Input use, cost structure and economic analysis of wheat production in the northern region of Iraq

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Abstract

Wheat is the most important cereal crop in the world, and it is in the forefront of global strategic crops for its importance. The main objective of this study is to investigate the socio-economic characteristics of wheat farmers and to analyze the main limiting factors of wheat production. This study used the survey data which has been collected from 182 wheat farmers in the Northern Region of Iraq. The descriptive statistics and regression methods were used to analyze data. The statistical analysis of the socio-economic characteristics revealed that the average yield was 508.8 kg acre^{-1} and wheat is a profitable product for farmers. The cost analysis showed that harvest cost was the main cost item followed by fertilizer cost. According to regression analysis, the farm size, irrigation, seed quantity, pesticide quantity, and sowing date were the main important variables that significantly affect wheat production.

Keywords: Wheat. Cost. Production function. Iraq.

1. Introduction

Wheat is the most important cereal crop in the world, and it is a food source for more than 35% of the world population. It is one of the most important grain crops that cover a larger planted area of the earth compared to other food crops. It is thought that the cultivation of wheat reaches far back into history. Wheat has been a major food source in the human diet for 8000 years in Europe, West Asia and North Africa (Zhang et al., 2004). According to the Food and Agriculture Organization of the United Nations, wheat was grown over 200 million hectares and produced nearly 770 million tons in 2020 (FAO, 2021).

Iraq's total area is 435,000 km^2, equivalent to 43,505 million hectares, with available areas for agriculture around 11.1 million hectares, 26% of the total area of Iraq (FAO, 2021). Wheat production for the year 2019 reached to 4.3 million tons, this is a modest amount compared to other countries in spite of the influx of sufficient resources to increase production and productivity to reach the highest wheat production levels (Al-Hachami, 2015; FAO, 2021). But at present, Iraq is facing a very important nutritional challenge. The most prominent features of this challenge were inadequate food production to meet the needs of food commodities especially grains. Iraq imports most of these needs (grains) from the outside, because of the low productivity of grains (287 kg $acre^{-1}$) that decline year after year for many reasons (FAO, 2021).

Erbil city is considered as the second largest area for growing wheat which reaches 34% of the area planted to wheat in Northern Iraq (Othman, 2002). In Erbil wheat cultivated area increased from 537480 acres in 2007 to 1441142 acres in 2015 with an increase of 268 % between the two periods and wheat yield kg/acre increased from 255 kg in 2007 season to 435 kg in 2015 with an increase of 50% between the two periods (MOAWR, 2015). In Erbil province, the crop production level is lower compared to the production of the neighboring countries, as well as world rates according to international percentage rates by acre. This is due to the fluctuation of rainfall rate from one year to another year, and not utilizing modern technology in Erbil.

Grain crop is considered as the main crop in Erbil governorate which has a great role to satisfy the local demand and ensure food security. In recent years, significant changes have been seen in the agricultural sectors in the Erbil province. Accordingly, this has played a prominent role in supporting the growth of the local economy. Field crop production, especially wheat and barley as two main crops under cultivation, is the main source of life for many rural families in Erbil. This region is distinguished by its good fertile soil, suitable climate, availability of irrigation water, together with experienced formers in the production of many crops, particularly wheat (Jaradat, 2003).

It is expected that Erbil province will have a major contribution to wheat production in Iraq. Because of favorable climatic conditions for the production of major crops, the province of Erbil has a relative advantage in wheat production. Compare to other regions, farmers in the province are experienced and skilled farmers, especially in wheat production. In spite of these advantages, the expected levels of wheat production in the province of Erbil is elusive because of many obstacles and problems facing wheat production. The most important are; High production costs that can be attributed to the high cost of imported inputs such as tillage,

seeds, irrigation, fertilizers and transport and low level of productivity compared to neighboring countries such as Turkey, Syria and Iran.

The main objective of this study is to investigate and analyze the economics of wheat in the province of Erbil. Specific objectives are to analyze the social and economic characteristics of farmers that affect wheat production, the main costs of wheat production and factors that limit wheat production in the province of Erbil.

