MARGIN OF SAFETY OF HIRING DECISION OF AGRICULTURAL MACHINERY SERVICES BY RICE FARMERS IN ALNAJAF AL-ASHRAF PROVINCE

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ABSTRACT

The main objective of this study is to compute margin of safety of hiring decision of agricultural machinery services in Iraq. A cost-volume-profit analysis by using breakeven point technique has been followed to find out the margin of safety by using cross- section data in rice production farms in Alnajaf province. Results showed that the break-even point for different types of original agricultural field machinery were 427, 6.5, and 221 hours for tractor and machinery of soil preparation, farm sprayer, and combine harvester, respectively, while the values of break-even point for different types of used agricultural field machinery were 309, 10, and 319 hours for tractor, farm sprayer, and combine harvester, in that order. Results also pointed out that the negative sign of safety margin of areas of all machineries indicated that there are losses faced by small scale farmers in case of ownership these machineries, and the minimum lose amounted about $ 316116 for original tractor, $ 52611 for used tractor, $ 220.5 for original farm sprayer, $ 88 for used farm sprayer, $ 664664 for original combine harvester and $ 584650 for used combine harvester. The study recommended that it is useful for small scale farmers in Alnajaf province to continue hiring various agricultural machinery services rather than purchase them due to the absence of safety margin of holding areas. Therefore machine stations of agricultural machineries services maybe developed by Iraqi government in the study region to provide these services to the farmers with supported prices.

Key words: cost-volume-profit analysis, break-even point, owning cost, hiring cost, agricultural machinery,

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مجلة العلوم الزراعية العراقية -2021 :52 (3):756-762 كاظم

هامش الامان لقرار استئجار خدمات المكننة الزراعية من قبل مزارعي الرز في محافظة النجف الاشرف*

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المستخلص

الهدف الرئيسي من هذه الدراسة هو حساب هامش الامان لقرار استئجار خدمات المكننة الزراعية في العراق. باتباع مبدأ تحليل الكلفة . الحجم . الربح وباستخدام تقنية نقطة التعادل تم استخراج هامش الامان بواسطة استخدام بيانات مقطعية من مزارع إنتاج الرز في محافظة النجف. بينت النتائج أن اقيام نقطة التعادل لمختلف انواع المكائن الحقلية الزراعية الجديدة كانت 427 و6.5 و221 ساعة للجرارات ومعدات تحضير التربة ومرشات الحقل والحاصدات المركبة على الترتيب نفسه، في حين أن اقيام نقطة التعادل لمختلف انواع المكائن الحقلية الزراعية القديمة او المستخدمة كانت 309 و10 و319 ساعة للجرارات ومعدات تحضير التربة ومرشات الحقل والحاصدات المركبة على الترتيب نفسه. أشارت النتائج أيضًا إلى أن الاشارة السالبة لهامش امان المساحات لجميع المكائن والالات تشير الى أن هناك خسائر يواجهها صغار المزارعين في حالة امتلاك هذه المكائن، وان اقل كمية خسائر بلغت ما مقداره 316116 دولار امريكي للساحبة الجديدة، 52611 دولار للساحبة المستعملة، 220.5 دولار لمرشة الحقل الجديدة، 88 دولار لمرشة الحقل المستعملة، 664664 دولار لماكنة الحصاد الجديدة، و584650 دولار لماكنة الحصاد المستعملة. اوصت الدراسة بأنه من المفيد او النافع لصغار المزارعين في محافظة النجف الاستمرار في استئجار مختلف خدمات الآلات والمكائن الزراعية بدلاً من شرائها بسبب غياب هامش الامان للمساحات المملوكة من قبلهم. لذلك فأن تطوير المحطات الآلية لخدمات المكائن الزراعية وبأسعار مدعومة من قبل الحكومة العراقية في منطقة الدراسة سيساعد في توفير هذه الخدمات للمزارعين المحتاجين اليها.

