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PROFITABILITY OF CARP PRODUCTION IN MACEDONIA AND SERBIA

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Abstract: Macedonia and Serbia are countries with long tradition in freshwater carp production. In this study, the aim is to assess the carp fish production economics, with particular focus on profitability. The findings revealed that carp production is profitable in both cases, though with better returns in the Macedonian case with the rate of profitability being 17.18%, in comparison to 8.10% at the Serbian farm. The full cost of production per kg is €2.56 and €2.25 in Macedonia and Serbia, respectively. The current profitability levels are highly sensitive to market price fluctuations, and there is considerable room for yield improvement and costs reductions.

Key words: carp production, profitability, Macedonia, Serbia

Introduction

Carp culture is the most widely practiced fish production system in Central and Eastern Europe *(Woynarovich et al., 2010)*. In Macedonia and Serbia, fish culture is mainly practiced in cold waters on trout farms and in warm waters on carp farms, with rainbow trout and common carp being the dominant species (*Spirkovski, 2007; Marković and Poleksić, 2008)*.

The consumption of fish in Macedonia and Serbia is very low, *i.e.* only 4.6 and 5 kg per capita on annual basis, respectively *(Milijašević et al., 2012; SSORM, 2016)*. This situation can be attributed to eating habits, low purchasing power of the population, relatively high price and limited and inadequate offer on the market *(Kostov, 2014; Kokot et al., 2015)*.

The development of any type of economic activity, including fish culture, needs to be supported with relevant economic analysis. Our aim is to investigate the profitability of carp production on Macedonian and Serbian carp enterprises. Although there is a long tradition of warm-water fish ponds culture in both

countries, as well as a large number of proven experts in practice, there is not enough research on the economics of fisheries in Serbia *(Čanak, 2012)* and this situation is even more pronounced in Macedonia, where no specific fish economics research has been conducted so far. This paper aims to fill part of this gap and to contribute to the freshwater fisheries economics literature in these two countries.

Material and Methods

The general trends in fish culture with focus on carp production are based on available data from Macedonian and Serbian state statistical offices *(SSORM, 2016; SSORS, 2016)*, FAO database *(FAO, 2016)*, as well as some national reports *(Kostov, 2014; MAFWE, 2014; Čanak, 2015)*.

This research additionally uses primary data collected from two case farms, in Macedonia (cage system, with 30 cages totalling 750 m^2 or 3,750 m^3) and in Serbia (pond system, with 215 ha of production area). A basis for calculation of the carp production enterprise performance is the analytical enterprise budget. The costs are allocated based on the relationship with the specific production line (enterprise) and therefore are further classified into direct costs and indirect costs.

In order to compare the carp enterprise performance between the two case farms, our analysis focuses on per unit derived indices, coefficients and ratios *(Milanov and Martinovska Stojcheska, 2002; Marković et al., 2014)*: gross and net profitability rate (as share of gross and net profit in the total income); income-to-cost ratio (total value of production as potential income in direct *i.e.* total costs); cost of production per kg of output (direct and total costs per quantity produced). The feed conversion ratio is also an important indicator of the efficiency of feeding referring to the quantity of feed necessary to produce one kilogram of fish.

Lastly, a sensitivity analysis is performed examining the change in profitability and costs of production on hypothetical shifts in yield, market price and costs. Potential increases or decreases on yield are set at a range from 1,000 to 2,500 kg per cage or hectare in the Macedonian and Serbian case, respectively. The market price and costs sensitivities are tested with 10 to 20 percent variation.

Results and Discussion

Fish and carp systems and production in Macedonia and Serbia

Different production systems are used worldwide for carp production *(Rahman et al., 1992)*: (i) extensive production (natural feed sources, low cost, low output); (ii) semi-intensive production (manure based, supplementary feeding is limited, moderate production cost and output); (iii) intensive production (pellet feed, high stocking density, high cost and high output).

Most of the carp production in both Serbia and Macedonia is characterized as semi-intensive. More concretely, in Macedonia carp production is carried out in classical and cage systems *(Kostov, 2015)*. The classical warm-water system is present in larger water areas, and functions without major costs and relatively low yields (900 to 1,500 kg ha^{-1}). The most intensive type of carp production in the country is in cages; the cages are set in some of the larger artificial lakes – accumulations and most of these are located in Lake Tikveš.

