Iranian Journal of Applied Animal Science

Economic Evaluation of Ostrich Production Using Fuzzy Approach in Sistan

Research Article

Z. Ghaffari Moghadam[1*]

[1] Institute of Agricultural Center at University of Zabol, Zabol, Iran

Received on: 11 Jan 2016
Revised on: 11 Apr 2016
Accepted on: 15 May 2016
Online Published on: Sep 2016

*Correspondence E-mail: ghafari_m_gh@yahoo.com

Online version is available on: www.ijas.ir

ABSTRACT

This study aimed to economic evaluation of ostrich production in Sistan region by the use fuzzy conception in five platforms including (1 bird, 30 birds, 50 birds, 100 birds and 200 birds). The result showed that amount of benefit cost for 30, 50, 100 and 200 was 0.20, 0.26, 0.30, 0.31 and present value was 105, 549, 1460, 2927 million rials. According to the results obtained from present value and benefit-cost in fuzzy state, all the suggested units in the study are economically justified. Therefore, construction of fattened ostrich production, from one bird to 200 birds, is justified in the region of Sistan. Results shows that, the implementation of some research projects, such as ostrich farming, would be an effective step to revive the livestock industry in this region.

KEY WORDS benefit cost, fuzzy, ostrich, present value, Sistan.

INTRODUCTION

Ostrich farming has been started in Iran since the last decade through imports of ostrich chicks from south Africa and Italy. Fuzzy logic issued in many disciplines of science by different methods but little attention has been paid to the use of this methodology in economics. Hashemi *et al.* (2012) compared and ranked several economic projects using fuzzy approach and chose the most economical project based on fuzzy outputs. In their study, they proposed a good approach dealing with cash flows using triangular fuzzy numbers, which were applied in the economic analysis of projects. For the first time, Ghasemi and Mahmoudzadeh (2010) provided a fuzzy model to evaluate the economic projects under condition that could be as the unique method in terms of generalization and application compared to conventional procedures. Pochampally *et al.* (2003) proposed a fuzzy cost-benefit function based on multi-criteria economic analysis to select the most economical products and to process in a closed-loop supply chain. Buckley (1987); Ward (1985); Chiu and Park (1994); Wang and Liang (1995); Kahraman *et al.* (1995); Kahraman *et al.* (2000) and Anagnostopoulos and Petalas (2011) are among the authors who deal with the fuzzy present worth analysis, the fuzzy benefit/cost ratio analysis, the fuzzy future value analysis, the fuzzy payback period analysis, and the fuzzy capitalized value analysis.

Ostrich production is involved different phases from hatchlings to mature breeders, however, in the present study; we are going to economic evaluation of growing phase of three-month old chicks to slaughter using fuzzy approach.

MATERIALS AND METHODS

Expressions like “not very clear”, “probably so” and “very likely” can be heard very often in daily conversations. The commonality in such terms is that they are all tainted with imprecision. This imprecision or vagueness of human decision-making is called “fuzziness” in the literature. With different decision-making problems of diverse intensity, the results can be misleading if fuzziness is not taken into account. However, since Zadeh (1965) first proposed fuzzy set theory, an increasing number of studies have dealt with imprecision (fuzziness) in problems by applying the fuzzy set theory.

Fuzzy set theory presents an alternative to having to use exact numbers or to have a probability distribution of the cash flow. Using the basic concepts of fuzzy logic and also due to its specific mathematics, analysis of engineering economic models can be extended. Therefore, these models are more consistent with the real world. Some of common discounted criteria which were used to assess agricultural projects and also are applied in this study are net present value and benefit-cost ratio (Ghasemi and Mahmoudzadeh, 2010).

Net present value

One of the main indices of project assessment is the method of net present value. This index is calculated based on differential net profit or differential cash flow. Net present value can be defined as the present value of the income generated by the capital. Net present value formula for evaluation of economical projects is as follows:

$$NPV = \sum_{i=0}^{n} \frac{R_i}{(1+r)^i} - \sum_{i=0}^{n} \frac{C_i}{(1+r)^i} \qquad (1)$$

Where:
R: represents the income.
C: cost.
r: interest rate.
i: (1, 2, 3, …).
n: years.

