. Transportation	591.9	5224	115	898
Total energy input	6671.1	34393	1513	5408
B. Output				
1. Grain yield (kg ha^{-1})	1626.5	2667	700	382

The total energy input in field operations was calculated as 6671.1 MJ ha^{-1}; also, from Figure 1 it is evident that, The highest contribution from total operational energy was consumed in irrigation operation (36.7%), followed by tillage (25.7%) and harvesting (19.1%). The majority of energy in irrigation operation was consumed in direct form as electricity energy. Diesel fuel was the major energy consumer input in both the tillage and harvesting operations.

Canakci et al. [26] reported that the total energy consumption in the various farm operations for cultivating the cotton, maize and sesame crops was 14348.9, 11366.2 and 5398.2 MJ ha^{-1}, respectively; also, the irrigation and seedbed preparation operations were the most energy consumer operations for all of the field crops. Singh et al. [27] investigated the energy consumption in different operations of selective crops in India; they found that, total operational energy consumption for cluster bean, cotton, maize, wheat and mustard was 2728.9, 11549, 6196.9, 10257.3 and 7145.1 MJ ha^{-1}, respectively. Also, the seedbed preparation and irrigation consumed the maximum contribution from total operational energy.

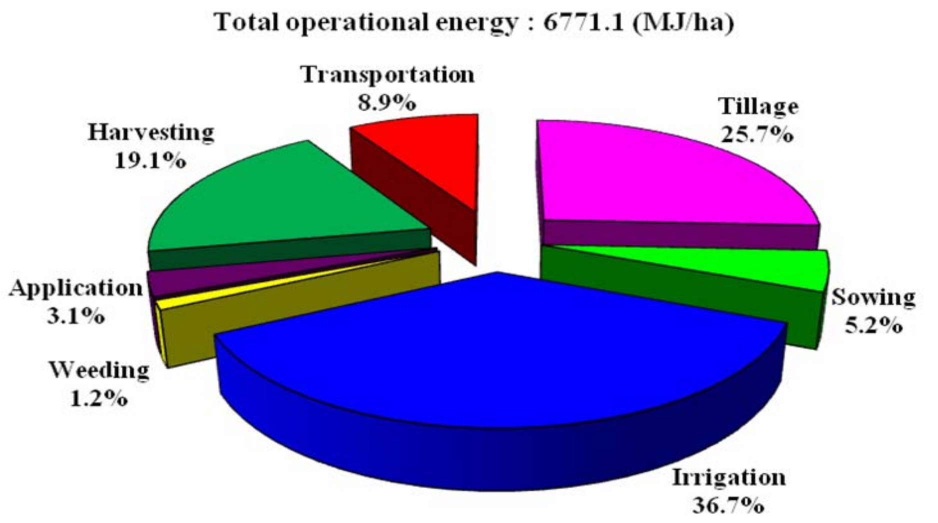

Figure 1. Contribution of energy use in different operations of sunflower production

For investigating the efficiency scores of farmers, both the CCR and BCC models were employed for the specified input and output variables. The efficiency score distributions of farmers are depicted in Figure 2. As it is evident, about 42% (40 farmers) and 64% (61 farmers) from total farmers were recognized as efficient under constant and variable returns to scale assumptions, respectively. From these efficient farmers 40 ones were fully efficient in both the technical and pure technical efficiency scores, indicating that they were operating at the most productive scale size of farms; while, the reminder of 21 ones were confronted with disadvantagiouse conditions of scale size of production; however, they moved toward the BCC efficient frontier when the effect of scale size was omited. On the other hand, from inefficient farmers 7 and 10 ones, with respect, had their technical and pure technical efficiency scores in the 0.9 to 0.99 range. This means that the farmers should be able to produce the same level of output using the efficiency score of their current level of energy input when compared to their benchmark which are constructed from the best performers with similar characteristics.

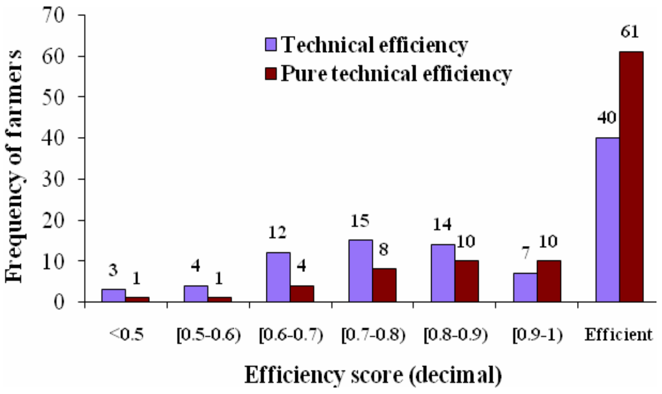

Figure 2. Efficiency score distribution of sunflower producers

The summarized statistics for the three estimated measures of efficiencies are presented in Table 2. The technical, pure technical and scale efficiency scores were calculated as 0.85, 0.94 and 0.91, respectively. Also, the high variation in technical efficiency scores of farmers is noticeable; indicating that all the farmers were not fully aware of the right production techniques or did not apply them at the proper time in the optimum quantity. Chauhan et al. [20] investigated the optimization of energy input for paddy production in India. They reported that the technical, pure technical and scale efficiency scores were 0.77, 0.92 and 0.83, respectively.

