ESTIMATING ECONOMICAL COSTS FOR OPERATING AGRICULTURAL MACHINES AND EQUIPMENT DURING PLOWING OPERATIONS

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ABSTRACT:
This study was conducted in a field of Al-mahmodia Region in Baghdad , 2014 to estimate the costs of operating Massy Ferguson tractor and tillage equipment in a clay loam soil. Three factors studied through the experiment included:- Three linear speeds for tractor were 2.85, 3.77 and 5.83 km/hr. Two types of plows included moldboard and chisel plow and two systems of plowing included one passage and orthogonal passage for each type of plows. The properties which were studied included fuel consumption, oil costs, maintenance and repair costs, labor costs per hectare. The research was done by applying the factorial experiment according to randomized complete block design with four replications and data were analyzed statistically, mean values of each treatment were compared using LSD at the 0.05 level of confidence to test significance. The results showed the following: Using chisel plow in the orthogonal pass led to increase the rate of fuel consumption, oil costs, maintenance and repair costs and labor costs per hectare, while moldboard plow in one passage achieving decrease the fuel consumption, oil costs, maintenance and repair costs and labor costs . Increasing linear speeds of tractor from 2.85 to 3.77 and 5.83 km/hr caused decreasing in fuel consumption, oil costs, maintenance and repair costs and labor costs per hectare. Linear speed of tractor 5.83 km/hr in one passage indicated significant superiority up on 2.85 and 3.77 km/hr. in achieving decrease the rate of fuel consumption for one hectare.

Key words: Linear speed, Fuel consumption, Maintenance cost, Orthogonal pass.

تقدير التكاليف الاقتصادية لتشغيل المكائن والمعدات الزراعية أثناءعمليات الحراثة

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الخلاصة
أجريت هذه الدراسة في احدى حقول منطقة المحمودية في بغداد في عام 2014 لتقدير تكاليف تشغيل الجرار الزراعي نوع ماسي فوركسن ومعدات الحراثة في تربة طينية مزيجة. تم من خلال التجربة دراسة ثلاثة عوامل: – هي ثلاث سرع خطية للجرار الزراعي تضمنت 2.85 و 3.77 و 5.83 كم / ساعة، بالاضافة الى نوع المحراث وتضمن محراث مطرحي قلاب والمحراث الحفار ونظامين من الحراثة لكل نوع من أنواع المحاريث مع الجرار الزراعي هما مرور واحد و مرور متعامد. الصفات التي تم دراستها : معدل استهلاك الوقود، وتكاليف الزيت وتكاليف الصيانة والتصليح، تكاليف اجور العمال للهكتار الواحد . تم تنفيذ التجربة بأستخدام تطبيق التجارب العاملية وفقا لتصميم القطاعات العشوائية الكاملة بأربعة مكررات والبيانات تم تحليلها إحصائيا وقورنت معدلات المعاملات باستخدام اقل فرق معنوي عند مستوى 0.05 أوضحت النتائج مايلي: أدى استخدام المحراث الحفار في المرور المتعامد أدى إلى زيادة في معدل استهلاك الوقود، وتكاليف الزيت وتكاليف الصيانة والتصليح بالاضافة الى تكاليف العمال، في حين حقق المحراث المطرحي القلاب في المرور الواحد اقل معدل استهلاك للوقود للهكتار الواحد، وتكاليف الزيت وتكاليف الصيانة والتصليح بالاضافة الى تكاليف العمال كما وتم ملاحظة ان زيادة السرعة الأرضية للجرار (السرعة العملية) من 2.85 الى 3.77 ثم الى 5.83 كم / ساعة ادى الى انخفاض في معدل استهلاك الوقود، وتكاليف الزيت وتكاليف الصيانة والتصليح بالاضافةالى تكاليف العمال.أشارت السرعة الأرضية للجرار(السرعة العملية) 5.83 كم / ساعة في المرور الواحد تفوقا معنويا على 2.85 و3.77 كم / ساعة في تحقيق اقل معدل استهلاك الوقود في الهكتار الواحد.

كلمات مفتاحية: السرعة الخطية، استهلاك الوقود، تكاليف الصياتة ، مرور متعلمد.