In the new method, the value of variables cannot be identified exactly; therefore, these variables are represented by asymmetrical triangular fuzzy number using fuzzy mathematics as follows (Ghasemi and Mahmoudzadeh, 2010):

$$R_i^{FUZZY} = (R_i, \alpha_i, \beta_i)$$
$$r^{FUZZY} = (r, \alpha', \beta') \qquad (2)$$
$$C_i^{FUZZY} = (C_i, \alpha_i'', \beta_j'')$$

In the fuzzy number $X^{FUZZY} = (X, \alpha, \beta)$.

Fuzzy: shows the fuzziness of number.
X: center of fuzzy number that occurs with most probability.
α, β: respectively left and right side.

Hence, net present value, by using the fuzzy number, can be defined as follows (Ghasemi and Mahmoudzadeh, 2010):

$$NPV_{FUZZY} = \sum_{i=0}^{n} \frac{R_i^{FUZZY}}{(1+r^{FUZZY})^i} - \sum_{i=0}^{n} \frac{C_i^{FUZZY}}{(1+r^{FUZZY})^i} \qquad (3)$$

$$NPV_{FUZZY} = \left(\begin{array}{l} \sum_{i=0}^{n} \left(\frac{R_i}{(1+r)^i} - \frac{C_i}{(1+r)^i} \right), \\ \sum_{i=0}^{n} \left(\begin{array}{l} \left(\frac{1}{1+r} - \frac{1}{1+r+\beta'} \right) \frac{iR_i}{(1+r)^{i-1}} \\ + \left(\frac{1}{1+r-\alpha'} - \frac{1}{1+r} \right) \frac{iC_i}{(1+r)^{i-1}} + \frac{\alpha_i}{(1+r)^i} + \frac{\beta_i''}{(1+r)^i} \end{array} \right), \\ \sum_{i=0}^{n} \left(\begin{array}{l} \left(\frac{1}{1+r-\alpha'} - \frac{1}{1+r} \right) \frac{iR_i}{(1+r)^{i-1}} + \left(\frac{1}{1+r} - \frac{1}{1+r+\beta'} \right) \\ \frac{iC_i}{(1+r)^{i-1}} + \frac{\beta_i}{(1+r)^i} + \frac{\alpha_i''}{(1+r)^i} \end{array} \right) \end{array} \right) \qquad (4)$$

Equation below was calculated for comparing fuzzy value $X^{FUZZY} = (X, \alpha, \beta)$ with zero.

$$S = (-\alpha + 2X + \beta) / 4 \qquad (5)$$

If the equation is positive, then it can be said that the obtained value is larger than zero and project will be economically justified.

Benefit-cost method

Benefit-cost analysis is an economic tool to aid social decision-making, and is typically used by governments to evaluate the desirability of a given intervention in markets. The deterministic B/C ratio can be defined as the ratio of the equivalent value of benefits to the equivalent value of costs. The equivalent values can correspond to present, annual or future values. The purpose of benefit cost analysis is to give management a reasonable picture of the costs, benefits and risks associated with a given project so that it can be compared to other investment opportunities (Davis 1999). By use of fuzzy logic, benefit- cost ratio estimated as follows (Ghasemi and Mahmoudzadeh, 2010):

$$B/C = \frac{R_{total}}{C_{total}} \Rightarrow \frac{|B_{FUZZY}}{C_{FUZZY}} = \frac{\sum_{i=0}^{n} \frac{R_i^{FUZZY}}{(1+r^{FUZZY})^i}}{\sum_{i=0}^{n} \frac{C_i^{FUZZY}}{(1+r^{FUZZY})^i}} \qquad (6)$$

$$\frac{B_{FUZZY}}{C_{FUZZY}}=\frac{\left(\sum_{i=0}^{n}\frac{R_i}{(1+r)^i},\ \sum_{i=0}^{n}\left(\left(\frac{1}{1+r}-\frac{1}{1+r+\beta'}\right)\frac{iR_i}{(1+r)^{i-1}}+\frac{\alpha_i}{(1+r)^i}\right),\ \sum\left(\left(\frac{1}{1+r-\alpha'}-\frac{1}{1+r}\right)\frac{iR_i}{(1+r)^{i-1}}+\frac{\beta_i}{(1+r)^i}\right)\right)}{\left(\sum_{i=0}^{n}\frac{C_i}{(1+r)^i},\ \sum_{i=0}^{n}\left(\left(\frac{1}{1+r}-\frac{1}{1+r+\beta'}\right)\frac{iC_i}{(1+r)^{i-1}}+\frac{\alpha''_i}{(1+r)^i}\right),\ \sum_{i=0}^{n}\left(\left(\frac{1}{1+r-\alpha'}-\frac{1}{1+r}\right)\frac{iC_i}{(1+r)^{i-1}}+\frac{\beta''_i}{(1+r)^i}\right)\right)} \quad (7)$$

Now the question is; whether the obtained value is considered larger than one or not.

