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FACTORS AFFECTING ENERGY EFFICIENCY IN MECHANIZATION CASE STUDY: FARMERSOF KHORRAMABADCOUNTY

Saeed Gholamrezai[*], Fatemeh Sepahvand[**] and Farzad Amirian[***]

Abstract: *The present study done to investigate the factors affecting energy efficiency among farmers is Khorramabad city, is applied in terms of its objective and since it describes personalcharacteristics and the relationship among data, it is kind of descriptive – correlation study.Data were collected through library research, field work and web browsingand library and documentary method was used to develop review of the literature .The statistical population consisted of all farmers owned tractorsinKhorramabad selected through popular methods of sampling in which 109 of them were selected for the study. A questionnaire prepared by the researcher was used as the ameasuring tool and for its validity the panel method consisting of professors and experts related to the area was used.Regarding its reliability,Cronbach's alpha equals to 0.62,.This research indicates energy efficiency among farmers is low. To increase the performance, 3 factors of traffic management, tools configuration management, service management werren extracted which can help farmers to reduce their cost and receive energy efficiency by following them.In conclusion, applying proper equipment with farm soil, using appropriate devices, powerful tractors and Baylor in large scale are proposed for large packaging and reducing the vehicles movement.*

Key words: *Energy efficiency, fuel consumption, farmers with tractors, the city of Khorramabad, optimal consumption¡ RegionLorestan¡ IRAN*

INTRODUCTION

In today's world, with regard to issues such as fuel and energy prices, scarcity of resources and developing the greenhouse gases caused by the indiscriminate use of these fuels,demands for food with regard to the growing population of the world and changes in nutrition regime bring about energy crisis in food and agriculture field (Jokiniemiand Ahokas, 2011).To the extent that the European Union has identified as a binding target, at least 10% of petrol and diesel consumed in the transport sector should come from bioenergy by 2020 (Madelene *et al*, 2012). Therefore, it has made

* Faculty memberin LorestanUniversity- IRAN

** M.S. Student Rural Development IN Lorestan University-IRAN, *E-mail: sepahvandfa0@gmail.com*

*** M .S. Student Mechanicsbio-system IN Lorestan University-IRAN

nations to consider the crisis and managing optimal energy and fuel consumption leading them to effective, sustainable, and economic utilization of energy (Bahattin, 2008). Energy is one of the most significant inputs in agricultural production applied in different form such as mechanical(machinery, human labor, etc.) and chemicals (herbicides and pesticides), electricity etc (Khambalkar, 2010). Therefore, to optimize the fuel and energy, input energy per area unit should be achieved for the various products through which the performance index, the ratio of energy output to energy input, can be calculated (Ajabshirchi Oskooi *et al.*, 2011). In fact, determining the costs and the amount of energy consumption at every stage of our agricultural production will lead us to better management of resources, sustainable production and protecting resources and production institutions. Measuring the rate of energy consumption by three main indices of energy helps us to better determination of the costs. There are three main indices in agriculturalmechanization which provide us comprehensive understanding of the current energy situation in agriculture.By studying the energy indices mentioned below, different stages of production, comparison of energy efficiency in the production of different products can be studied with different approaches in different regions (Canakci, 2005):

1. *The energy ratio*:is the ratio between calories of heat energy output and total energy of output production and total consumed energyof production factors. This ratio is lack of unit and shows the influence of the input energy unit in achieving the objectives of consumer such as food, biomass or biofuels and products.
2. *Net Energy Gain (NEG):* NEG orproduction net energy is the difference between energy production and total gross energy produced andtotal energy required for production. In the agricultural process, NEG unit is related to the production unit. This index is measuredbased on MJ ha.
3. *Energy Productivity (EP):* EP is an index of produced product in the input energy unit. The ratio of EP to energy is in fact the productcalorific value. The ratio of energy based on position, situation and time is different and can be applied as an index to evaluate the energy in production system with specific products. To improve the ratio of energy in a process both consumed energy in input production can be reduced and the performance of the product can be improved or reduce the waste.

The present study tried to identify the factors affecting the fuel efficiency among farmers with tractors in Khoramabad city and led to identifying the factors affecting the fuel consumption and recommended practical and useful solutions.

REVIEW OF LITERATURE

In a research conducted in Turkey to measure the value of input energy and production productivity of cotton, the input energy in to the farms was divided into direct and indirect- renewable and nonrenewable energy and concluded that the most important

costs of the farms are work forces, machinery, renting the land, and pesticides costs and large farms were more successful in energy productivity and economic performances and to better usage of energy minimum-till or reduced tillage was suggested (Ibrahim, *et al.*, 2005). In another study conducted in Lorestan Province to measure energy efficiency in planting wheat rain fed cultivation, it was concluded that the highest rate of energy consumption among all farms cultivating wheat is on inputs energy of seeds, fertilizers and chemicals. Then , the highest energy consumption is related to fuel energy consumption. The highest consumption of seeds and fertilizer, the energy consumption are allocated to the farms between 0.1 to 2 hectares cultivating wheat (AjabshirchiOskooi *et al.*, 2011).In another study, diesel fuel was called the primary and direct energy into the farm used for farms machinery as well as drying seeds and it is affected by different factors including cultivation methods, applying technologies, weather conditions, tuning up tractors and even the ways of driving and to save the fuel without tillage or low tillage practices were offered (Mikkola *et al.*, 2011).