INTRODUCTION:

The agriculture mechanization was very important through their contribution to fill a need in the growing numbers of people in the world to product and agricultural crops, particularly strategic ones like wheat, barley, rice and maize and other crops that enter a staple food for humans. Subsequent years have seen great progress in the field of agricultural tractors industry showed the different types and capabilities of a variety of horsepower to meet the technological requirements of various agricultural operations. The most important of these equipment and the most widely used with agricultural tug plows of various types and which is one of the basic mechanical equipment transactions soil (2). The estimate operation of the equipment and machinery costs depends on several factors: the economic life of the machine and the cost of fuel and operating costs of workers (4).Although the first requirement of a machine is that it be able to perform its intended function satisfactorily, the management and economic aspects of the machine application are also of great importance. In fact, the engineer soon finds that his approach to a farm machinery design problem is largely controlled by economic considerations (13). To work most effectively, he should have a thorough understanding of the factors affecting field capacities and of the economic principles governing the costs of owning and operating field machines (13). The increase in tractors and equipment working hours means increased labor productivity and thus reduce the cost of use per hour, or the cost of doing the work. It was found that in the case of using tractors to three meals a work rather than a single meal (12). The increase in the operation speed has influenced significantly to the economic costs of the tractor and the plow as it resulted in increased speed operation to reduce the total costs of the operation of the mechanized unit (tractor and plow) (8).

The purpose of the research is to estimate the costs of operating machine unit (tractor and tillage equipment) in a clay loam soil.

Methods and material:

This study was conducted in the field of Al-Mahmodia Region in Baghdad- 2014. The research was performed by applying the factorial experiments according to randomized complete block design with four replications and data were analyzed statistically, Mean values of each treatment were compared using LSD at the 0.05 level of confidence to test significance.

1-practical speed of tractor:

Tractor speeds were used in this study included 2.85,3.77 and 5.83 km/hr. This was done using a tractor-type Massy Ferguson (MF) 240 Horse Power 46, The weight of the tractor 3500 kg, The distance between the front and rear wheels 269.90 cm, drawbar height 54.80 cm.

2- Plow type:

This was done by using a moldboard and chisel plow the kind of mounted, tri-moldboard plow: width 170 cm, height 85 cm. Chisel plow: width 214 cm , total length of 120 cm , total width 220 cm, height 115 cm, weight 327 kg, and two systems of plowing for each type of plows one passage and two passages. Tillage depth 17 cm.

Indicators studied:

1-Fuel consumption (liter/hr.):

Measuring fuel consumption rate achieved by using a device to measure the fuel discharge from the fuel tank of the tractor. This manufactured in mechanization and agricultural equipment department at the Technical Institute – al-Musayab, and consists of a graduated cylinder up to 500 ml, metal division, valves, metal rods, rubber tubes, was connected with the tractor fuel tank from one side and with the injection pump from other side. At first we can fill the cylinder listed before until the fuel up to the level of 500 milliliters, then we close the valve which take the fuel from the tank and open the valve which take the fuel from the cylinder of the device until the end of the experiment, the reading of fuel consumption was in ml. By using the formula below can be determine the fuel consumption in unite of liter\ hectare.

$$Vco = V * 10000 / St * Bp * 1000 \quad (3)$$

Where:

Vco – Fuel consumption in liter\ hectare.

V- Amount of fuel consumed during treatment in ml.

St – Length of treatment in m.

Bp – Practical plow width in m.

If we have to determine the of the fuel consumption in the unit of Dinar\ hectare we

can multiply the magnitude in liter\ hectare which obtained by the price of the fuel in Dinar\ liter.

2- Oil costs: It is calculated by using the following equation:

$$\textbf{O.c} = \frac{Q.o * O.p}{P.o * P.pr} \quad \textbf{----- (Dinar / ha).} \qquad \textbf{(7)}$$

O.c :- Oil costs (Dinars / ha).

Q.o :- Oil amount which added for each replaced with an oil (15.3 liters) of the tractor.

O.p:- Price of a liter of oil (2000 Dinars/liter.) according to Official pricing.

P.o:- The duration of the oil (100 hours of work).

