Economical issues on production of roes in rainbow trout (*Oncorhynchus mykiss*) for consumption

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Abstract. The capitalization of the salmonid production is mainly made through fish meat by various types of meat products, but from the trout roes are also successfully marketed. In Romania, the most trout farms prefer to import the rainbow trout (*Oncorhynchus mykiss*) by embryonated eggs which can be marketed in a production cycle of 8-12 months. Given that the imported embryonated eggs come from various crosses and they are single or multi-racial hybrids, usually female, we decided to perform an economic analysis of the business of producing eggs for consumption in the trout farm. To understand in which measure, activity of production of trout eggs for consumption can be an efficient economic activity in a trout farm, it was necessary to determine the zero limit of profitability. Thus, the results showed that the activity of producing rainbow trout eggs, using hybrid females, is profitable both as secondary production or primary production in a trout farm.
Key Words: Rainbow trout, roe, estimated economic efficiency, *Oncorhynchus mykiss*.

Rezumat. Valorificarea producţiei salmonicole se face, în principal prin peştele de consum, sub diferite forme, dar de la păstrăvi se comercializează cu succes şi icrele. În majoritatea păstrăvăriilor din România se practică importul de icre embrionate de păstrăv curcubeu (*Oncorhynchus mykiss*) care într-un ciclu de producţie de 8-12 luni se poate comercializa. Având în vedere faptul că icrele embrionate importate provin din variate încrucişări, constituind hibrizi mono- sau multi-rasiali, de obicei femele, ne-am propus să efectuăm analiza economică a activităţii de producere a icrelor de consum în cadrul unei unităţi salmonicole. Pentru a înţelege în ce măsură activitatea de producere a icrelor de păstrăv pentru consum este sau poate fi o activitate economică eficientă într-o păstrăvărie s-a determinat pragul de rentabilitate zero. Rezultatele obţinute dovedesc faptul că activitatea de producere a icrelor de păstrăv curcubeu, utilizând femele hibride, este rentabilă atât ca şi producţie secundară cât şi ca producţie principală.
Cuvinte cheie: Păstrăv curcubeu, icre, eficienţă economică estimativă, *Oncorhynchus mykiss*.

Introduction. In salmonid production the capitalization is made mainly through fish for consumption in various forms (live, refrigerated, smoked, file), but from the trout, eggs are also successfully marketed, called "red caviar" (Monfort 2002; Vandeputte et al 2008), whose biological and culinary value is high due to the fact that they are fall into the category of large sized eggs (4-6 mm) and can be consumed as such, without suffering transformation process. High protein level (30-32%), organoleptic characteristics and eggs size emphasizes commercial aspect and potential exploitation of this production (Boaru 2007; Boaru et al 2008, 2009a, 2009b, 2010).

According to international statistics (Eurostat 2009; FAO 2009) trout production from Romania (almost 1300 tons) is represented by the following species: *Oncorhynchus mykiss* 77%, *Salvelinus fontinalis* 16% and *Salmo trutta fario* 7% (ANPA 2006), species which are also found in our country's aqua fauna (Mureşianu et al 2011; Gabor et al 2012), but they are also breed all over the world (Mehdizadeh et al 2011). In most trout farms we have in our country is practiced the import of the embryonated eggs from

Netherlands, Denmark, Australia or Austria of which is obtained a biological material with high growth rates, the fish efficiently use the feeds and is marketed in a short period of time (8-12 months). Rainbow trout hybrids are mainly females and the body size can attain 1.5-3.0 kg. From the large specimens can be obtained trout fillets or they can be processed by smoking. Another way to exploit the large size trout consists in extraction of the eggs and their use, being marketed in this form, followed by processing and trading of carcasses. Starting from these premises, we decided to perform an economic analysis of the business of producing eggs for consumption in salmonid production units.

Material and Method. The research was conducted in 2005 in the trout farm Remeţi, Bihor County, Romania, on a group of fifty rainbow trout females (*O. mykiss*), aged three years and derived from embryonated eggs, imported from Denmark. Situated at an altitude of 435m, trout farm Remeţi has the main source of water supply Valea Iadului River (80%) and secondary source Bila spring (20%), providing a total flow of about 600 L/min. The surface of trout farm is by 9000 m² and the ponds made of concrete are representative of a classic trout farms from Romania (Bud et al 2009; Boaru et al 2010) (Figure 1).

Figure 1. Remeţi trout farm, Bihor County, Romania.

