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Dry farming wheat in peasant farming system in Kuhdasht county of Iran: energy consuming and economic efficiency

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In addition to role and vital importance of peasants, survival and durability of them under golobalization process is doubtable. One of characteristics of this exploitable system is that economic and energy efficiency is low because of small units. One of problems at agricultural sector is that energy consuming at agricultural production to other economic sectors has increased for high speed of mechanized works and using of fertilazers that this rate of energy consuming is dependent to employ population in this sector and rate of cultivatable lands and mechanization level. The propose of this study is considering of energy consuming process and economic operation of dry farming wheat production in Kohdasht county. The statistical populations had formed of 57 persons of farmers that planted dry farming wheat, that were chosen by random sampling and data collection instrument was questionnaire. The whole input energy accounted 10143MJ/ha and output energy 39541 MJ/ha that fuel of disel, fertilizer and seed respectingly 39%, 33% and 21% were the most input energy. Grain and straw respectivly from 66% and 34% of output energy was found. The energy ratio for grain and total accounted 2.6 and 3.9. According to economic, the production of dry farming wheat has economic profit and net margin of each hectare is 3,428,000 Rials.Opportunity cost of land, machinery and seed are 35%, 28% and 17%, respectivly and have the most share in production cost.

Key words: peasant farming system, dry farming wheat, energy ratio, economic efficiency, Kohdasht County.

Introduction

Farming is one of human activities that is dependent to earth (Matson *et al*., 1997; Tilman *et al*., 2001) and always have had a vital role in social and human development and will have this role in future. In most of developing countries, farming has an important role on economic and stability at agricultural sector must result in decreasing of poverty, food security and

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permanent income for population's growth (Lee, 2005; Bhutto and Bazmi, 2007).

As the new millennium approaches, the world faces a massive food security and production challenge. Although the world population currently stands at 5.9 billion people, the UN Population projects increases to 7.5 billion by 2020 and to 8.4 billion by 2050, by which time 84% of the world's population will be in those countries that currently make up the 'developing world (Pretty, 1999).

Nowadays, agricultural sector for providing more food needed the population increase like other sectors has depended to energy sources like electricity and fossil fuels (Gowdy *et al*., 1987; Hatirli *et al*., 2005). In reaction to population's increase, limitation of arable lands and rise of life standards level, consuming of energy at agricultural sectore has increased (Hiremath *et al*., 2007). These factors at all societies have increased input energy for maximum production of crop or minimum concentraction of labour force at operation and or both of them (Esengun *et al*., 2007).

Consuming of energy at agricultural productions in relation to other economic sectors of world has increased more for high speed of mechanization and using of reenforcements like commerical fertilizers (Karkacier and Goktolgu, 2005), the rate of energy consuming to employ population in this sector is dependent to the rate of cultivated lands and mechnization level (Ozkan *et al*., 2004). Different agricultural sectors that are consuming or productive nets, have different energy situation (Karkacier and Goktolgu, 2005) and can be as consumer and producer of energy in form of bioenergy (Alam *et al*., 2005).

Energy efficiency in farming is one of criteria of agricultural stability consideration and increasing of it causes economic saving, sources protection and pollution decreasing (Pervanchon *et al*., 2002). Energy, economic and environment are dependent to each other. Agriculture has communication with energy so that, in addition to consuming of energy, provides energy and profitablity of it is related to energy consuming (Hatirli *et al*., 2005). Energy is the main element at economic processes. The lack of energy causes serious limitation in developing countries and countries with low income (WEC, 2000).

The knowledge of energy consuming at each productive operation is a useful method for determining areas that consume energy that is cleaned with analyzing of consuming rate in production operation. Analysis of energy gives this possibility a productive unit that existed operation levels to compare with new method of production and or production lines to be adjusted (Jekayinfa, 2007). In fact, awarness of energy sources and consuming methodes for proper policy for increasing of productive systems output are important especially in

developing countries (Mani *et al*., 2007). Sources limitation and effects of using different energy sources on environment and human's health show the necessity use of energy in farming (Hatirli *et al*., 2005).

Agriculture in Iran

Agriculture is one of the most important economic sectors of Iran. Its contribution to GDP is approximately 27 percent, in employment is 23 percent (employed 3.5 million people) and its share in non-oil exports is 24 percent. In recent years, the agriculture sector has shown a significant development potential. It can meet 85 percent of Iran's food need and 90 percent of the raw material need of its food processing industries. Therefore, the agriculture sector has the most important place in the macroeconomics in Iran (Kalantari and Abdollahzadeh, 2008; Fami *et al*., 2009).

