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Application of Safety-First Approach to Measure Risk Behavior of Wheat Farmers in Reclaimed Lands in Iraq for the Season 2019 (Wasit province as an Applied Model)

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Abstract: This study aimed to investigate the application of safety-first approach to measure the risk behavior of wheat farmers in unreclaim land. A random sample of 105 farms in Wasit province for season 2019 were used. The analysis was divided into three stages. The first stage was to estimate the production function (Cob-Douglas) of wheat using the regression method of the Robust M-Weighted Estimator (R.M.W) to represent the functional relationship between quantity of produced wheat and the independent variables (seed, fertilizers, pesticides, number of mechanical and human).The second stage included an analysis of farmers' behavior towards risk based on safety-first standards. It was found that the number of farmers affording high, medium and natural risks were 46, 24 and 33, respectively, representing 43.8%, 24.76%, 31.34% of the total farmers, respectively. Third stage analyzed the factors affecting the farmers' behavior towards risk, using a multiple logistic regression model. The results indicated that farmers having normal or medium salinity soil, long experience (more than 25 years) and those owning their agricultural lands bear the risks more than their counterparts with high salinity soils, shorter experience and tenants of agricultural lands. Therefore, the study recommends conducting maintenance operations on the main and secondary drainage networks to ensure low salinity levels to obtain high productivity.

Keywords: unreclaim land, Robust M-Weighted, multiple logistic regression, salinity soils.

Introduction

Wheat crop is one of the most important cereal crops that occupies a distinguished economic position in most countries of the world as it is an important food source for humans due to its contents of basic nutrients (Al-Younes, 1993). Therefore, it is not surprising that it occupies a strategic position in international economic relations with most developing countries, including Iraq, seeking to achieve sufficiency from it (Al-Hussine & Alyousuf, 2021). The wheat crop is of great importance in Iraq. Its cultivated area ranked first among the cereal crops, reaching 6331 thousand dunums with a production of 4343 thousand tons for the 2019 season (Ministry of Agriculture, 2019). Wasit governorate is considered as one of the largest irrigated governorates in Iraq in terms of cultivated area and production of wheat. It ranks third among the Iraqi governorates and the cultivated areas were estimated at about 703 thousand dunums with a production of 515 thousand tons, representing 11.9% of the total wheat production in Iraq. These include 481 thousand dunums of reclaimed land and 160 A thousand tons of semi-reclaimed lands and 244 reclaimed lands. The governorate includes more than one land reclamation projects through which it is possible to know the salinity levels in these lands. (Ministry of Planning and Development Cooperation, 2019).

Salinity is one of the most important problems facing agriculture in Iraq, and affects half of the total area of the country, especially in central and southern Iraq. The presence of salinity is usually associated with low productivity (Monjezi, 2021). Therefore, the best option in light of the limited arable lands, the limited irrigation water and the costs of horizontal expansion, is the land reclamation and reducing of high salinity (Rijib & Nasir, 2019).

Wheat farms suffer from production, technical and administrative problems that affect farmers 'behavior towards risk, as farmers' decisions are fraught with risks, and every decision taken by producers has consequences in the future. So, it is necessary for producers to understand the risk before making a decision about it (Sadiq, 2018).

Wheat crop production on reclaimed lands is one of the activities that is characterized by risk, whether on the production or economic aspect, as high levels of salinity in the soil contribute to low productivity on the one hand, and high production costs on the other hand. The importance of this study lies in identifying a set of factors that play an important role in producers' behavior towards risk, especially when the variables are qualitative. Previous local, Arab and international studies focused on studying the qualitative response (King, 2002; Najm & Saleh , 2011; Nto *et al*., 2011; Teweldemedhin, 2012; Faisal, 2016; Ali *et al*., 2018; Mohsin, *et al*., 2019) and the production function for different crops (Obaid, 2011; Abbas, 2012; Farhan *et al.*, 2013; Ali & Mahmood, 2018; Al-Mashadani & Mahmood 2019) while there is a scarcity of studies related to risk and the qualitative response toward it (Moscardi & de Janvry, 1977; Gadhim *et al*., 2005; Olarinde *et al*., 2007; Salimonu & Falusi, 2009; Fakayode *et al*., 2014; Dadzie & Acquah, 2015; Sadiq, 2018; Al-Obeidi, 2020). Therefore, the present study aimed to measure the farmers 'response to the productive risk of wheat crops in the reclaimed lands in Wasit governorate for the 2019 season, and to study the effect of the most important factors affecting the behavior of wheat farmers towards production risks using qualitative response models. The research is based on the hypothesis that there are certain factors that affect farmers 'behavior towards risk, especially those related to the presence of salinity ratios in reclaimed lands that affect the producers' behavior towards risk.

Materials & Methods

The data were obtained through field survey based on the questionnaire form prepared for this purpose according to the method of stratified sampling. The study community was divided into homogeneous sections known as layers, then a random sub-sample was chosen whose size commensurate with the size of the layer. A total of 105 wheat farmers were given a questionnaire representing 5% of the total crop farmers in reclaimed lands. The sample was taken from the following areas of Wasit governorate, Al-Kut, Al-Hay, Al-Muwafaqiyah, Al-Bashaer, Al-Aziziya, Al-Suwaira, Al-Hafriya, Sheikh Saad.