2. Literature Review

There are various literature studies on the economic analysis of wheat farms (Ahmed et al., 2001; Semerci et al., 2012; Moradi et al., 2013; Omidi et al., 2014; Sureshkumar et al., 2014; Iqbal et al., 2014; Zhang et al., 2014; Ahirwar et al., 2015; Kashani et al., 2015; Kan et al., 2016; Tiruneh and Geta, 2016;), however, there are just a few studies on research area (Othman, 2002; Kerdi et al., 2014). Ahmed et al. (2001) analyzed the wheat production and revealed that the most of factors affecting wheat productivity in the context of the study were the average age of farmers, using family labor, the distance between land and the farm, wage labor and the number of irrigation. Tiruneh and Geta (2016) analyzed the technical efficiency of smallholder wheat farms in Ethiopia and found that age and education level of the household head, livestock holding, farm size, tenure status and investment in inorganic fertilizers affect efficiency positively. Ahirwar et al. (2015) analyzed the cost and income structure of the wheat crop in the Vindhyan Plateau of Madhya Pradesh and reported that the cost of cultivation was considered the highest on a large farm compared with the average or small farm. Moreover, the benefit-cost ratio was highest on a small farm compared to medium and large farms. Zhang et al. (2014) analyzed the costs of wheat and farm income with correlation analysis in Shandong province and concluded that seed investment cost and the costs of pesticides have a great effect on wheat production. Iqbal et al. (2014) analyzed the effect of various factors on wheat production in Peshawar district and indicated that there is a positive relationship between profit and the price of wheat, quantity of wheat, and the quantity of by-product and also show a negative relationship between profit and total cost. Literate farmers produced more per acre yield of wheat than illiterate farmers. Sureshkumar et al. (2014) analyzed the use of inputs, cost structure, return of the wheat product in India. Found that the average total cost of wheat crop in large farms were higher than medium and small farms. Moreover, the higher costs on large farms are associated with intensive use of human labor, bullock labor, manures, irrigation costs, and fertilizer. Moradi et al. (2013) analyzed the

cost-effectiveness of wheat production in Iran. And reported that the rent of land had a maximum influence and the price of fertilizer had minimal influence on the frontier of production cost. Semerci et al. (2012) estimated wheat production functions in Turkey and found increasing return to scale in wheat production, based on the sum of elasticity coefficient of variables in the function. According to their results, increasing fertilizer and pesticide costs increase wheat production due to increasing return of scale.

3. Material and Methods

This study was conducted in Erbil located in the Northern region of Iraq. Erbil is the capital of Northern Iraq and one of the oldest continuously inhabited cities in the world (UNESCO, 2010; Ayad, 2010). The study depends on the survey data which has been collected from 182 wheat farmers in 9 Districts: Center of Erbil, Rawandoz, Choman, Mergasor, Shaqlawa, Soran, Steppe Erbil, Khabat and Koya in Erbil governorate. Data includes socio-demographic and economic characteristics of farmers such as age and education level of farmers, farm size, land tenure, seed quantity, seed varieties, fertilizer and pesticide quantities and also the total costs such as cost of leasehold, cost of tillage, cost of seeding, cost of irrigation, cost of fertilizer, cost of harvest, cost of transportation and marketing.

Cobb-Douglas production function was widely used in economics and productivity studies. In this study, the double logarithm forms of the Cobb-Douglas production function was proposed and tried because of the nature of the relationship between the dependent and independent variables. The double logarithm form of the Cobb-Douglas production function was found to be the best form that describes the relationship between the dependent and independent variables. The general form of the transform logarithm's Cobb-Douglas production function could be written as follows (Tan, 2008):

$$Y = AX_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} \dots\dots\dots\dots\dots\dots\dots X_n^{\beta n} \quad (1)$$

where y is the yield, X_i is the production inputs of (i= 1, 2, 3 … n) with a positive value, A is the intercept and β_i is the inputs elasticity. The above-mentioned function has a nonlinear form and its logarithmic form as shown below was used to make it linear.

$$LnY = \beta_0 + \sum_{i=1}^{n} Ln\beta_i X_i + \varepsilon \quad (2)$$

$$LnY = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \cdots + \beta_n LnX_n + \varepsilon \quad (3)$$

where *Ln* is the natural logarithm, Y is wheat production (kg), X_i are independent variables, β_0 is constant, β_i are parameters associated with variables (output elasticity of inputs) and Ɛ is error terms.

