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THE ECONOMICS OF CARP FARMS IN POLAND

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Background. Poland is one of the largest common carp producers in the European Union. By 2006, the annual production of carp and other cyprinid fish species had reached around 17 000 t. The economic efficiency of pond farms is not only significant for the performance of Poland's traditional carp market, but it also supports the non-productive environmental functions of earthen carp ponds. The objective of this study was to determine the costs and revenues of carp ponds, and to identify the key conditions for improving the profitability of carp farming in Poland.

Materials and Methods. Data from 2005–2007 were collected through a survey of 18 carp farms keeping full accounting records of a total pond area of 17 302 ha, accounting for around 34% of the total in Poland. Data was both biological and economic. The former consisted of survival rate of different age groups of fish. The latter included farm revenues (sales of carp and other species, angling fees, and other income sources) and annual production costs. The cost was separated into two main parts, variable- and fixed costs. The income was determined by subtracting the annual total cost from the total revenue. The profitability was defined as the cost-to-income ratio. The results were compared with available economic indicators of carp production in Germany and Hungary in 1999–2002.

Results. The proceeds from the sale of market-size carp had a predominant share of total revenues of the investigated farms. The variable cost consisted of labour (37%) and feed (20%), while the share of the remaining cost components did not exceed 10% of total expenses of fish farms. Only in 2007 was pond fish production profitable (merely 3.95%) while in 2005 and 2006, the total costs of the farms were higher than their revenues (on average –7.42% and –2.42%, respectively). The average survival rates of stocking carp in the studied farms, including fry between 0 and 2 years of age, were very low at 36% and 38%, respectively. The survival rates of market-size carp were much higher, on average 67%.

Conclusion. The economic situation of Polish carp farms, within the studied time period, was difficult. The low survival rates of stocking carp seemed to be one of the main causes for the low return on carp production. This may be a compound effect not only of epizootic diseases but also of piscivorous animals and environmental restrictions imposed on carp ponds. Farmers could find it difficult to reconcile fish production with the pond environmental functions and the need to maintain a healthy profit margin without external financial support.

Keywords: common carp, carp pond farms, economic effectiveness, Poland

INTRODUCTION

Poland is one of the largest common carp producers in the European Union. By 2007 the annual production of carp and other cyprinid fish species had reached around 15 575 t. A slightly higher production level was reported by the Czech Republic in the same year (17 947 t), while the remaining EU countries noted much lower results at 9244 t in Germany, 9570 t in Hungary (Anonymous 2010).

There are two predominant types of freshwater aquaculture in Poland: the production of coldwater fish, mostly the rainbow trout, and the production of warm water fish species, mainly the common carp. (There are no mariculture enterprises in Poland.) Ponds, including trout ponds, account for only 15% (71 000 ha) of inland fisheries, but they supply around 35 500 t, i.e., nearly 70% of total inland fish yield in Poland (Table 1).

The natural properties of earthen ponds, used for carp culture are known to enhance production. The quality and quantity of ponds significantly determine the type and method of fish culture. Carp yield is affected by various environmental- and natural factors, such as water temperature, precipitation, sun exposure, fish diseases, and losses caused by piscivorous animals (Guziur 2009). Economic considerations are equally important, among them operating costs, market demand and price level (Turkowski et al. 2007, 2008, Lirski and Myszkowski 2009).

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Extensive carp farming, the predominant form of carp production, has a beneficial effect on the natural environment by, among other things, improving the quality and retention of surface water, offering a habitat for protected fauna and flora species, and preserving biological diversity (Dobrowolski 1995, Turkowski et al. 2007, Guziur 2009). The economic viability of pond culture is not only significant for the performance of Poland's traditional carp market, but it also supports the environmental non-productive functions of earthen carp ponds. The objective of this study was to determine the operating costs and revenues of carp ponds, and to identify the key factors contributing to effective carp production in Poland.

MATERIALS AND METHODS

The financial viability of carp farms was evaluated based on data supplied by 18 farms. The survey covered large farms keeping full accounting records. A total of 28 questionnaires were forwarded to carp farms with a return rate of 64.3%. The studied farms had a total registered area of 17 302 ha, accounting for around 34% of the total registered carp pond area in Poland (around 51 700 ha; Lirski and Myszkowski 2008). The majority of the surveyed subjects were located in central and southern Poland (Fig. 1), where carp ponds are the predominant form of local aquaculture practice. The farms were characterized by considerable size differences, their water surface area ranging from 86 to 7634 ha, but relations between pond areas and economic viability of the farms were not found to be statistically significant.

