

ESTIMATING OFF –FARM LABOR SUPPLY AND ANALYSING RELATIONSHIP BETWEEN RISK AND FARM SIZE

Awf A. A.

E. H. Ali

A. S. Shukr

Lecturer

Prof.

Lecturer

Dept. of agri. Eco. Coll. of Agri. Eng. Scie. University of Baghdad

Eskanderhali81@gmail.com

aalsaad@coagri.uobaghdad.edu.iq

ali.s@coagri.uobaghdad.edu.iq

ABSTRACT

This study was aimed to estimate off-farm labor supply model. Data were collected randomly from 267 wheat producers in Salah El-Din province for the year 2020, 67.4% of them are produced using pivot sprinklers for irrigation and with three tenure categories (60,80,12) dunums. Furthermore. The KS coefficient was used to analyze the producers' risk-taking behavior after estimating the production function and determining the area variable that has the most influence on the production process. If it increased by 1%, production would increase by 0.802%. The farmer's decision to adopt the technology was based on economic, social, and institutional factors. It turns out that 40% of farmers make their decision based on financing. When analyzing the decisions of farmers under risk, it was found that 35% of them make the decision in relation to the price, which is the main incentive for production. In order to understand the relationship between the risk, the return, and the size of the farm, it was found that when the area is increased, the return increases, and the revenue of a dunum at the tenure size of 10 dunams amounted to 481,600 dinars and at a higher KS level, what is known as risk-haters, the revenue was the highest possible and the risk also increased with it, and the farmers became among the large holdings they prefer. In any case, some farmers believe that when you want to get a higher return, it is important to keep in mind that there is a greater risk. Risk is affected by a number of factors, including economic, divided into price and productivity, social ones, and others related to the farmer himself in terms of efficiency, management, skill, and experience. . The research recommended a review of tenure laws and the development of risk management strategies by providing adequate funding that ensures ,Providing factories within rural areas that contribute to absorbing surplus production, creating price stability, as well as creating a labor market that reduces poverty in the rural area.

Keywords: Risk management strategies, tenure security, utility maximization, time allocation, Tobit.

عوف وآخرون

مجلة العلوم الزراعية العراقية- 541-526:(1)55:2024

تقدير عرض العمل خارج المزرعة وتحليل العلاقة بين المخاطرة وحجم المزرعة

علي صلاح شكر

اسكندر حسين علي

عوف عبدالرحمن السعد

مدرس

استاذ

مدرس

قسم الاقتصاد الزراعي - كلية علوم الهندسة الزراعية - جامعة بغداد.

المستخلص

يهدف البحث الى تحديد العلاقة بين المخاطرة والعائد والانتاجية والتكنولوجيا والعمل والكفاءة في احجام مزرعية مختلفة. وتحليل سلوك المنتجين من حيث مواجهتهم للمخاطرة وتحليل قراراتهم تحت تأثيرها، وتقدير نموذج عرض العمل خارج المزرعة. جمعت البيانات بصورة عشوائية من 267 منتجا للقمح في محافظة صلاح الدين للعام 2020، 67.4 % منهم ينتجون بالمرشحات المحورية وبيثلاث فئات حيازية (60:80:120) دونم . و32.6 % مزارعا ينتجون تحت نظام الرش الثابت بخمس فئات حيازية (10:20:30:40:50) دونم. استخدم معامل Ks لتحليل سلوك المنتجين اتجاه المخاطرة بعد تقدير دالة الانتاج وتحديد متغير المساحة العامل الاكثر تأثير في العملية الانتاجية اذ لو زاد بنسبة 1% فان الانتاج سيزداد بنسبة 0.802 % . قرار المزارع في تبني التقنية اعتمد على عوامل اقتصادية واجتماعية ومؤسسية، وتبين ان 40 % من المزارعين قرارهم يعتمد على التمويل، وعند تحليل قرارات المزارعين تحت المخاطرة اتضح ان 35 % منهم يتخذون القرار نسبة الى السعر وهو الحافز الاساسي للإنتاج. ولمحاولة فهم العلاقة بين المخاطرة والعائد وحجم المزرعة تبين عند زيادة المساحة فان العائد يزداد، ان ايراد الدونم عند حجم الحيازة 10 دونم بلغ 481600 دينار وعند مستوى KS اعلى اي كارهون للمخاطرة، فعند الحيازة الاكبر في عينة البحث كان اليراد اعلى ما يمكن. والمخاطرة ارتفعت معه ايضا واصبح المزارعون ضمن الحيازات الكبيرة يفضلونها. وعلى اي حال يرى بعض المزارعون انه عندما تريد ان تحصل على عائد اعلى يجب ان تضع في اعتبارك ان هناك مخاطرة اكبر، تتأثر المخاطرة بعدد من العوامل منها اقتصادية تقسم الى سريعة وانتاجية، ومنها اجتماعية، ومنها تتعلق بالمزارع نفسه من حيث الكفاءة والادارة والمهارة والخبرة. تم معرفة تأثير هذه العوامل من خلال تقدير نموذج Tobit.

الكلمات المفتاحية: استراتيجيات ادارة المخاطر، الامن الحيازي، تعظيم المنفعة، تخصيص الوقت.توبت

Received:13/6/2022, Accepted:19/9/2022

INTRODUCTION

Almost every day, farmers encounter situations in which the outcome is uncertain due to the nature that has a significant impact on agriculture. One of the problems in dealing with risk and uncertainty is that individuals including farmers differ in their willingness and preference to take risks and uncertainty. No one would normally enter into an environment of risk and uncertainty without expectations of greater reward than would be the case without risk and uncertainty(12,11). That individuals differ markedly in their willingness to take risks and uncertainty, and this can be illustrated by a simple game. Suppose a person has four different strategies and each strategy produces different levels of income and has probabilities associated with each income level. The farmer must have open alternatives in order to make the decision. If two or more alternatives are not available, no decision can be made. The alternatives available to the farmer represent the actions or strategies that are open to the farmer. The set of measures should include the full range of open farm alternatives. Agriculture is of a high biological nature and sensitive to risk and uncertainty, which is one of the essential features of agricultural production. The decision-making process in the agricultural sector is inevitably subject to two basic terms which are risk and uncertainty, and thus farmers make their decisions in a risky environment in which price fluctuations and returns are among the greatest sources of risk as well as legal and social obstacles, human work and the environment (21). Here, the farmer makes a decision whose consequences are not known until after a while, so the results may come in line with what is expected or worse than that expectation (12). A farmer's willingness to take risks is largely related to his psychological situation. The satisfaction or benefit that farmer receives from each outcome determines to a large extent the strategy he will pursue and maximizing the benefit subject to the constraints imposed by the availability of income is the ultimate goal of the farmer or anyone else. The risk can be faced by several strategies, including vertical integration, diversification, production contracts, marketing contracts, as well as some