3 - Maintenance & Repair Costs:

It is calculated by using the following equation:

$$\textbf{M. R.c} = \frac{(\text{M.R.})\text{Rate}}{h * P.pr} \quad \textbf{------ (Dinar/ha).} \qquad \textbf{(14)}$$

M. R.c = Maintenance and Repair Costs (Dinar/ha).

(M. R)rate = Percentage of maintenance and repairs between (2.2 to 7.4%) from purchase price of tractor. Will depend percentage (4.5%) at the expense of maintenance and repair costs.

4- Labor Costs:

It was calculated by using the following equation:

$$\textbf{L.c} = \frac{D.l}{d * P.pr} \quad \textbf{------- (Dinar/ha).} \qquad \textbf{(9)}$$

L.c:- The Costs of workers operating.

D.l:- Fare worker for everyday (Dinar/ Day) (15000), According to the conducting in the experiment site.

d:- The number of daily hours of operation, (8 hours / day).

Results and Discussion:

The table (1) shows the impact of Fuel consumption by plow type and practical speed, as the results of the statistical analysis showed that there are significant effect plow type by using LSD at the 0.05 level where the superiority moldboard plow in the one passage registered the less rate fuel consumption amounted 22.898 (liter/ha), while registered chisel plow in the orthogonal passage higher rate fuel consumption amounted 48.430 (liter/ha) because an increase in soil resistance to penetration led to an increase in the required power of the engine to carry out plowing. As shown in table (1) that tractor speed are significant effect by using LSD at the 0.05 level where the superiority practical speed of tractor 5.83 km/hr registered the less rate fuel consumption amounted 30.301 (liter/ha), while registered practical speed of tractor 2.85 km/hr registered higher rate fuel consumption amounted 39.541 (liter/ha), the reason in that was the tractor achieve the work with higher speed that's mean in less time for one hectare (area constant) therefore the amount of fuel consumed for one hectare was lower.

Table 1. Impact of plow type and practical speed on Fuel consumption(liter\ha)

Plow type	plowing system	Practical speed of tractor (km/hr)			Average
		2.85	3.77	5.83	
Moldboard plow	One passage	27.319	23.150	18.224	22.898
	Orthogonal passage	46.733	41.812	35.372	41.306
Chisel plow	One passage	31.746	28.485	22.865	27.699
	Orthogonal passage	52.367	48.179	44.743	48.430
		0.381			L.C.D%0.05
		39.541	35.407	30.301	Average
		0.215			L.C.D%0.05

The table (2) shows the impact of oil costs by plow type and practical speed, as the results of the statistical analysis showed that there are significant effect plow type by using LSD at the 0.05 level where the superiority moldboard plow in the one passage registered the less oil costs amounted 6534.73 (dinar/ha), while registered chisel plow in the orthogonal passage higher oil costs amounted 15413.9 (dinar/ha) because of more energy and time required for this operation. As shown in table (2) that tractor speed are significant effect by using LSD at the 0.05 level where the superiority practical speed of tractor 5.83 km/hr. registered the less oil costs amounted 9041.89 (dinar/ha), while registered practical speed of tractor 2.85 km/hr. registered higher oil costs amounted 13136.21 (dinar/ha), the reason for this is that the increased practical speed has led to increased productivity process

and achieve the operation in less time which led to decrease oil costs.

Table 2. Impact of plow type and practical speed on oil costs (Dinar\ha)

Plow type	plowing system	Practical speed of tractor (km/hr)			Average
		2.85	3.77	5.83	
Moldboard plow	One passage	8012.48	6472.31	5119.40	6534.73
	Orthogonal passage	11647.35	9286.35	7631.62	9521.77
Chisel plow	One passage	15294.55	13462.63	10662.58	13139.92
	Orthogonal passage	17590.47	15897.26	12753.96	15413.9
		39.04			L.C.D%0.05
		13136.21	11279.64	9041.89	Average
		37.19			L.C.D%0.05