The production function was defined as a mathematical table or equation between the maximum quantities of production that are produced using a special set of inputs while the other things remain constant (Doll & Orazem, 1984). There are many types and formulas for production functions used in the agricultural sector, but there are restrictions and limitations on each type. However, some of these functions have advantages over others. The Cob-Duglas function (CD) is the most common function and used in the agricultural sector due to its ease of estimation and interpretation. It can be used in linear form by taking the logarithmic outputs of the variables used. The input constants in the function represent the elasticity of production for it. The sum of elasticities of these inputs is used as an indicator to measure the degree of return to capacity of production (Al-Mashadani & Mahmood, 2019).

The production function for reclaimed lands was estimated using the square method based on the ordinary least squares (OLS) to estimate model parameters. This method is one of the most widely used in estimating economic model because of its typical characteristics such as unbiased and minimal variance. Several models, including the linear function, the double logarithmic function were was designed to represent the relationship between the total output of the wheat crop in reclaimed lands as a dependent variable, and the quantity of the cultivated area, seeds, fertilizers, pesticides, human and mechanical hours as explanatory variables. Results showed that the double log function was the most suitable one which is in line with economic logic. For representing the relationship, the model (Debertin, 1986):

$$\boldsymbol{Y_I = b_o + b_1 lnX_1 + b_2 lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + U_i} \dots\dots (\mathbf{1})$$

If:

Dependent Variable: represents the total production of wheat actually achieved in tons in reclaimed lands.

Independent Variables Xs: included the following:

1. Total seed quantity (X_1): The actual quantity of seeds used by farmers (Kg).

2. Quantity of Fertilizers (X_2): The total quantity of urea and compound fertilizers during the production season (Kg).

3. Quantity of pesticides (X_3): All control materials, pesticides and liquid stimulants used during the production season.

4. Number of working hours (X_4): The manual work (family and wage) used during the season (hr).

5.Mechanical work hours (X_5): Total mechanization services used during the season (hr). These services included (tillage, modification, settlement, planting, fertilization, control, spraying of pesticides and quarries).

The variable (Ui), stochastic variable, includes all other variables that affect the production of wheat crop and not included in the model such as climatic, environmental and technical conditions ... etc.

To detect econometric problems, D.W was used to verify the absence of a autocorrelation problem, while a coefficient test involving variance inflation factor (VIF) wase used to explore the presence of a multiple linear correlation problem (Gujarati, 2004). For the detection of heteroskedasticity, Breusch-Pegan Goldfrey and White tests were used.

Results & Discussion

First: Estimating the function of wheat production in reclaimed lands

After conducting statistical analysis using Eviews.10, the production function of the wheat crop was estimated according to the following model (Table 1). In order to demonstrate the efficiency of the estimates, the diagnostic tests were carried out on the estimated model. The results indicated that the model passed all standard tests such as lacking of autocorrelation using the D.W test , which showed the absence of the problem of autocorrelation because the value of (D) was located in the acceptance area of the null hypothesis i.e., D equals 1.966, 5% and degrees of freedom (105), it was found that D lies between 1.441 <1.539 <1.647 i.e., du <D <4-du, and from this we conclude that there is no positive or negative autocorrelation of the random variable of the first order.

Table (1): Estimated parameters of the wheat production function in unreclaim land (Method: Least Squares, Sample: 1 105, included observation: 105)

Variable	Coefficient	Std. Error	t- Statistic	Prob.
C	3.657984	0.115083	31.78557	0.0000
LX_1	0.497346	0.047985	10.36453	0.0000
LX_2	0.008685	0.007199	1.206433	0.2305
LX_3	0.018388	0.008129	2.262171	0.0259
LX_4	0.196246	0.042382	4.630419	0.0000
LX_5	0.306485	0.054007	5.674961	0.0000

R-squared	0.979167	Mean dependent var	2.505025
Adjusted R-squared	0.978115	S.D. dependent var	1.186697
S.E of regression	0.175556	Akaike info criterion	0.586273
Sum of regression	3.051168	Schwarz criterion	0.434618
Log likelihood	36.77933	Hannan-Quinn criter.	0.524819
F-statistic	930.6122	Durbin-Watson stat.	1.539151
Prob(F-statistic)	0.000000		

Source: Calculated using Eviews.10

On the other hand, multicollinearity between independent variables was found to be less than 20 using VIF test as shown in table (2). From the last result, it can be concluded that the model is free from multicollinearity (Gujarati, 2004). Because the research depends on cross-sectional data, it is necessary to detect the extent of the heteroscedasticity problem for which Pagan-Godfrey test was employed. The test proved the significance of (F), from which it can be concluded that the estimated model has a heteroscedasticity problem as illustrated in table (3).

Table (2): Coefficient of variance inflation factor for wheat crop production function in unreclaim land

Variable	Coefficient Variance	Uncenter VIF	Centered VIF
C	0.013244	45.12134	NA
LX_1	0.002303	370.5296	11.02199
LX_2	5.18E-05	10.97164	1.364865

LX_3	6.61E-05	1.428521	1.418033
LX_4	0.001796	205.2110	8.537530
LX_5	0.002917	287.9208	11.80544

Source: Calculated using Eviews.10

Table (3): The BPG test shows a heteroscedasticity problem. (Heteroskedasticity Test Breusch –pagan –Godfrey).