The 2004 public agricultural census revealed that from the total number of 3,473,383 of farming plots which are owned by farmers, 3011461 (approximately 86.7 percent) of them held less than 10 hectares from which 34.62 percent less than 1 hectare; 15.04 percent 1 to 2 hectare (s); 22.91 percent 2-5 hectares and finally 14.12 percent 5-10 hectares (Ashrafi *et al*., 2007; Fami *et al*., 2009).

Characteristic of peasant farming system

In general, peasantry is hard to define. Historically, it has survived within different social systems. While maintaining some of its basic characteristics, it has also been affected by these systems. Today the characteristics that distinguish peasant farming from kinds are declining in strength. The main characteristics may be defined as primary reliance on family labor (Long, N., 1984; Fami *et al*., 2009) and the fusion of commodity production with the domestic economy of household (Buttel, 1982). Thus, the peasant's motivation for production is not only determined by considerations of profit, but also the needs of the family. Capital investment in production equipment is low since these farms mainly exist to produce crops without any aim for expansion, i.e. for the survival of those who grow them. On the other hand, peasants must be able to call upon members of other families for mutual economic, social and emotional help (Moghadam, 1996).

In addition to role and vital importance of peasants, durability and survival of them under golobalization process is doubtable. There is a possitive relation between farmer's size and labour productivity (Shenggen and Chan-kang, 2005). Most time, injustice distribution of agricultural lands is known as

inefficiency factor in farming. It means that if land distribution among exploiters is more compatible and Gini coefficient will become near to zero and productivity becomes more too (Vollrath, 2004). Farmers' productivity decreases with increasing of fragments of lands. The regression analyzed results showed that in addion to fragments of land, the distance of farmers from dwelling place of farmers and also farming productions share from whole factors have meaningful and negative effect (Lermam and Cimpoises, 2006). Considerations show that small and middle farmers in field of using nitrogen fertilizer has no efficiency in view point of economic and allocating efficiency of large farmers is more than middle farmers and middle farmers is more than small farmers (Torkamani and Hardaker, 1996).

One of reasons about the low technical efficiency of small exploitabilities is the low amount of investing in creating of substructures especially in providing farming water (Rios, 2005). If more sources are invested in extension services and accessibility to credibilities is improved and scattering of farms be less, technical efficiency improvement in farmers will result (Obwona, 2006). For helping small farmers' prosperity under golobalization process, governments have to change some of their tendencies. For example innovative land reform is essential for legal security of these kinds of farmers and increasing of their farm's size. In addition to these reforms of public organizations to help the peasants for accessibility to credibilities, marketing and innovation become importance and the variety of valuable productions are an important role in their increased income (Shenggen and Chan-kang, 2005).

Kohdasht County with extent of 3904 Km^2 has located in longitude of 47 degrees and 39 minutes at east and in latitude of 33 degrees and 31 minutes in north. This county is placed in semiarid region in west of Lorestan province and hight of it from sea surface is 1198 meters. Annual rainfall average of county is 405 milimeters, the minimum temperature is -20.6°C and maximum temperature is 43 °C (Anon, 2009). Number of exploitable units of county is 15000 units that 70 percent of them have a space under 10 hectars and place in group of peasant farming system units. Wheat under cultivated land in Kohdasht County is 51000 hectars that about 35000 hectars of this rate cultivate in form of dry farming (Anon, 2006).

The energy importance in fields of economic, environmental and human’s health, determining of consuming energy of dry farming and its economic operation at peasant farming system are an essential affair. The purpose of this study was to process energy consuming and assessment of economic operation of dry farming wheat production in Kuhdasht county and presenting of increasing ways of energy output and economic efficiency.

Materials and methods

This research was applicable purpose and in view of data collection was a kind of field researches. The statistical populations of this study designed as dry farming wheat farmers of Kohdasht County. The data were collected through a well-structured questionnaire. Validity of the questionnaire was assessed through expert judgment. Applying random sampling technique, 57 dry farming wheat were selected that have fewer than 10 hectars land and interviewed.The sample volume is estimated by using of equation (1).

$$n = \frac{Nt^2S^2}{Nd^2 + t^2S^2} \quad (1)$$

N is the size of statistic society or number of dry farming wheat farmers in region, t as acceptable confident coefficient that with normal supposition of related adjective distribution from normal student t table. S2 is variance evaluation of studied adjective (Efficent variance of using energy). The Cultivation of dry farming wheat in this county is in form of mechanization (to plow with and cultivation with). In region, it is used of MF 285 tractor for operation of plough, fertilizing, spraying, transportation and thresher. Harvest takes place with combine that most of combines are Jhandeer 955.