Table 2. Average efficiencies of the farmers

Particular	Average	SD	Min	Max
Technical efficiency	0.85	0.16	0.46	1
Pure technical efficiency	0.94	0.11	0.50	1
Scale efficiency	0.91	0.12	0.58	1

For ranking the efficient units, the benchmarking method was used. the results of ranking the 10 superior efficient farmers are tabulated in Table 3. Considering the results obtained by the study, DMUs 96, 84, 108, 40 and 30 appear 56, 32, 30, 26 and 25 times in the referent set, respectively. Those efficient DMUs that appear more frequently in the referent set of inefficient DMUs, are considered superior because they are not only efficient but are also close to input–output levels of inefficient DMUs in the sample. By considering these farmers as benchmarks, inefficient farmers are capable to determine which changes in energy use in operations are necessary in order to establish the best practice management and improve their performance.

Table 3. Ranking 10 superior efficient farmers based on the results of BCC model

Benchmark ranking	Farmer No.	Times references	Benchmark ranking	Farmer No.	Times references
1	20	21	6	58	7
2	94	13	7	24	6
3	59	12	8	1	5
4	57	10	9	4	5
5	41	9	10	72	5

Table 4 presents a comparison between 10 superior efficient farmers and inefficient ones with respect to energy use in different operations of sunflower production. It is evident that, energy consumption in all of the field operations for inefficient farmers was higher than that of efficient ones; so that, total operational energy for inefficient farmers with compared to efficient ones was about 60% higher. The energy consumption in irrigation operations for inefficient farmers was more than three times higher than that of efficient ones. This was mainly due to excessive use of irrigation water resulted in high use of electricity in pumping systems. In other operations, the diesel fuel, used for operating the machinery was the main energy consumer input [21] and also had the highest inefficient use. On the other hand, the sunflower yield obtained by inefficient farmers was found to be 9.8% lower than that of the superior efficient ones. Totally, the results indicate that inefficient farmers have not used the resources efficiently.

The improper use of machinery and groundwater in agricultural practices may result in land quality degradation such as soil erosion, compaction, salinization and reduction of organic matter. The high water input in sunflower farms may exacerbate the problem of soil drainage and excessive leaching of water to shallow groundwater aquifers which may impact groundwater table and soil salinity dynamics [19]. Also, Soil compaction may be caused by the repetitive and cumulative effect of heavy machinery, resulting in reduction of soil porosity and root penetration and alters the biological activity on the farm scale. On the watershed scale, soil compaction increases surface runoff and water erosion, loss of topsoil and nutrients, and non-point source pollution of water resources [28].

The results of optimization of energy in different operations are tabulated in Table 5, in which, the target energy requirement, saving energy and the saving percentage are presented. The results revealed that from different practices, a total energy of 6048.2 MJ ha^{-1} was required for sunflower production in target condition; from which the major contribution was required for irrigation practices (1972.7 MJ ha^{-1}), followed by tillage (1673.3 MJ ha^{-1}), harvesting (1234.3 MJ ha^{-1}) and irrigation (1685.8 MJ ha^{-1}) operations. Moreover, the operational energy in transportation, sowing and fertilizer and chemical application operations was required as 573.6, 332.1 and 191.4 MJ ha^{-1}, respectively; while, the target energy requirement for weeding practices was the lowest.

Table 4. Comparison of operational energy inputs and output for 10 superior efficient farmers and inefficient ones

Item	10 superior efficient farmers (A)	Inefficient farmers (B)	Difference (%) (B-A)*100/A
A. Inputs (MJ ha^{-1})			
1. Tillage	1583.1	1833	15.8
2. Sowing	282.5	373.8	32.3
3. Irrigation	632.6	2682.3	324
4. Weeding	32.9	100.8	206.4
5. Application	151.5	265.7	75.4
6. Harvesting	1346.5	1391.4	3.3
7. Transportation	401.6	451.9	12.5
Total energy input	4430.8	7098.8	60.2
B. Output (kg ha^{-1})			
1. Grain yield	1790	1614.2	-9.8

Table 5. Target and savings of operational energy for sunflower production in Golestan, Iran

