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ECONOMIC ASPECTS OF TABLE CARP PRODUCTION UNDER VARIOUS MANAGEMENT CONDITIONS

EKONOMICZNE ASPEKTY PRODUKCJI KARPIA TOWAROWEGO (K_{2-3}) W WARUNKACH ZRÓŻNICOWANYCH ZABIEGÓW TECHNOLOGICZNYCH

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The objective of the study was to determine the economic aspects of three treatments of table carp (C_{2-3}) production. The treatmens disffered in the management measures used: (A) control ponds traditionally filled with water in spring, (B) experimental ponds filled in autumn, with intensive mineral fertilization, (C) experimental ponds filled in autumn, with intensive mineral fertilization and regulatory catches during the growing season made in order to decrease the fish density. Each the three treatments was studied using different stocking rates (1800-3600 ind. ha^{-1}). In all treatments fish were fed with cereal feeds (barley) ad libitum.

All ponds in treatmens B and C were fertilized in two stages: initially in Februar-March over the ice, and secondly from April until July. In total 900 $kg.ha^{-1}$ NPK of fertilizers were used in each pond: 292 $kg.ha^{-1}$ of nitrogen (N), 108 $kg.ha^{-1}$ of phosphorus (P) and 500 $kg.ha^{-1}$ of potassium (K).

The highest production and the highest profit were obtained in treatment C. Cost of the stocking material represented the main item of the variable costs (from 60% in ponds with low stocking rates to 80% in ponds with highest stocking rates). Cost of fertilizers which were used in treatmens B and C was low and amounted to only 1.5-2%.

INTRODUCTION

In Poland carp is a traditional fish. Its production during the past 10 years was over 90% of table fish produced in pond culture and showed an increasing trend

(Krüger 1988). The main problems of intensive carp culture are: feeding, water quality, and optimalization of stocking rates so as to maximise the use of natural food resources by the fish (Kozuń 1969, Stegman 1969, Guziur 1979, Grygierek 1980). Feeds and stocking material are the main cost items in carp culture (Worniałło 1973, Kubů 1982, Stasiniewicz 1985). In view of this, attempts are being made to obtain high fish production (1–3 $t.ha^{-1}$) based on the use of natural food resources (Lech 1975, Lech et al. 1977, Guziur 1979, Guziur and Markiewicz 1987). The objective of this paper was to determine the economic aspects of the traditional and new (modified) methods of table carp production in ponds.

MATERIAL AND METHOD

The economic analyses embraced an experimental production of table carp in the Fishery Research Station of the Agricultural Academy in Kraków-Mydlniki in 1983 and 1984 (Guziur, in press).

Studies were carried out in 11 experimental ponds each with surface area 0.01 ha and average depth 1 m. The ponds were characterized by the same type of soil (Guziur, in press) and were individually supplied with water from the same source (Guziur and Markiewicz 1987).

Ponds were stocked with two-year-old carp of individual weight 0.350-0.520 kg, at densites ranging from 1200 to 3600 per ha. The material selected for testing was homogeneous, of variety grown in Mydlniki, with a prevailing number of mirror carp.

The fish were fed ad libitium with cereal feeds (burley) 3-4 times a week each time after previous checking of the degree of food consumption, from May till September.

There were three treatments. Ponds in treatment A were filled with water in a traditional way at the begining of March. Ponds in treatment B and C were filled in November, immediately after the fish catch. Filling the ponds with water in autumn accelerated the effects of fertilization, allowed the bottom fauna to survive winter and, thus, accelerated its development in spring so that the fish stock could commence to feed much earlier (Guziur 1979).

All ponds in treatments B and C were fertilized in two stages: initially in February-March over the ice, and secondly from April until July. In total 900 kg ha^{-1} of fertilizers were used in each pond: 292 ka ha^{-1} of nitrogen (N), 108 ka ha^{-1} of phosphorus (P) and 500 ka ha^{-1} of potassium (K).

Regulatory catches were made only in treatment C in July and August in order to decrease the fish stock density during the growing season. Thirty-seven to fifty-five percent of the stock were taken out (Table 1). Usually, fishes over 1 kg in weight were caught (Guziur, in press).

