PRODUCTION RISK ANALYSIS OF FISH FARMING PROJECTS IN FISH PONDS AND FLOATING CAGES A CASE STUDY IN DIYALA GOVERNORATE

*E . A. Alobaidy O. K. Jbara
Researcher Prof.
Dept. of Agri. Eco. Coll. of Agric. Engine. Scie. – University of Baghdad
os_mansi@coagri.ubaghdad.edu.iq

ABSTRACT

This research was aimed to study the problems related to fish farming and the risks that they face. Diyala Governorate was chosen as an applied model for measuring risk facing fish farmers. Research data were collected according to the random sample method, which included (30%) of all fish farming projects in Diyala Governorate. This sample has included 28% of the total fish farming projects in fish ponds and (31.5%) of the total Fish farming projects in cages through a questionnaire prepared for this purpose. The study focused on analyzing the behavior of fish farmers of the research sample towards risks by adopting a safety model in the form of the risk avoidance criterion ($K_{(s)}$).The production functions for fish farming projects in fish ponds and floating cages were estimated, and these functions were estimated by the absence of dummy variables (educational level, years of experience) and with their presence, as well as estimating the risk functions of fish farming projects in fish ponds and floating cages. The results showed that the percent of fish farmers who prefer to take risks in fish ponds (25%) and in floating cages (33.3%), and that the percent of fish farmers who prefer moderate risk (natural or medium) were about (53%) in the ponds and the proportion (66.7%) in Cages, while the fish farmers who avoid risks, they constitute (22%) in ponds and (0%) in cages, from which we conclude that fish farmers in floating cages prefer a greater risk than fish farmers in fish ponds, also the results of the risk function for farming projects in fish ponds and floating cages revealed that dummy variables (educational level, years of experience) have a negative relationship with production risks, which means that the improvement of the educational level and the increment of experience years contributes to a decrease in production risks.

Keywords: Fish projects, risk analysis, risk function, risk avoidance.
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تحليل مخاطر الإنتاج لمشاريع تربية الأسماك في الاحواض الترابية والاقفاص العائمة (محافظة ديالى – أنموذج تطبيقي)

*افتخار احمد إسماعيل العبيدي أسامة كاظم جباره العكيلي
باحث استاذ
قسم الاقتصاد الزراعي /كلية علوم الهندسة الزراعية / جامعة بغداد

المستخلص

يهدف البحث الى دراسة المشاكل المتعلقة بالاستزراع السمكي وما يواجها من مخاطر، تم اختيار محافظة ديالى كأنموذج تطبيقي لقياس المخاطرة التي تواجه مربي الأسماك ، تم جمع البيانات الميدانية وفق أسلوب العينة العشوائية والتي شملت (30%) من مجموع مشاريع تربية الأسماك في محافظة ديالى ، اذ شملت العينة (28%) من مجموع مشاريع تربية الأسماك في الاحواض الترابية و (31.5%) من مجموع مشاريع تربية الأسماك في الاقفاص من خلال استمارة استبانة اعدت لهذا الغرض ،استهدفت الدراسة تحليل سلوك مربي الأسماك لعينة البحث تجاه المخاطر باعتماد انموذج السلامة متمثلا بمعيار تجنب المخاطرة ($K_{(s)}$) ، تم تقدير دوال الإنتاج لمشاريع تربية الأسماك في الاحواض الترابية والاقفاص العائمة وتقدير هذه الدوال بعدم وجود المتغيرات الوهمية (المستوى التعليمي ، سنوات الخبرة) وبوجودها ، فضلا عن تقدير دوال المخاطرة لمشاريع تربية الأسماك في الاحواض الترابية والاقفاص العائمة. وقد أظهرت النتائج بأن نسبة المربين المفضلين للمخاطرة في الاحواض الترابية (25%) وفي الاقفاص العائمة (33.3%) ، وان نسبة المربين الذين يفضلون المخاطرة المعتدلة (الطبيعية او المتوسطة) يشكلون نحو (53%) في الاحواض و نسبة (66.7%) في الاقفاص ، اما المربين المتجنبون للمخاطر فانهم يشكلون نسبة (22%) في الاحواض و بنسبة (0%) في الاقفاص ، من ذلك نستنتج ان مربي الأسماك في الاقفاص العائمة يفضلون المخاطرة بنسبة اكبر من مربي الأسماك في الاحواض الترابية، وتبين من نتائج دالة المخاطرة لمشاريع التربية في الاحواض الترابية والاقفاص العائمة بان للمتغيرات الوهمية (المستوى التعليمي ، سنوات الخبرة) علاقة عكسية سالبة مع مخاطر الإنتاج ، أي ان تحسن المستوى التعليمي وزيادة سنوات الخبرة يساهم بانخفاض مخاطر الإنتاج .