practices such as early or late cultivation and supplementary irrigation or modifying the input-output mix (35). The ability of farmers to face and take risks is related to liquidity, financing and market perfection procedures, and because agricultural risks are not independent, but are linked to each other as part of a system that includes all available tools and strategies and policies taken to manage risks, therefore, following a comprehensive approach is necessary and important (2). According to the differences in risk preference and in the environment of risk and uncertainty, farmers can be divided into three types of risk-loving, neutral, and risk-averse as there are significant differences between these types. Based on these preferences and willingness to risk, the risk may be directly proportional to the returns and requires a higher investment in high-productivity agriculture, and this may happen in farms with large areas. And due to the lack of complete markets and lack of insurance and financing, the farmer chooses low investment and low return and therefore the risk is low, which reduces the possibility of investing in large farm holdings (19). Accordingly, it can be said that the problem of land possession is one of the old, modern and persistent problems, as it requires that the optimal farm size meet the minimum requirements to absorb the degree of full use of the labor available within the scope of the agricultural family and its ability to absorb modern resources with high productivity to ensure a net income that satisfies the requirements of those families and to create a surplus for stabilizing the status quo in the countryside, as the fragmentation of lands into small units may not help to provide that level of income that helps to exploit the surplus for reinvestment in order to increase the level of profits in the long run. All of the foregoing is directly and indirectly related to risk, and the farmer is not secure in his possession, and therefore is vulnerable to shocks and risks as the percentage of farmers working in subsistence farming remains high and their participation in the production market is relatively low, as the poverty reduction strategy provides for improving the participation of owners Smallholders in the market. Possession is the starting point

towards increasing production, achieving efficiency, and managing it in an optimal and sustainable manner, affecting development issues directly and indirectly. This research aims to understand and determine the relationship between risk, return, productivity, technology, labor and efficiency in different farm sizes. The research also aims to analyze the behavior of producers in terms of facing risks, analyze their decisions under their influence, and estimate the off-farm job offer model, which is built on maximizing the benefit and knowing the factors that affect the decision to participate in the work.

MATERIALS AND METHODS

The data were obtained through a questionnaire distributed randomly to wheat producers in Salah al-Din Governorate / Iraq, which is located north of the capital, Baghdad, at a line 43.35 degrees east of Greenwich, and at a latitude of 34.27 degrees north of the equator. The total area is 24,363 km², inhabited by about 1595,000 people, in which there are 22 agricultural divisions. The area of wheat planted in it amounted to 56,555 dunams, which contributed 8.9% of the cultivated wheat area in Iraq, with a production of 454394 tons. The governorate has 6129 working pullers and 471 working harvesters. The study sample targeted wheat producers by means of fixed and pivotal sprinklers. Data were collected from 180 farms under pivot sprinklers, distributed over three tenure categories: (60, 80, 120) dunams, and 87 farms under fixed sprinklers in four

categories of possessions: (10, 20, 30, and 40) dunams.

Theoretical framework:

Recognizing farmers' preferences towards risk is important for farmers themselves, as they enable them to better manage their farms, and for agricultural policy makers, as they can take and follow measures that increase the efficiency of the agricultural sector by improving the expenditure of public funds. It is also important for the industry seeking to provide inputs, and their knowledge of risk situations enables them to provide more appropriate services to farmers (28). The search for factors that constitute risk aversion is an essential issue that helps in risk management, which should take a special place in agricultural policy (31). Because risk aversion leads to a reluctance to take a decision surrounded by risks that can not be avoided in any way in agriculture, which is associated with risk and uncertainty (12). The risk aversion in developed countries is smaller than in developing countries as they are risk-neutral or, in some developed countries, risk-loving because of the good subsidies that were able to protect the agricultural sector from market and production risks. And the risk-averse farmers will use less inputs than the optimum level, which leads to a lower level of efficiency, as they expect a certain production and based on the risk they do not use the amount of inputs needed and do not achieve that expected production. As it is shown in figure 1.

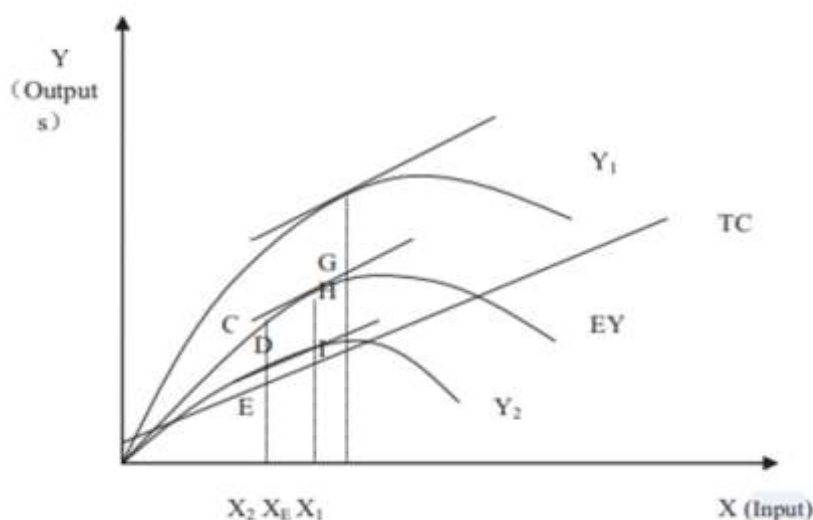


Fig 1. Farmer's behavior according to risk preferences

Source: (2)

As long as the use of resources by the farmer depends on his attitude towards risk, the income and efficiency will depend indirectly on the risk as well as the size of the land tenure because it is related to efficiency and income, and therefore it can be said in general and in the long term that returns and efficiency depend largely on the size of the resources used as long as the available land is limited in size. Figure 2 depicts the options for trade-offs between farm size and resource efficiency. Figure A shows the slope of the curve that expresses the decrease in yield to capacity when the farm size decreases and the number of farmers increases. As for the slope of the

curve in Figure B, it expresses the stability of the yield to capacity. In this case, there is no relationship between the efficiency and the size of the farm, regardless of the number of farms, as a result of achieving the same level of production for each unit of production factors. As for the figure C, it indicates the change in the increase in capacity to size and also indicates the improvement in the level of efficiency when increasing the size of the farm when moving to the left. The slope of the carry-over curve is in Figure A and the relationship between these shapes is affected by political decisions related to the agricultural sector reform laws. (15).

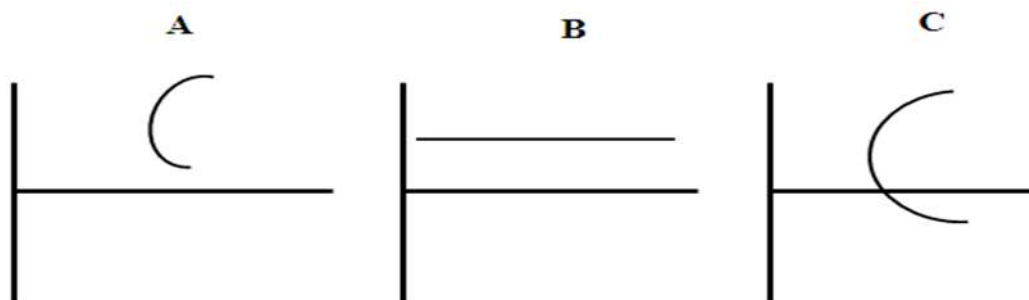


Fig. 2. Transfer options between farm size and resource use efficiency

Source: (10).