F-statistic	5.85934	Prob. F(5,99)	0.0001
Obs*R-squared	23.9768	Prob. Chi-	0.0002
Scaled explained	39.4158	Prob. Chi-	0.0000

Source: Calculated using Eviews.10

After verifying the estimates were consistent with the logic of the economic theory, the statistical tests were used to test the validity of the estimated model. The z-test showed significance of parameters at a significant level of 1% and the value of the determination factor was 0.79. This means that 79% of the changes in the wheat production function in reclaimed lands are due to the explanatory variables included in the model, while the remaining changes (21%) attributed to other factors not included in the model such as education, experience, age, family size and others.

It can be noted from the estimated results in table (4) that the function of wheat production after the correction was as follows:

$$LY = 13.906 + 0.631\, ln\, X_1 + 0.002\, ln\, X_2 + 0.014\, lnX_3 + 0.149\, lnX_4 + 0.237\, lnX_5$$

Table (4): Estimated parameters of the wheat production function in unreclaim land by Robust Least Squares (Dependent Variable: LY, Method: Robust Least Squares, Sample: 1 105, Included observation: 105, Method: MM-estimation).

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.905797	0.092528	42.21221	0.0000
LX_1	0.631083	0.038581	16.35753	0.0000
LX_2	0.002235	0.005788	0.386163	0.6994
LX_3	0.014000	0.006535	2.142162	0.0322
LX_4	0.149744	0.034075	4.394490	0.0000
LX_5	0.237236	0.043422	5.463548	0.0000
Robust Statistics				
R-Squared	0.792715	Adjusted R-squared	0.782246	
Rw-Squared	0.990183	Adjust Rw-squared	0.990183	
Akaike info criterion	134.4368	Schwarz criterion	152.9306	
Deviance	1.983135	Scale	0.125953	
Rn-squared statistic	7393.521	Prob(Rn-squared stat.)	0.000000	
Non-robust Statistics				
Mean dependent var	2.505025	S.D. dependent var	1.186697	
S.E. of regression	0.184898	Sum squared resid	3.384526	

Source: Calculated using Eviews.10

The problem of variance persistence was treated using the R.M.W regression method (de Menezes *et al.,* 2021). The natural data is often characterized by a natural distribution, but sometimes they may take a different pattern or not a particular pattern of distributions.

This is due to the existence of outliers, which have a negative impact on the results of statistical and standard methods in the light of a heteroscedasticity problem. Therefore, this method corrects the standard errors of white heteroscedasticity- correct stander errors, when the model is estimated with usual methods such as OLS (de Menezes *et al*., 2021). In contrast, R. M. W. modifies the extreme values in the matrix Independent variables using the weighting matrix for the method of weighted minimum squares (WLS) and then addressing the extreme values in the response vector by using the error vector (the vector of the weighted minimum squares) using the H-hippocampal method and M finding new capabilities after the recent amendment of these capabilities are called the capabilities of M fortified weighted (Audibert & Catoni. 2011).

The parameters (b_1-b_5) refer to the partial productive elasticities, as the function was estimated by the double logarithmic formula. These elasticities showed the relative responsiveness in the total production of wheat crop for changes in the quantity of the variable productive element by 1% with the other factors are fixed. The total elasticity gives the overall elasticity of the function, which refers to the nature of the return to scale, including the stage of productivity in which production takes place and thus the efficiency of the use of productive resources (AL-Shafi'i, 2005).

The production function showed that the total elasticity value was 1.033, which is greater than the correct one, and implies an increase in scale return, which means that it is possible to increase wheat production more and more by addition of equal proportions of resources. In other words, the increase in the use of resources will lead to rise in production at increasing rates. Thus, wheat farmers produce wheat under the first stage of production of the decreasing yield law. The production function of the wheat crop indicates that all the variables (seed, fertilizers, pesticides, hours of human and mechanical work) are used at the second stage (the economic production stage) as long as the marginal production is less than the average production which is also decreasing.

The results of the wheat production function indicate that the signal of all the parameters was consistent with the economic logic. It was found that the production elasticity of the seed quantity (0.63) which is a positive value as 1% increase in seed usage increases wheat production by (0.63%).The production elasticity of fertilizers showed a low positive value (0.002) due to intensive use of this resource. The increase in fertilizers by 1% results in 0.002 % increase in wheat production. For pesticide, the production elasticity was (0.014), i.e. the increase in the quantity of pesticides by (1%) leads to an increase in production by (%0.014). Likewise, the production elasticity of the number of human working hours was (0.149) which is also positive and low due to the intensive use of this resource. This means that an increase in the number of human working hours by 1% leads to increased wheat production by %0.149. As for the number of mechanical working hours, the production elasticity was about (0.237), i. e, the increase in the number mechanical working hours by (1%) leads to an increase in wheat production by (0.237%).