Starting with November, in the females diet a characteristic breeding category feed was introduced. Starting from the objectives proposed we chose extruded pelleted feed protein level of 53% and grain size of 8 mm. Feeding was done in compliance with the recommended daily allowance by the manufacturer, depending on water temperature (kg feed/100 kg fish/day). The spawning period was between 7.01.2005 and 22.01.2005. The females were milked by classical methodology and the measurements and weighings were made on a sample of 50 individuals. Values obtained for the followed characteristics were statistically processed (Graph Pad statistical program Inst 3) and have been calculated the mean and standard error of mean (X±sx). Samples were digitally photographed and using Irfan View software program we determined the number and diameter of the eggs. Further we calculated the breakeven to highlight that the business of producing trout eggs for consumption is economically efficient.

Results and Discussion. From the 50 females could be milked 43 heads, representing 86% from the studied group (Table 1). Eggs weight emphasize a mean of 248.26±8.58 g with a number of grains which varies between 3286.00±99.85 pieces and gonadosomatic

index value (9.82±0.26%) falls within the minimum specific of this index (Bud et al 2009).

Average for followed characters in female rainbow trout

Feature	$X \pm sx$	Limits
Weight of roes (g)	248.26 ± 8.58	150-375
No of roes/female (no)	3286.00 ± 99.85	2071-4516
Gonosomatic index (%)	9.82 ± 0.26	6.41-16.53
Diameter of roes (mm)	4.98 ± 0.41	4.20-5.90

Regarding to eggs diameter it was by 4.98±0.41 mm and limits between 4.2-5.9 mm shows high values for the size and very favorable for exploitation. Regarding the quality of eggs, the analysis revealed, like expected, great nutritional value and which is due to protein and fat content. Commercial aspect it appears evident from the organoleptic characteristics and their size (Table 2). As the chemical analyzes results shows, is particularly noted the protein level by 31.36% and by point of view of granulation, eggs were relatively uniform, with compact consistency over the entire surface analyzed, and did not show foreign odors.

Physical, chemical and organoleptic features of roes

Chemical composition (%)		Aspect, Color, Consistence	Smell and taste
Water	58,06	Big seed with uniform aspect;	
Proteins	31,36	Yellow-orange; Compact-	Characteristic
Lipids	8,84	elastic on entire analyzed	
Ash	1,74	surface	

In any economic activities an extremely important indicator of efficiency is the profitability rate (limit of profitability). To calculate the profitability, profit is dimensioned on each action, as well on the whole activity. Based on the calculated profitability activities are motivated and establish objectives in the sphere of profit distribution. Limit of profitability expressing the relationship between output and input volume. Total operating expenses are grouped into: fixed and variable costs (Obst et al 2007). The level of fixed costs (depreciation, rent, insurance premiums, overheads etc.) is independent of the size of production. This independence operates normally on certain ranges of output because when production reaches a certain level and size of fixed costs changes in one direction or another. Variable expenses (consumption of materials, payment and their sums related, etc.) are determined directly by operating phases so that their evolution depends on variation of volume of production. Nistor (2004) highlights the fact that determining breakeven is based on the assumption of constancy variable costs per unit and that is the critical point where sales cover their expenses.

For this purpose, should be anticipated and achieved a sales volume that will cover variable and fixed costs. Limit of profitability which indicates sales volume it the level to which by production activity performed is calculated profit is done in two forms, namely: zero limit of profitability and hoped limit of profitability (Barry et al 2000). In salmonid farms production cost structure is differentiated mainly of one element, decisive to assess the performance of the finished product. Food costs can vary between 40-65% from the total production costs and to maintain the performance limits of production is very important the quantity and quality of food. The main expenses necessary to carry out the whole process within a trout farm technology are: feed costs, employee payroll costs, electricity and water costs, indirect costs. Within these, highest rate have feed costs, which can represent up to 65% of production. To emphasize in which way activity of trout eggs for consumption it can be an efficient economic activity in a trout farm was

determined zero limit of profitability. For this purpose, both, expenses and income have been sized to produce 100 kg of eggs. The technological flow order to achieve this requirement involves the production of biological material, taking into account the estimated losses by age categories to collecting and use of eggs for consumption. Results analysis on body development and the amount of eggs obtained from female rainbow trout from trout farm Remeţi was the basis to establish the necessary of biological material (Table 3). Considering the total losses (49.5%) from the stage of embryonated eggs and by the age of 36 months it was established that in order to ensure a number of approximately 590 rainbow trout hybrid females at the age of 36 months may be milking a number of approximately 950 embryonated eggs. Setting the price and acquisition of trout embryonated eggs in our country is usually calculated to 1000 pieces, so that, starting from these premises have been considered acquisition of 1000 pieces embryonated eggs.