Studies indicate that farmers are willing to take a higher risk with the increase in property and wealth, and this is expected to happen in large farms because the amount of capital invested in them is greater (30). The importance of the risk is highlighted by a question asked to farmers in China, why did you wait 10 years before adopting the cultivation of Bt cotton (a cotton kind which contains a gene that carries toxins that kill pests). About 97% of them answered due to the risk and uncertainty of the effectiveness of this variety to reduce pest infestation (40). Risk preferences play an important role in technology adoption and thus play the same role in wealth accumulation and income growth in labor and financial markets (37). The risk as well as the size of the farm has become an obstacle to the adoption of modern agricultural technologies because these technologies can increase production and also can increase the possibilities of productivity fluctuations and the possibilities of crop failure. Therefore, risk-neutral farmers adopt agricultural technologies at a lower rate (23). Also, risk-takers use less labor on farms, and social capital plays a large role in improving

land management, but this varies according to farmers' risk preferences. The utility function relates utility or acceptability to the quantity of one or more available commodities. Utility maximization becomes the criterion by which choices are made by the manager. The benefit or satisfaction of the farmer is inseparable from his expected income, but it is not the same as his expected income either. If utility and expected income are the same, a farmer interested in maximizing utility will always choose the strategy that yields the highest expected income. Economists have devoted a great deal of effort to proving the existence of utility functions to individuals, and in particular to farm managers. Figure 3 shows three possibilities with respect to the possible functions relating utility to income. Assuming that the farmer can achieve greater income only at the expense of taking on greater risk or uncertainty, then the average risk will have a function of utility that increases at a decreasing rate with the rise in income. The utility function of the risk-neutral will have a constant slope. The benefit function of the risk preference will increase at an increasing rate.

One utility function that is sometimes assumed is the quadratic utility function:

$$U = z + bz^2 \dots\dots\dots 1$$

where z are some of the variables of concern that generate utility for the manager. And if we assume that it relates to the level of income so that z is replaced by (expected z) and E (z):

$$E(U) = E(z) + bE(z^2) \dots\dots\dots 2$$

The expected value of the square of the variable is equal to the variance of the variable plus the square of the expected value:

$$E(z^2) = \delta^2 + (E(z))^2 \dots\dots\dots 3$$

Then:

$$E(U) = E(z) + b(E(z))^2 + b\delta^2 \dots\dots\dots 4$$

Thus, utility is not only a function of expected income but also its variance. Neutral curves showing the possible combinations of income and their variance that result in the same amount of utility to the manager can be

obtained by assuming U equals U₀ and taking the total differential of the utility function:

$$dU^0 = 0 = (1 + 2b) dE(z) + b d(\sigma^2) \dots\dots\dots 5$$

Then

$$dE/d\sigma^2 = - b/[1 + 2bE(z)] \dots\dots\dots 6$$

The denominator [1 + 2bE (z)] will always be positive. The shape of the neutral curves depends on the value of b. If b is zero, the farmer is neither willing nor averse to the risk. Here the farmer is risk neutral. If b is positive, the farmer likes to take risks, and the slope of the neutral curves will be negative. If b is negative, then the farmer is risk averse and the neutral curves will be pointing upwards to the right. Figure 3 shows some of the possible relationships suggested by this utility function.

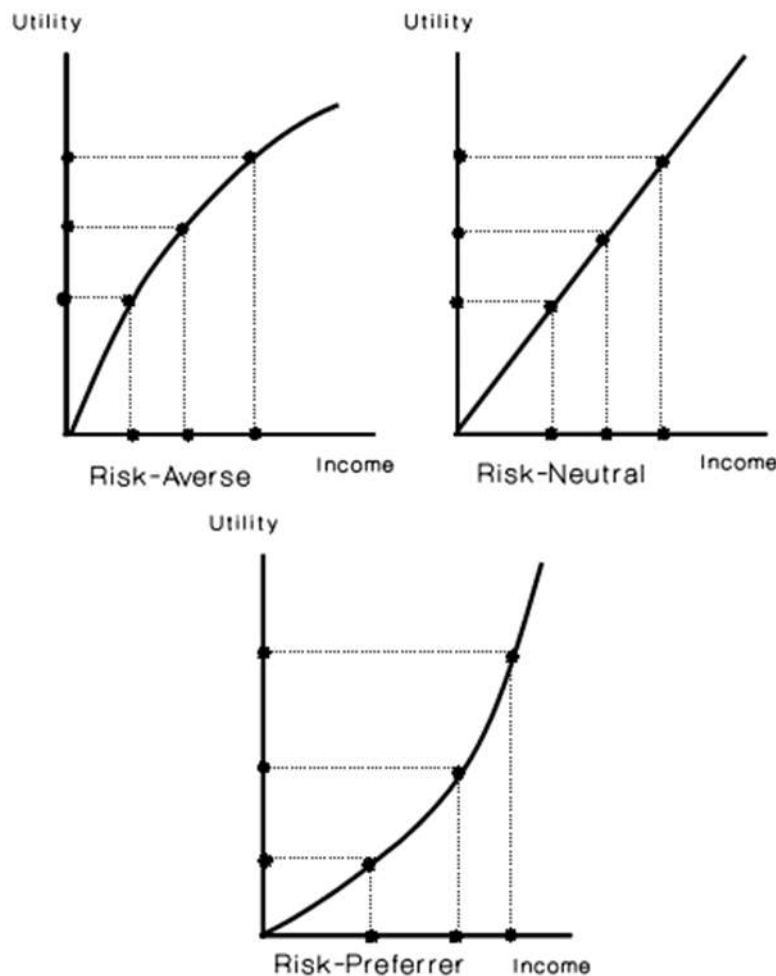


Fig.3 Relationship between utility and income in case of risk

Source: Debertin,2012

It can be argued that utility maximization is a logical goal when the decision maker is faced with risky choices. In this framework the

individual will objectively evaluate the expected value given the probability of each alternative occurring. This evaluation is

performed first by entering the probabilities and expected outcomes into the utility function and then selecting the set of available alternatives that maximize utility. The general form of the utility function is as follows:

$$.....7 \quad U(P_1, \dots, P_i, \dots, P_N) = \sum_{i=1}^n p_i u(x_i)$$

Risk aversion can be viewed as absolute and relative. The direct measure of absolute risk aversion is expressed by the following formula (16), which is a theoretical measure of independent risk aversion as suggested by (33) and (6) :

$$..... \quad8 \quad R_a = \frac{-U(X)'}{U(X)''}$$

So, $U(X)'$ is the first derivative and $U(X)''$ is the second derivative of the utility function:

It should be noted here that absolute risk aversion is not a simple indicator but rather a function that reflects the effect of changes in wealth on risk aversion. It is usually expressed in monetary units, and the relative aversion coefficient can be the best expression of risk and can be represented by the following formula:

$$R_r = R_a X \quad9$$

R_a , is the absolute risk aversion coefficient and X is the utility function. It could be, for example, the value of agricultural production. The range values is $4 \geq R_r \geq 0.5$. Where the risk aversion is normal if its value is 0.5 and continues and this aversion escalates to strong if it reaches 4. As it is shown in figure 4:



Fig. 4 Continuity of risk

Source : Deberetin,2012

Despite the ongoing controversy that began at the end of the seventies about the ability of utility theory to correctly represent human behavior, studies have appeared recently that question the results of these models (25). Sometimes the Antle model is used as an estimate of the risk preferences of the average population. Farmers engage in the trade-off between expected average and gross margin variance when choosing their inputs. This trade-off is determined by risk aversion. Antle's model assumes that a population of N farmers where each bet on his mix of inputs is equivalent to one farmer making N bets in the lottery. The level of risk aversion is estimated based on the level of production, showing the best relationship between risks and individual choices. In other words, the producer is supposed to maximize the expected utility of profit according to the following function (5):

$$max Eu(\pi) = max \int u\{pf(\varepsilon, x) - wx\}dG \quad10$$

Since $G(x, z, \gamma/x, z, \varepsilon)$, represents the joint distribution of the variable input x , the constant z , and the risk position ε , no functional form of the distribution is assumed

here, because the Antel model is a flexible linear model and it sufficient that it has a first order condition requirement FOC (33):

$$\frac{\partial \mu_1}{\partial x_k} = \left(\frac{1}{2}\right)AP \frac{\partial \mu_2}{\partial x_k} + \left(-\frac{1}{6}\right)DS \frac{\partial \mu_3}{\partial x_k} + u \quad \text{----- 11}$$

AP and DS allow the calculation of the risk position:

$$R = \frac{1}{2} \mu_{2k} AP - \frac{1}{6} \mu_{3k} DS \quad \text{----- 12}$$

The Safety First Model can be used for the purpose of analyzing the producers' preferences towards the risks surrounding their projects, and it can be written according to the following formula (32):

$$.....13 \quad K(s) = \frac{1}{Cv} \left(1 - \frac{px_i \cdot xi}{py \cdot ei \cdot \mu y}\right)$$

Where:

$K(s)$ = the value of the risk aversion parameter
 Cv = coefficient of variation (y) of the quantity of fish production

Pxi = Factor price

xi = resource quantity

py = output price

e_i = elasticity of output

μ_y = average production

The behavior of producers towards risk is classified into three groups based on the value of the risk aversion parameter $K(s)$ which are:

Preferred risk producers, when $0 < K(s) < 0.4$

Neutral producers, when $0.4 < K(s) < 1.2$

Risk-averse producers, take a high risk when $1.2 < K(s) < 2$

Production elasticity is obtained by estimating the production functions and then determining the variable most affecting production.

RESULTS AND DISCUSSION

First: Estimating risk and analyzing the behavior of producers:

1. To estimate the risk, the first step is to estimate the production function and take the parameter of the most influential variable in the production process to enter it in the formula of risk: accordingly, the production function was represented by the following formula:

$$Q = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$$

Q: Quantity of wheat production in tons

X1: the cultivated area in dunams.

X2: the amount of pesticides

X3: The number of hours of manual labor.

X4: The number of working hours (machines).

X5: The amount of water added, m^3 .

X7: the amount of fertilizer in kg.

The production function was estimated by the method of Ordinary Least Squares (OLS) in the logarithmic form to pass the statistical and standard tests. It was found from the function that there is a technological level applied in the study sample and that there is a productive efficiency through the value of the constant in the Cobb-Douglas function, which represents the technical level or even the total productivity of resources. This was clear as the productivity of the dunum of the crop varied from 890-1100 kg / dunum according to the area, the cultivated varieties and the nature of the administration. But in general, the use of all resources occurred in the rational production stage. If the resource use increased by 1%, the production increased by less than 1%. The effect of increasing resource on production differed according to the

importance of the productive factor in the production process. The estimated function is almost subject to an increase in the return to scale, as the total elasticity of the function reached 1.035, meaning that the function increases at an increasing rate. In other words, the marginal product of productive resources is declining. But the marginal product of the resources group along the imaginary lines of isoquants is increasing. This means that the production surface above this imaginary volume line is convex rather than concave from below. Area cultivated was the most productive variable and the most influential in the production process, as by increasing it by 10%, production will increase by 8.02%. This reflects that availability of space helps to benefit from the advantages of large production and the application of technology. It also contributes to a decrease in the average fixed cost with the increase in the size of the farm, as there is a relationship between farm size and economic efficiency either because of the economies of capacity in the production function or because of the relatively low prices and the consequent reduction in costs as a result of the increase in size. The efficiency that accompanies the economies of scale is technical efficiency, while the efficiency that accompanies the adjustment of resource prices and the combination of output for relative prices is price efficiency. Therefore, economic efficiency is a function of price efficiency and technical efficiency. It is also related to the optimal farm size, which represents the minimum requirements for absorbing the degree of full use of the labor available within the agricultural family and its ability to absorb modern resources with high productivity to ensure a net income that satisfies the requirements of those families and to create a stimulating surplus to stabilize the current situation in the countryside, as the land is divided into small units may not help to provide that level of income that helps to exploit the surplus for reinvestment in increasing the level of profits in the long run. It is thus considered a risk factor that increases aversion to farming and off-farm work.

Table 1. Production function according to double logarithmic form

Variables	Co.	t	SE	Pro.
Area	0.802	11.062	0.0725	0.0000
Pesticide	0.071	1.235	0.0579	0.2178
Hand labor	0.047	2.700	0.0175	0.0078
Mechanization	0.018	0.790	0.0233	0.4297
Irrigation	0.057	0.704	0.0809	0.481
Fertilizer	0.087	1.846	0.0473	0.0560
C	5.993	9.651	0.6209	0.000
R ²	0.955	0.954		N=267
F. Test= 920.77 D.W.= 1.58 ARCH.TEST:F=0.674				

Source: Done by researchers using Eviews software outputs

2. Reasons why farmers do not adopt modern technologies:

Modern technologies contribute to increasing productivity, reducing production fluctuations, and thus ensuring good returns for farms that make them secure. But the availability of these technologies and their adoption by farmers is not easy as the decision of the farmer to adopt the technology depends on several factors, including economic, social and institutional ones. The decision is also influenced by the human capital represented by experience, age and education. Knowing the reasons behind non-adoption is an important matter that helps in drawing effective policies to overcome the obstacles and make the farmer decide to adopt modern technology because it will contribute to increasing productivity, increasing his profits, achieving the welfare of the rural family and reducing risk(10). This adoption decision is also linked to the offer to work outside the farm. When a group of farmers was asked questions about their reasons for not adopting modern technologies, it was found that 40% do not have enough money to purchase this technology. For example, only a 60-acre sprinkler costs 40 million Iraqi dinars. In addition to installation fees and the production process. Moreover, the farmers' dues from marketing their product to the state for the past years have not been received due to administrative complications, and this is what weighs them down on the one hand, because the next production process needs capital, so some of them are forced to buy production elements on credit, and this entails a higher cost and not using the resources in the recommended quantities technically and economically. On the other hand. The survey also indicated that 27.1% of them do not have sufficient space to absorb technology (sprinklers) (7). As some agricultural reform laws in Iraq or inheritance or urban effect,

agricultural lands decreased because of modernization, led to dwarfing of areas and became unable to adopt technology. For example, a small size pivot sprinkler with needs an area of 60 dunums, and most of the farmers, due to the mentioned reasons, do not have this acreage, so some of them tend to rent, and this is not feasible for them because they think that investing in sprinklers is long-term strategic decision and it is not appropriate to use it in the case of short-term rented land. This is one of the reasons for the lack of tenure security so that the farmer feels that his project is threatened, as well as the availability of work and that tenure security is linked to food security. As for the risk factor, part of which is implicit in the previous two reasons, and the other part is the lack of knowledge of market conditions and the nature of production, which made 32.9% of them avoid taking risks by not adopting modern technology.