There are two major variables including dependent and independent variables in the model. Dependent variables represent the amount of production capability in kg of wheat crop. Independent variables include farm size, land tenure, seed quantity, seed varieties, fertilizer quantity, pesticide quantity, sowing date, labor and irrigation.

4. Results and Discussion

4.1. The socio demographic characteristics of farmers

The total number of the interviewed farmers in the sample was 182 and all farmers who cultivate wheat were male. The role of women has just supported as a worker with their coworkers. The age distribution of the farmers and their average age is demonstrated in Table 1. It is clear that the majority of the farmers (47.8%) were above 45 years. While 23.6% of the farmers were below 40 years and 28.6% of farmers are in the age group of 40-45 years. The average age of farmers was 44.6 years. According to the findings, the majority of farmers aged above 40 are great for agriculture because the farmers are more dynamic and active. This result is similar to the result reported by Musa et al. (2013) found that the average age of farmers was 42 years. Abdalla (2005) stated that the average age of the farmers was 48.5 years in Dongola province. This indicated that most of the farmers were within the active age group.

Education status plays an important role in skill acquisitions and technology transfers. According to survey results, about 48% of the farmers were illiterate, 35% of the farmers have a primary school, 12% of the farmers have a secondary school, while only 5% of the farmers have tertiary education (bachelor and above). The finding showed that the majority of farmers were uneducated. This influenced the production because the more educated farmers can use agricultural machines and modern tools and they have more productivity. The result is similar to Abdalla (2005) reported that most of the farmers in Dongola are literate and about 18.8% of farmers were illiterate.

The findings also showed that the majority of farmers (90%) were married. This result is similar to the result of Musa et al. (2013) reported the majority of farmers were married.

Farmer's family members were considered as an important source of labor source in the study area. The family labor ranged between 1 and 12 members. Table 1 indicated that

most of the farmers (44.5%) have more than 4 people with an average family size of 5 persons.

Land tenure is a critical factor affecting wheat cultivation. The results showed the distribution of the sample farmers according to the land. 85.7% of the farmers were cultivating their private land and 14.3% of them cultivated a rented land. According to the findings, the majority of the farmers own lands which can have a positive impact on wheat production because renting land for one acre costs 100,000 IQD. This result is similar to the result obtained by Al-Delaimi (2009). This was among the factors that contributed to increasing production. And the result is also similar to results obtained by Moradi et al. (2013). The result showed that the rent of land prices has a maximum influence on production cost per hectare.

According to the size of wheat cultivated area, only 44.5 % of the farmers have less than 10 acres of wheat crop area, 27.5 % of them have between 10 and 35 acres, while 28.0 % have area ranged more than 35 acres (Table 1).

Table 1: Socio-demographic characteristics of farmers

	Frequency	Percentage
Age group (Mean: 44.6 years)		
< 40	43	23.6
40-45	52	28.6
> 45	87	47.8
Total	182	100.0
Education status		
No School	87	47,8
Primary School	64	35,2
Secondary School	21	11,5
Tertiary	10	5,5
Marital status		
Single	19	10,4
Married	163	89,6
Farmer's family members		
≤4	81	44,5
5-6	71	39,0
≥7	30	16,5
Land tenure		
Owner	156	85,7
Rented	26	14,3
Farm size (acre; *Acre = 2500 m^2)		
< 10	81	44.5
10-35	50	27.5
>35	51	28.0

4. 2. The structure of wheat farming

Land preparation also called tillage is important to ensure that the wheat field is ready for planting. The basic purpose of tillage is to provide a favorable soil environment for better germination and growth of seeds. Other purposes of tillage include weed control. Plowing or primary tillage is usually done to break the soil compaction. The field survey revealed that about 95% of the farmers used disc plough and disc harrow while the rest of the farmers used traditional tools (animals). Mousavi-Avval et al. (2010) have reported that soil tillage has a major influence on water intake, storage, evaporation, extraction of water from the soil by the plant roots, and on microbial activity which influences soil aeration, moisture and temperature.