Second: Safety-first behavioral approach:

Moscardi & de Janvry (1977) proposed a method to analyze the farmer behavior against production risk aversion parameter (Ks coefficient) as follows (Sadiq, 2018):

$$K_s = \frac{1}{\theta}\left[1 - \frac{P_i W_i}{P_y B_i \mu_y}\right] \ldots\ldots\ldots\ldots\ldots (2)$$

Where; Ks is the risk index of i[th] farmer, θ is coefficient of variance parameter calculated according to the following law $\theta = \frac{\delta_y}{\mu_y}$, δ_y is the standard deviation of output and μ_y is the mean output. P_i is the unit price of the chosen most influential input for i[th] farmer; Wi is quantity of the most influential input of the i[th] farmer; P_y is the unit price of the output of i[th] farmer; β_i is the elasticity coefficient of output with respect to the chosen input. Following Moscardi& de Janvry (1977) the risk aversion parameter Ks was used to classify farmers into three (3) distinct categories as shown below:

0<Ks<0.4 = Low risk aversion/Risk bearing

0.4<Ks<1.2 = Intermediate/moderate risk aversion/Risk neutral *1.2<Ks<2.0* = High risk aversion/Risk aversion

After applying the formula for the *Ks* criterion, the results were demonstrated in table (5). The percentage of high risk aversion farmers was 43.81% with an average of 0.16, which falls within the third category of risk classifications, while the farmers who bear the risk came in second place by 31.43% with an average of 0.65, which falls within the first category. The farmers who bear the natural risk came last, as they represented 31.43%, with an average of 1.52 of the risk ratings.

Table (5): Farmers' behavior towards a risk in unreclaim farms in Wasit province.

Type of risk	Number of farms	Average value of k_s	Relative importance %
0<Ks<0.4 = Low risk aversion/Risk bearing	33	0.16	31.43
0.4<Ks<1.2 = Intermediate/moderate risk aversion/Risk neutral	26	0.65	24.76
1.2<Ks<2.0 = High risk aversion/Risk aversion	46	1.52	43.81
Total	105		%100

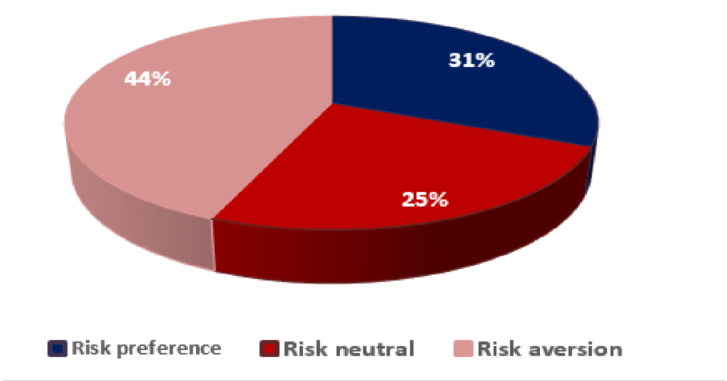

Fig. (1): Farmers' behavior towards a risk in unreclaim farms in Wasit Governorate. Source: Prepared by the researcher, based on the table (5)

Third: Multinomial logistic regression model

Multiple logistic regression is used when there are one nominal variable and two or more measurement variables. The researcher wants to know how the measurement variables affect the nominal variable. It can also be used to predict probabilities of the dependent nominal variable for suggestions about which independent variables have a major effect on the dependent variable (Dutta & Bandopadhyay, 2012).

The model form for predicted probabilities is expressed as a natural logarithm (ln) of the odds ratio:

$$Ln\left[\frac{P(Y)}{1-P(Y)}\right] = B_0 + B_1X_2 + B_2X_2 + \cdots \ldots . + B_kX_k \ldots \ldots \ldots \ldots (3)$$

$$\text{and } \left[\frac{P(Y)}{1-P(Y)}\right] = e^{B_0+B_1X_2+B_2X_2+\cdots \ldots .+B_kX_k} \ldots \ldots \ldots ..(4)$$

$$P(Y) = e^{B_0+B_1X_2+B_2X_2+\cdots \ldots .+B_kX_k} - P(Y)e^{B_0+B_1X_2+B_2X_2+\cdots \ldots .+B_kX_k} \ldots \ldots \ldots ..(5)$$

$$P(Y) = \frac{e^{B_0+B_1X_2+B_2X_2+\cdots \ldots .+B_kX_k}}{1 + e^{B_0+B_1X_2+B_2X_2+\cdots \ldots .+B_kX_k}} \ldots \ldots \ldots \ldots \ldots (6)$$

Where $\left[\frac{P(Y)}{1-P(Y)}\right]$ is the log (odds) of the outcomes, Y is the dichotomous outcome; $X_1, X_2 \ldots \ldots X_k$ are the predictor variables, $B_0, B_1, B_2 \ldots \ldots B_k$ are the regression (model) coefficients and β_0 is the intercept.

The Multinomial logistic regression equation has been formulated according to the following formula:

$$Y^* = a + X\beta + \varepsilon$$

Where Y^* is censored variable

Y_i=0 Low risk aversion/Risk bearing

Y_i=1 Intermediate/moderate risk aversion/Risk neutral

Y_i=2 High risk aversion/Risk aversion

$$Y^* = a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon_i$$

Where:

Y^*= Risk index of i^{th}farmer.