Table 3

Biological material requirements

Age category	Losses (%)	Entrance no.	Losses no.	Necessary no.
Embryoned roes	4.5	1000	45	955
Larvae	15	955	143	812
Alevins	10	812	81	731
Sapling	10	731	73	658
♀ 12-36 months	10	658	66	592

Because a significant share from the total production costs in a trout farm are the feed costs (40-65%), in table 4 have revealed their value depending on the age and growth phase established according to the technology of growth in our country for rainbow trout (Bud et al 2009; Boaru et al 2010), and based on and the results obtained in trout farm analyzed. Acquisition prices of feed vary by age group, so that technological phases were adjusted taking into account this aspect. Highest acquisition price is for the category of larvae and juveniles (7.308 RON/kg feed) and the lowest price (4.200 RON/kg feed) to the category trout from 12-36 months.

In the case of trout between the ages of 3-12 months, acquisition price of feed is about 6 RON/kg. To stimulate gonadal development, two months before the spawning period of species *O. mykiss* was estimated a using of about a 20 kg of feed, particular for breeding category and is purchased at a price of 6.51 RON/kg. Economic efficiency indicators were calculated starting from variable costs (Table 5) and fixed costs (Table 6). Variable costs deducted by age group were calculated starting from the assumption that 60% are trout feed. Their analysis emphasizes the highest value (11.137 RON) for 12-36 months category is justified, taking into account the longer period.

To calculate total variable costs, the starting point was the purchase of the embryonated eggs. Purchase price of embryonated eggs varies between 14 and 18 € (plus Tax), so that, we calculated a purchase price of their 89.964 RON/1000 pieces. Total variable costs calculated to achieve a production of 100 kg eggs for consumption have a value of around 11448 RON. Fixed costs structure is as follows: for maintenance and repairs and general administrative expenses have been allocated each 1.68 percent (228.977 RON) and general administrative expenses represented 12.6%, respectively 1717.33 RON.

Profit prediction is an important section of financial prevision and has as objective an analyze of activities for mobilization of economic efficiency factors. Economic efficiency indicators (Table 7) which otherwise justifies to activity of rainbow trout breeding for egg production, emphasizes that net income which may be obtained is by 16779 RON, while the kilogram of eggs is sold in the value of 336 RON, representing 80 € at an exchange rate calculated for 1 € = 4.2 RON (source www.bnr.ro).

Zero limit of profitability (dead point) is given by that volume of production, sales respectively, at which level is recovered in total the costs which was made without profit. Knowing this critical point is very important because failure to set production and sales will lead to losses. 0 breakeven point is calculated from the relationship described by Nistor (2004) as follows:

$$Q_M = \frac{CF}{P_r - C_v}$$

where:

Q_m = sales volume
CF = fixed costs – total
P_r = sale price/product unit
C_v = variable costs/product unit

Starting from this relationship, in this case zero limit profitability (breakeven) of 9.82 kg shows that for a lot of 1000 embryonated eggs acquired in the initial phase, from where results 530 females who are milked, the activity becomes profitable in the specified technological conditions. Profitability of invested capital specifies that each monetary unit (um) invested in production, gains 1.23 um. Comparing this rate of profitability at 123% of the average market interest rate (around 12-15% www.bnr.ro source) we can see that the possibility of recovery of secondary production is particularly attractive economically.

Table 4

Cost value with fodder on breeding phases

Age group	FCR	B_i (kg)	B_f (kg)	BWG (kg)	FC /age groups (kg)	AP/kg fodder (RON)	Total value (RON)
Larvae+Alevin	1.0	0.14	106.02	8.58	8.58	7.308	62.69
Sapling	1.2	8.72	106.02	97.29	116.75	6.01	701.23
♀ 12-36month	1.4	106.02	1219.00	1112.98	1558.17	4.20	4674.52
2 months before milking	0.8-1.5% from final biomass				18.56	6.51	120.83

FCR = fodder conversion factor, B_i = initial biomass, B_f = final biomass, BWG – body weight gain, FC – fooder consumption, AP - acquisition price.
Note: prices were calculated at on exchange rate value of 1 € = 4,20 RON including Tax.

Table 5

Variable costs on breeding technological phases

Age group		M.U.	%	Real costs (RON)
Embryonated roes		1000 pc.	-	89.964
0-3 months	Fodder	kg	60	73.080
	Salaries	Kw/h	15	18.270
	Energy and water	RON	25	30.450
	Total	-	100	121.800
3-12 months	Fodder	kg	60	60.060
	Salaries	Kw/h	15	15.015
	Energy and water	RON	25	25.025
	Total	-	100	100.100
12-36 months	Fodder	kg	58	6552.000
	Fodder before milking	kg	2	130.200
	Salaries	Kw/h	15	1670.550
	Energy and water	RON	25	2784.250
	Total	-	100	11137.000
	Variable Total Costs 11448.864 RON			

M.U. – measurement unit.