الكلمات المفتاحية: مشاريع الاسماك ، تحليل المخاطر ،دالة المخاطرة ، تجنب المخاطرة .
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INTRODUCTION

The food issue is one of the most vital strategic issues in the world in general and developing countries, particularly in Iraq, because of its economic, social and political dimensions. Also food security is one of the main components of strategic security (4). The fish wealth was gained the attention of many countries, in order to achieve sustainable development and what this wealth contains for value from great technical and economic aspects, especially after increasing population numbers and changing consumption pattern as a result of openness to the outside world and the development of food awareness (6), also the fish wealth contributes to improving the economic and social conditions of the people, which makes the necessity to take care of them and develop them; the fish wealth is among the important sectors that open horizons for the workers and provide a generous income for workers in this sector. Although Iraq has the water resources and area, it is unable to meet the increasing demand for fish meat, and this has encouraged the attention towards fish farming, and fish farming has become one of the approved methods for developing and increasing the quantity and quality of fish production and has become a major role in investment expansion in the fish sector. The agricultural sector is one of the most important economic activities compared to other sectors due to the impact of the agricultural sector on many factors, including climatic conditions, technology, markets and support services (19). The decisions of producers in agriculture are risky, and every decision that producers make has its consequences in the future. It is imperative that producers understand the risk before making a decision about it (18). It became necessary to take the components of the risk into consideration, hence the motivations for caring of fish farming projects and the risks associated with them. A number of researchers also cared about risk analysis , among them (2,3). The research used cross-sectional data according to the random sample method which included (30%) of 241 the total fish farming projects in Diyala governorate; the sample has included 28%. of the total fish farming projects in fish ponds and (31.5%) of the total fish farming projects in floating cages based on a questionnaire prepared for this purpose, the research was aimed to analyze farmers behavior against production risks by using (safety model first) for the purpose of determining the position of producers towards Risks, as well as a comparison of production risks for fish farming projects according to the type of schemes (breeding projects in fish ponds, floating cages), also the research was included analyzing factors that affect production and production risks by estimating the risk functions of fish farming projects in fish ponds and floating cages.

MATERIALS AND METHODS

The research used cross-sectional data according to the random sample method, which included (30%) of the total fish farming projects in Diyala governorate; the sample included (28%) of the total fish farming projects in fish ponds and (31.5%) of the total fish farming projects in cages floating depending on the questionnaire prepared for this purpose. Economists (Moscardi and De janvry) were the first to use the safety - first model in 1977 for the purpose of analyzing the behavior of producers towards the risks surrounding their projects(13), and there are a number of researchers using this model for the purpose of determining the attitudes of producers towards risk, (9,14,16,17).

(8): The model is defined as follows (12):

$$K_{(s)} = \frac{1}{\text{CV}}\left(1 - \frac{P_{xi}.\text{xi}}{P_y.\text{fi}.\mu_y}\right)$$

As:

$K_{(s)}$ = risk avoidance parameter

C.V. = coefficient of variation of the quantity of fish production

P_{xi}= resource price

x_i = quantity of resource

p_y = output price

f_i = production elasticity

μ_y = average production

The behavior of producers towards risk is classified into three groups according to the value of the risk avoidance parameter K (s), which are:-