METHODOLOGY

Data collection

The present study is applicable in terms of its objectives and as it described the personal features and the relationship between data, it is kind of descriptive-correlation method. Data were collected through library research, field work and web browsing and library and documentary method was used to develop review of the sources. The statistical population consisted of all farmers owned tractors in Khorramabad selected through popular methods of sampling in which 109 of them were selected for the study. A questionnaire prepared by the researcher was used as the a measuring tool and for its validity the panel method consisting of professors and experts related to the area was used and for its reliability Cronbach's alpha and the amount obtained was 0.620. And also KMO test was used to carry out analysis of the items in question which its result, 0.538, confirms an acceptable level of this test, eventually the data obtained from this study was processed using SPSS 22 software.Descriptive and inferential statistics were used in both groups to Analyze and classifythe data.

Farmers' personal and professional characteristics

*Farmers' age:*Age classification showed that the mean age of respondents is equal to 45. The age range is between 22 to 73 years, 64% of people are in the age range between 36 years to 76 years and only 26% are between 22 and 35 years.

Orchard ownership: the least area of orchard ownership is1 hectareand maximum is 5 hectares. The most abundant orchard ownership was for 1 hectare which totally 47 farmers (89% of farmers) owns 1 hectare orchard and only 1 person owned 5 hectares of orchard.

Water ownership: Most ownership of lands with water was 20 hectares, 27 families had no lands with water and only 1 family had 20 hectares of land with water. In this study, the mode (most frequent), was 2 hectares of land and 31 familyowned 2 hectares.

Rain fed ownership: the range of rain fed lands was at least 0 hectare and at most 20 hectares (1% of farmers). The highest abundance was related to 3 hectares and 5 hectares (16% of farmers) and 87% of farmers have less than 10 hectares of dry lands.

Education: Of the 109 farmers in our study, 6.93% had degrees below high school diploma that in this domain, the highest rate was 36 people for those with the only ability to read and write and from the farmers just 1.8% had a bacheloror higher degree with the rate of 2 persons.

Fuel consumption: the minimum fuel consumption in the growing season is 200 liters and maximum 50,000 liters. 2000 liters had the most frequency in fuel consumption among farmers. Overall, it can be said that in this research the average fuel consumption in liters per season among farmers is 3544.91liters.

Type of tractor: Among all of the 109 farmers with tractors, only 2 types of tractors, universal and Massey Ferguson including 4 models (MF 285 - MF 399 - MF88 - MF 485) were seen. Tractor MF 285 had the highest frequency with the number of 54, then Universal in the second place with 42 numbers among tractor owners.

RESULTS

The questionnaire used in thisstudy to determine the fuel efficiencyincludedan option of 18 items in a Likert scale classified with always, often, sometimes, seldom, and never with the scores of 5-4-3-2,respectively. Table 1,by determining the low mean and variance for each item, represents low fuel efficiency among farmers.

Table 1

Items	*S.D*	*CV*	*x*
I use the equipment according to tractor power	1.33	.627	47.
I consider low engine speed When working with light equipment,	1.95	1.106	56.
I use combined equipment	3.52	1.417	40.
I tune up based on the type of equipment	1.52	.859	55.
I use the full capacity of the machine	2.71	1.128	41.
I set tractor speed with gas pedal when working in the farm	1.60	.853	53.
I set tractor speed by changing the gears when working in the farm	1.43	.700	48.
I use the plowing pattern appropriate to the land when plowing the land	1.43	.659	46.
I check injector and pump settings based on the hours tractors worked	1.80	.915	50.
I follow, daily services (inflated tires, etc.) based on the manual	2.06	.915	44.
I follow, monthly services (filters, etc.) based on the manual	1.91	1.164	61.
I follow, annually services (valves and injectors, etc.) based on the manual	3.13	1.388	44.
I replace oil and fuel filter, based on the amount of hours tractor worked	1.55	.961	62.
I pour water into the tires to prevent wheel slip.	4.11	1.270	30.
I add weights to prevent extra slip over the tractors wheel.	3.56	1.481	41.
I do not use sudden brakes and spiky movement when tractors start moving	3.76	1.459	37.
I always check the fuel tank cap after refueling	1.22	.688	55.
I warm up the tractor for 5 minutes before movement	1.26	.661	52.