The table (3) shows the impact of maintenance & Repair Costs by plow type and practical speed, as the results of the statistical analysis showed that there are significant effect plow type by using LSD at the 0.05 level where the superiority moldboard plow in the one passage registered the less maintenance & Repair Costs amounted 3039.133 (dinar/ha), while registered chisel plow in the orthogonal passage higher maintenance & Repair Costs amounted 6965.2 (dinar/ha) because the chisel plow consumed more energy from the engine of the tractor than moldboard plow and the plowing with orthogonal passage needs more time than one passage therefore the maintenance and repair costs were increased. As shown in table (3) that tractor speed are significant effect by using LSD at the 0.05 level where the superiority practical speed of tractor 5.83 km/hr. registered the less maintenance & Repair Costs amounted 3576.725 (dinar/ha), while registered practical speed of tractor 2.85 km/hr registered higher maintenance & Repair Costs amounted 6048.7 (dinar/ha),because the machine unit achieve the operations of plowing with high speed in less time for one hectare (area was constant), also less time for consuming energy therefore this led to decrease the maintenance and repair costs.

Table 3. Impact of plow type and practical speed on maintenance and repair costs (Dinar\ha)

Plow type	plowing system	Practical speed of tractor (km/hr)			Average
		2.85	3.77	5.83	
Moldboard plow	One passage	4285.7	2956.5	1875.2	3039.133
	Orthogonal passage	5689.1	4793.8	2751.3	4411.4
Chisel plow	One passage	6083.8	4724.2	3852.9	4886.967
	Orthogonal passage	8136.2	6931.9	5827.5	6965.2
		25.83			L.C.D%0.05
		6048.7	4851.6	3576.725	Average
		23.18			L.C.D%0.05

The table (4) shows the impact of labor Costs by plow type and practical speed, as the results of the statistical analysis showed that there are significant effect plow type by using LSD at the 0.05 level where the superiority moldboard plow in the one passage registered the less labor Costs amounted 10942.97 (dinar/ha), while registered chisel plow in the orthogonal passage higher labor Costs amounted 16795.03 (dinar/ha), because the chisel plow was larger in size and weight than moldboard plow therefore required more time for mounting, adjusting, as well as the plowing with orthogonal passage required more time, this led to increase the labor costs. As shown in table (4) that tractor speed are significant effect by using LSD at the 0.05 level where the superiority practical speed of tractor 5.83 km/hr. registered the less labor Costs amounted 12278.03 (dinar/ha), while

registered practical speed of tractor 2.85 km/hr. registered higher labor Costs amounted 15599.58 (dinar/ha), the reason in that The number of working hours is directly proportional with workers' wages, leading to decrease wages with the increase in the practical speed of tractor for a constant area.

Table 4. Impact of plow type and practical speed on labor costs(Dinar\ha)

Plow type	plowing system	Practical speed of tractor (km/hr)			Average
		2.85	3.77	5.83	
Moldboard plow	One passage	12985.3	10491.2	9352.4	10942.97
	Orthogonal passage	14725.4	12633.6	11825.2	13061.4
Chisel plow	One passage	16319.7	14738.2	12644.7	14567.53
	Orthogonal passage	18367.9	16727.4	15289.8	16795.03
		49.71			L.C.D%0.05
		15599.58	13647.6	12278.03	Average
		45.89			L.C.D%0.05

Conclusions:-

1- Increasing the rate of fuel consumption (48.430) liter\ha, oil costs (15413.9) dinar\ha, maintenance &repair costs (6965.2) dinar\ha and labor costs (16795.03) dinar\ha when using chisel plow in the orthogonal passage.

2- Decreasing fuel consumption (22.898) liter\ha, oil costs (6534.73) dinar\ha, maintenance &repair cost's (3039.133) dinar\ha and labor costs (10942.97) dinar\ha when using moldboard plow in one passage.

3- Decreasing fuel consumption (30.301) liter\ha, oil costs (9041.89) dinar\ha, maintenance &repair costs (3576.725)dinar\ha and labor costs (12278.03) dinar\ha in case of linear speed of tractor 5.83 km\hr.

4-From the triple interpenetrate we got maximum costs for all studied adjectives when using moldboard plow with one passage at speed of 5.83 km\hr and minimum costs when using chisel plow with orthogonal passage at speed of 2.85 km\hr.

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