Input	Target value (MJ ha^{-1})	Saving value (MJ ha^{-1})	Saving (%)
Tillage	1673.3	42.5	2.5
Sowing	332.1	17.6	5
Irrigation	1972.7	478.8	19.5
Weeding	70.8	7.1	9.1
Application	191.4	16.6	8
Harvesting	1234.3	42	3.3
Transportation	573.6	18.3	3.1
Total	6048.2	622.9	9.3

The total saving energy was calculated as 622.9 MJ ha^{-1}; which consisted of as 9.3% from total energy consumption in present condition in sunflower production operations. Furthermore, the results revealed that, the energy consumption for irrigation, weeding, fertilizer and chemical application and sowing may be saved by 19.5%, 9.1%, 8% and 5%, respectively. Chauhan et al. [20] used DEA approach to determine the efficiencies of farmers with regard to energy use in rice production activities. They found that an average 12% of the total input energy could be saved if the farmers follow the input package recommended by the study.

Figure 3 shows the potential improvement of energy consumption from different operations. The results revealed that from the total saving energy, the share of irrigation energy (76.9%) was the highest; indicating that there is a great scope for saving energy by improving the energy use in irrigation operation. It followed by tillage (6.8%) and harvesting (6.7%) practices, respectively. Given their higher potential to improve the energy use efficiency, it is recommended that the energy usage pattern in these operations be considered as priorities providing significant conservation of energy consumption for sunflower production in surveyed region.

Improving timing, amount, and reliability of water applications, utilization of new irrigation systems with high efficiency, increasing the water pumping systems efficiency by timely maintenance and repair practices or employing technological upgrade to reduce fossil-fuel inputs by substitution with renewable energy such as biogas and solar energy could be the pathways to make the sunflower production more environmental friendly and thus reduce its environmental footprints. Moreover, proper tractor selection, applying a better machinery management technique, employing the conservation tillage method such as no-till and minimum tillage, good maintenance of harvester combines and introducing of suitable headers for combines in the area may help to save the energy consumption in these operations, improve the efficiency of energy use and to reduce their environmental impacts.

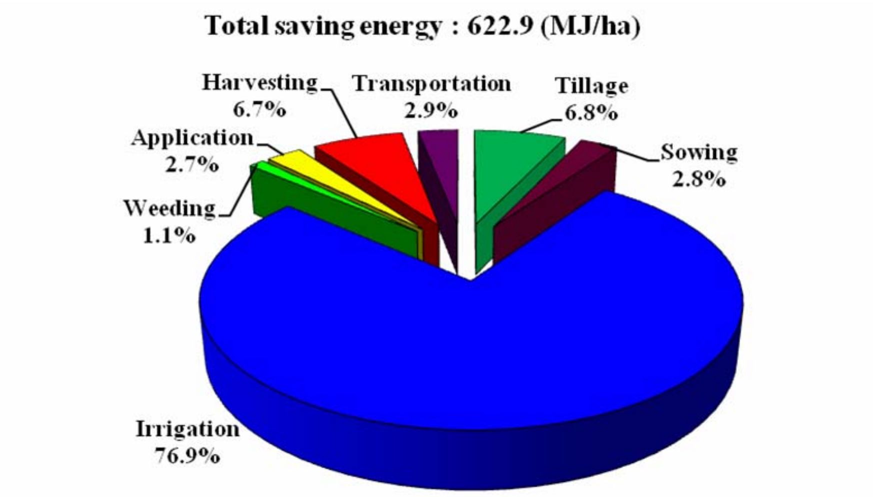

Figure 3. Distribution of saving energy for each operation

A pure technical efficiency score of less than one for a farmer indicates that, at present conditions, he is using more energy than required value. Therefore, it is desired to suggest realistic levels of energy to be used in each operation for every inefficient farmer in order to avert wastage of energy without reducing the yield level. In Table 6 the operation wise present and target quantities of energy inputs (MJ ha^{-1}) for individual inefficient farmers in sunflower production are presented. Using this information, it is possible to advise an inefficient farmer regarding the better operating practices followed by his peers. The target values of energy requirement are the recommendations resulted from this study, indicating how individual inefficient farmers can reduce their practice wise energy inputs without reducing their output level; so suggestion of these results will help to improve efficiency of farmers for sunflower production in surveyed region. The energy saving percentage for inefficient farmers is tabulated in the last column of Table 6. It is evident that, the PTE score for inefficient farmers was averagely as 0.83; also, total operational energy for inefficient farmers could be saved by 15.3%.