X_1= Salinity (natural=0, medium =1, high=2)

X_2= Experience (<25=0, ≥25=1)

X_3 = Education (primary = 0, secondary =1, high = 2)

X_4= Possession (Private property =0, Rent=1)

Estimating the qualitative response to the most important factors that affect the farmers response to the risk in reclaimed lands

Table shows the sample size distributed according to the main variables. The number farmers that bear the risk in the research sample was 33 representing 31.43% of the sample size, while the farmers who bear natural risk naturally were 26 (24.76%), and finally the number of farmers who avoid risk was 46 (43.81 %). As for the salinity, medium salinity land represented the highest percentage of risk aversion farmers and those who bear natural risk, as it reached 63.4% and 42.30%, respectively, while the high salinity percentage was among farmers who bear the high risk, reaching 97.83%. In terms of experience, we find that farmers with less than 25 years' experience were the highest among farmers who bear the natural risk accounting for 61.5%. On the contrary, we find the vast majority (84.84%) of farmers who bear high risks have an experience of ≥25 years. This is logical, as farmers rely on their long experience to take risks by cultivating unreclaim land.

The percentage of highly-educated farmers was 58.70% among those who bear high risks, compared to 21.21% and 26.93% with primary and secondary education, respectively. In contrast, the percentage of primary and secondary education was 45.45% for risk aversion farmers and those who take natural risks. Farmers with higher education are able to deal with high risk by optimizing resource use. About two thirds (67.39%) farmers who bear high risk have their own farms as they do not bear rental costs. That enables them to bear the risk, while 72.73% of risk aversion farmers are tenants of agricultural land. Parameters of the Multinomial logistic regression model were estimated by the maximum likelihood as an efficient method. Table (6) summarizes the parameters of the model, which includes the standard error, Wald statistics, degrees of freedom, and Exp (B) parameters that we will explain after the model passes the diagnostic tests.

Table (6): Frequency of explanatory variables according to farmers' behavior towards risks.

Variable	Low risk (Risk bearing) N=33	Natural risk N=26	High (Risk aversion) N=46
Salinity			
Natural salinity	11 (33.3%)	5 (19.23%)	1 (2.17%)
Medium salinity	21 (63.4%)	11 (42.30%)	0 (0.00%)
High salinity	1 (3.03%)	10 (38.46%)	45 (97.83%)
Experience			
<25	16 (48.48%)	16 (61.54%)	7 (15.22%)
≥25	17 (51.52%)	10 (38.46%)	39 (84.78%)
Education			
primary	15 (45.45%)	11 (42.31%)	6 (13.04%)
secondary	15 (45.45%)	8 (30.77%)	13 (28.26%)
high	7 (21.21%)	7 (26.93%)	27 (58.70%)
Possession			
Private property	9 (27.27%)	8 (30.77%)	31 (67.39%)
Rent	24 (72.73%)	18 (69.23%)	15 (32.61%)

Table (7): Multinomial logistic regression analysis.

Rick[a]	Variable	B	S.E	Wald	d.f	Sig	Exp (B)	95% C.I. for Exp (B)	
								Lower	Upper
Low risk (Risk bearing)	Intercept	-3.584	1.194	9.018	1	0.003			
	Salinity=0	3.672	1.234	8.853	1	0.003	39.347	3.502	442.090
	Salinity=1	3.688	1.142	10.424	1	0.001	39.971	4.260	375.069
	Salinity=2	b[a]			0				
	Experience =0	0.238	0.704	0.114	1	0.736	1.268	0.319	5.044
	Experience=1	b[a]			0				

	Education=0	1.415	0.989	2.049	1	0.593	4.117	0.593	28.591
	Education=1	1.497	0.901	2.760	1	0.764	4.468	0.764	26.126
	Education=2	b[a]			0				
	Property=0	-0.1084	1.067	2.642	1	0.02	0.338	0.092	1.250
	Private Property =1	b[a]			0				
Moderate Risk Aversion/Risk Neutral	Intercept	-1.039	0.569	3.327	1	0.068			
	Salinity=0	0.565	0.940	0.361	1	0.548	1.760	0.279	11.108
	Salinity=1	0.460	0.738	0.389	1	0.533	1.584	0.373	6.724
	Salinity=2	O[b]			0				
	Experience =0	1.661	0.683	5.921	1	0.015	5.263	1.381	20.055
	Experience=1	O[b]			0				
	Education=0	0.553	0.850	0.423	1	0.515	1.738	0.329	9.196
	Education=1	0.365	0.736	0.246	1	0.620	1.440	0.341	6.088
	Education=2	O[b]			0				
	Property=0	-1.207	0.609	3.932	1	0.047	0.299	0.091	0.986
	Private Property =1	O[b]			0				

a. The reference category is high risk. B This parameter is set zero because it is redundant.