Table 1

Selected indices of carp production in control (A_i) and experimental (B_iC_i) ponds per 1 ha of pond surface area in 1983 and 1984

Production index	Year	Control ponds A_i			Experimental ponds B_i		Experimental ponds C_i					
		stocking rate (indiv.)										
		1200	1200	2400	1800	2400	1800	1800	2400	2400	3000	3600
Initial biomas (kg)	1983	590	480	x	821	x	1040	1016	1345	1375	x	x
	1984	516	489	997	x	910	x	x	976	1002	1499	1474
Gross weight increment (kg)	1983	835	798	x	1342	x	1325	1420	1502	1525	x	x
	1984	937	815	1264	x	1417	x	x	1643	1620	1838	1800
Level of summer catches reducing fish density (indiv./% of stock)	1983	–	–	x	–	x	660/36.7	680/37.8	1310/54.6	1230/51.3	x	x
	1984	–	–	–	x	–	x	x	990/41.2	1070/45.6	1270/42.2	1460/40.6
Stock survival (%)	1983	90.0	94.2	x	93.3	x	95.5	100.0	96.3	99.2	x	x
	1984	85.8	89.2	90.8	x	90.8	x	x	91.3	97.9	99.0	96.1

Assessment was based on profit which in this paper represents a difference b between the value of production and its variable costts. Such app roach can be used when different methods of production are compared at the same level of the fixed costs (Manteuffel 1979).

Variable costs incurred during the experiments were: purchase of the stocking material (two-year-old carp), feeds, fertilizers and costs of labour. Costs of materials were calculated by multiplying material amount by the price. Prices for 1984 were used for both years of the experiment (1983 and 1984) in order to make the results comparable (Stasiniewicz 1985).

Costs of labour were calculated by multiplying the man-hours by the hourly payment. These costs embraced labour connected with fish feeding, pond fertilization and regulatory catches. Other labour was not included as this was similar in all tresatments (control catches, final catch, pond guarding etc.).

Average variable costs were calculated dividing overall variable costs by the level of productucn. Marginal costs were calculated dividing increase of variable costs by the increase of production.

RESULTS

Cost of the stocking material represented the main item of the variable costs. It varied from 60% in ponds with lew stocking rates to 80% in ponds with the highest stocking rates.

The opposite was true of the costs of feeds. These were the highest in the control treatments A (30%) in which fish production was based on feeding only. The share of these costs decreased to about 15% with increasing stocking rates and application of other management measures in treatments B and C.

Cost of fertilizers which were used in treatments B and C was low and amounted to only 1.5-2%.

Labour costs were of the same magnitude in these abovementioned treatments, while in the treatment A they were even smaller (0.5%), bacause no labour required for pond fertilization and regulatory catches.

In the first year of the experiment (Fig. 1 – broken line) the profit increased with the stocking rates and treatments used.

Attention should be given to the variant C_1 in relation to the B_1 (treatments C and B with the same stocking rate – 1800 indiv. ha^{-1}) in which profit increased by 54934 zł ha due to regulatory catches (Table 2).

Increase of the stocking rate to 2400 indiv. ha^{-1} in the variant C_3 resulted in further increase of profit by 33578 zł (Table 3).

Table 2

The effect of change in technology at fixed stocking rate (per 1 ha of pond surface area)

Year	Variant	Stock (indiv.)	Initial biomas (kg)	Final production (kg)	Variable costs ($zł \cdot 10^3$)	Average variable costs ($zł \cdot kg^{-1}$)	Marginal costs ($zł \cdot kg^{-1}$	Profit ($zł \cdot 10^3$)	Increase of profit ($zł \cdot 10^3$)
1983	B_1	1800	929	2163	533	246	–	224	–
	C_1	1800*	1028	2400	561	234	117.72	279	55
1984	A_2	2400	997	2261	556	246	–	235	–
	B_2	2400	910	2327	554	238	25.79	260	25
	C_2	2400*	989	261	564	215	32.25	354	93

* Average of two ponds

In the calculations were used following prices: two-years-old carp (stocking material) 420 $zł \cdot kg^{-1}$, table carp 350 $zł \cdot kg^{-1}$, feed (barley) 23.8 $zł \cdot kg^{-1}$, amonia water (20%) 3.2 $zł \cdot l^{-1}$, saltpeter (33% N) 9.2 $zł \cdot kg^{-1}$, superphosphate (18% P_2O_5) 2.25 $zł \cdot kg^{-1}$, potasium salt (45% K_2O) 2.65 $zł \cdot kg^{-1}$ and labour 90 $zł \cdot h^{-1}$