Farmers in the Erbil province use traditional varieties which they obtain from the previous harvest. Most of the farmers often use their own seed production, although some farmers use other sources such as the directory of agricultural research (DARE) in Erbil province. The Ministry of Agriculture also distributes seeds upon occasion. The quality of seeds and the amount of applicative per unit area are presumed to affect the output to a very large scope. The quantum of seeds applied per unit area depends on the farmers' knowledge and experience, which are of course functions of the farmers' socio-economic characteristics such as education and age as well as functions of the extension services in Erbil province. For wheat, the recommended seed amount is 20-38 kg/acre in the research area (DARE, 2015).

Iqbal et al. (2014) reported that farmers who have used certified seeds were 127.41 kg more yield per acre than the farmers who do not use certified seed. In general farmers in the Erbil province use conventional varieties which they procure from the antecedent harvest and very scarcely use improved varieties because they are riskily averted in an addendum to the fact that it is very difficult to obtain reliable supplies of betterment varieties. According to the directory of agricultural research DARE in Erbil, the types of seeds are Smetto, Aredo, Adana and Rezgary. The surveyed farmers were classified according to wheat varieties cultivated. According to survey results, 65% of the farmers used Smetto and their average yield is 499.84 kg acre^{-1}, 15% of the farmers used Aredo and their average yield is 462.04 kg acre^{-1}, 12% of farmers used Adana and their average yield is 468.13 kg acre^{-1}, while 8% of farmers used Rezgary and their average yield is 454.01 kg acre^{-1}. According to these results, more farmers (about 80%) in Erbil use coarse wheat which consists of Smeeto and Aredo, because it’s more famous and better than the others. This type of wheat seed withstands mildew and high yield cereal; the farmers have previous experience using this type of seed. In general, as Table 2

mentions those small scale farmers with less than 10 acres used about 30.81 kg seed. Middle-sized farmers used 28.48 kg while farm sizes bigger than 35 acres used an average of 29.22 kg of seed ($p<0.05$).

In the past in Erbil province, the farmers were depended on rainfall in wheat production. From the southern plain to the gentle hills, rain-fed wheat predominated in irrigation mostly. Irrigation facilities such as center pivots have been introduced in recent years. In Erbil the wheat is mainly rain-fed, farmers may use supplemental irrigation using river or sprinkler or artesian method whenever needed. The research findings showed that the majority of the farmers (about 80%) in Erbil governorate do not irrigate but mostly depend on the rain as the only source for watering the wheat. Only 20% of the farmers have watered because the rainwater in the area has not been enough and the land has needed more irrigation. Irrigation is very important to increase production yields. Al-Mahmada and Khalaf (2014) concluded that the increase of precipitation in the lands which are classified as precipitation guaranteed by %1 will lead to an increase in production by 29%. But complementary irrigation must also be used and this will increase the productivity of these lands. Erekul et al. (2012) showed that with additional irrigation the cereal yield increase significantly up to 58%. The highest cereal yields could be ensured with additional irrigation of 80 mm. The protein content, deposition value and gluten index among the bread-making quality parameters have found the highest levels for all varieties in both trial years when no additional irrigation has been applied. In the research area, 80% of the farmers didn't use irrigation, 10% of the farmers used river, 7% of farmers used sprinkler and 3% of farmers used artesian well (Table 2). The findings also revealed that most of the farmers have used river water because it costs less and riches in good minerals.