Table2. Reasons why farmers don't adopt modern techniques

Reason	Percentage
Risk	32.9
Limited Capital	40
Limitation of tenure	27.1

Source: Done by researchers based on questionnaire

3. Analyzing farmers' decisions at risk

Decision analysis and decision making is one of the main tasks of management and must be done early. For instance, wheat farmer has to analyze the decision to expand the area, purchase the sprinkler, seed rates and fertilizer levels, especially since prices and returns are not known with certainty. Farmers do not know exactly the consequences of their decisions because it can be more than one result due to the changes that occur between the time of deciding and the time of obtaining the result of this decision. Therefore, the nature of the decisions varies from one farmer to another and depending on many variables.

But when the farmers were surveyed about the nature of their decision under risk, it was found that 35% of them make the decision relative to the price, which is the main incentive for the farmer because his goal is profit, so he responds to the increase in price, especially that the wheat crop is priced from government accepts and receives the quantities produced from it within the program to support farms and enhance food security. Therefore, we see that they want to produce wheat for its good and specified price, which reduces the price risk. However, not all farmers are marketed to the government and benefited from the price advantages due to stunted areas, low marketing efficiency and the need for financing, which forces them to sell directly and lose part of their profits, as well as administrative complications and delays in receiving their financial dues from government. Therefore, subsidized price, as well as government programs such as providing loans or providing requirements such as fertilizers and seeds, and in some cases, mechanization made 32% of them related their decision to government directives, and 19% of the sample farmers depend on other farmers, relatives or ideal farmers, and it is one of the ways of managing farms, as farmer makes his decision based on his observations and his influence on the behavior of other farmers. Accordingly, we see that there is a set of goals and objectives behind the farm decision and the bearing of risks, especially since the wheat crop is a cash crop, so the farmer's goal is to obtain profit as long as some surveyed areas consider wheat as the only source of income because in these areas only this crop is grown, as well as other reasons including rain. Therefore, some farmers, when deciding to deal with risk, sacrifice part of the income in exchange for reducing the risk.

Table 3. Analysis of farmers decisions under risk

Decision	Percentage
With market price	35
Tentative decision	9.7
Based on others	19
According to government	32
According to tradition	4.3

Source: Done by researchers based on questionnaire.

4. Relationship between risk and return and farm size: After estimating risk parameter from production function it was found that the area is the most specific to the risk factor, so its parameter was taken and put in the risk law and the behavior of the producers was determined. The farmers have three preferences for risk: The first is risk-prefer, as the value of KS is greater than zero and less than 0.4 (0.3, 0.34, 0.23) and they prefer risks and they represent 44.2% of the sample. The second behavior is that they are risk averse (do not prefer it), as their KS value was greater than 1.2 and less than 2 as it reached (1.5, 1.4, 1.3), and their percentage was 49.4% of the research sample. As for the third behavior that some farmers preferred, it is the neutral who is neither willing nor hated. For the risk, whose KS value was 0.63, and their representation in the sample was 6.3%, and it can be said that the largest percentage of farmers are risk-averse and unwilling to take it, as they were 133 farmers. This lack of preference may be attributed to many reasons, including the nature of risky agricultural production, whether productivity or prices and poor financing, as part of the production operations are borrowed by the farmer or the payment is deferred, as well as due to rain forecasts, as well as weak administrative capabilities and fear of recent fire accidents. In order to try to understand the relationship between the risk, the return and the size of the farm, it turns out that when the area is increased, the return increases and this is economically logical, as by increasing the size of the farm, one can benefit from the economies of scale and the advantages of large production. The cost is also distributed over a larger area, and thus its average decreases, which enables it to benefit from the lower cost by expanding by using larger quantities of resources according to the recommended quantities, as the revenue of a dunum at the tenure size of 10 dunams amounted to 481,600 dinars and at a higher KS level, any risk-takers. With the expansion of the area, we notice that the revenue rises, and at the same time the risk increases, and with the increase of tenure, the farmer turns his behavior into a preference for risk. When the largest tenure in the research sample amounted to 120 dunams, the revenue was the highest

possible as it reached 510720 dinars / dunum, and the risk also increased with it and the farmers became within large land holdings prefer it. In any case, some farmers believe that when you want to get a higher return, you must bear in mind that there is a greater risk, especially since the capital paid in growing wheat under sprinkler irrigation systems, whether pivotal or fixed, is very large due to the high purchase costs as well as the wells as well. About production requirements, so farmers who fear risk do not want to lose, so they avoid it by hating risk, knowing that return and risk do not always reflect success and failure, but rather miserable in their expectations because they are subject to ups and downs. The farmer must balance the risk and the return in order to have a hoof, and this

is what appeared in the farmers of the 30-dunum holding category, as they were neutral in their behavior towards risk and achieved lower productivity and lower return as it is obvious from table 4.

Table 4. Relationship between risk, revenue and farm size

Farmers number	KS value	Donum revenue (dinar)	area
18	1.5	481600	10
26	1.4	488880	20
17	0.63	478800	30
26	0.3	500080	40
88	1.3	489600	60
56	0.341	510720	80
36	0.23	513520	120

Source: Done by researchers based on questionnaire and KS equation.

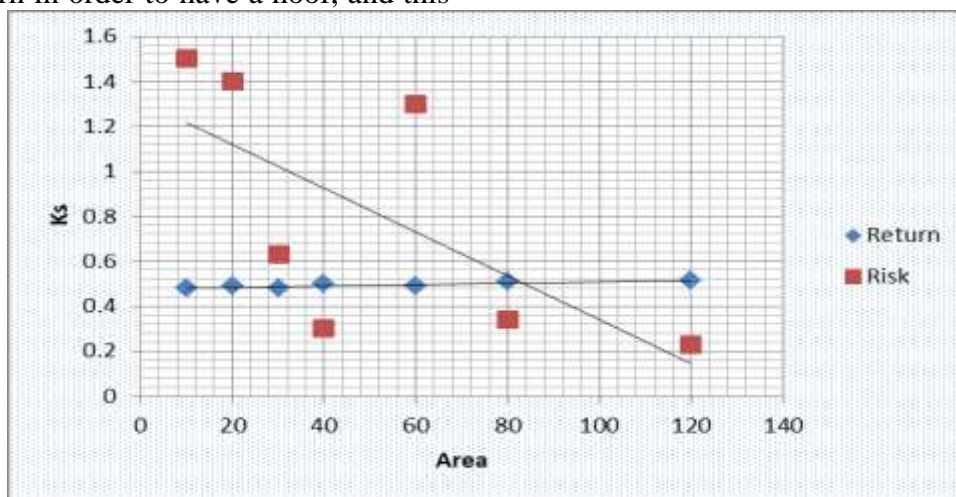


Fig 5. Relationship between risk revenue in different tenures

Source: Done by researchers based on table 4

Second: Determining factors impacting risk using TOBIT model: Risk is affected by a number of factors, including economic, divided into price and productivity, social ones, and others related to the farmer himself in terms of efficiency, management, skill, and experience, especially since agriculture is affected by risk, which is an inherent characteristic of it. The research tried to find out the effect of factors (seeds, the farmer's experience with supplemental irrigation, the age of the farmer, efficiency), as the risk was expressed as a qualitative variable expressing the risk cases that were previously calculated. The TOBIT model was estimated, and the results were as in Table 5 (26). It is clear that seeds affect risk, as by increasing it by one unit, the probability of the risk increases, and this comes from the farmers' lack of sufficient