The questionnaires covered the period of 2005–2007 and they concerned the following data:

– fish-pond surface area (including estimated production area in July and August);

Table 1

Freshwater fish catch [1000 t] excluding stocking material (Anonymous 2009)

Year	Aquaculture				Commercial lake catch	Angling	Total freshwater fish
	Total	Carp	Trout	Other			
2002	33.9	20.1	11.8	2.0	3.4	18.2	55.5
2003	35.0	19.5	13.5	1.9	3.4	18.3	56.8
2004	34.8	18.3	14.6	1.8	3.1	16.6	54.5
2005	36.1	18.3	15.7	2.0	3.0	15.9	54.9
2006	34.6	15.6	17.1	2.0	2.8	15.2	52.7
2007	35.0	15.5	17.5	2.0	2.7	14.1	51.8
2008[a]	35.0	17.2	15.5	2.3	2.5	14.7	52.3

a = Seremak-Bulge (2009).

Fig. 1. The location of 18 surveyed Polish carp farms with a total registered area of 17 302 ha

– sales volume and value per fish species and product type;
– volume and value of fish purchases per fish species and product type;
– revenues from special fishing areas and other revenues;
– production costs, including the cost of stocking material, labour, feed, feed components, electricity, fuel, fertilizers, veterinary services, medicinal and pharmaceu tical products, advertising, promotion, administration, loan re-payment, repairs and overhauls, depreciation write-offs, and other farm operating costs and charges;
– survival rates.

RESULTS

Revenues. The examined 18 carp ponds generated the highest total revenues in 2007 at an average of PLN 2712 per ha (1 Polish Złoty (PLN) = Euro 3.91; 4 November 2010) (Table 2).

In the remaining two years of the study, revenues were 12 percentage points lower at PLN 2395 per ha in 2005 and PLN 2376 per ha in 2006, respectively (Table 2). The main source of revenue was the sale of market-size carp which accounted for 79.2% of total revenues, and when combined with the sale of stocking material, the two accounted for 85.1% share of total revenues. The remaining fish species (mostly tench, silver carp, bighead carp, grass carp, and sturgeon) had a relatively small share of revenues at 6% and 7.8%, respectively. The revenue generated by ponds design for angling constituted 6.7% of the total revenue of carp farms. Other sources had a minimal share of total revenues at 0.3%.

An analysis of revenues in 2005–2007 indicates that despite efforts to diversify the operating profile of the investigated farms, the proceeds from the sale of market-size carp had a predominant share of total revenues. This trend is unlikely to be reversed in the coming years. In 2007, the average price of market-size carp was PLN 8.77 per kg, marking a 15 percentage point increase from 2006 (Table 3). This increase was two-fold higher than the price hike noted in 2006 from 2005. The prices of secondary consumable fish species were characterized by an even higher increase of 62 percentage points in 2007. Despite such a steep growth, this group of fish did not have a high share of the total revenues in the studied farms (Table 2) owing to low sales in 2007.

The high spread in the prices of other species, both market-size and stocking fish (Table 3) was not so much affected by local market demand as it was the case with carp, but it could rather be attributed to the species diversity of this group of fish. In general, the selling prices of fish in 2007 were much higher than in the remaining two years investigated by the survey. However, in the next two years the average price of market-size carp diminished slightly to average level of 8.54 PLN per ha in 2008 (Lirski and Myszkowski 2009) and of 8.62 PLN per ha in 2009 (Lirski and Wałowski 2010).

Farms operating costs. Similarly to revenues, the total operating costs of the 18 investigated farms were the highest in 2007 at PLN 2609 per ha (Table 4). The relevant costs were not significantly lower in the remaining

Table 2

Sources of revenue in the examined eighteen carp pond farms [PLN per kg]

Year	Carp		Other species		Angling fees	Other revenues	Total revenues
	Table	Stocking	Table	Stocking			
2005	1861	140	150	44	190	10	2395
(%)	77.7	5.8	6.3	1.8	7.9	0.4	100
2006	1919	125	155	49	122	6	2376
(%)	80.8	5.3	6.5	2.1	5.1	0.3	100
2007	2150	179	145	44	188	6	2712
(%)	79.3	6.6	5.3	1.6	6.9	0.2	100
2005–2007 average	1977	148	150	46	167	7	2495

Table 3

Weighted average prices of market-size and stocking fish and the range of prices [PLN per kg] (based on 18 studied carp farms)