Fertilizer is known to be one of the most critical inputs in wheat production because of the high response of the crop to fertilizer application. The most widely uses fertilizers among wheat farmers are inorganic fertilizers which are manufactured and of various sorts. The most popular types among them are NPK and urea. It is obvious that using NPK is to strengthening plants and urea to increase plant height; these fertilizers are known as the fast release of their constituent nutrients, owing to their scarcity. However, many farmers resort to the use of organic fertilizers. The results reveal that the average using fertilizer application was 30 kg $acre^{-1}$ and the amount of fertilize in the small farms is bigger than in larger farms ($p<0.01$). The study stated that the majority of the farmers (83.5%) used fertilizer and about 16.5% did not use fertilizer because they believed that their land did not need it due to its good soil. This result is similar to the result obtained by Matsumoto and Yamano (2011) and Ahmed et al.

(2005) who revealed that fertilizer and irrigation have significant positive effects on sorghum production levels. Hassan and Ahmad (2005) found that the production function indicates that wheat yield can be increased by escalating the use of irrigation, fertilizer and tillage. In wheat fertilization, the farmers use mainly urea and composite NPK, or they use triple superphosphate (TSP). The farmers apply NPK or TSP fertilizer at the time of seeding, while the area can be split into two doses, the first half can be added at the time of seeding and the second dose can be used at tillage or elongation stage. The fertilizer amount applied per acre is significant in explaining the variation in wheat yield. According to results, 16.5 % of farmers didn't use fertilizer, 38% of farmers used urea, 13% of farmers used Composite (NPK), while 32.5 % of farmers used both (urea and NPK). Afridid et al. (2014) found that the estimated results of yield indicated that the NPK (nitrogen, phosphorus and potassium) have a positive and significant effect on wheat yield.

In fact, like other grains, wheat requires prompt application of agrochemicals such as insecticides and herbicides to check the menace of pest and disease infestation also for controlling the weeds that may occur because of overgrowth of weeds. Among common problems are fungal diseases caused by obligate parasites including the three rusts, powdery mildew, the bunts and smuts, etc. Results indicated that in the study area an average of 134.37 ml acre^{-1} of pesticide was used (Table 2). Many farmers indeed use pristine applications in the study area.

Table 2: Amount of input used by farm size

Farm size (acres)	Seed (kg acre^{-1})	Fertilizer (kg acre^{-1})	pesticide (ml acre^{-1})	Percentage of farmers using irrigation
<10	30.81^{a}	34.20^{a}	134.20	25.9^{a}
10-35	28.48^{ab}	25.10^{b}	133.80	16.0^{b}
> 35	29.22^{b}	28.14^{b}	135.20	15.7^{b}
Total	29.73	30.00	134.37	20.3
F tests (P value)	3.444(0.03)	5.046 (0.007)	0.233 (0.792)	26.343 (0.000)

Acre = 2500 m^2

The optimum time to harvest differs from one location to another. It is generally done between the 1st of June and the end of July. Harvest of wheat can be done mainly by a combined harvester, but the hand method can be used for small areas due to the high slope. Stony areas or small areas are not suitable for the combined harvester. Rahimi and Rezaei-Moghaddam (2014) recommended that the harvesting duration for wheat is 105- 120 days

after sowing. However, in Erbil, the harvesting duration of wheat is 150-180 days after sowing.

4.3. Economic Analysis of Wheat Production

Wheat production costs are given in Table 3. The average cost of tillage in wheat production was estimated at about 27319 IQD acre^{-1} and 17.5% of the total production cost. The percentage share of seed cost was 17.1% and seeding cost was 2.3%.

In the past, in Erbil province farmers depended on rainfall in wheat production. From the southern plain to the gentle hills, rain-fed wheat was predominate irrigation and common in a small area. Irrigation facilities such as center pivots have been introduced in recent years. Farmers use supplemental irrigation using sprinkler or surface irrigation methods whenever needed. The average share of irrigation cost in the total cost of production was 3.1%.