If it is larger than one, the project is economically justified and otherwise it does not have economic justification. For comparing fuzzy value $X^{FUZZY}=(X, \alpha, \beta)$ with one, the following equation is being estimated.

$$S=(-\alpha+2X+\beta)/4 \quad (8)$$

If the mentioned equation is positive, therefore obtained value is larger than one and the project is economically justified.

RESULTS AND DISCUSSION

In this study, the fattened ostrich breeding project was economically assessed for 5 units including a one bird, 30 birds, 50 birds, 100 birds and 200 birds. Information was collected by conducting field visit to estimate the costs of production and revenue. Also different manufacturers in Sistan region and experts in the industry were interviewed and the required costs and revenue for each ostrich production unit was calculated using the existing reports. For ease of calculation, the total costs and revenues are expressed in Table 1.

To evaluate a project under uncertainty conditions using fuzzy logic, it is necessary to show all the numbers in fuzzy state to insert uncertainty into the model. To determine fuzzy values of each parameter, three values including optimistic, pessimistic, and the most likely value were extracted by referring to investors and experts.

For this purpose, all costs in C were considered as (30%, C, 30%). This means that 30 percent of change (variation) is possible for costs. Also revenues are considered as (20%, R, 20%).

Interest rate is also considered as (2%, 22%, 2%) that shows the possibility of change in the interest rate from 20 to 24 percent with the centrality of 22 percent. The Table 2 shows the costs and revenues and the range of left and right change for the calculation of the present value. The Table 3 shows the amounts of present value of project with its intervals.

$$S=(-12750349+2\times 39231843+16786090)/4=82499427$$

The result shows that obtained value is positive therefore the project would be economically justified if costs and incomes changed. The results of benefit- cost method in fuzzy state are as follows in Table 4.

Benefit to cost ratio in the proposed fuzzy method is approximately obtained as (1.27 and 1.48, and 0.80). The results of ranking criterion show if costs and revenues changed in the benefit- cost method, the project would be economically justified. For other units, the same methods are utilized; that for simplicity and conciseness only the final results are listed.

The results of using present value and benefit- cost method in fuzzy state for all units show that ranking criterion is positive for all units. The final ranking of the projects is obtained by calculating the crisp value through equation (4) and equation (8).

Table 1 Cost and revenue of breeding ostrich

Cost and revenue	Capacity of unit: 1 bird		30 birds		50 birds	
	Number/area	Total cost	Number/area	Total cost	Number/area	Total cost
Fence	20 m^2	880000	600m^2	600m^2	1000 m^2	20000000
Shady place	3 m^2	600000	90	90		30000000
Reservoir		-	40m^2	40m^2	40 m^2	20000000
Drinking-cup		90000				3050000
Sand		-	1 ton	1 ton	1 ton	1000000
Food	300 kg	2550000	9000 kg	9000 kg	15000 kg	127500000
Hygienic cost		300000				15000000
Labour		400000				45000000
Chicken	1 birds	3500000	30 birds	30 birds	50 birds	17500000
Other cost		-				1700000
Sale of crop	1 birds	10000000	30 birds	30 birds	50 birds	500000000

Cost and revenue	Capacity of unit: 100 birds		200 birds	
	Number/area	Total cost	Number/area	Total cost
Fence	2000 m^2	800000000	4000 m^2	400000000
Shady place	300 m^2	120000000	600 m^2	60000000
Reservoir	40 m^2	30000000	60 m^2	20000000
Drinking-cup		10000000		65000000
Sand	10 ton	3000000	30 ton	1000000
Food	30000 kg	510000000	60000 kg	255000000
Hygienic cost		60000000		30000000
Labour		90000000		45000000
Chicken	100 birds	700000000	200 birds	350000000
Other cost		58000000		40000000
Sale of crop	100 birds	200000000	200 birds	1000000000