Producers prefer to risk when it is $0 < K_{(s)} < 0.4$

Producers prefer natural (average) risk when it is $0.4 \le K_{(s)} \le 1.2$

Producers avoid high risk when $1.2 < K_{(s)} < 2$

Coefficient of Variation: The coefficient of variation is a relative (or standard) measure of risk because it links the risk ratio of the variable (the standard deviation) and the average of the values of the variable (the mean) and therefore the coefficient of variation takes into account the percent of risk that the variable includes; therefore, it is valid for comparison between several variables that differ with between them in terms of risks and averages, and the higher the value of the coefficient of variation, the more indicative of the high level of risk of the variable (5). The coefficient of variation is calculated by dividing the standard deviation by the mean of the values according to the following formula (1,7):

Coefficient of variation (CV) $= C.V. = \frac{S}{\bar{y}}$

S=(standard deviation)

$\bar{y}$ =(mean)

The elasticity of production is obtained by estimating the functions of production and thus determining the variable that most affects production. In light of the values of the risk avoidance parameter $K_{(s)}$, the behavior of producers is explained in terms of their preference or avoidance of risks. To estimate the production functions and production risks for fish farming projects, the following variables were chosen as the most influential variables in the models adopted in estimating the production functions and the risks of fish production (feed quantity, number of fingerlings, number of workers) as well as included in the dummy variables represented by the educational level and years of experience for fish farmers, also the effect of these variables was determined in the light of previous studies and researches that were relied upon, as well as a study of the reality of the governorate under study. The various formulas were estimated to determine the appropriate relationship to the variables included in the mathematical form of the production function, including (linear formula, double logarithmic formula, semi-logarithmic formula) and the double logarithmic formula of the production functions were chosen subject to the (economic, statistical, and econometrics) tests, and the risk function were adopted, as follows: -Production function

$$\ln y = \ln\beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \varepsilon \ldots (1)$$

Production function (Under risks)

$$\ln y = ln\beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \delta_1 D_1 + \delta_2 D_2 + \varepsilon_1 \ldots (2)$$

Risk function

$$(\varepsilon_1)^2 = ln\,\beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \delta_1 D_1 + \delta_2 D_2 + \varepsilon_2 \ldots (3)$$

y = total production during the season (tons)

ε_1^2 = production risk (the residual squared of the estimated production function)

X_1 = Feed quantity during the season (tons)

X_2 = number of fingerlings or coffees (finger or enough)

X_3 = number of workers (worker)

D_1 = dummy variable representing educational level (below intermediate) = 0, (intermediate and above) = 1

D_2 = dummy variable representing years of experience (1 to 6 years) = 0, (more than 6 years) = 1

β_i , α_i = parameters of the independent variables

β_0, α_0 = constant term

□ = the dummy variable parameter

ε = random variable

Risk function: The economist (Pope and Just) developed a model in 1977 to deal with production risks economically (11); This model was popular among agricultural economists and is still used prominently. In many studies, including (10,12,15), this model allows economists to distinguish between the impact of inputs on outputs and production risks. The model can be written as in equation 3 (8).

RESULTS AND DISCUSSION

1- Analyzing the behavior of fish farmers towards the risks of fish farming projects for the research sample

The results of the estimation of the production functions of fish farming projects in fish ponds and floating cages of the research sample showed that the feed quantity variable is the most important and most influential variable in the amount of fish produced in both types of breeding (fish ponds and floating cages) as the feed parameter (partial elasticity) in fish farming projects in fish ponds were about (0.666), while the feed parameter (partial elasticity) in fish farming projects in floating cages is about (0.594) as shown in table (1).

Table 1. Production functions for fish farming projects in fish ponds and floating cages for breeding projects for the research sample

Variables	Production function of fish pond projects		Production function for floating cage projects	
	Estimated Parameters	Sig	Estimated parameters	Sig
Constant	-2.771	0.006	-3.190	0.000
Feed quantity ln x_1	0.666	0.000	0.594	0.000
Fingerling number lnx_2	0.380	0.038	0.416	0.000
Workers number ln x_3	0.012	0.850	0.260	0.000
R^2	0.942		0.98	
R^{-2}	0.937		0.98	
F	176		1003.9	
D.W	1.454		1.435	

Source: from the work of the researcher, using the statistical program (Eviews 10)

According to the results shown in Table 2. The coefficient of variation for fish-farming projects in floating cages was 95.6%, which is higher than the coefficient of variation for fish farming projects in fish ponds, which reached 64%. Based on the values of the difference coefficient, it is clear that the fish farming projects in floating cages were more risky compared to fish ponds.