كلمات مفتاحية: تحليل الكلفة . الحجم ـ الربح، نقطة التعادل، تكاليف الامتلاك، تكاليف الاستئجار، المكائن الزراعية،

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INTRODUCTION

Agriculture sector in Iraq has a distinguished importance in aspect of food security and providing the different nutrition goods of Iraqi population. The total area of Iraq is about 39547800 hectares. The total arable area for farming in the country is about 12,904,045 hectares. Total cultivated area under different crops in the country is about 3,506,028 hectares of which cereal crops (Wheat, Parley and Rice) area is about 3,365,787 hectares (21 and 17). Rice has been planted in Iraq since 400 BC. From Babylonia, its cultivation spread to Syria and Turkey (4). Rice is one of the most important cereal crops in Iraq, ranking third after wheat and barley in terms of importance and first as a major summer crop in terms of the area and production. Thus, rice has a prominent place in agricultural production in Iraq, the production rates and yield per hectare of rice in Iraq are estimated by 90,000.438 tons and 2.7 tons, respectively (2). This level of productivity is considering very low in comparison with progressed countries. The main reason of declined productivity of rice in Iraq belongs to use the old and customary methods in rice transplanting as manual farming instead of mechanical transplanting, where the use of agricultural mechanization service limited to machineries of soil preparation for planting and harvesting processes (1). At present, rice cultivation in Iraq is constrained because of water shortage, and hence, its cultivation in year of 2016 is only done in the six provinces located in the middle Euphrates region, namely, Alnajaf, Almuthanna, Aldiwaniyah, Babel, Maysan and Dhi Qar (4 and 16). The cereal crop farmers of Iraq have gained from the supportive policies over the past two decades. However, these policies in place are still inadequate to cover the deployment and distribution requirements of agricultural technologies, which can benefit several cereal crop farmers. Modern agricultural mechanization can help farmers recover their agricultural lands and increase production. But in spite of the available of arable areas for agriculture and the fuels for operating of different agricultural mechanization services, the use of agricultural mechanization in Iraq is still low compared to other countries for many reasons (13 and 22). However, owing to the lack of modern mechanization, farmers shave had to resort to other options, such as those provided by the private sector like large farmers, to access agricultural technology (13). The limitations and problems of ownership of agricultural machinery services have led several cereal crop farmers, many of whom are rice farmers, to make a hiring decision and seek the private sector in the country to hire agricultural machinery services. Moreover, admission to suitable mechanization services was constrained by a particular agricultural condition faced by each province. Imported agricultural machinery by Iraqi government has no scope on small scale farms level due to the really small size of holdings which are less than 3 hectares, even though these small holdings are not found together but dispersed over the country provinces. Small scale rice farmers decided to hire the agricultural machinery from private markets whereby the suitable characteristics to conditions of small farm (3). Hiring contracts maybe can lead to increases in using efficiency of agricultural machinery services by providing farmers with motivations to deliver services and to produce crops in ways that decrease processing costs and, finally, trade prices, where the use of hiring contracts suggestion some advantages to farmers (14). First, hiring contracts can assure farmers of passages for services in markets with few providers and, thus, assure a better income on investments in physical capital and time. Second, hiring contracts can also link prices more closely to service attributes and, thus, provide incomes to farmers who can hire those attributes. In addition, hiring is one of the sources of medium- and long-term financing because it enables organizations (producers) to extract benefits from the asset without ownership (19). As an alternative to owning agricultural machinery and equipment, a farmer can hire machinery services to achieve specific farm tasks. Selections and comparisons between hired services and owning machines are important decisions taken by a farmer as it mostly affects farm success (11). In Alnajaf province, as in other provinces in Iraq, hiring decisions problem is faced by rice farmers when they seeking agricultural machinery services. Custom hiring

issues in Iraq, in aspect of use of agricultural machinery services, have been documented since long time. On the other hand the studies related with such issues are still limited and they are technical more than economic studies. In addition, most these studies showed similar outcomes that custom hiring of agricultural machinery services comprises a significant proportion of farm decisions, and there is a group of internal and external factors can affect farmers' decisions to hire these services. Therefore the research question is what is the margin of safety associated with the hiring decision in comparison with the other alternatives? The main purpose of this study is to figure margin of safety of hiring decision of different agricultural machinery services in Iraq.