Table 2 Analysis of fuzzy present value for 1 bird

Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Costs	1570000	6750000	6750000	6750000	6750000	6750000
Amount of cost interval	471000	2025000	2025000	2025000	2025000	2025000
Present value of cost	157000	5532787	4535071	3717271	3046944	2497495
Income	0	10000000	10000000	10000000	10000000	10000000
Amount of income interval	0	2000000	2000000	2000000	2000000	2000000
Present value of income	0	8196721	6718624	5507069	4513991	3699992
Present value	1570000-	2663934	2183553	1789797	1467047	1202498
Left side interval	471000	3342768	5/2775701	2304450	1912898	1587624
Right side interval	471000	3351700	2790344	5/2322453	1932573	1607784

Items	Year 6	Year 7	Year 8	Year 9	Year 10
Costs	6750000	6750000	6750000	6750000	6750000
Amount of cost interval	2025000	2025000	2025000	2025000	2025000
Present value of cost	2047127	1677973	1375388	1127367	924071
Income	10000000	10000000	10000000	10000000	10000000
Amount of income interval	2000000	2000000	2000000	2000000	2000000
Present value of income	3032781	2485886	2037611	1670173	1368994
Present value	985654	807913	662224	542806	444923
Left side interval	1317459	1093103	906822	752178	623819
Right side interval	1337288	1112066	924585	768558	638737

Table 3 Result analysis of fuzzy present value for 1 bird

Net present value	Right side interval	The most promising value	Left side interval
Fuzzy value	16786090	39231843	12750349

Table 4 Fuzzy benefit- cost method for 1 bird

Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Costs	1570000	6750000	6750000	6750000	6750000	6750000
Amount of cost interval	471000	2025000	2025000	2025000	2025000	2025000
Present value of cost	157000	5532787	4535071	3717271	3046944	2497495
Income	471000	1757840	1521184	1312718	1129970	970444
Amount of income interval	471000	1761440	1527085	1319973	1137899	978568
Present value of income	0	10000000	10000000	10000000	10000000	10000000
Present value	0	2000000	2000000	2000000	2000000	2000000
Left side interval	0	8196721	6718624	5507069	4513991	3699992
Right side interval	0	1784536	1581744	1394060	1222630	1067695
Costs	0	1789868	1590486	1404808	1234377	1079731

Items	Year 6	Year 7	Year 8	Year 9	Year 10
Costs	6750000	6750000	6750000	6750000	6750000
Amount of cost interval	2025000	2025000	2025000	2025000	2025000
Present value of cost	2047127	1677973	1375388	1127367	924071
Income	831707	711450	607518	517935	440905
Amount of income interval	839698	719091	614677	524536	446917
Present value of income	10000000	10000000	10000000	10000000	10000000
Present value	2000000	2000000	2000000	2000000	2000000
Left side interval	3032781	2485886	2037611	1670173	1368994
Right side interval	928881	805411	696266	600294	516294
Costs	940719	816732	7067871	610073	525200

Table 5 Results of benefit cost method for 1 bird unit

Fuzzy value	Right side interval	Most promising value	Left side interval
Income	10698865	39231843	10597810
Cost	9869883	26481494	9801671
Invers of cost	0.000000022	0.000000037	0.000000017
Benefit to cost	1.27	1.48	0.8
Ranking	-	0.35	

Table 6 Results of present value method for 30, 50, 100 and 200 birds units

Present value	Right side interval	The most promising value	Left side interval	Ranking
Value fuzzy for 30 pieces unit	543713298	207928770	538285610	105321307
Value fuzzy for 50 pieces unit	878533288	466858936	869630376	549797077
Value fuzzy for 100 pieces unit	1715583263	1114184350	1698242291	1460062260
Value fuzzy for 200 pieces unit	3216287418	1447655019	3183636672	2927960784

Table 7 Results of benefit cost method for 30, 50, 100 and 200 birds units

Benefit-cost	Right side interval	Most promising value	Left side interval	Ranking
Value fuzzy for 30 pieces unit	1.04	1.21	0.65	0.20
Value fuzzy for 50 pieces unit	1.31	1.13	0.71	0.26
Value fuzzy for 100 pieces unit	1.2	1.39	0.7	0.30
Value fuzzy for 200 pieces unit	1.2	1.39	0.75	0.31

Since the obtained values in Tables 6 and 7 are positive then the projects are economically justified and the mentioned projects by assuming change in costs and revenues are economically justified (Ghasemi and Mahmoudzadeh, 2010).