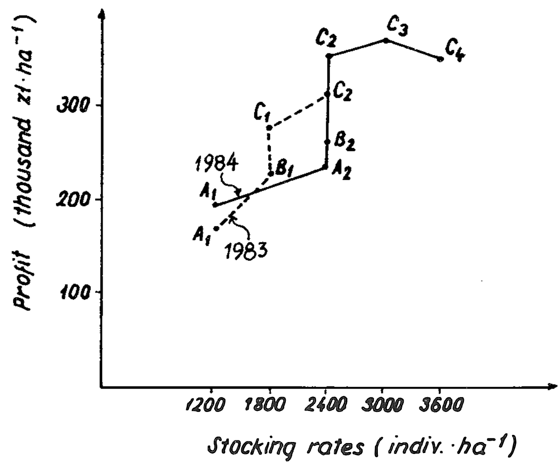

Fig. 1. Profit in relation to the stocking rate and range of the management measures

Experiment made in the next year confirmed these results. Fig. 1 (continuous line) shows that the profit increased with increasing stocking rates and application of the management measures. A characteristic section of the profit curves is denoted by points A_2, B_2 and C_2 which represent the same stocking rates but different range of the management measures. In these cases the profit increased along with the application of successive treatments: section between A_2 and B_2 an increase of 24802 zł ha^{-1} which was obtained due to the autumnal pond filling coupled with intensive fertilization (Table 2), section between B_2 and C_2 a further increase of 93418 zł ha^{-1} due to the regulatory catches (Table 2). Totally, there was an additional profit of 118220 zł ha^{-1} in the treatment C compared with A.

An increase of the stocking rate to 3000 indiv. ha^{-1} in the variant C_3 (Fig. 1) resulted in successive increase of the profit by 13959 zł ha^{-1} (Table 3). But the next increase of the stocking rate to 3600 indiv. ha^{-1} in variant C_4 did not result in an increase of profit. On the contrary, it decreased by 15750 zł ha^{-1} compared with the C (Table 3).

DISCUSSION

The highest profits was attained at initial stocking rate 3000 indiv. ha^{-1} in the treatment C which embraced all management measures used in the experiment. Further increase of the stocking rate to 3600 indiv. ha^{-1} in this treatment decreased the profit (Tabale 3).

This suggests that the stocking rate used in the variant C_3 was an optimal one in the given conditions, producing the highest profit.

Table 3

The effect of change in stocking rate for the best technology (per 1 ha of pond surface area)

Year	Variant	Stock (indiv.)	Initial biomass (kg)	Final production (kg)	Variable costs (zł·10^3)	Average variable costs (zł·kg^{-1})	Marginal costs (zł·kg^{-1})	Profit (zł·10^3)	Increase of profit (zł·10^3)
1983	C_1	1800*	1028	2400	561	233.68	–	279	–
	C_2	2400*	1360	2874	693	241.18	279.16	313	34
1984	C_2	2400*	989	2621	564	215.04	–	354	–
	C_3	3000	1499	3337	800	239.81	330.50	368	14
	C_4	3600	1474	3274	794	242.50	100.00	352	–16

* Average of two ponds

However, tgis suggestion was not confirmed by the analysis of the average and marginal costs. Both These costs should increase beyond the point of optimal production according to the rule of decreasing income (the rule of Turgot) (Fig. 2).

In our case the average and marginal costs showed contradicting trends. The average costs increased beyond the optimal point C_3 whereas the marginal costs decreased (Table 3).

In order to explain this contradiction it is necessery to go back to the initial (Table 1). It appeared that the variants C_3 and C_4 first of all differed considerably as regards the individual weight of the fish stocked (Table 2). This difference was so great that the fish stock in the C_3 weighed less than in the C_3 although the stocking rate was much higher in the first-mentioned one (3600 indiv. ha^{-1} versus 3000 indiv. ha^{-1}) (Table 1). As a result variable costs were in the C_3 higher too (Table 3).