knowledge of the actual needs of the dunum. Rather, they add more seeds than they think that it is better to increase production. In anticipation of the lack of germination and birds, but the increase in the amount of seed per dunum reduces productivity if the number of plants increases and there is not enough space for lighting and the branching process, and thus increases the production risk. Education is an important factor and helps in adopting technology, knowing the needs of the plant and managing the crop well. Therefore, increasing education at one level will lead to a decrease in the possibility of risk. Also, experience, and here expertise was introduced in the supplementary irrigation process, as this technique is new and expensive and requires certain experience in its use and in the timing of irrigation and the duration of irrigation, so

increasing the experience in supplementary irrigation will contribute to reducing the possibility of risk. Increasing the experience by one year, the risk decreases by 0.011, as the dates and quantities of irrigation are related to the efficiency of water use and the return of the unit of water on the one hand, and its effect on the plant and the increase in production on the other hand. As for the technical efficiency, which reflects the ability of the farmer to

adjust the ratio between the inputs and the outputs, it was positively related to the risk, meaning that the efficiency increases by one unit, the risk probability increases by 0.07. This is in line with the reality of the production process as well as the literature, because when efficiency increases, production and return will increase and therefore higher levels of returns mean higher levels of risk.

Table 5. Factors affecting risk (TOBIT model)

Variable	Coefficient	z-Statistic	Pro.
SEED	0.208	1.893	0.058
Education	-0.020	-2.831	0.004
Experience	-0.011	-0.822	0.410
Technical efficiency	0.079	0.113	0.909
C	-0.745	0.710	0.477
Loglikelihood	-263.19		
Hannan-Quinn crite..	2.04	Akaikeinfo criterio	2.01
Wald Test	F.St.=3.597	Df=4(761)	Pro.=0.007

Source: Eviews output.

Third: Off-farm labor supply:

Agriculture is characterized by fluctuations in production conditions for natural, economic and social reasons. This fluctuation results in severe fluctuations in income, so rural families have to face these fluctuations and their survival depends on their ability to anticipate and deal with this fluctuation or fluctuation. Families can arrange a set of mechanisms to cope with these fluctuations through credit, asset accumulation, savings, livestock possession, and diversification to face risks (38). Because providing work outside the farm when needed in rural areas may be an important way to address the problem of poverty and face risk. The availability of work and the existence of the labor market is necessary because work is one of the main assets owned by poor or simple farmers (27). In many cases, rural families resort to off-farm work to cope with income shocks as an alternative to letting go or borrowing (36). The study of family work outside the farm has appeared frequently in the literature, and the process of discussing it and analyzing its presentation is important to identify and study the opportunities and obstacles that rural families face and thus lead to instability. It is also important in arriving at an economic and social vision of how families deal with income volatility and the need to formulate policies that include dealing with these shocks and providing alternatives that contribute to family

stability on agricultural land. As agricultural areas are dwarfed due to inheritance, urban sprawl or agricultural reform laws, desertification, increased urbanization, increased family members, weak agricultural productivity, invasion of imported goods and dumping of the market, with the agricultural sector inability to provide a safe life for farmers. Providing non-agricultural activities is a way to create favorable conditions for reducing poverty in the rural area, stopping migration to the city, and thus increasing production efficiency. All of the foregoing can contribute to an increase in the percentage of non-farm work's contribution to rural family income, as studies in developing countries indicate that off-farm work contributes 35-50% of the income (20). While in many developed countries such as the United States of America and the European Union, they are increasingly interacting with the off-farm labor market as a means to improve income or as an option to diversify it. In America, for example, they found that there is a positive relationship between income volatility and off-farm work, and off-farm earnings play a prominent role in income diversification. Another important observation is that the majority of agricultural women in the United States work off the farm (18). This leads us to say that the effect of family work and rented work is heterogeneous, and they are non-ideal alternatives, and the selection of the optimal mix of them is not

theoretically determined, and they are treated as separate inputs (see Figure 1). Many farmers resort to this work to provide liquidity or finance agricultural activities, and a large part of the allocative inefficiency in agricultural production comes from inefficiency in distributing work between agricultural and non-agricultural activities. Theoretical models that dealt with the offer of work outside the farm built on the assumption of benefit maximization and focus on allocating family time and estimating individuals, husband or wife, work outside the farm is one of the common decisions, so the importance of modeling farm decisions emerged. An increase in wages outside the farm has a negative or positive effect on the supply of work, as an increase in wages leads

to an increase in the supply of work outside the farm. If leisure time is a normal commodity, the increase in wages may have the opposite effect and reduce the working hours on the farm. We assume that the farm family maximizes the utility (9) (29) (24):

$$U = u(O, L_i, L_2, H, E)$$

$$P_Q = P_Q - R_S + W_1 M_1 + W_2 M_2 + V \dots \dots \dots 14$$

$$Q = F(S, F_1, F_2, H, G)$$

$$T_1 = L_1 + F_1 + Y_1 \text{ and } y_1 \geq 0 \quad i=1,2$$

The rural family that works for wages outside the farm depends on the characteristics of the family and the characteristics of the labor market, and these characteristics constitute constraints, and accordingly the budget constraints are (1):

$$P_c c = P_q Q(T-L-H^0), X, A, E(\phi), \theta - P_x X + w H^0 + Y \dots \dots \dots 15$$

$$G(C, L) = U(C, L) + \lambda \left[P_c C - \left(P_q Q(\bar{Y} - L - H^0), X, \bar{A}, E(\theta), \theta \right) - P_x X + w H^0 + \bar{Y} \right] + \gamma (E(\theta) - \bar{\theta}) + \psi (\theta - \bar{\theta})$$

λ is the engulging multiplier associated with budget constraints. The first necessary condition for offering work outside the farm:

$$H^0 = - \frac{P_q}{\partial Q / \partial H^0} \lambda + \lambda w = 0 \Rightarrow \frac{\partial Q}{\partial H^0} = W \dots \dots \dots 16$$

The content of the above equation states that the work outside the farm that is saved up to a

point where the value of the marginal product of work outside agriculture is equal to the wage. Figure 1 illustrates that point as well as the budget in determining the time allocated to work outside the farm F , work inside the farm M , rest time L , and total family income L^* .