Table 2. Parameters for calculating the risk avoidance parameter for fish farming projects for the research sample

Variables	fish farming method	
	Fish ponds	floating cages
Feed variable parameter(fi)	0.67	0.59
Average production of farm (tons)	6.525	53.64
Standard deviation	4.181	51.32
Coefficient of variation C.V	0.64	0.956
%C.V	%64	%95.6

Source: from the work of the researcher, using the statistical program (Eviews 10)

After applying the formula for the criterion of K (s), the results shown in Table (3) revealed that the percent of preferred fish farmers for risk in fish ponds constituted about (25%) while preferred fish farmers for risk in floating cages formed a percent of (33.3%), where the parameter (K) in floating cages gave a higher percent than fish ponds, while it falls within the second category of risk categories, which is the average risk percent of fish farmers in fish ponds and floating cages reached (53%) and (66.7%), respectively, that is, preference for medium risk Fish farmers in floating cages have a higher rate compared to fish ponds, while the third category of risk categories is to avoid risk as a percent of fish farmers in fish ponds is (22%), while no percent of floating cage fish farmers falls into this category. Also the average parameter values of risk (K (s)) for the first category (risk preference) in the fish ponds and floating cages reached (0.13) and (0.005), respectively, while the mean values of the risk avoidance parameter ($K_{(s)}$) for the second category (medium risk) were about (0.82) in fish ponds and (0.71) in a for floating cages. The mean values of the risk avoidance parameter (K (s)) for the third category (risk avoiders) were about (1.31) in floating cages.

Table 3. Fish farmers distribution according to their behavior toward risk for the research sample

Risk type	Fish cages			floating cages		
	Farms number	%	Average Value $K_{(s)}$	Farms number	%	Average Value $K_{(s)}$
prefer risks $0 < K_{(s)} < 0.4$	9	%25	0.13	12	%33.3	0.005
Medium risk $0.4 \le K_{(s)} \le 1.2$	19	%53	0.82	24	%66.7	0.71
avoid risk $1.2 < K_{(s)} < 2$	8	%22	1.31	0	0	0
Total	36	100		36	100	

Source: from the work of the researcher, using the statistical program (Eviews 10)

2- Estimating the risk function of fish farming projects in fish ponds results in table 4. Revealed that the value of the coefficient of the determination of the production function in the dummy variables of fish farming projects in fish ponds reached about 0.94, which reflects the changes in the amount of production are 94% attributed to the studied explanatory variables, from the above it turns out that There is a statistically positive relationship between the amount of feed and the amount produced in fish farming projects in fish ponds, and this is identical to the logic of economic theory, where an increase in the amount of feed by 1% with other factors remaining constant leads to an increase in production by 0.76% in the fish ponds. Results also revealed that there is a statistically positive correlation between the amount of feed and production risks, and the positive relationship indicates that the increase of feed by 1% with other factors remaining constant leads to an increase in production risks by 0.055%, The results of the analysis showed that there is a negative relationship with a significant effect in the fish ponds, which means that the increase of fingerlings by 1% with other factors remaining constant leads to a reduction in production risks by 0.068 %. while the dummy variables (educational level, years of experience) showed a negative relationship with statistically significant between the educational level and the quantity produced in fish pond projects, while the dummy variables (educational level, years of experience) in the risk function of fish farming projects in fish ponds the results showed that there is a negative relationship with statistically significant between the educational level and the production risks, and this is identical to the economic logic, that is, the improvement of the educational level of the fish farmers by 1% contributes to reducing the production risks by (0.022%), whereas the effect of variable (years of experience) was negative, which means that increasing the years of experience for the fish farmers reduces production risks, but this variable was not not significant at acceptable statistical levels.