Diagnostic tests

To fully test the adequacy and quality of the model (Goodness of fit), the Log likelihood ratio, which follows the Chi-Square distribution, was used according to the following relationship (Hosmer & Lemeshow, 1980):

$$\chi 2 = -2[log_e L_O - log_e L_1] \dots\dots(7)$$

Table (8) shows the χ^2 value which was 64.632 at 12 degree of freedom, and the level of significance p-value <0.00. That means the model is statistically significant and reconciles the data well, i. e. the variables included in the model have a significant effect in determining the farmers' behavior towards the risk. To find out the significance of each independent variable on the dependent variable separately, the criterion of the maximum likelihood based on the χ^2 statistic was adopted (Andrews, 1988). It was found that the p-value was significant the level at 5% for all study variables except Property which was significant at 10% (table 9).

Table (8): Statistical significance test for the model.

Model	Model fitting criteria -2Log Likelihood	Chi-Square	df	Sig
Intercept	149.206			
Final	84.574	64.632	12	0.00

Table (9): The results of the maximum likelihood test.

Variable	Model fitting criteria -2log likelihood of reduced model	Chi-Square	df	P-value
Intercept	50.075[a]	0.00	0	0.000
Salinity	111.530	61.46	4	0.015
Experience	58.532	8.458	2	0.012
Education	51.598	1.523	4	0.023
Property	51.568	1.493	2	0.064

Source: Collected and calculated from research questionnaires.

To assess the quality fit of the logistic regression model, two $R^2_{\text{Nagelkerke}}$, $R^2_{\text{Cox- Snell}}$ statistics with the same statistical goal (R^2) were used (Hosmer *et al.*, 2013)

$$R^2 = 1 - \left[\frac{L_O}{L_1}\right]^{\frac{2}{n}} \dots\dots\dots (9)$$

$$R^{-2} = \frac{R^2}{R_Z^2} \dots\dots\dots (10)$$

$$R_Z^2 = 1 - (L_O)^{\frac{n}{2}} \dots\dots\dots (11)$$

L_O : maximum likelihood model contains only the constant.

L_1 : maximum likelihood model contains all independent variables.

Table (10): The value of the R^2 test.

Pseudo R-Square	
Cox and Snell	0.634
Nagelkerke	0.718
McFadden	0.469

Source: Calculated using Spss.25

It is clear that the value of the first scale (R_ (Cox-Snell) ^{2}) was 0.634, meaning that 63.4% of the variance in the response variable was explained (table 10). The second scale

(R_Nagelkerke^2) whose value was 0.718 explains about 71.8% of the variance described in the Multinomial logistic regression model.

Economic of analysis

According to the results in the table (7), it is evident that most of the explanatory variables were significant in terms of their impact on the farmers' response to the risk, especially level of salinity of agricultural lands, experience and ownership, while the level of education did not have a significant association. It is evident that farmers who have naturally saline soil bear the risk 36-time greater than farmers who have high salinity soil (under 1% level of significance). Also, farmers who have a medium salinity soil bear the risk by approximately 37-time greater than farmers who have high salinity soil (under 1% level of significance). The choice of lands with high salinity implies that farmers bear high risk because high salinity will lead to a decrease in the productivity of a dunum, and thus the level of farm income, and waste of economic resources.

Farmers with less than 25 years of experience accept risks 1.27-time greater than their corresponding farmers with experience of more than 25 years; however, the association was no significant. That is because the accumulated experience enables farmers to use good types of production inputs, and the farmer is familiar with operations necessary for the growth and harvesting of the crop. Furthermore, experience earns the farmer the necessary skill for farm management as well as gaining a future vision of the prices of inputs and the selling prices of the crop. Thus, those farmers have the ability to bear the high risk. In contrast, farmers who own land intended to have a higher risk of 1/ 0.738-time higher than farmers who rent land. It is worth mentioning that the landownership may have a positive impact on the farm because there will be a surplus in capital through which the farmer can buy good quality seeds and fertilizers as well as financing part of the production requirements without resorting to borrow and carries financial benefits. Accordingly, the land ownership renders farmer not affording a large part of the fixed costs, and this, in turn, is reflected in the farmers' behavior towards their high risk tolerance.

Regarding farmers behavior towards natural risk, the results showed that farmers who have lands of natural salinity bear natural risk over high risk by 1.76-time more than farmers who have high salinity land, although this association was not significant at level of 5%. Farmers with less than 25 years of experience tend to choose natural risk over a high risk 5.26-times greater than farmers with more than 25 years of experience. With regard to farmers who own their land, they tend to take a high risk over natural risk of approximately 3-time higher than tenant farmers.

Conclusions and recommendations

Based on the obtained, it can be concluded that wheat farmers are producing within the second production phase of the stages. There is an increase in return scale that allows increased production of wheat crop by increasing the resources used in equal proportions. It implies that increase in the used resources causes increasing in the production rates as the total flexibility of the function is greater than one, and that the efficiency of the resources used in production is close to the correct one. But it is still under ambitious when compared to the productivity of the same level of reclamation in other countries. Farmers with normal and moderately saline soils and those with long experience (more than 25 years) as well as farmers who own their agricultural lands tend to bear risk more than their counterparts with high saline soils, and those with less than 25 years of experience and tenants of agricultural land. Therefore, the study recommends the maintenance of main and subsidiary drains to ensure low salinity levels to obtain high productivity.