In wheat fertilization, the farmers use mainly Urea and Composite (NPK), half of the urea can be added at the time of seeding and the second dose can be used at tilling or elongation stage. The fertilizer amount applied per acre is significant in explaining the variation in wheat yield. The sources of fertilizers in the Erbil province are the local markets. About 16.5% of the farmers don't apply fertilizers, while 83.5% of farmers used fertilizer. The average cost of fertilizers was 30000 IQD acre^{-1} and 19.2% of the total cost of production.

The operation of pesticides application is usually carried out by the farmers themselves or by hired labor. The percentage share of pesticides cost in the total cost of production was 2.4%.

Harvest of wheat can be done mainly by combining harvester, but the hand method can be used for small areas due to high slope. The percentage share of harvest cost in the total cost of production was 21.8%. The seed cleaning can be done by most farmers manually or by the machine method using cleaner and clipper screens. The cleaner machines are available at the Directory of Agricultural Research (DAR) in Erbil province. The average cost of seed cleaning was 13857 IQD acre^{-1}. The percentage share of seed cleaning cost in the total cost of production was 8.9%. Transporting of wheat after harvesting can be done by farmers themselves, in general, our farmers use the big car to transportation wheat in farm to store wheat (silo). The percentage share of transportation cost in the total cost of production was 3.3%.

The average total variable cost of production was 156006 IQD acre^{-1}. As shown in Table 3, the highest average variable cost was recorded in harvest, fertilizer, tillage and seed, while the lowest average variable cost was recorded in other costs, seeding and pesticide. Khan et al. (2008) reported that operations such as harvesting; threshing and land rent were the major cost components in the production of wheat and were 14.28% and 45.54% of the total cost respectively. Asmatoddin et al. (2009) stated that among the various cost components of cultivation, the rental value of land was the main contributor with 23.35% in wheat production. Singh (2006) analyzed the variability and cost structure of wheat and found that harvesting and soil preparation were the variables that affected the cost of labor and the tour cost of the most cultivation.

Table 3: Wheat production costs per planted acre (IQD acre^{-1})

Variable costs	**Mean**	**Std. deviation**	**Share of Costs (%)**
Tillage	27319	13717	17,51
Seed	26665	6390	17,09
Seeding	3626	1629	2,32
Irrigation	4764	9953	3,05
Fertilizer	30000	17039	19,23
Harvest	34066	18890	21,84
Cleaning seeds	13857	9562	8,88
Transportation	5154	2965	3,30
Pesticide	3725	1068	2,39
Erasing the grass weed	3676	1266	2,36
Other costs	3154	1508	2,02
Total variable Cost	156006	45856	100,00
Leasehold (rent)	11236	28127	70,60
Management cost	4680	1376	29,40
Total fixed cost	15916	28670	100,00
Total cost	171922	63364	
Total Income (IQD acre^{-1})	218885	74644	
Total variable cost (IQD acre^{-1})	156006	45856	
Total cost (IQD acre^{-1})	171922	63364	
Gross profit (IQD acre^{-1})	62879	78877	
Net Profit (IQD acre^{-1})	46963	27790	
Benefit-Cost Ratio	1,27		

The average yields were 486.71 kg/acre in the Erbil province (Table 3). Abdul Ratha (2013) reported that the average yield of wheat in Iraq is generally low as it is affected by many environmental and cultural practices. Farmgate price is the price that the farmer received for his crop when he sells his product at the boundary of his farm. As for the wheat price of the Iraqi government buys wheat from farmers, the farmer's sells their products to the government marketing institute and received support price. Many farmers found it difficult to sell all their wheat production to the government institute. At a price more than the market price, the government support farmers, the average price of wheat per one kg is about 442.31 IQD. The study figured out that the average income of wheat production is about 218885 IQD $acre^{-1}$, and gross profit is about 62879 IQD $acre^{-1}$, also the net profit is about 46963 IQD $acre^{-1}$. Hassan et al. (2005) stated that the cost of production and gross income of wheat per acre increases with increasing in farm size. The main reason for this could be increased mechanization and agricultural inputs such as fertilizers, irrigation and weed with increasing in farm size. Iqbal et al. (2014) in their study showed that there is a positive relationship between profit and the price of wheat, quantity of wheat, prices of other products.