CONCLUSION

According to the results obtained from Present Value and Benefit-Cost in fuzzy state, all the suggested units in the study are economically justified. Therefore, construction of fattened ostrich production, from one bird to 200 birds units, is justified in the region of Sistan. If the number of existing components in each unit is larger, the justifiability of the project would be better. However, due to the high degree of uncertainty in the current economic environment, there are several shortcomings in this approach. Thus, an alternative application is proposed that models the uncertainty of critical variables with the aid of fuzzy set theory. Maravas and *et al.* (2012) used cost benefit analysis with the aid of fuzzy set theory and showed that fuzzy cost benefit analysis is a promising tool for modeling uncertainty. Anagnostopoulos and Petalas (2011) demonstrated that the fuzzy method allows the comparison of different alternatives according to many criteria, in order to guide the decision maker towards a judicious choice. Due to its suitable climatic conditions and climate variability, Sistan has a high potential in breeding various birds, animals, and especially ostrich. Therefore, ostrich breeding is recommended because of their high resistance to diseases, environmental compatibility and not dependent to energy. Ostrich farming brings high economic potential in its products and there is not any dependence on foreign countries in this industry. Therefore, it can be proposed to construct fattened ostrich farms in Sistan as a profitable activity for farmers in the region.

REFERENCES

Anagnostopoulos K.P. and Petalas C. (2011). A fuzzy multicriteria benefit-cost approach for irrigation projects evaluation. Agric. Water Manag. **98,** 1409-1416.

Buckley J.U. (1987). The fuzzy mathematics of nance. *Fuzzy Sets. Syst*. **21,** 257-273.

Chiu C. and Park C.S. (1994). Fuzzy cash flow analysis using present worth criterion. *Engin. Econom*. **39(2),** 113-138.

Davis W.S. (1999). Cost/benefit analysis. Pp. 1-23 in The Information System Consultant's Handbook: Systems Analysis and Design. W.S. Davis and D.C. Yen, Eds. CRC Press, Boca Raton.

Ghasemi A. and Mahmoud Zade S. (2010). Evaluation economic projects in uncertainty. (Approach fuzzy). *J. Econ. Res*. **93,** 83-108.

Hashemi M., meftahi H. and bromandzadeh M. (2012). Analysis and evaluation economic enterprise projects with approach fuzzy. P. 102 in Proc 1th Nation. Conf. Inform. Technol. Comp. Canals. Payame Noor Univ.,Tabas, Iran.

Kahraman C., Tolga E. and Ulukan Z. (1995). Fuzzy flexibility analysis in automated manufacturing systems. Pp. 299-307 in Proc. INRIA/IEEE Conf. Emerg. Technol. Fact. Automat. Paris, France.

Kahraman C., Tolga E. and Ulukan Z. (2000). Justification of manufacturing technologies using fuzzy benefit / cost ratio analysis. *Int. J. Prod. Econ*. **66(1),** 45-52.

Maravas A., Pantouvakis J.P. and Lambropoulos S. (2012). Modeling uncertainty during cost benefit analysis of transportation projects with the aid of fuzzy set theory. *Proc. Soc. Behav. Sci*. **48,** 3661-3670.

Pochampally K., Gupta S.M. and Cullinane T.P. (2003). A fuzzy cost-benefit function to select economical products for processing in a closed-loop supply Chain. Pp. 23-28 in Proc. SPIE Int. Conf. Environ. Conscious. Manuf. III. Providence, Rhode Island.

Wang M.J. and Liang G.S. (1995). Benefit / cost analysis using fuzzy concept. *Engin. Econom*. **40(4),** 359-376.

Ward T.L. (1985). Discounted fuzzy cash flow analysis. Pp. 476-481 in Proc. Conf., Indust. Engin. California, USA.

Zadeh L.A. (1965). Fuzzy sets. *Inform. Control*. **8,** 338-353.