Specification	2005		2006		2007	
	Average	Price range	Average	Price range	Average	Price range
Market-size carp	7.13	6.31–9.21	7.61	7.19–8.94	8.77	8.29–10.26
Change in average price	0%		7%		15%	
Stocking carp	7.94	7.72–11.00	7.83	7.30–10.00	8.40	7.51–10.33
Change in average price	0%		–1%		7%	
Other commercial fishes	8.56	4.44–16.00	7.29	5.80–14.00	11.83	5.86–17.00
Change in average price	0%		–15%		62%	
Other stocking fishes	12.20	7.47–13.16	13.63	8.73–15.00	14.06	8.33–15.00
Change in average price	0%		12%		3%	

Table 4

Structure of costs in the eighteen studied carp farms [PLN per ha]

Cost component	2005	%	2006	%	2007	%	Annual average	%
(A) VARIABLE COSTS								
Labour	963	37.2	917	37.7	911	34.9	931	36.6
Feed	481	18.6	381	15.6	641	24.6	501	19.7
Stocking fish	59	2.3	112	4.6	70	2.7	80	3.1
Fuel and electricity	160	6.2	161	6.6	148	5.7	156	6.1
Fertilizers	31	1.2	25	1.0	25	1.0	27	1.1
Veterinary products	14	0.5	13	0.5	16	0.6	14	0.6
Total	1708	66.0	1609.00	66.1	1811	69.4	1709	67.2
(B) FIXED COSTS								
Depreciation	144	5.6	144	5.9	148	5.7	145	5.7
Administration	205	7.9	178	7.3	176	6.7	186	7.3
Repairs	130	5.0	95	3.9	103	3.9	110	4.3
Rents	39	1.5	46	1.9	57	2.2	48	1.9
Loan servicing	9	0.3	6	0.2	8	0.3	8	0.3
Advertising and promotion	7	0.3	5	0.2	7	0.3	6	0.2
Other costs	345	13.3	352	14.5	299	11.5	332	13.1
Total	879	34.0	826.00	33.9	798	30.6	835	32.8
Total costs (A + B)	2587	100.0	2435	100.0	2609	100.0	2544	100.0

two years covered by the study, reaching PLN 2587 per ha in 2005 and PLN 2435 per ha in 2006. Variable costs accounted for 67.2% of total costs, on average, and their share increased steadily in the following years. Fixed costs accounted for 32.8% of total production costs on average, and they had a steadily falling share in the successive years covered by the study.

The cost structure was most affected by labour charges which accounted for 36.6% of total costs (Table 4). In the last analyzed year, labour had a lower share (34.9%) of total expenses in comparison with the two previous years (37.2% and 37.7%, respectively). The relation between labour charges per 1 ha and total pond areas of the farms was not found to be statistically significant. The second most cost-intensive factor was feed which accounted for 19.7% of total costs on average. Feed had the highest share of the cost structure in 2007 (24.6%), while in 2005 and 2006 feed costs were at a level of 18.6% and 15.6%, respectively (Table 4). The share of the remaining cost components did not exceed 10% of fish farms' total expenses. In this group, the highest share of fixed costs was reported in respect of administration charges (7.3% on average with a clearly falling trend), followed by fuel and electricity consumption (6.1% on average) and the remaining fixed costs: depreciation write-offs (5.7% on average) and current repairs (4.3% on average). The cost of purchasing stocking fish (3.1% on average), rents (1,9%) and fertilizers (1,1%) had a relatively small share of the expenditures of studied farms. Pharmaceutical products and veterinary services (0.6% on average), advertising and promotion (0.2% on average) had a marginal share of the relevant costs. Overall, the investigated farms were not indebted—the average loan servicing costs approximated 0.3%. Cost components identified as "other costs" had a relatively high share of total expenses (average of 13.1%). Excluding taxes and insurance (1.2% and 0.6% share, respectively), this group of expenses had more than an 11% share in the total statistical costs of the analyzed farms. This could be a potential area for cost reduction. The share of rents did not exceed 2% of total costs in the studied farms (Table 4). It should be noted, however, that the reported results were stated in terms of average for 8 farms paying rent and 10 farms not paying rent. All of the investigated farms used to be state-owned enterprises in the past, and they were privatized during the transformation period in Poland in the 1990s. In some of the farms, fixed assets were not bought out and today they are leased by private users. In the group of 8 farms leasing out their fixed assets, rents had 6.7% share of operating costs, on the average.

Production profitability. The combined income of the studied carp farms was positive only in 2007, reaching PLN 103 per ha with a profitability ratio of 3.95% (Table 5). In the remaining two years, the farms generated losses of PLN –192 per ha in 2005 and PLN –59 per ha in 2006. In the analyzed period, the least satisfactory results were reported in 2005 when the combined profitability ratio for the examined farms fell down to –7.42%.