The Benefit-Cost Ratio was estimated as 1.27, and this value shows that wheat farming in the region is economically efficient and beneficial. Moreover, the benefit/cost ratio was highest on large farms compared to small and medium-sized farms. Cetin and Vardar (2008) reported that the benefit/cost ratio in large farms is more successful in the use of energy and economic performance.

4.4. Factors affecting wheat production

In the present study, the double logarithm forms of Cobb- Douglas production function types were found to be the best form in order to describe the relationship between the dependent and independent variables. The model includes two categories of independent variables namely continuous and dummy variables. The continuous variables include farm size, pesticide quantity, seed quantity, fertilizer quantity and labor, and dummy variables are irrigation, sowing date, seed types, and education level of farmers. The specified model has an adjusted R^2 of 0.71. The F-test statistic (48.20) is significant at all levels of significance (Table 4).

The coefficient of the independent variable in the model represents the elasticities which indicate the change in wheat yield relative to the change of one of the inputs when all

other things stay constant (ceteris paribus). Among the variables included in the model namely farm size, pesticide quantity, seed quantity, irrigation, and sowing date are significantly different from zero at a 1% level of significance. All variables have the expected signs which are consistent with the economic theory.

Table 4 showed the farm's size has got positive and coefficient of 0.035 which is significantly different from zero at a 1% level of significance. The result means that a one percent increase in the farm size will lead to an increase in the production of wheat by 0.035%. Ohen and Ajah (2015) found that small-scale rice production in the region was profitable. Shahin et al. (2008) found large farms were more successful in energy use and energy ratio. Tipi et al. (2009) reported that the average ratio of output-input energy was 3.09 and increases as the farm size increased in wheat production. Yilmaz et al. (2005) found that large farms are more successful in the productivity of energy use efficiency and economic performance. On the other hand, Awad (2001) reported that family size has no significant effect on yield.

Table 4: Estimates of variables from the Cobb- Douglas production function

Variable	Coefficient	Standard error	T value	P value
Constant	0.026	0.734	0.04	0.971
LnFarm size (Acre)	0.035 *	0.011	3.00	0.000
LnPesticide quantity(ml acre^{-1})	0.693 *	0.163	4.25	0.000
LnSeed quantity (Kg acre^{-1})	0.854 *	0.068	12.51	0.000
LnFertilizer (Kg acre^{-1})	-0.001	0.002	-0.05	0.633
Lnlabor	-0.047	0.031	-1.51	0.132
Irrigation	0.111*	0.031	3.55	0.000
Sowing date	0.140 *	0.033	-4.25	0.000
Seed types	0.031	0.023	1.36	0.175
Education	-0.020	0.023	-0.89	0.373
Adjusted R- square	0.71			

*: significant at 1% level.

The using pesticide has a positive effect and coefficient of 0.693, which is significantly different from zero at a 1% level of significance. This result means that a one percent increase in the quantity of pesticide will lead to an increase in the production of wheat

by 0.69%. Zhang et al. (2014) found that regardless of the investment of the workforce, seeds investment cost and the investment costs of pesticides have a great effect on the yield of wheat in Shandong Province. Abdul Ratha (2013) found positive effects of herbicide on production. The shares of herbicide cost in variable and total cost in his study were 5.77% and 3.69%, respectively.

The seed quantity has got a positive coefficient of 0.854 which is significantly different from zero. This result means that a one percent increase in seed quantity will lead to an increase in the production of wheat by 0.85%. According to the results, it could be recommended to increase the cultivation of crop area and this could be achieved by using effective resources with recommended quantities through specialists. Afridid et al. (2014) indicated that the seed rate, NPK (nitrogen, phosphorus and potassium) and labor use have a positive and significant effect on the yield of wheat.