In Serbia, two main intensity levels of carp production are identified *(Čanak et al., 2015)*: (i) lower level, or classical semi-intensive production, where supplementary cereals, fertilization and liming are used; and (ii) higher level, or partly intensive production that was introduced since 2004, where instead of cereals, concentrated or pelleted feed is the main source of nutrition.

During the period 2005-2014, both Macedonian and Serbian fish productions show an increasing trend. The average fish production in Macedonia is 1,338 tons, out of which 228 tons of carp, since trout is the dominant *(SSORM, 2016)*. During the last decade, the average fish production in Serbia is 6,483 tonnes of fish, out of which 5,077 tons of carp *(SSORS, 2016)*.

Carp production in Serbia is more stable compared with the Macedonian carp production, with an average yield of 0.75 t ha^{-1}. The negative change rate per unit utilized area (-1.82%) indicates that there is still need for improvement of the production technologies in Serbia. The average annual carp production in Macedonia is 0.23 t ha^{-1}.

The area under carp ponds has significantly increased in Serbia during the last decade. The carp production was organized on a total area of 8,724 ha in 2014, which is almost doubled compared to the utilized area for carp production in 2005 (4,374 ha), the 2005-2014 average being 8,079 ha *(SSORS, 2016)*. On the other side, during the same period, the total area for fish production in Macedonia in the official statistics remains unchanged *i.e.* registered as being on1,000 ha, including ponds, reed beds and fish ponds for all fish species *(SSORM, 2016)*.

Both countries are importing fish to satisfy the domestic demand with 4,185 tons in Macedonia (SSORM, 2016) and 1,020 tons in Serbia *(SSORS, 2016)*. Export levels are comparatively low.

Comparative profitability analysis of carp production

In intensive culture systems such as cages, carp is usually bred as monoculture or dominant species. The analytical budget of carp enterprise in Macedonia is based on a farm that practices cage monoculture (Table 1). The budget is calculated on one cage basis (surface of 5m x 5m i.e. 25 m², with a depth of 5 m) and per hectare. The production value, given the yield of 1,500 kg per cage and the market price of €3.09 kg^{-1}, is estimated at €4,635 ha^{-1}.

The costs per cage amount to €3,838, confirming the high intensity of this production. The cage carp is fed exclusively by pelleted or extruded feed, which

represents the highest cost item and takes up almost two-thirds of the total costs structure. The farmer uses 2 kg of feed to produce 1 kg of carp, which leaves room for improvement. The producer breeds own fry and that is reflected in the low cost attributed to that segment (only €309 per cage, or 8% of the costs), which in other conditions could be rather significant. In terms of other costs, labour is in its minimal range, with only 10% share in the total cost. Other direct costs, such as veterinary services, are minor. Indirect costs are mainly derived from the depreciation of fixed assets (cages and nets). The producer pays concession fee in order to use the accumulation. The calculation of the interest on working capital is based on the assumption, in both Macedonian and Serbian carp budget, that one fourth of the variable investment is financed from borrowed sources of financing.

The cage production is profitable, leaving a €796 net result per cage. In addition to that, fish producers are entitled to use subsidy support, which in 2015 amounted to €0.16 kg^{-1} *(OG, 2013)*.

Table 1. Analytical budget calculation of carp production, Macedonia (case capacity 25 m^2)

1. Production value	**Quantity**	**Price (€)**	**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Carp fish (kg)	1,500	3.09	4,635	1,853,921	100
Production value			**4,635**	**1,853,921**	**100**
2. Direct costs	**Quantity**	**Price (€)**	**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Material costs					
Fish fry (fingerlings, kg)	58	5.37	309	123,432	8
Pelletted feed (kg)	3,000	0.81	2,439	975,748	64
Packaging (30 kg bags)	50	0.08	4	1,626	0
Total material costs			**2,752**	**1.100.806**	**72**
Labour (ratio per kg)	1,500	0.24	366	146,362	10
Transport (ratio per kg)	1,500	0.16	244	97,575	6
Veterinary services (visits)	3	10.84	33	13,010	1
Total direct costs			**3,394**	**1,357,753**	**88**
Contribution margin (1-2)			**1,240**	**496,168**	
Cost of production at direct costs (€/kg)				**2.26**	
3. Indirect costs			**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Concession for accumulation			4.88	1,951	0
Fixed assets depreciation			362.42	144,968	9
Interest on working capital			34.40	13,760	1
Other costs			42.28	16,913	1
Total indirect costs			**444**	**177,593**	**12**
Total costs (2+3)			**3,838**	**1,535,346**	100
Profit (1-2-3)			**796**	**318,575**	
Cost of production at total costs (€/kg)				**2.56**	

For poly-culture in ponds, carp can be the major or a secondary species. In the Serbian case farm (Table 2), common carp is the major species with dominant share (94%). The total production value in the analysed pond is €4,767 ha^{-1}. Yields

in the fisheries sector in Serbia are modest in comparison with the yields which are realized in the world *(Marković et al., 2014)*, hence the low profitability.