MATERIALS AND METHODS

This investigation is based on an empirical case study done in Alnajaf province during 2016 agricultural season. In this province a lot of contractual bargains to hire agricultural mechanization services especially in scope of tractors, farm sprayers, and rice combine harvesters have already appeared by small scale rice farmers. A randomized sample by 10% (5) was made and about 391 respondents from 3,898 rice farmers in Alnajaf province were interviewed to collect the required data. The questionnaire included twenty questions. The questionnaire was divided into four sections: The first section dealt with the factors of the social demographics of farmers, and the second section dealt with the items of fixed costs of different agricultural field machinery, while the third section was questioned about the items of variable costs of different agricultural field machinery, finally the fourth section was asked questions related to the prices of custom hire for different agricultural field machinery. A cost-volume-profit analysis by using breakeven point technique (7) has been followed to realize the margin of safety of agricultural field machineries from owners of these machineries. In scope of agricultural machineries field, the main purpose of this analysis is to calculate the minimum size of area (or hours) needed to purchase a specific machine (11). This size can help respondents in the study area to make a correct decision about hire or own different types of field machinery. The contents of this analysis are distributed into three parts: the first one clarifies computing of total costs for buying a machine, second one describes the communal prices rates of custom hiring of different machinery in the study region, and third part discusses calculating of breakeven point of these machines. The breakeven point (BEP) units in agricultural machinery field can be estimated from the following equation (18 and 20).

$$BEP\ Units = \frac{TFC}{HPR - TVC}$$

Where TFC is the annual fixed costs (ownership costs), HPR is the hire fee rate per hectare or hour (annual machinery revenues), and TVC is the variable costs per hectare or hour (annual operation costs), where at low levels of use, hiring a custom operator is fewer expensive, while for higher use, the cost is lesser if the option is own. In other words, in order to realize the profits from use of different agricultural machinery, the farmer can hire the agricultural machinery if he has area (or hours) less than breakeven area, while he can own these machinery if he has area (or hours) more than breakeven area (Refer to Figure 1).

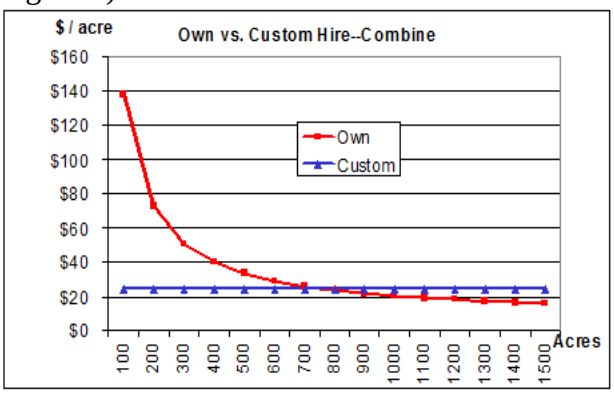

Figure1. Analysis of Break-Even Point in Agricultural Machinery Field

Source Kay, 2015

This figure indicates that hiring a custom operator at low levels of use is less expensive, and the cost is lower at high levels of use if the machine is owned. The break-even quantity at use cost rate can be read off the horizontal axis (number of acres or hours) and the break-even price at each use cost rate can be read off the vertical axis. The total cost of owning, total cost of hiring, and fixed cost curves can each be higher with simple formula (10). A determination of the breakeven point provides

a useful guide to help farmers choose between machinery ownership and custom hiring. The exact sizes of area, they have increased or lost and whether they are over or below the break-even point can be known by computing the equation of margin of safety (6, 15 and 23). In break-even analysis, margin of safety is the extent by which actual or farm areas exceed the break-even areas (23):

Margin of Safety (MOS) = (Current Area – Breakeven Area): In the aspect of agricultural machinery uses, the amount of margin of safety means there is a different between the likely profits from holding actual areas and the size of areas profits computed at break-even point. It determines the level by which areas or hours can drop before a farmer gains in losses (7). In other words, the margin of safety is the support by which actual areas may be decreased (in case of possessing agricultural machinery services) without resulting in any losses (6). Margin of safety represents the strength of the business. It enables a farmer to know what the exact units they have gained or lost is and whether they are over or below the break-even point. Margin of safety analysis has high place in financial management due to some advantages, which are: 1) it is useful in knowing how much cushion the farm has if products decline before the farm starts making losses.; 2) higher margin of safety provides freedom to the management of the farm to alter the selling price of their product in order to gain market share from its competitors.; and 3) higher margin of safety allows the farm to spend more on an advertisement or other activities that can help in improving products in the long run (12 and 6).