The average survival rates of stocking carp in the studied farms, including fry between 0 and 2 years of age, were very low at 36% and 38%, respectively (Table 6). The indicators point to a highly adverse epizootic situation and suggest breeding problems related to the production of stocking material. Low survivability resulted also from high losses caused by fish-eating animals, including the cormorant (Lirski and Myszkowski 2008, 2009). The

average survival rates of market-size carp were much higher at 67% (from 60% to 73%) (Table 6).

The lowest survival rates of carp in all age categories noted in 2005 (Table 6) were accompanied by the lowest financial results (Tables 5). This was not validated in the remaining years of the study. In comparison with 2007, the financial results for 2006 were less satisfactory despite generally higher survival rates (Tables 5 and 6). These unexpected results could be attributed to higher carp prices in 2007 (Table 3).

DISCUSSION

The economic performance of the studied carp farms was compared against the results recorded in Germany and Hungary within 1999–2002, which were also related to 1 ha of pond water surface (Winkel 2005). Fish sales were the main source of income in all of the compared countries, with a higher share of total revenues in Poland and Hungary (93% and 83%, respectively) and a slightly lower share in Germany (68%) (Table 7).

Carp was the predominant harvested fish. Other fish species had an estimated 6%–8% share of the catch in Poland and Germany, and a much higher share of approximately 30% in Hungary which accounted for mostly herbivorous fish (Winkel 2005).

Variable costs accounted for 61%–70% of overall costs with a 61% share in Germany, a 65% share in Hungary, and a 67% share in Poland (Table 7). Labour was the highest variable cost component in Poland. The share of labour charges in the compared countries was nearly half that noted in Poland (37% in Poland, 19% in Hungary and 16% in Germany). Administration and accounting also had a higher share of total costs in Poland (7%) than in Hungary (1%) and Germany (4%). The low employment level noted in Germany was due to the wide use of machinery and specialized equipment in the production process (Winkel 2005), accompanied by high depreciation and maintenance costs (12% and 12%, respectively in Germany, compared with Poland's 6% and 4%, respectively, and Hungary's 5% and 6%, respectively) (Table 7).

German farms declared the highest spending on stock material purchases (22%), while the relevant expenses reached only 3% of total costs in Poland and 4% in Hungary in the analyzed period (Table 7).

According to Winkel (2005), since the reported losses (caused, for example, by cormorants) were similar in Germany and Hungary, the above resulted from a shortage of producers-own stocking material in German farms. Feed had a similar share of total costs in Poland and Hungary (20% and 19%, respectively), while its share was clearly lower in Germany at less than 12% of overall expenses (Table 7).

In German and Hungarian farms, carp production yielded profits and was marked by profitability ratios of 28% and 23%, respectively. Polish farms declared negative results with an average profitability ratio of –2% (Table 7). Carp production in the compared countries was subject to different subsidization schemes. In Germany, the value of subsidies exceeded income by 149 percentage points, subsidies accounted for 20% of the generated income in Hungary, while Polish farms did not receive any financial assistance from the state. If not subsidized, fish production in Hungary would still be characterized by relatively high profitability at 23%, it would continue to be marked by a deficit of –2% in Poland, while the highest deficit of –11% would be observed in German farms

Table 5

Key economic indicators in the eighteen studied carp farms [PLN per ha]

Specification	2005	2006	2007	2005–2007 average
Revenues	2395	2376	2712	2495
Costs	2587	2435	2609	2544
Income	–192	–59	103	–49
Profitability ratio [a)]	–7.42%	–2.42%	3.95%	–1.93%

a = calculated as the ratio of income to costs.

Table 6

Carp survival rates (%) in the surveyed pond farms

Specification	2005	2006	2007	2005–2007 average
Market-size fish[a]	60	73	69	67
Two-year-old fish[a]	32	48	35	38
Autumn fry[b]	34	36	37	36
Summer fry[c]	39	45	43	42

a = weighted average accounting for the registered area of each of the 17 examined farms;
b = weighted average accounting for the registered area of each of the 15 examined farms;
c = weighted average accounting for the registered area of each of the 10 examined farms (the number of observations points to farms where the respective data were acquired).