The total costs per unit area are very high (€4,381ha^{-1}). Such high costs, place aquaculture in rank of highly intensive productions. The direct costs of this complex production include: the material costs (yearlings and fry, pellets, hydrant lime, fuel and lubricants, other materials), labour costs and direct services. Within the direct costs, pelleted feed has the largest share (€1,662 ha^{-1}, or 38%). Spawn represents a significant cost, which coupled with the feed costs takes up 73% of total costs. The remaining material costs have no significant share (less than 4%). Labour costs amount to €501 ha^{-1}, or 11% of total costs. In intensive production systems, labour costs could be lower, so their reduction significantly affects the level of the production economy. Direct services include pond maintenance and do not represent a significant element of the costs. The general or indirect costs are covered by the corresponding part of the depreciation of buildings and equipment, various overhead expenses, and interest on current assets.

Looking at the absolute performance indicators (contribution margin and profit), the achieved results are relatively modest. The realized contribution margin (€892 ha^{-1}) and profit (€386 ha^{-1}) cannot be considered as satisfactory for production with such intensity, which is characterized by high investments per unit of capacity.

The carp production analysis is done using performance indices (Table 3). Carp production is profitable in both cases, though with better returns in the Macedonian case (26.76% contribution margin and 17.18% rate of profitability), in comparison to the Serbian farm (18.71% and 8.10%, respectively). This is also reflected in the income-to-cost ratio, whereas there is €1.21 of return on €1 of related total costs in the Macedonian case, *i.e.* in the Serbian case only €1.09 of production value is achieved on €1 of the total costs.

Nevertheless, the cost of carp production calculated per unit of output is more elevated in Macedonia; the cost of production per kg calculated at direct costs is €2.26 and €1.99, and the full cost of production per kg €2.56 and €2.25, in Macedonia and Serbia, respectively. This indicates that the higher profitability previously discussed on the Macedonian farm is linked to the higher production value, as function of the achieved yield and market price of the product.

Table 2. Analytical budget calculation of carp production, Serbia (case capacity 215 ha)

1. Production value	**Quantity**	**Price (€)**	**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Carp 1 (kg)	22,498	2.73	61,420	286	6
Carp 2 (kg)	74,594	2.73	203,642	947	20
Carp 3 (kg)	296,260	2.38	705,099	3,280	69
Grass carp (kg)	8,351	1.88	15,700	73	2
Silver carp (kg)	11,503	1.53	17,600	82	2
Catfish (kg)	6,312	3.41	21,524	100	2
Production value			**1,024,983**	**4,767**	**100**
2. Direct costs	**Quantity**	**Price (€)**	**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Material costs					
Carp yearlings (units)	12,794	2.73	34,928	162	4
Two-year carp fry (units)	99,112	2.73	270,576	1,258	29
Two-year grass carp fry (units)	2,910	2.05	5,966	28	1
Two-year silver carp fry (units)	4,172	1.64	6,842	32	1
Two-year catfish fry (units)	2,690	4.09	11,002	51	1
Pelleted food 25/7 (kg)	533,562	0.47	250,774	1,166	27
Pelleted food 30/7 (kg)	208,841	0.51	106,509	495	11
Hydrant lime (kg)	131,729	0.07	9,221	43	1
Fuel and lubricants (total)			21,398	100	2
Other materials (total)			6,710	31	1
Total material costs			**723,925**	**3,367**	**77**
Labour (total)			107,615	501	11
Other direct costs			1,630	8	0
Total direct costs			**833,170**	**3,875**	**88**
Contribution margin (1-2)			**191,813**	**892**	
Cost of production at direct costs (€/kg)				**1.99**	
3. Indirect costs			**Total (€)**	**Total (€ ha^{-1})**	**Share (%)**
Fixed assets depreciation			101,226	471	11
Interest on working capital			7,601	35	1
Total indirect costs			**108,828**	**506**	**12**
Total costs (2+3)			**941,998**	**4,381**	100
Profit (1-2-3)			**82,986**	**386**	
Cost of production at total costs (€/kg)				**2.25**	