In view of the above, it may be stated that from economic point of view the fish stock weight represented an intensifying factor rather than the stocking rate. It can be readily concluded that the decrease of production and profit in the variant C_4 (Table 3) was caused by a decrease of this intensifying factor and not by exceeding the limits established by the rule of decreasing income.

It seems that with more uniform stocking material in terms of individual weight of the fish, the optimum of production would not occur in point C_3 but would move towards variants of the treatment C_4 with higher stocking rates. This suggestion should be confirmed by future studies.

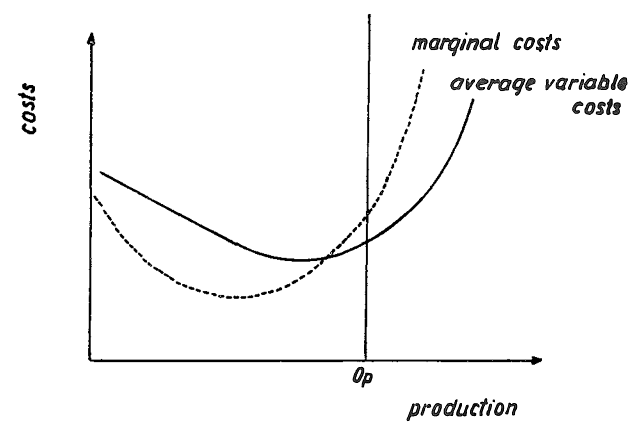

Fig. 2. Dependence between costs and production according to the rule of decreasing income (after Meimberg 1966). Op — optimal production

CONCLUSIONS

1. The highest production and profit were obtained in treatment C with embraced all management measures used in the experiment: autumnal pond filling coupled with intensive fertillization and regulatory catches during the growing season.
2. The highest production and the highest profit were obtained at the initial stocking rate of 3000 indiv. ha^{-1}, but it turned out to be below optimum under actual of production.
3. In the highest profit treatment, the main item of the variable costs was the cost of stocking material (about 80%) and the lowest coust of fertilizers (1–2%).
4. The cost of feeds in the experimental treatments was almost by half lower than that in the control treatments and decreased with increasing stocking rates.
5. Individual weight of the fish stocked had the essential effect on the profit, basides stocking rates.

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EKONOMICZNE ASPEKTY PRODUKCJI KARPIA TOWAROWEGO (K_{2-3})
W WARUNKACH ZRÓŻNICOWANYCH ZABIEGÓW TECHNOLOGICZNYCH

STRESZCZENIE

W pracy przedstawiono efektywność ekonomiczną trzech wariantów intensywnej produkcji karpia towarowego (K_{2-3}) z lat 1983 i 1984, o zróżnicowanym zakresie stosowanych czynników intensyfikacyjnych. Wariant A_i stanowiły stawy kontrolne zalewane tradycyjnie wiosną, nie nawożone, wariant B_i — stawy doświadczalne, zalewane jesienią z intensywnym nawożeniem mineralnym, wariant C_i — stawy doświadczalne zalewane jesienią, nawożone oraz letnimi odłowami rozrzedzającymi obsad. W stawach kontrolnych stosowano obsadę 1200 oraz 2400 szt. ha^{-1}, a w stawach doświadczalnych: od 1800 do 3600 szt. ha^{-1}. Ryby we wszystkich stawach żywione były jęczmieniem (ad libitum). Stawy doświadczalne (B_i, C_i) nawożono w dwóch etapach: I — etap tzw. nawożenie wstępne (zimowe przed zarybieniem) oraz II — główne (od kwietnia do lipca włącznie) w łącznej dawce 900 kg NPK na 1 ha stawu (w czystym składniku).

Wykazane koszty bezpośrednie produkcji karpi (pasze, nawozy, robocizna, obsada) posiadały nietypową strukturę (%). Największy udział posiadały koszty obsady (do 83%), najmniejszy nawozy i robocizna (ok. 1-2%). Koszty paszy w stawach doświadczalnych były prawie o 1/3 niższe w stosunku do grupy kontrolnej i malały wraz ze wzrostem zagęszczenia obsad (do 15%). Najwyższą produkcję oraz najwyższy zysk brutto w stosunku do grupy kontrolnej uzyskano w wariancie C_i, przy czym największy wzrost zysku brutto (83,1—91,3%) wykazano przy obsadach najgęstszych.

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