Direct energy in production of dry farming wheat include of diesel fuel and human force and indirect energy includes of consumed energy in production of machineries and agricultural tools, fertilizers and energy equal of Machines includes of energy equal of machines that be used in tillage, planting, fertilizing, spraying and harvesting.

For calculating of labour energy, number of whole necessary labour f took into consideration at all production of operations levels. Equal energy of labour force is 1.96 MJ/h (Singh and Mital, 1992) that with multiplication of it in necessary labour for each hectare, achieved energy of labor for each hectare.

Diesel fuel for creating of power by tractor that it is used for ploughing, spraying, fertilizing, threshing and transportation and harvest with combine by tractor were estimated. Diesel fuel energy is equal to multiplication of consuming amount of it was in hectare in equal energy coefficient of it.

Machines energy achieved by considering of their equal energy and economic life and whole output houres at each hectare. Inputs equal energy of fertilizer, pesticide, fungicide and seed are equal with multiplication of consuming amount at each hectare in their energy equal coefficient. Consuming of phosphate and nitrogen fertilizer are customary in dry farming wheat production in region. Exiting energy contains of equal energy of grain and straw. Straw is used for herbivorous animal.

The important criteria for energy consuming assessment on agricultural sector related with technique and quality of input that consume for production, so the criteria of energy ratio, energy productivity and exiting pure energy and energy intensity are achieved of equations 2, 3 and 4 (Hatirli *et al*., 2006).

$$\text{Energy ratio} = \frac{\text{Output energy } \left(\frac{\text{MJ}}{\text{ha}}\right)}{\text{Input energy } \left(\frac{\text{MJ}}{\text{ha}}\right)} \qquad (2)$$

$$\text{Energy productivity} = \frac{\text{Yield } \left(\frac{\text{kg}}{\text{ha}}\right)}{\text{Input energy } \left(\frac{\text{MJ}}{\text{ha}}\right)} \qquad (3)$$

$$\text{Net energy gain} = \text{Output energy } \left(\frac{\text{MJ}}{\text{ha}}\right) - \text{Input energy } \left(\frac{\text{MJ}}{\text{ha}}\right) \qquad (4)$$

The production costs include of seed, fertilizer, herbicide, fuel, agricultural machines, labourer and opportunity cost of land. The costs of agricultural machines, labourer and opportunity cost of land respectively to renting price of machines, labourer wage average and amount of land rent in region are taken into consideration for standardizing of calculations. Machine cost includes of total necessary machine cost for plowing, spraying, fertilizing, harvesting and threshing. With supposition of renting machines and tools, the cost of fuel and lubricant is not calculated separately and is a part of their renting cost.

Results and discussion

Consideration of input and output energy: input and output energy are shown in table 1. Input energy contains of 39.6% of direct energy and 60.4% of indirect energy that about 78% of input energy was not renewal. Diesel fuel, fertilizer (more nitrogen fertilizer) and seed from 39, 33 and 21 percent respectively. The most consuming of diesel fuel was related to plough operation. Labour force formed a little share of input energy but it was an expensive input. Inspite of this input, that was a little share of energy but showed negative effects on environment. Grain energy ratio accounted 2.58 that in comparison with Saveh region that calculated to 0.99 (Safa and Tabatabaeefar, 2002) and Ardabil province 1.97(Shahin *et al*., 2008), this affair depended on the reason of rainfall rate in this area. Energy productivity achieved for grain 0.171 and straw 0.281 that showed consume of each unit energy (MJ), produce 0.171 kg/ha grain and 0.281 kg/ha grain and straw (biologic) (Table 2).

Table 1. Input and output energy in dry farming wheat in Kuhdasht County.