4. Conclusions

In this study the performance of 95 farmers with respect to energy consumption in field practices for sunflower production in Golestan province of Iran was investigated. For this purpose the input-oriented CCR and BCC DEA models have been applied. The methodology presented in this paper demonstrates how farmers may benefit from applying operational management tools to assess their performance. The results revealed that 64% of farmers were operated efficiently and the inefficient farmers generally used higher energy inputs in all of the operations resulting in soil quality degradation, yield reduction and risk on environment and human health. The total target energy requirement was just 6048.2 MJ ha^{-1}. Accordingly, about 9.3% from total energy consumption in present condition could be saved without affecting the yield level. Irrigation operation had the highest potential for improving the energy efficiency; it followed by tillage and harvesting operations. Therefore, investments are needed in new technologies and farming practices to make sunflower production more sustainable and improve the energy use efficiency without impacting the environment.

Table 6. The operation wise present and target quantities of energy inputs for inefficient farmers in sunflower production in Golestan, Iran

DMU	PTE	Present quantity (MJ ha^{-1})							Target quantity (MJ ha^{-1})							Saving (%)
		Tillage	Sowing	Irrigation	Weeding	Application	Harvesting	Transportation	Tillage	Sowing	Irrigation	Weeding	Application	Harvesting	Transportation	
7	0.99	2120	452	16654	251	144	3198	2136	2120	386	1771	44	144	3198	1057	65.1
10	0.79	3396	549	8453	151	217	3207	356	3151	506	8453	53	217	3207	356	2.4
11	0.89	2971	549	581	100	217	2727	356	2781	468	581	44	217	2727	356	4.4
17	0.96	1306	380	0	138	0	325	237	1306	380	0	105	0	268	237	3.8
28	0.68	1976	585	0	38	275	960	446	1976	536	0	38	275	960	446	1.1
29	0.72	1399	292	0	188	179	1233	374	1399	239	0	188	171	1233	374	1.7
31	0.90	1678	109	0	110	208	960	214	1317	109	0	110	197	960	203	11.7
32	0.77	1366	366	0	107	203	2399	128	1366	329	0	107	158	1432	128	22.9
33	0.82	1678	109	0	113	270	1439	128	1678	109	0	113	245	1305	128	4.3
34	0.50	2103	366	0	157	514	2138	285	2103	366	0	157	399	1890	285	6.5
39	0.89	1917	562	0	63	166	609	451	1917	407	0	63	166	609	329	7.3
40	0.78	1638	287	0	276	274	303	240	1277	287	0	212	212	303	208	17.2
43	0.74	1705	564	0	78	406	1288	128	1705	418	0	78	210	1288	128	8.2
46	0.90	2130	567	0	94	135	264	197	1390	361	0	94	135	264	197	27.9
47	0.66	1371	283	0	134	203	2209	366	1371	283	0	134	203	1765	366	9.7
49	0.67	1319	401	0	113	270	525	255	1319	374	0	113	270	525	181	3.5
50	0.88	882	377	0	85	135	2053	163	882	266	0	85	135	932	163	33.4
51	0.99	1306	377	0	0	273	381	171	1221	377	0	0	273	381	171	3.4
52	0.58	1519	377	0	188	273	517	199	1519	354	0	188	273	517	179	1.4
54	0.78	2239	267	0	132	269	360	136	1800	267	0	132	199	360	136	15
60	0.65	1893	274	0	157	278	1814	320	1893	238	0	157	226	1814	320	1.9
66	0.96	1355	564	0	47	166	554	415	1355	345	0	47	166	554	276	11.6
67	0.96	1168	191	0	78	138	1069	157	1168	191	0	78	138	1069	157	0
68	0.98	1385	366	4320	0	311	1105	342	1385	280	2550	0	311	1105	159	26
75	0.94	1842	366	2372	0	286	2571	249	1842	366	2372	0	286	2571	249	0
76	0.95	2201	274	2039	38	556	2399	356	2178	274	2039	23	186	2194	356	7.8
77	0.94	1198	329	12441	0	144	1105	269	1198	329	1305	0	144	1105	187	72.4
81	0.87	1532	457	19864	0	393	2430	267	1532	408	7766	0	393	2430	267	48.7
86	0.85	2304	274	1361	38	674	1199	121	2058	274	1361	38	244	1199	121	11.3
88	0.79	2210	439	3238	88	145	1693	115	2210	339	3238	68	145	1693	115	1.5
90	0.88	1944	380	0	188	278	272	149	1160	259	0	173	159	272	149	32.3
91	0.86	2818	366	8448	63	499	2879	196	2259	366	4703	36	426	2187	196	33.4
92	0.78	2508	366	2199	47	112	2399	64	2508	306	1310	15	112	2276	64	14.3
95	0.81	2238	439	6544	163	290	2563	160	2238	439	5575	54	290	2563	160	8.7
Ave	0.83	1842	380	2603	101	262	1504	298	1723	330	1265	81	215	1387	247	15.3

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