The overall structure of costs is very similar between the comparative budgets on the level of total direct and indirect costs shares. Namely, in both cases, total direct costs account for 88% and indirect costs for 12% in the total costs, which is an expected proportion. Looking more closely into the direct costs structure, major component is feed, the respective share in total costs being 64% in the Macedonian case and 38% in the Serbian case. The costs of carp production vary according to the culture practice and usually feed costs comprise the largest portion of production costs *(Weimin, 2004)*. The major feed in both cases are commercial feeds – pellets that ensure stable feeding patterns and higher intensity of production. Nutrition with pelleted complete feed allows higher yield in all the categories of analyzed cyprinid fish *(Ljubojević et al., 2012)*. However, many fish

farms both in Macedonia and Serbia, still use maize, wheat and barley as feed, which impacts the yield levels negatively, and therefore the quality of produced fish. Feed costs' share in the Serbian case is comparable with the literature whereas feed costs in carp production typically range from 30% to 50% in total costs *(Leopold, 1981)*. In the Macedonian case, this segment is higher, which results from the higher cost of feed, and also to the small contribution of other direct material costs such as fry.

The share of other direct costs, apart from labour, is higher in the Macedonian case. The labour share points to more effective use of this resource in the Macedonian case. This is related mainly to the fact that breeding and collecting fish in cage usually requires less labour input *(Weimin, 2004)*, but also may indicate more operative environment and management practices.

Table 3. Comparative carp production performance indices

	Macedonian case	***Serbian case***
Contribution margin rate (%)	26.76	18.71
Profitability rate (%)	17.18	8.10
Profit (€ per kg)	0.53	0.20
Income-to-cost ratio (at direct costs)	1.37	1.23
Income-to-cost ratio (at total costs)	1.21	1.09
Cost of production at direct costs (€ per kg)	2.26	1.99
Cost of production at total costs (€ per kg)	2.56	2.25
Feed conversion ratio	2.00	1.77

Feed intake and relative efficiency can be analysed through the feed conversion ratio. This ratio in carp production usually ranges from 1.5 to 2.5, depending on the type and quality of feed and feeding system *(Woynarovich et al., 2010)*. Similarly to other livestock productions, nutrition is of highest importance and in that respect increases in feed conversion efficiency contribute to improved farmer's profitability *(Petrovic et al., 2013)*. In our analysis, the Serbian case farm is more successful converting 1.77 kg feed to 1 kg of output, in line with the usual feed conversion ratio for such production in Serbia ranging from 1.4 to 1.8 *(Marković, 2010)*. In the Macedonian case, 2 kg of feed are needed in order to produce 1 kg of output.

Yield, market price and costs impact on profitability

The sensitivity analysis (Table 4) of hypothetical yield shifts takes into account the variable nature of most of the direct costs. Decreased outputs result into lower profitability or even potential loss in the Serbian case. We further calculated the threshold break-even yield levels at 536 kg in the Macedonian and 1,110 kg in the Serbian case, respectively, meaning that production volume beneath those levels would be unprofitable, *i.e.* the costs will out-weight the income.

Profitability levels are highly sensitive to market price reductions and total costs increases. The cost of production at full costs in this sense can be interpreted as a break-even threshold; hence, product sales below that price would result into negative financial result and unprofitability. It is interesting to note that if the market price for the Macedonian farmer is assumed to be at the Serbian market level, the costs would rise above the value of production and the farm will have negative result. In the case of the Serbian farm, even slightest 10% reduction in sales price would result in loss. The Serbian producer is more sensitive to cost changes; a 10% increase in cost, given the same production value, would already turn the net result under the break-even level; in the Macedonian case, a 20% increase in cost, would diminish the profits.

Table 4. Sensitivity analysis (Macedonia on 25 m^2 cage basis and Serbia on 1 ha basis)