Item		Quantity	Energy intensity	Energy	
				MJ/ha	(%)
Input					
Direct					39.6
	labourer	31.7 (MJ/h)	1.96 (MJ/h)	62.1	0.6
	Diesl fuel	82.8 (L/ha)	47.8 (MJ/L)	3557.8	39
Indirect					60.4
	Machine			599.5	6
	Tractor	1.43 (Kg/ha)	138 (MJ/kg)	243.3	2.3
	Plow	0.645 (Kg/ha)	180 (MJ/kg)	98.6	0.97
	Disk harrow	0.448 (kg/ha)	149 (MJ/kg)	66.7	0.7
	Planter	0.237 (kg/ha)	133 (MJ/kg)	31.5	0.3
	sprayer	0.067 (Kg/ha)	129 (MJ/kg)	5.7	0.06
	Fertilizing equipments	0.059 (Kg/ha)	129 (MJ/kg)	13.7	0.13
	Trailer	0.14 (Kg/ha)	138 (MJ/kg)	24.4	0.24
	Thresher	0.18 (Kg/ha)	148 (MJ/kg)	55.8	0.6
	Combine	0.593 (kg/ha)	116 (MJ/kg)	68.8	0.7
	Fertilizer			3339.7	32.9
	Nitrogene (N)	36.5 (Kg/ha)	78.1 (MJ/kg)	2850.7	28.1
	Phosphate	28.1 (Kg/ha)	28.1 (MJ/kg)	489	4.8
	Herbicide (actived material)	0.18 (L/ha)	85 (MJ/L)	15.3	0.15
	Seed	147.3 (Kg/ha)	14.7 (MJ/kg)	2165.3	21.35
Total input				10142.7	100
Output					
	Grain	1780 (Kg/ha)	14.7 (MJ/kg)	26177	66
	Straw	1070 (Kg/ha)	12.5 (MJ/kg)	13375	34
Total output				39541	100

Table 2. Energy criteria in basis of grain and straw grain (biologic).

Grain and strow (Biologic)			Grain		
Net energy gain (MJ/ha)	Energy productivity (kg/MJ)	Energy ratio	Net energy gain (MJ/ha)	Energy productivity (kg/MJ)	Energy ratio
29398	0.281	3.9	16023	0.171	2.58

Economic analysis

The whole level average and number of fragments under cultivation of dry farming wheat of every farmer was about 8.2 hectares and 2.4 fragments (the average of each fragment of land was 3.4 hectares). About 61% of farmers that plant dry farming wheat just proceeded to farming and in addition to farming, animal husbandry was 64% rental tractor and agricultural tools, 33% of them have private tractor and agricultural tools and 3% cooperative service tractor and tools. Dry farming wheat in region was mechanization and labour

force. The cost and income of every hectare were shown in Table 3. The opportunity cost of land showed the most shares in production cost. Machines and seed with 28 and 17 percents are in the next rank. The whole cost in hectare was 3,196,000 Rials and the total income was 6,624,000 Rials. The fertilizer reached to farmers in farm of governmental and subsidization as a part of production cost.

Table 3. The total cost and income of energy in per hectar in dry farmin wheat.

Item	Cost per unit	Quality	Cost ($/ha)	Percent of total
cost				
Labour	120000 (Rial/day)	4 (day/ha)	480000	15
Machine	*	*	905000	28
Seed	3600 (Rial/kg)	147.5 (kg/ha)	531000	17
Fertilizer	€	€	75000	2
Herbicide	65000 (Rial/L)	1.62 (L/ha)	105000	3
Land	1100000 (Rial/ha)	1	1100000	35
Total cost			3196000	100
Income				
Grain	3000 (Rial/kg)	1780 (kg/ha)	5340000	81
Straw	1200 (Rial/kg)	1070 (kg/ha)	1284000	19
Total income			6624000	100

*Different machines cost is calculated separately. Nitrogen € is calculated separately.

Table 4. The criteria of economic operation of dry farming wheat.

Output	Net margin	Benefit cost ratio
Grain	2144000	0.67
Straw	-1912000	-0.56
Total	3428000	1.07

Preparation of seed bed and harvesting with 34 and 29 percents constituted the most cost of machines (Fig. 1). The harvest included operation with combine harvester and thresher. Transportation was the least share in machine cost.

The net margin and benefit cost ratio achieved 3,428,000 Rials and 1.07 respectively, (table 4) and showed that dry farming wheat production was economic profit in region.

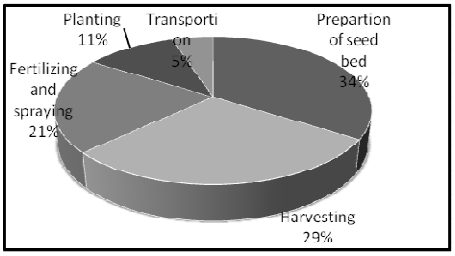

Fig. 1. Cost share of energy operation of the whole machines cost.

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