Low mean for each item indicates the low efficiencyof fuel consumption among farmers and the highest mean for the items represent carefully fuel consumption and energy efficiency. Also the notes that farmers observed carefully are the following items:

1. 60.6and 41.3%of farmers respectively pour water into the tires and add weights to prevent wheel slip.
2. 51.4% of farmers do not use sudden brakes and spiky movement when tractors start moving.
3. 66.1% of farmers set the power of tractors based on the equipment they use.

Correlation results

In this part, correlation tests were used for the independent variables including age of farmers, the number of literate family members, the number of hours they study in a month and the amount of hours tractors worked in the month for packaging, land leveling and cargo, and the main dependent variable in this study which is energy efficiency. Table 2 indicates the results:

Items	*Significance level*
Between the efficiency of fuel consumption and the number of literate family members	00/00
Between the fuel consumption and age of the farmer	0/001
Between the fuel consumption and the rate of studying per month	0/000
Between the fuel consumption and the number of hours tractors worked	0/003
Between the efficiency of fuel consumption and using tractors for packaging	0/001
Between the efficiency of fuel consumption and using tractors for transportation	0/000
Between the efficiency of fuel consumption and using tractors for land leveling	0/000

Factor analysis Results

The results of the factor analysis led to three factors affecting fuel efficiency of tractors owners that these factors together determine 68..38% of fuel efficiency mentioned in the table below:

First factor: Driving management

Items	*Load factor*
I set tractor speed with gas pedal when working in the farm	.733
I set tractor speed by changing the gears when working in the farm	.567
I use the plowing pattern appropriate to the land when plowing the land	.627
I follow, annually services (valves and injectors, etc.) based on the manual	.518

Second factor: Setting equipment management

Items	*Load factor*
I use combined equipment	.615
I replace oil and fuel filter, based on the amount of hours tractor workedã	.548
I pour water into the tires to prevent wheel slip	.542
I do not use sudden brakes and spiky movement when tractors start moving	.860

Third factor: Services management

Items	*Load factor*
I check injector and pump settings based on the hours tractors worked	.664
I follow, daily services (inflated tires, etc.) based on the manual	.641
I follow, monthly services (filters, etc.) based on the manual	.540
I warm up the tractor for 5 minutes before movement	.656

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Although Iran is one of the most oil-rich countries of the world, this great honor may change into a critical and unsolved crisis in the following years.According to the reports by the organization of fuel consumption optimization, we had 12.1 percent growth even exceeding the production growth of fuel (7.9 percent) while consumption of petroleum products had 2.1 percent growth in 2007 (Rajabi *et al.*, 2011). Todays, the most significant parts of energy needed in agriculture is provided from crude oil that provides energy needed to operate machinery. Therefore, a good amount of the consumption can be reduced through applying principal methods in all stages of cultivation, growing and harvesting the crops done by tractors and other agricultural machineries which leads to energy efficiency (Esmaealniaand Nikjeh, 2011) and since increasing energy efficiency is one of the aspects of technologies the mechanization growth and economic development of rural communities can be achieved by making the fuel consumption of agricultural machineries and equipment efficient.In order to meet these important needs, the following suggestions are proposed:

- Due to the low education level of farmers (6.93% below high school diploma),the best method to memorialize and remember the important tips is to save fuel by holding training courses, training videos along with explanations.
- Monthly services (filters,..), annually services (valves and injectors,…) , and daily services (inflated tires,…) done based on the manual were the items followed by the farmers due to the manual accessibility and the manual was studied even by the farmers with the lowest degrees. Therefore, to optimize the fuel consumption, the weak points in fuel consumption can be presented in clear imagery brochures for farmers to use.

- Expressing each item with their advantagescan be effective. For example, applying standard air filters and replacing them on time based on the tractor brochures is due to the reason that reduces the fuel consumption 10%.
- Farmers should be asked to organize their work before movement and selecting short distances ways helps to save time and cost and fuel consumption.
- Reminding the important notes such as proper changing the light gear to heavy gear in any places can reduce the fuel consumption.
- According to the significant relationship between fuel consumption and the number of literate family members, briefings for farmers at least 1 literate person from families can be held by agriculture extension agents so that when the agents are not available these individuals remind the family members of the most important issues.
- There is a negative relationship between the efficiency of fuel consumption and using tractors for transportation which indicates thispoiny that sometimes tractors are used to transport the goods for short distances which are not needed to use them and following these issues can lead to optimize the fuel consumption.
- Checking the water level in radiator, checkingthe fan belt in terms of worn outand traction, visually inspection of radiator core and its net, filling the tractor fuel tank, checking the air pressure of the tires are the activities that farmers should be done daily to prevent the parts to be worn outs soon as well as preventing the cost of repairing them.

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