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Conflicts of interest

The authors declare that they have no conflict of interests.

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Reference

Abbas, A. K. (2012). Using logistic regression model to predict the functions with economic categorical dependent variable. *Kirkuk University Journal Administrative and Economic Sciences, 2,* 234-2563.https://www.iasj.net/iasj/download/02385e57f0f237af

Al-Hussine, H. D., & Alyousuf, A. A. (2021). Responses of local wheat varieties to greenbug *Schizaphus graminum* and bird-cherry oat aphid *Rhopalosiphum padi* infestation. *Basrah Journal Agricultural Sciences, 34,* 124-138. https://doi.org/10.37077/25200860.2021.34.1.11

Ali, K. A., & Mahmood, Z. H. (2018). Estimating profit, cost function and technical efficiencies of rice production in Nejaf (sic) for season 2016. *Iraq Journal of Agricultural Sciences*, *50,* 1237-1246. https://doi.org/10.36103/ijas.v50i5.789

Ali, S. S., Mubeen, M., Lal, I., & Hussain, A. (2018). Prediction of stock performance by using logistic regression model: evidence from Pakistan Stock Exchange (PSX). *Asian Journal of Empirical Research, 8,* 247-258. https://doi.org/10.18488/journal.1007/2018.8.7/1007.7.247.258

Al-Mashadani, A. K., & Mahmood, Z. H. (2019). Estimation of production function of rice in Najaf province for season 2016. *Journal of Plant Archives, 19,* 1457-1463.

Al-Obeidi, E. A. (2020). *Economic analysis of production risks for fish farming projects in Iraq Diyala governorate as a model*. M. Sc. Thesis. University of Baghdad, 78pp.

Al-Shafi'i, M. A. (2005). *Modernization in the Economics of Production and Analysis of Competencies between Theory and Practice*, Al-Muraqqab University, Libya, 315 pp. (In Arabic).

Al-Younes, A. H. (1993). *Production and Enhancing Field Crops*. Baghdad University, Baghdad. 218pp. (In Arabic).

Andrews, D. W. (1988). `Chi-Square diagnostic tests for econometric models. *Journal of Econometrics, 37,* 135-156. https://doi.org/10.1016/0304-4076(88)90079-6.

Audibert, J. Y., & Catoni O. (2011). Robust linear least squares regression. *Annals of Statistics, 39,* 2766–2794.

Dadzie, S. K. N., & Acquah, H. D. (2015). Attitudes toward risk and coping responses: the case of food crop farmers at Agona Duakwa in Agona East District of Ghana. *International Journal of Agriculture and Forestry, 2, 29-37*. https://doi.org/10.5923/j.ijaf.20120202.06

Debertin, D. (1986). *Agricultural Production Economics*. MacMillan Publishing Company, New York, 366pp.

Doll, J. P., & Orazem F. (1984). *Production Economics Theory with Application.* 2nd edition, John Wiley and Sons, New York, 117pp. https://www.worldcat.org/title/production-economics-theory-with-applications/oclc/10018291

Dutta, A., & Bandopadhyay, G. (2012). Performance in the Indian stock market using logistic regression. *The International Journal of Business and Information*, *7,* 105-136. https://doi.org/10.18488/journal.1007/2018.8.7/1007.7.247.258

de Menezes, D. Q. F., Prata, D. M., Secchi, A. R., & Pinto, J. C. (2021). A review on robust M-estimators for regression analysis. *Computers and Chemical Engineering*, *147*, 107254.

https://doi.org/10.1016/j.compchemeng.2021.107254

Faisal, N. F. (2016). Logistic regression dual response technique to determine the variables affecting the monthly income adequacy for the Iraqi family. *Journal of Baghdad College of Economic Sciences University, 47,* 131-148. https://www.iasj.net/iasj/article/109027

Fakayode, S. A., Rahji, M. A. Y., & Adeniyi, S. T. (2014). The application of logistic regression analysis to the cumulative grade point average of graduating students: a case study of students of applied science, federal polytechnic, Ilaro. *Developing Country Studies, 4,* 26-30.

Farhan, M. O., Ali, S. H., & M. H. Ali, M. H. (2013). Study of the economics of wheat crop production in Wasit province for the year (2008-2009). *Journal of Administration and Economics, 94,* 1-10.

Gujarati, D. N. (2004). *Basic Econometrics*. 4th edition, McGraw-Hill Book Co. New York, 1032pp. https://www.amazon.com/Basic-Econometrics-4th-Damodar-Gujarati/dp/0070597936

Hosmer, D. W., & Lemesbow, S. (1980). Goodness-of-fit test for the multiple logistic regression model. *Communications in Statistics*, *9*(10), 1043-1069.

https://www.tandfonline.com/doi/abs/10.1080/03610928008827941?journalCode=lsta20

Hosmer, D. W., Lemeshow, S. A., & Sturdivant, R. X. (2013). *Applied Logistic Regression.* Hoboken, N. J: John Wiley & Sons, 528pp.

King, J. E. (2002). Logistic Regression: Going Beyond Point-and-Click. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, L. A.