Table 7

Economics of carp pond production in Hungary, Germany, and Poland

Specification	Hungary[a] 1999–2001		Germany[b] 1999–2002		Poland 2005–2007	
	€ per ha	%	€ per ha	%	PLN per ha	%
(A) REVENUES						
Table and stocking fish	1367	82.7	978	67.8	2321	93.0
Revenues from other animal and plant production	13	0.8	5	0.3	not specified	
Angling fees	not specified		not specified		167	6.7
Stock changes animal	98	5.9	–3	–0.2	not specified	
Other revenues	90	5.4	50	3.5	7	0.3
Commercial wares	11	0.7	14	1.0	not specified	
Public direct payments	73	4.4	398	27.6	0	0.0
Total revenues	1652	100.0	1441	100.0	2495	100.0
(B) VARIABLE COSTS						
Labour/employment	249	19.3	184	15.7	931	36.6
Feed	239	18.6	135	11.5	501	19.7
Stocking material	54	4.2	260	22.1	80	3.1
Fuel and electricity	114	8.9	63	5.4	156	6.1
Lime/fertilizers	17	1.3	9	0.8	27	1.1
Veterinary services/medicines	63	4.9	1	0.0	14	0.6
Other variable costs	103	8.0	64	5.5	not specified	
Total variable costs	839	65.2	716	60.9	1709	67.2
(C) FIXED COSTS						
Depreciation write-offs	59	4.6	144	12.3	145	5.7
Administration/accounting	16	1.2	52	4.4	186	7.3
Repairs/maintenance	81	6.3	136	11.6	110	4.3
Rents	152	11.8	28	2.4	48	1.9
Loan servicing	30	2.3	19	1.6	8	0.3
Other fixed costs	110	8.5	79	6.7	not specified	
Total fixed costs	448	34.8	458	39.0	497	19.5
Total other costs	213	16.6	143	12.2	338	13.3
(D) TOTAL COSTS	1287	100.0	1174	100.0	2544	100.0
Income (A – D)	365		268		–49	
Income less subsidies	292		–130		–49	
Share of subsidies in income	20%		149%		0%	
Profitability ratio including subsidies	28.4%		22.8%		–1.9%	
Profitability ratio excluding subsidies	22.7%		–11.1%		–1.9%	

a – based on data by Winkel (2005);
b – based on average data for Saxony and Brandenburg by Winkel (2005).

(Table 7). In 2006 a total turnover of carp sector in Germany was about 49.7 million Euro, but only two thirds of the turnover derived from sales of fish, one third from "other incomes" [in fact revenues] which primarily comprise public subsidies under agricultural and environmental programmes (Framian 2009).

The above results are partially consistent with objective performance indicators noted in carp farms in various countries. Hungary has the most supportive climate for carp rearing with higher temperatures and a longer breeding season. Poland and Germany (Saxony and Brandenburg) have a similar climate which is less favourable for carp farming than in Hungary. But the German carp market offers less supportive terms for breeders with a preference for ca. 2 kg market-size carp. In less productive breeding seasons, carp has to be farmed in 4-year cycles (Winkel 2005) which significantly increases production costs. Polish consumers show a preference for lighter market-size carp weighing around 1–1.5 kg per fish which enables farmers to shorten the traditional 3-year breeding cycle to 2 years in warmer breeding seasons (Guziur 2009).

The reported results confirm that carp production in pond farms is marked by low profitability. In a study surveying the economic effectiveness of various forms of inland fisheries in Poland in 2007, pond farms were marked by slightly higher profitability (6.95%), but they were outpaced by lake farms (8.46%) and trout farms (11.77%) (Wołos et al. 2008).

Nearly all of Poland's carp output is sold on the domestic market. Carp exports had an estimated 1% share of overall production in 2008 and they were of no significance for the domestic market (Lirski and Myszkowski 2009). Despite the existence of an extensive market of sea fish and sea food, the capacity of the Polish carp market is estimated at 18 000–20 000 t annually (Lirski and Myszkowski 2009). If the supply of carp (production + import/export balance) exceeds the above limit, carp prices on the domestic market will decrease.

Earthen carp ponds are a valuable and a characteristic feature of the traditional rural landscape. They are a source of fish, and they play a number of important environmental functions (Dobrowolski 1995, Turkowski et al. 2007, Guziur 2009). Parts of the Nature 2000 network cover large earth ponds which are a habitat of rare plant and animal species. The need to maintain production intensity at a low level, the introduction of permanent or temporary production bans in selected ponds or parts thereof and the loss of fish and feed caused by preying birds and other animals contribute to a steep increase in operating costs. The ponds' environmental functions often imply costs that go beyond the limits of standard fishing practice (Turkowski et al. 2008). The installation of special pond devices and the observance of special environmental functions, in particular on ponds which are part of nature reserves and the Natura 2000 network, generate additional costs. Farmers find it difficult to reconcile fish production with the ponds' environmental functions (and these positive externalities) and the need to maintain a healthy profit margin without external financial support. Aqua-environmental subsidies (Anonymous 2006), which will practically start in Poland in 2010, should improve to some degree the economic efficiency of the carp sector in Poland.

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