	Macedonian case				***Serbian case***			
Yield level (kg)	**1,000**	**1,500***	**2,000**	**2,500**	**1,000**	**1,500**	**1,951***	**2,500**
Total costs (€)	2,706	3,838	4,970	6,103	2,494	3,486	4,381	5,470
Production value (€)	3,090	4,635	6,180	7,725	2,443	3,665	4,767	6,108
Profit (€)	384	796	1,209	1,622	-51	179	386	638
Profitability rate (%)	12.41	17.18	19.57	21.00	-2.08	4.88	8.10	10.44
Income-to-cost ratio	1.14	1.21	1.24	1.27	0.98	1.05	1.09	1.12
Cost of prod. (€ per kg)	2.71	2.56	2.49	2.44	2.49	2.32	2.25	2.19
Sales price (€/kg)	**2.47**	**2.78**	**3.09***	**3.40**	**1.95**	**2.20**	**2.44***	**2.69**
Total costs (€)	3,838	3,838	3,838	3,838	4,381	4,381	4,381	4,381
Production value (€)	3,708	4,171	4,635	5,098	3,814	4,291	4,767	5,244
Profit (€)	-131	333	796	1,260	-567	-91	386	863
Profitability rate (%)	-3.52	7.98	17.18	24.71	-14.88	-2.12	8.10	16.45
Income-to-cost ratio	0.97	1.09	1.21	1.33	0.87	0.98	1.09	1.20
Profit (€ per kg)	-0.09	0.22	0.53	0.84	-0.29	-0.05	0.20	0.44
Total costs (€)	**4,606**	**4,222**	**3,838***	**3,455**	**5,258**	**4,820**	**4,381***	**3,943**
Production value (€)	4,635	4,635	4,635	4,635	4,767	4,767	4,767	4,767
Profit (€)	29	413	796	1.180	-490	-52	386	824
Profitability rate (%)	0.62	8.90	17.18	25.47	-10.28	-1.09	8.10	17.29
Income-to-cost ratio	1.01	1.10	1.21	1.34	0.91	0.99	1.09	1.21
Cost of prod. (€ per kg)	3.07	2.81	2.56	2.30	2.69	2.47	2.25	2.02
Profit (€ per kg)	0.02	0.28	0.53	0.79	-0.25	-0.03	0.20	0.42

Note: *Actual levels.

Conclusions

Although the production systems illustrated though the country specific cases differ, the carp profitability comparative analysis provided new insights and grounds for further deeper investigation. The current performance of both Macedonian and Serbian farms reveals considerable room for interventions in yield

improvement and costs reductions, and accordingly increasing the profitability of carp production.

Overall, the fish production in both countries is still underdeveloped, considering that most of the production takes place at semi-intensive ponds, with outdated supporting infrastructure, while there are a small number of modern fish farms. The production is not cost-effective enough, relative to the volume of invested assets.

The applicability of economies of scale is evident through the sensitivity analysis. This concept applies primarily to the potential to decrease the average cost per unit; the increase of the volume of production, mainly attributable to the indirect/fixed costs segment, when allocated on per unit of output, triggers a decrease in the overall cost of production. Also, larger output volumes enable finding optimal operating levels, gains in productivity, and specialization in terms of more efficient use of the available production factors. Other reasons for enhancing economies of scale can be related to increased benefits for large-scale producers in discounts when procuring inputs *i.e.* getting lower input prices when purchasing higher quantities of input. Finally, producing larger volumes of output can boost the negotiating powers and market positioning of the producer.

Both Macedonia and Serbia have very favourable climatic and soil conditions for freshwater fish production, but the producers are faced with subordinate position compared to other branches of agriculture. As the consumption levels are low in both countries, there is realistic growth potential for changing consumer food patterns and increasing fish consumption on the domestic market. Increased production can additionally lead to intensified export in the case of Serbia (to the European Union and to Russia), and import substitution in the case of Macedonia. Nevertheless, in order to achieve that, it is necessary to emphasize the need for adequate fisheries' development strategy and stimulating support from the state *i.e.* policy for production, processing and marketing of fish.

Profitabilnost proizvodnje šarana u Makedoniji i Srbiji

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Rezime

Makedonija i Srbija su zemlje sa dugom tradicijom u proizvodnji slatkovodnog šarana. Cilj ove uporedne studije je procena ekonomskih obeležja proizvodnje šarana, sa posebnim naglaskom na profitabilnost. Rezultati su pokazali da je proizvodnja šarana profitabilna u oba slučaja, iako sa većom efikasnošću u slučaju Makedonije, gde je stopa profitabilnosti 17,18%, u poređenju sa 8,10%

koliko iznosi na ribnjaku u Srbiji. Ukupni troškovi proizvodnje po kg iznose 2,56 € u Makedoniji, odnosno 2,25 € u Srbiji. Trenutni nivoi profitabilnosti su veoma osetljivi na fluktuacije tržišnih cena, a postoji i značajan prostor za povećanje prinosa i smanjenje troškova.

Ključne reči: proizvodnja šarana, profitabilnost, Makedonija, Srbija

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