RESULTS AND DISCUSSION

Breakeven Point Analysis: Break-even point involves computing the annual possession and operating costs of agricultural machinery and the valuation of the costs of service in case of hire it. Calculating the breakeven point needs several details (7 and 10): the total fixed costs, the average of annual operation costs, and the average of hire price. Total costs of agricultural machinery include two types of costs (9 and 8). Fixed costs or called ownership costs which are experienced unrelatedly of use yearly of the units of area or time. They contain of premium of annual depreciation, rate of interest, premium of annual insurance, and housing costs (Table 1).

Table 1. Total Fixed Costs of Different Agricultural Field Machinery

Type of Machine	Tractor and Machinery of Soil Preparation		Farm Sprayer		Combine Harvester	
Items of Fixed Cost $US/ Yearly	Original*	Used*	Original*	Used*	Original*	Used*
Depreciation[1]	2400	1440	28.80	28.80	6240	8640
Interest[2]	2000	400	24	8	5200	2400
Insurance[3]	100	20	1.20	0.40	260	120
Shelter[4]	400	80	4.80	1.60	1040	480
Total fixed cost	4900	1940	58.80	38.80	12740	11640

Source: calculated by the researcher based on survey (2016), (11)

Where:

1- (Purchasing cost minus salvage value: 10% of purchasing cost) / Useful life years.

2- 5% of purchasing cost (amount can be earned on other investment).

3- 0.25% of purchasing cost

4- 1% of purchasing cost.

*(Purchasing costs in the study area are: 40000, 8000, 480, 160, 104000, and 48000 US$, respectively). Variable costs or called operating costs which are usually related with the hours of machinery use. Operating costs contain of oil and fuel, lubricants, repair and maintenance and labor wages (Table 2).

Table 2. Total Variable Costs of Different Agricultural Field Machinery

Type of Machine	Tractor and Machinery of Soil preparation		Farm Sprayer		Combine Harvester	
Items of Variable Cost $US/ Hour	Original	Used	Original	Used	Original	Used
Fuel[1]	4.3	3	1.6	1.2	2.8	2.13
Lubricants and oil[2]	0.64	0.45	0.24	0.18	0.42	0.32
Repair and maintenance[3]	0.25	0.18	0.32	0.24	3.2	3.7
Operators labour[4]	1.01	0.6	1.6	0.8	4	2.7
Total variable cost	6.21	4.22	3.76	2.42	10.42	8.85

Source: calculated by the researcher based on survey (2016)

Where: 1- Consumed amount of fuel for each machine x buying price per liter of fuel in the study area

2- Estimated at 15% of fuel costs

3- Obtained directly from survey data

4- Obtained directly from survey data

Table 3 shows various prices of custom hire for different types of agricultural field machinery of study sample during 2016 planting season

Table 3. Prices of Custom Hire for Different Agricultural Field Machinery

Field Machinery Custom Rate	Original Tractor	Used Tractor	Original Sprayer	Used Sprayer	Original Harvester	Used Harvester
Custom Rate: $US/ Per Hour	17.69	10.49	12.80	6.4	68	45.33

Source: calculated by the researcher based on survey data (2016)

Breakeven point of different agricultural machinery in the study region was estimated based on the number of hours of annual use of agricultural machinery, where the relationship between both number of area units and annual use hours of agricultural machinery was explained in Table 4.

Table 4. Breakeven Point of Different Agricultural Field Machinery (Hours)

Field Machinery	TFC ($US/ Yearly)*	TVC ($US/ Hour)*	Custom Rate ($US/ Hour)*	Break-Even Point/ Hours
Original Tractor	4900	6.21	17.69	427
Used Tractor	1940	4.22	10.49	309
Original Sprayer	58.80	3.76	12.80	6.50
Used Sprayer	38.80	2.42	6.4	10
Original Harvester	12740	10.42	68	221
Used Harvester	11640	8.85	45.33	319

Source: calculated by the researcher based on break-even point equation = [(total annual fixed costs ÷ (custom rate per hour – variable costs per hour)].