The irrigation variable has got a positive and significant coefficient of 0.111. This result means that irrigation affects positively wheat production. In the other words, with irrigation, the production of wheat is getting increase. Mohamed (2000) found that irrigation and land preparation were the common factors affecting all crop yields. Abdulaziz (2008), Ahmed et al. (2005) and Hassan et al. (2005) found that fertilizer, irrigation and family size variables were a highly significant effect on agricultural production. Besides, the country as a whole is facing a severe shortage of canal water; so the coefficient of the irrigation variable is higher and statistically significant.

The sowing date variable shows that the sowing date affects positively and significantly wheat production. In other words, when the farmers sowing is in October the production of wheat is more than in other periods. Awad (2001) found that the number of irrigation, seed rate, fertilizer amount and sowing date were the main important variables that affect significantly wheat yield.

Moreover, some variables such as fertilizer, seed types, education and labor cost have no significant effects on wheat production. Mousavi-Avval et al. (2010) found that the use of fertilizer, seeds and land inputs was incompatible with the production. Semerci et al. (2012) found that fertilizers and pesticide quantity affected wheat production positively. Moreover, Maize (2014) concluded that education had a positive impact on the agricultural productivity of small-scale female corn producers.

It has been proved that there is increasing return to scale based on the sum of elasticity coefficient of variables in the function ($\Sigma\beta i=1.5$) in wheat production means that farmers in the area can increase their wheat output by increasing their farm size, pesticide quantity, seed

quantity, fertilizer and labor. That is to say that the farmers are producing in the first stage of production. When factors such as farm size, seed quantity, fertilizer, pesticide quantity and labor increase, the wheat production also increase due to increasing return of scale. This result is similar to the result obtained by Semerci et al. (2012) found the marginal efficiency coefficients of the production factors in the wheat production equation. He concluded that it has been an increase in these inputs in order to be concluded that there able to use production area, pesticide and fertilizer cost variables at the optimum economical level as the marginal efficiency coefficients, reached by division of marginal crop income to factor price, is greater than 1.

5. Conclusion and Recommendation

Wheat represents the main food crop in Erbil province and it is one of the major strategic crops in Iraq. It has a great role to satisfy the local demand and ensure food security as well as the relative importance it occupies in terms of area planted and production. However, there are many constraints facing wheat production especially in Erbil province which include high production costs, which can be attributed to the high cost of imported inputs such as tillage, seeds, irrigation, fertilizers, transport and low level of productivity.

The main objective of this study is to analyze the economics of wheat in the province of Erbil. The data used in this research was collected from 182 wheat farmers in the study area.

The average yield of wheat in the study area was 486.70 kg acre^{-1}. Crop budget analysis showed that the total variable cost of production of wheat was 156006 IQD acre^{-1}, the average gross profit were 62879 IQD acre^{-1} and the average net returns was 46963 IQD acre^{-1}. Regarding the percentage share of different cost items in the total variable cost of production, the main cost items for wheat were harvest cost followed by fertilizer cost and land preparation cost followed by seed cost. There is a positive relationship between profit and price of wheat and quantity of wheat. The benefit-Cost Ratio is 1.27 and indicates that wheat is a profitable product for farmers.

Regression analysis was used to investigate the impact of the factors that were assumed to affect wheat production. The results showed that the Cobb- Douglas form of wheat was significant in explaining the variation in the production function. The results showed that the farm size, irrigation, seed quantity, pesticide quantity, and sowing date were the main important variables that significantly affect wheat production. As a result of the study, the following recommendations were presented:

- The use of certified seeds and germination guaranteed high yielding and assist the task achieved by farmers.
- Raising the level of technology used in the production of wheat by using the effective elements in increasing the yield of wheat such as the use of improved seeds and qualified and follow scientific methods to creation of the ground.
- To increase the productivity of farmers by increasing their education levels and encouraging them to become cooperatives.
- To encourage farmers to use fertilizers and pesticides at appropriate times and amounts.
- The use of modern scientific methods in farms, especially to produce wheat.
- To follow a balanced and stable pricing policy to motivate the producers and to encourage them to increase their production and improve the quality of wheat.
- Benefiting from the experiences of other countries through participation courses and scientific conferences and meetings.

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