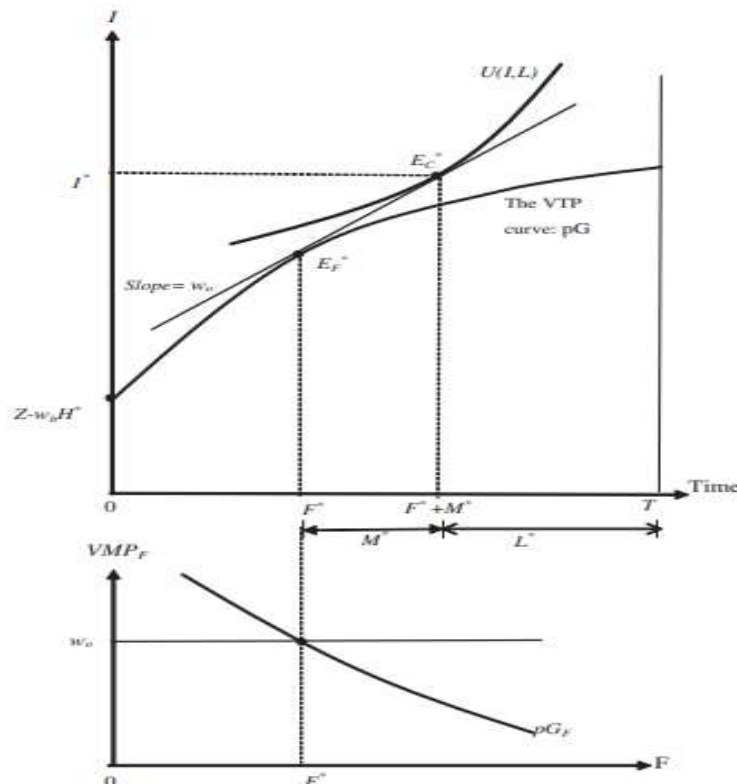


Fig 6. Time allocation between agricultural labor and equilibrium point

Source: (8)

And by using the first condition, we can derive the function of supplying labor outside the farm as (1)

$$H^0 = f(P_q, P_x, A, Y, E(\phi), G, K, Z) \quad \text{if } w > w^*$$

$$H^0 = 0 \quad \text{if } w > w^*$$

The above equation shows the work of the farm, which depends on the prices of inputs, the prices of resources, the quantity of fixed inputs, and income without work. Theoretical and empirical models have been developed to show off-farm wages, family participation, and farmers' working hours, and that off-farm wages depend on the farmer's human capital, and on the local labor market, as well as the effects of seasonal factors, risk and life cycle (14). It is possible to include the participants in the work outside the farm and the non-participants in one equation, and this method depends a lot on the variables that affect the

decision to participate in the work outside the farm. Although the possibility of working off-farm may not have the same effect on the amount of time a worker spends off-farm (39). From the above, the job offer model outside the farm was described in the research sample according to the following function:

$$L = F(E, D, FS, F, An)$$

Since:

L: participation in the work outside the farm, where it is = 1 in the case of participation and = 0 otherwise (dummy variable).

E: educational level.

D: The distance to the nearest labor market, commercial center or employment center.

Fs: the size of the farm (acres).

F: The size of the farming family.

An: dummy variable 1 if owns farm animals and 0 otherwise.

Table 6. Off-farm labor model

Variable	Coefficient	z-Statistic	Pro.	
family size	0.0200	0.1474	1.448896	
Education	0.0074	0.7131	-0.367666	
distance	-0.023340	0.0000	-5.159705	
Animals	-0.132154	0.0493	-1.965555	
farm size	-0.050615		-1.182541	0.2370
C	1.264168	0.0000	6.245465	
Loglikelihood	-179.0405			
Hannan-Quinn crite..	1.431340	Akaikeinfo criterio	1.393562	
Wald Test	F-statistic 8.882421	Df: (4,260)	Pro.0.000	

Source: Eviews output

After estimating off farm labor model and knowing the effect of factors in it, it is clear that the impact of the size of the farming family is positive on off farm labor, as with the increase in the number of family members, part of them tend to work outside the farm because the farm and due to the economic and social conditions surrounding it are unable to provide sufficient income for all family members that provides them with individual food security. This is entirely related to the farm size variable, which is inversely related to the supply of labor. Because the tenure system is the family farm system, as well as inheritance, urban sprawl, and reform laws, the areas are stunted and unable to absorb technology and unable to absorb or reduce risk. This made the farmer insecure in his possession under the concept of tenure security, which would be an incentive for investment and limit land degradation and lead to increased land productivity and thus achieve

food security. While it is generally agreed that security of tenure can stimulate investment, the opposite may be the case. Another important factor that influences participation in off farm labor is the educational level, whose parameter was positive, with a value of 0.007. This means that increasing the educational level will increase the possibility of participating in work outside the farm for two reasons, the first is that agriculture and because of what it suffers from neglect and lack of protection made it a repulsive environment, and the second because of the conditions that Iraq is going through made the employee (working in government) the most economically stable person, which made the learner tend to work outside farm. Because of unemployment, which increases monthly at high rates and the suspension of many industries, it made work outside the farm not always available to farmers, and sometimes it is located in remote areas, forcing the farmer

working outside his farm to bear the costs of the distance, for this the parameter of the distance variable reached -0.02 and it indicates Off-farm workers distance inversely affects their likelihood of engaging in off-farm labor. Many farmers, due to the nature of the agricultural system and in order to maintain a diversified income, they raise animals with crop production, so we see that the presence of animals on the farm reduces the chances of participation in external work. The research concluded that the problem of tenure is one of the important problems that casts its shadow on economic and social variables related to the sample farmers, and that this tenure has a relationship to economic efficiency resulting either because of the economies of scale or prices. Likewise, it is not possible to eliminate risk from agricultural production, but rather work must be done to develop risk management strategies in agricultural production which is resulted by the lack of sufficient funding to adopt modern technologies. Considering that the largest percentage of the sample farmers are risk taking, and that the decisions of most of them under risk depend on prices. Also, farmers are trying to face the risk and reduce the fluctuations of income through work outside the farm, which in turn is affected by other variables, the most important of which is the size of the farm and the availability of animals. Therefore, the research recommends reviewing tenure laws and developing risk management strategies by providing adequate funding that ensures the arrival of productive resources in the appropriate quantity, time and cost, and finding legal formulas that can transform the type of agricultural land into property instead of a contract, and addressing the issue of tenure to create family stability that leads to growth and development the rural area, activating the local product protection law and the investment law. It is also important to provide factories within rural areas that contribute to absorbing surplus production, creating price stability, as well as creating a labor market that reduces poverty in the rural area.