*** Tables 1, 2 and 3**

Results in table 4 display that the values of breakeven point for different types of original agricultural field machinery based on number of use hours were 427, 6.5 and 221 hours with respect to the tractor and machinery of soil preparation, farm sprayer and combine harvester services respectively, which means if each machine would be used for less than 427, 6.5 and 221 hours, it would be less costly to custom hire the work done, while above 427, 6.5 and 221 hours, it would be less expensive to own a specific machine. Also, the values of breakeven point for different types of used agricultural field machinery were 309, 10 and 319 hours with respect to the tractor and machinery of soil preparation, farm sprayer and combine harvester services respectively, which mean if each machine would be used for less than 309, 10 and 319 hours, it would be less costly to custom hire the work done, while above 309, 10 and 319 use hours, it would be less expensive to own a specific machine in the study region. As a result, if the respondents have desire to use original tractor, used tractor, original farm sprayer, used farm sprayer, original combine harvester or used combine harvester for period more than 427, 309, 6.50, 10, 221 or 319 hours during the agricultural season, in that order, it is better and less expensive to purchase a specific machine instead of hire it, where at these use hours, both costs buying and hiring are equal. With regard to the small scale farmers in the study region, decisions to purchase equipment and machinery will affect negatively their break-even points, since additional services will increase their fixed costs with new insurance and other items of cost.

Margin of Safety Analysis: Safety Margin of areas (S.M) —that enables farmers to know

what the exact size of area is they have gained or lost and whether they are over or below the breakeven area— is estimated at small scale level of area (3 hectares). The results were clarified in Table 5.

Table 5. Margin of Safety of Areas of Different Agricultural Field Machinery

Field Machinery	Area at Small Scale Level/ ha	*Break-Even Area/ ha	Margin of Safety / ha	**TC ($US/ Yearly per Hectare	***Minimum Amount of Loses / $US
Original Tractor[1]	3	67	- 64	4939.3	316116
Used Tractor[2]	3	29	- 26	1985.1	52611
Original Sprayer[3]	3	6.50	- 3.50	63	220.5
Used Sprayer[4]	3	5	- 2	44	88
Original Harvester[5]	3	55	- 52	12782	664664
Used Harvester[6]	3	53	- 50	11693.1	584650

Source: calculated by the researcher based on margin of safety (MOS) equation = (current small scale area – breakeven area)

* Table 4

** Table 4, where TC = TFC + TVC

*** Minimum amount of loses = margin of safety × TC

Where: [1]One hectare = 6.33 works hours for original tractor

[2]One hectare = 10.67 works hours for used tractor

[3]One hectare = one work hour for original farm sprayer

[4]One hectare = two work hours for used farm sprayer

[5]One hectare = four work hours for original combine harvester

[6]One hectare = six work hours for used combine harvester

Results in table 5 show that the margin of safety of small scale farmers was -64 hectares for original tractor, -26 hectares for used tractor, -3.50 hectares for original farm sprayer, -2 hectares for used farm sprayer, -52 hectares for original combine harvester and -50 hectares for used combine harvester. The negative sign of safety margin of areas of all machineries indicates that there is losing faced by small scale farmers in case of ownership of mentioned machineries. The minimum lose amounted about $ 316116 for original tractor, $ 52611 for used tractor, $ 220.5 for original farm sprayer, $ 88 for used farm sprayer, $ 664664 for original combine harvester and $ 584650 for used combine harvester. This result can help respondents to choice better decisions in relation to the use of agricultural machineries in the study area.

CONCLUSIONS: Results found out that the size of area at the breakeven point for both original and used tractors (67, 29 hectares) exceeds the size of area holding by small-scale farmers (3 hectares) at average with amount of 45 hectares. Similarly, the size of the area when the break-even point for both original and used control sprayer (6.5, 5 hectares) exceeds the size of area holding by small-scale farmers at average with amount of 2.75 hectares. Equally, the size of the area at the break-even point for both original and used harvester (55, 53 hectares) exceeds the size of area holding by small-scale farmers at average with amount of 51 hectares. In addition, results indicated that margin of safety of hiring decision of agricultural machinery services in the study region has negative sign which means there are amount of losses faced by small scale farmers in case of possession these machines. In light of these results, the study recommends that it is useful for small scale farmers in Alnajaf province to continue hiring various agricultural machinery services rather than purchase them due to the absence of safety margin of holding areas. Therefore Iraqi government should take their responsibilities for distributing the machinery and providing credit amenities to those farmers who are want to buy the machinery individually. In addition machine stations of agricultural machineries services maybe developed in the study region to give these services to the farmers on supported rates. Future researches are needed to evaluate suggests of the study that it is necessary to do other studies, and these studies must include a sensitive analysis of hiring decision in cases of changes each of farm size, custom hire prices rates and total costs level of different agricultural machinery services.

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