Table 4. Production function in the presence of fictitious variables and the risk function of fish farming projects in fish ponds of the research sample

variables	The risk function of fish pond projects: Estimated parameters	Sig	Production function in the presence of dummy variables for fish pond projects: Estimated Parameters	Sig
Constant	0.407	0.004	-2.042	0.052
Feed quantity $\ln x_1$	0.055	0.014	0.765	0.000
Fingerling number $\ln x_2$	-0.068	0.007	0.255	0.176
Workers number $\ln x_3$	0.008	0.348	0.026	0.686
Educational Level D_1	-0.022	0.007	-0.116	0.067
Years of Experience D_2	-0.007	0.354	0.003	0.952
R^2	0.29		0.94	

Source: from the work of the researcher, using the statistical program (Eviews 10)

3- Estimating the risk function of fish farming projects in floating cages of the research sample

Results in table 5. revealed that the value of the coefficient of determination for the production function under the dummy variables of fish farming projects in fish ponds reached about 0.99, which reflects 99% of the changes in the production amount are attributed to the studied explanatory variables. The results also revealed that there is a positive and direct relationship with statistically significant between the amount of feed and the number of fingerlings and the number of workers and the amount produced in the production function for fish farming projects in floating cages of the research sample as an increase in one of the mentioned variables by 1%, while the remaining factors remain constant, leading to an increase in the produced quantity by (0.54%), (0.46%), (0.21%), respectively. As for the variables (amount of feed, number of workers) in the risk function of fish farming projects in floating cages; Results also revealed that there is a positive direct relationship, i.e. by increasing one of the two variables while the other factors remain constant, this increases production risks by (0.006%), (0.004%) in the same sequence. As for the dummy variables (educational level, years of experience); the results revealed that there is a positive relationship with statistically significant between the educational level and the quantity produced in floating cage projects, which means that the educational level improved by 1% with other factors remaining constant contributing to increasing production by (0.07%), as for the dummy variables (educational level, years of experience) in the risk function of fish farming projects in floating cages, the results revealed that there is a negative relationship with statistically significant between the educational level and production risks, and this is identical to the economic logic, which means that to improve the educational level of the fish farmers by 1%, it contributes to reducing production risks by (0.01%), while the dummy variable (years of experience) did not show any significance, and its effect was negative, which means that increasing the years of experience for the fish farmers leads to a reduction in production risks.

Table 5. Production function in the presence of dummy variables and the risk function of fish farming projects in floating cages of the research sample

variables	The risk function of floating cage projects: Estimated parameters	Sig	Production function in the presence of dummy variables for floating cage projects: Estimated parameters	Sig
Constant	0.042	0.556	-3.475	0.000
Feed quantity $\ln x_1$	0.006	0.591	0.540	0.000
Fingerling number $\ln x_2$	-0.006	0.630	0.467	0.000
Number of Workers $\ln x_3$	0.004	0.644	0.215	0.003
Educational Level D_1	-0.011	0.059	0.072	0.096
Years of Experience D_2	-0.002	0.683	0.031	0.484
R^2	0.12		0.99	

Source: from the work of the researcher, using the statistical program (Eviews 10)

It can be concluded in light of the coefficient of variation recorded in fish ponds (64%) and recorded in floating cages (95.6%) that fish farming projects in floating cages are more risky compared to fish ponds. It was found through an analysis of the producer’s behavior towards risk that the study reached according to the risk avoidance criterion (K (s)) that the percent of preferred fish farmers for risk in fish ponds (25%) and in floating cages (33.3%), and that the proportion of fish farmers who prefer moderate risk (natural or Intermediate) constitute about (53%) in the ponds and the rate of (66.7%) in the cages. As for the fish farmers who avoid risks, they make up (22%) in the ponds and by (0%) in the cages, from this we conclude that the fish farmers in floating cages they prefer a greater risk than fish farmers in ponds. The results of the risk function of fish farming projects in fish ponds and floating cages have shown that the dummy variables (educational level, years of experience) have a negative relationship with production risks. It can be concluded that fish farmers with floating cages are more efficient in using productive resources, since the risk producers uses the resource to the highest possible efficiency compared to the producers that avoids risk. The research recommends working to find mechanisms to support fish farming projects by supporting production requirements in terms of prices or provision of them, especially forage because of its significant impact in reducing production risks.

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