REFERENCES

1. Abreha, N. H. 2007 An Economic Analysis of Farmers' Risk Attitudes and Farm, Households' Responses to Rainfall Risk in Tigray Northern Ethiopia, Ph.D. Thesis, Wageningen University. pp:134.
2. Aimin, H. 2010. Uncertainty, Risk aversion and risk management in agriculture. *Agriculture and Agricultural Science Procedia*. (1): 152–156.
3. Akinniran, T. N., M. O. Raufu, and A. Isola. 2017. Effect of risk attitude on rural household poverty of food crops farmers in surulere local government area of Ogbomoso, Oyo State, Nigeria. *International Journal of Agriculture, Environment and Bioresearch*. 2(1): 39-52.
4. Anderson, J.R. and J.L. Dillon. 1992. Risk Analysis in Dryland Farming Systems. *Farm Syst. Manag. Ser. FAO. Rome*, :PP:109.
5. Antle, J. M. 1987. Econometric estimation of producers' risk attitudes. *American Journal of Agricultural Economics*, 69(3):509-522.
6. Arrow, K. 1970. *Essays in The Theory of Risk Bearing*. Amsterdam, North-Holland Pub. Co. PP:278.
7. Ali, E. H., Baker, Y. T. and Al-Douri, B.F. 2022. Effect of supplementary Irrigation System on Wheat Production Efficiency using A Stochastic frontier Analysis. *Iraqi Journal of Agricultural Sciences* .53(2):353-364. <https://doi.org/10.36103/ijas.v53i2.1542>
8. Ali, E.H., D. A. Abu Duaila and M. KH. Mohamme. 2023. A Study Of Economic, Social, and Institutional Factors Affecting The Adoption Of The High-Rank Wheat Seeds . *Iraqi Journal of Agricultural Sciences* .54(1):161-175 <https://doi.org/10.36103/ijas.v54i1.1688>
9. Ali, E. H. and Faeq, M. F. 2019. Evaluation Management Broiler Production Projects at Baghdad Province Using Management Criteria. *Iraqi Journal of Agricultural Sciences* –:50(Special Issue):48-12. <https://doi.org/10.36103/ijas.v50iSpecial.180>
10. Ali, E.H. and A.H. Lafta. 2020. Measuring the Economic Efficiency and Total Productivity of Resource and the Technical Change of Agricultural Companies in Iraq Using SFA and DEA For The Period 2005-2017. *Iraqi Journal of Agricultural Sciences* –, 51(4):1104-1117. <https://doi.org/10.36103/ijas.v51i4.1089>
11. Ali G. Z., H. J. Mohammed, H. Eskander Ali. 2023. Measurement the Economic Efficiency and Risk Management Strategy for

Projects of Table Eggs Production in Diyala Governorate. *International Journal of Professional Business Review*.8(3):1-12.

[Ali, Eskander Hussain - Author details - Scopus Preview](#)

12. Bairwa, S. L., S. Kushwaha and S. Bairwa. 2013. Managing risk and uncertainty agriculture – A review. *Agricultural Education, Research and Extension in India*.pp:212-214.

13. Chang, Y. M. B. W. Huang and Y. J. Chen. 2012. Labor supply, income, and welfare of the farm household. *Labour Economics* 19(3): 427–437.

14. Daniel A. S..1982.The off-farm labor supply of farmers. *American Journal of Agricultural Economics*.64(3):499-509.

15. Eskander H.A. and J.M.AL-Izzy.2015. Estimating farm technical efficiency by using stochastic frontier approach. *Iraqi Journal of Agricultural Sciences* .46(2):262-268.

<https://www.iasj.net/iasj/article/99569>

<https://iasj.net/iasj?func=article&aId=99569>

16. Eskander, H. A. and M.A.Hamaza.2018. An economic analysis for the factors effecting on net farm income using panel data. *Iraqi Journal of Agricultural Sciences* .49(3):410-417.

<https://doi.org/10.36103/ijas.v49i3.112>

17. Feder, G. 1980.Farm size, risk aversion and the adoption of new technology under uncertainty. *Oxford Economic Papers*. 32(2): 263–283.

18. Francis H. K., M. J. Miranda, J. K. Kuwornu and H. A.Somuah.2020. Drought Experience, Risk Preferences and Adoption of Improved Production Technologies among Smallholder Farmers in Ghana,pp:1-30.

19. Giancarlo M. and D. A. Hennessy. 2000. Uncertainty, Risk Aversion and Risk Management for Agricultural Producers. *Handbook of Agricultural Economics* Amsterdam, Elsevier Science Publishers: 231-326.

20. Haggblade S., P. Hazell and T. Reardon .2010. The rural non-farm economy: prospects for growth and poverty reduction. *World Development*.38(10):1429–1441.

21. Hardaker, J. B, B.M. Huirne, and J. R. Anderson. 1997. *Coping with Risk in Agriculture*, 3rd edition : Applied Decision

Analysis. New York: CAB International. pp:274.

22. Hardaker, J. B. 2000.Some Issues in Dealing With Risk in Agriculture. *Work. Pap. Ser. Agric. Resour. Econ.* 3, 1–18.

23. Hill, R. V. 2009. Using Stated Preferences and Beliefs to Identify the Impact of Risk on Poor Households. *Journal of Development Studies*, 45(2): 151–171.

24. Huffman, W. E., and M. D. Lange. 1989.Off-Farm work decisions of Husbands and wives: joint decision-making. *The Review of Economics and Statistics*. 71(3):471.480.

25. Just, D.R., S.V. Khantachavana, and R.E. Just. 2010. Empirical challenges for risk preferences and production. *Annual Review of Resource Economics* 2:13–31.

26.Jassam Q. T., E. H. Ali, M. S. Ghaylan,2022.Estimating Factors Affecting Wheat Marketing Efficiency Using Tobit Model. *Iraqi Journal of Agricultural Sciences* .53(4):941-949

<https://doi.org/10.36103/ijas.v53i4.1606>

27. Kochar, A., 1999. Smoothing consumption by smoothing income: hours-of-work responses to idiosyncratic agricultural shocks in rural India. *The Review of Economics and Statistics* 81 (1): 50-61.

.28. Kumbhakar, S.C. 2002. Risk preference and productivity measurement under output price uncertainty. *Empirical Economics; Heidelberg*. 27(3):461–472.

29. Lass, D.A. and C.M.Gempesaw.1992. The supply of off-farm labor - A random-coefficients approach . *American Journal of Agricultural Economics*. 74(2):400-411.

30. Love, H.A.and S. T.Buccola.1991. Joint risk preference-technology estimation with a primal system. *American Journal of Agricultural Economics*. 73: 765–774.

31. Mateos,R. and R. J. Izquierdo.2020. Risk management tools for sustainable agriculture: A model for calculating the average price for the season in revenue insurance for citrus fruit. *Agronomy* . 10(2):2-25.

32. Moscardi, E and D. Janvry.1977.Attitudes toward risk among peasant : An econometric approach .*American Journal of Agricultural Economics*: 59(4):710-716.

33. Pratt, J., 1964. Risk aversion in the small and the large. *Econometrica*. 32(1-2):122-136.

34. Quiggin, J., 1993. Generalized Expected Utility Theory. The Rank Dependent Model. Boston: Kluwer Academic Publishers.pp:202.
35. Riabacke, A. 2006. Managerial decision making under risk and uncertainty, IAENG International Journal of Computer Science, 32(4):1-7.
36. Rose, E., 2001. Ex-ante and ex-post labor supply responses to risk in a low-income area. Journal of Development Economics 64(2):371-388.
37. Shaw, Kathryn L. 1996. An Empirical analysis of risk aversion and income growth, Journal of Labor Economics, 14(4), 626-653.
38. Udry, C., 1994. Risk and insurance in a rural credit market: an empirical investigation in northern Nigeria. Review of Economic Studies. 61 (3), 495-526.
39. Wayne H. and M. Swidinsky. 2005. Estimating the off-farm labor supply in Canada. Canadian Journal of Agricultural Economics. 48(1):1-14.
40. Yang, P., M. Iles, S. Yan and F. Jolliffe. 2005. Farmers' knowledge, perceptions and practices in transgenic bt cotton in small producer systems in Northern China," Crop Protection, 24(3), 229-239.