Table 6

Structure of fix costs

Specification	M.U.	Value
Maintenance and reparations		228.977
General administration costs		228.977
Construction amortization, installations and equipments	RON	1717.33
Total		2175.284

Table 7

Economic efficiency indicators

Specification	U.M.	Value
Total costs		13624.15
Income		33600.00
Gross profit	RON	19975.85
Tax 16%		3196.14
Net profit		16779.72
Zero profitableness limit	kg	9.82
Profitableness rate of invested capital	%	123.16

Conclusions. To analyze the stability of capitalization for this type of product depends on the selling price the sensitivity of breakeven zero (limit of profitability zero) was analyzed, respectively the rate of profitability on invested capital.
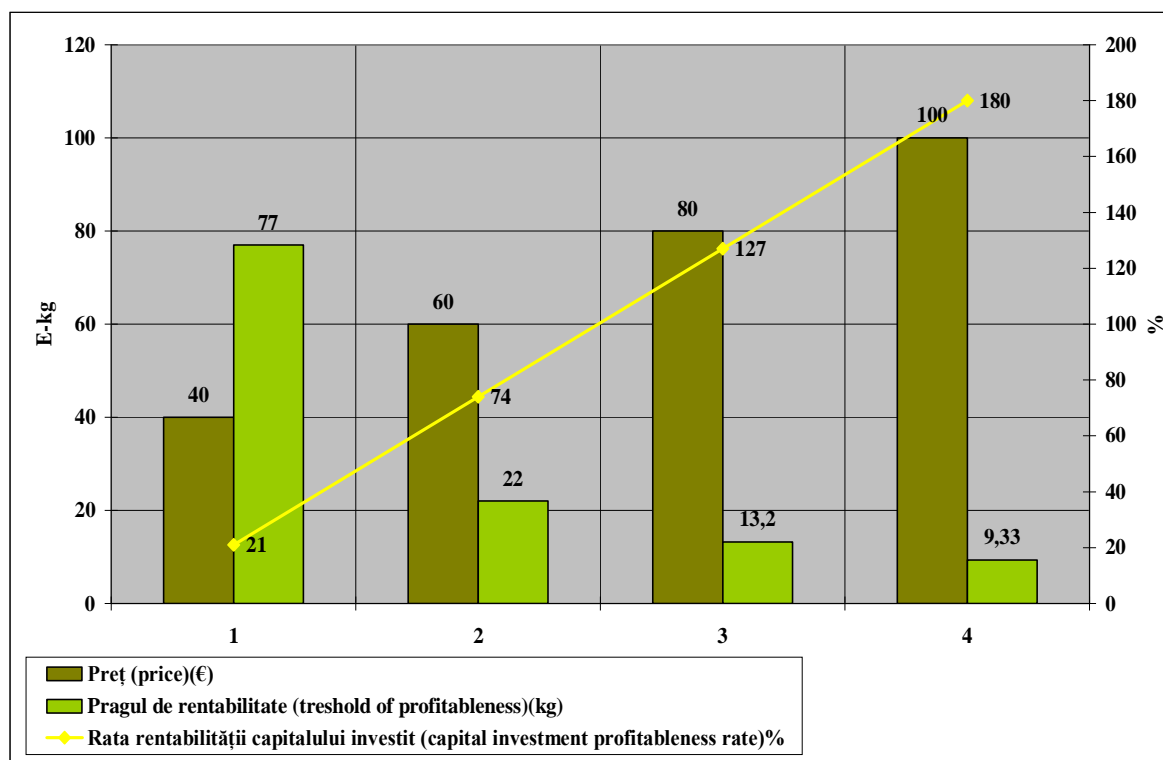

Figure 2. Analysis of zero profitableness limit.

From figure 2 we can see that from decreasing selling price by about 60% (worst case considered) trout farm unit is profitable because in these conditions should produce only 77 kg of eggs to cover all expenses generated by a production batch of 1000 embryonated eggs purchased.

The obtained result shows that the activity of producing eggs of rainbow trout (*O. mykiss*) is profitable both, as secondary production and as primary production as well. In our country's trout farms condition, economic efficiency can be echieved by production activity and exploitation of eggs collected from female rainbow trout.

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