Ministry of Planning and Development Cooperation (2019). *Central Organization for Statistics, Agricultural Statistics*. Statistical publications for years (1990-2019), 87pp.

Ministry of Agriculture (2019). Planning and Follow-up Department - Agricultural Statistics Records for the period 1990-2019, 114pp.

Mohsin, O. M., Kathem, H. H., & Karee, Z. I. (2019). Using logistic regression to study the most important determinants of the adequacy of family income. *Scientific Journal of Jihan University, 3*, 282-292. https://doi.org/10.29304/jqcm.2018.10.2.374

Monjezi, N. (2021). Energy prediction of wheat production using data mining technique in iran. *Basrah Journal Agricultural Sciences, 34,* 14-27. https://doi.org/10.37077/25200860.2021.34.1.02

Moscardi, E. A., & de Janvry, A. (1977). Attitude toward risk among peasants: an econometric application approach. *American Journal of Agricultural Economics, 59*, 710-721. https://doi.org/10.2307/1239398

Najm, A. K., & Saleh, M. A. (2011). The use of logistic regression in studying the causes of death in preterm babies in Babylon. *Journal of Karbala University, 16,* 52-64. https://kj.uokerbala.edu.iq/article_153409.html

Nto, P. O. O., Mbanasor, J. A., & Nwaru, J. C. (2011). Analysis of risk among agribusiness enterprises investment in Abia State, Nigeria. *Journal Economics and International Finance*, *3,* 187-194.

Obaid, R. I. (2011). Analytical study for economics of producing rice in Najaf governorate during 2009 season. *Journal of Al-Rafidain University College for Sciences*, *28*, 130-149.

Olarinde, L.E., Manyony, V. M. & Akintola, J. O. (2007). Attitudes towards risk among maize farmers in the dry savanna zone of Nigeria: Some prospective policies for improving food production. *African Journal of Agricultural Research, 2*, 399-408. https://doi.org/10.5897/AJAR.9000078

Rijib, M. Z., & Nasir, S. A. (2019). Economic analysis of the effect soil salinity levels on wheat production in the irrigated area (Wasit governorate: A case study). *Plant Archives***,** *19,* 118-122. https://doi.org/10.36103/ijas.v47i4.534

Sadiq, M. S. (2018). Application of safety-first approach to measure risk behaviour of Yam farmers in Benue state, Nigeria. *Journal of Scientific Agriculture, 2*, 52-61. https://doi.org/10.25081/jsa.2018.v2.890

Salimonu, K. K., & Falusi, A. O. (2009). Sources of risk and management strategies among food crop farmers in Osun State, Nigeria. *African Journal Food, Agriculture, Nutrition and Development, 9,* 1592-1605. https://doi.org/10.4314/ajfand.v9i7.47687

Teweldemedhin, M. Y. (2012). Factors influencing enterprise diversification as a risk strategy management in Namibia: a case study of communal farmers from the Kunene region. *International Journal of Agricultural Sciences, 2,* 845-853.https://agris.fao.org/agris-search/search.do?recordID=DJ2012079950

تطبيق نهج السلامة الأول لقياس سلوك مخاطر مزارعي القمح في الأراضي غير المستصلحة في العراق للموسم 2019 (محافظة واسط انموذج تطبيقي)

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المستخلص: هدفت الدراسة إلى تطبيق نهج السلامة أولا لقياس السلوك مزارعي القمح تجاه المخاطر في الأراضي غير المستصلحة. تم استخدام عينة عشوائية من 105 مزرعة في محافظة واسط لموسم 2019. تم تقسيم التحليل إلى ثلاث مراحل. تضمنت المرحلة الأولى تقدير دالة الإنتاج (كوب– دوغلاس) للقمح باستخدام طريقة الانحدار الحصين الموزونة لتمثيل العلاقة الدالية بين كمية القمح المنتج والمتغيرات المستقلة (البذور والأسمدة والمبيدات). اما المرحلة الثانية تحليلاً لسلوك المزارعين تجاه المخاطر بناءً على معايير السلامة أولاً. وجد أن عدد المزارعين المعرضين لمخاطر عالية ومتوسطة وطبيعية بلغ 46 و24 و33 على التوالي يمثلون 43.8٪ و24.76٪ و31.34٪ من إجمالي المزارع على التوالي. حللت المرحلة الثالثة العوامل التي تؤثر على سلوك المزارعين تجاه المخاطر باستخدام نموذج الانحدار اللوجستي المتعدد. أشارت النتائج إلى أن المزارعين الذين يمتلكون تربة عادية أو متوسطة الملوحة ولديهم خبرة طويلة (أكثر من 25 عامًا) والذين يمتلكون أراضيهم الزراعية يفضلون المخاطرة أكثر من نظرائهم ذوي التربة عالية الملوحة والخبرة القصيرة والمستأجرين للأراضي الزراعية. لذلك توصي الدراسة اجراء عمليات الصيانة لشبكات البزل الرئيسية والفرعية لضمان انخفاض مستويات الملوحة للحصول على إنتاجية عالية.

كلمات مفتاحية:: الأراضي غير المستصلحة، الانحدار الحصين، الانحدار اللوجستي المتعدد ، ملوحة التربة.